a che —

J. D. Baughman

From a Daguerreotype. *Eng.d by L.S. Punderson.*

Respectfully
yours
Edward Hitchcock

Eng.d for the Annual of Scientific Discovery 1854.

Gould and Lincoln, Boston.

ANNUAL

OF

SCIENTIFIC DISCOVERY:

OR,

YEAR-BOOK OF FACTS IN SCIENCE AND ART,

FOR 1854.

EXHIBITING THE

MOST IMPORTANT DISCOVERIES AND IMPROVEMENTS

IN

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

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 1853, ETC.

EDITED BY

DAVID A. WELLS, A. M.

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NOTES BY THE EDITOR

ON THE

PROGRESS OF SCIENCE IN 1853.

The fifth annual meeting, and seventh regular session of the American Association for the Promotion of Science, was held at Cleveland, Ohio, commencing Thursday, July 28, 1853. A fair number of members and strangers were in attendance, representing principally the southern and western sections of the country. From New England and the Northern States comparatively few were present. The President, elected at the Albany meeting, in 1851, was Prof. Benjamin Peirce, of Harvard University.

Among the papers presented, those in the Departments of Physics and Mathematics were much the most numerous, and were of high merit. In Chemistry and Geology, there were few contributions. The number of papers presented in the several departments was as follows. Physics, Mathematics, Astronomy and Meteorology, 40 ; Geology, Chemistry and Physical Geography, 12; Zoology and Botany, 12; Miscellaneous, 13.

A Committee for revising the Constitution of the Association was appointed, consisting of Prof. Bache, Dr. J. Lawrence Smith, Dr. Le Conte, of Georgia ; Dr. Gibbs, of New York; Dr. B. A. Gould, of Cambridge; Prof. W. B. Rogers; Prof. J. D. Dana, New Haven; Dr. J. Leidy, Philadelphia; Prof. Haldeman, and Dr. A. A. Gould, Boston.

Resolutions were adopted reducing the Annual Assessment from $3 to $1, and requiring that the Proceedings should be furnished to members at cost; or free of expense, when the Proceedings are published by the public liberality of the city where the meeting may be held. The Secretary was authorized to forward copies of the Proceedings to the learned societies of Europe and the United States. The whole number of members at present belonging to the Association, is upwards of 600.

The Association adjourned on Tuesday, the 2d of August, to meet in Washington, on the last Wednesday of April, 1854. The following officers were elected for the ensuing year. Prof. Jas. D. Dana, of New Haven, President ; Prof. J. Lovering, of Cambridge, General Secretary ; Prof. J. Lawrence Smith, Permanent Secretary ; Dr. Elwyn, of Philadelphia, Treasurer. Prof. S. F. Baird, Assistant Secretary of the Smithsonian Institution, who for the past three years has so ably managed the affairs of the Association, declined a re-election to the office of Secretary. The following gentlemen were appointed to report on the following topics at the ensuing meeting. Prof. Henry, "On our knowledge of the laws of Atmospheric Electricity ;" Prof. Jas. Hall, "On the recent additions to our knowledge of the Palæozoic Rocks;" Prof. H. L. Smith, "On Micro-Chemistry;" Dr. Wolcott Gibbs, "On the recent progress of Organic Chemistry;" Dr. B. A. Gould, "On the progress and development of the Electro-chronographical method of Observation;" Prof. Leidy, "On the remains of Extinct Mammalia and Reptilia of North America;" Prof. B. Peirce, "On the present state of the Theory of the Planetary Perturbations;" Dr. Burnett, "On the recent advances in Anatomy and Physiology;" Prof. Agassiz, "On the history of our knowledge of Alternation of Generation in Animals;" Prof. J. D. Dana, "On the Geographical Distribution of the Lower Animals." It was also voted that at the Washington meeting of the Association, a general session be devoted to the consideration of the expediency of a change in the present standards of weights and measures in the United States.

The twenty-third annual meeting of the British Association for the Advancement of Science, was held at Hull, September 7th, Prof. William Hopkins in the Chair. The attendance was less numerous than usual, and no communications of especial interest or novelty were presented. The Committee on the establishment of an Observatory and telescope of large optical power in the Southern Hemisphere, reported through their chairman, Lord Rosse, that an application had been made to the Government, and that the necessary funds would most probably be granted. A recommendation of the Association, that in the event of a survey of the Gulf Stream being undertaken, provision should be made for investigating its Zoology and Botany, has been communicated to the Admiralty, and favorably received. A proposition from Dr. Bache, Director of the Coast Survey of the United States, for a joint survey of the Gulf Stream by the United States and Great Britain, addressed to the President of the British Association since the Belfast meeting, has been forwarded to the hydrographer of the Admiralty. It was voted to hold the next meeting of the Association at Liverpool, the Earl of Harrowby having been elected President for the ensuing year.

The annual meeting of the German Association for the Promotion of Science, was held at Tubingen, on the 18th of September. It was attended by about 580 members, including a moderate sprinkling of French and Russians, two Americans, and a few English.

The President, Prof. Von Mohl, having for some reason absented himself, the chair was taken by M. Bruhns, Professor of Medicine at Tubingen.—Receptions by the various neighboring towns and cities were given to the Association, and public and private hospitality was displayed to an unlimited extent. The scientific part of the meeting was equally satisfactory. In the three general or public sittings none but subjects treated in a popular manner were this time admitted, and all papers that could in the least offend the ear of ladies had been strictly rejected,— a laudable restriction, probably adopted in consequence of the complaints made by the press that medical subjects, not intended for any but medical men, had been brought forward.

M. Schultz read an interesting paper "On the Development of the Natural Sciences from the Middle of the Sixteenth Century until the Middle of the Nineteenth." He assumed three periods : 1st, The period when knowledge was handed down by oral tradition. 2nd, When it was propagated by writing; and, 3rd, When perpetuated by printing. The present time he looks upon as the commencement of a fourth period, when, by the intimate international intercourse and the power of steam, knowledge is rapidly diffused. Dove, of Berlin, gave a comprehensive account of the present state of meteorology, and a very clear explanation of the causes which determine the weather of Europe. Carnal spoke on the importance of salt, gold, and coal,— three monosyllables playing an important part in the affairs of the world. He complained of the ignorance prevailing in England on the subject of German coal, and quoted a conversation he had with an Englishman of some scientific standing, who asked him whether there were any coal in Germany ?—a question he answered by stating that not only had Germany enough coal for its own demand, but it could supply England and all the world, at the rate coal is now used, for 500 years to come. Fraas gave an account of the oldest inhabitants of the Swabian Alps. It appears that a few years ago, fossil teeth were found, which some at once declared to be those of man. This determination, however, was called in question, as no human teeth of the mammoth period had ever been found in any part of the globe. Again, these teeth were exhibited last year in Wiesbaden, by Jaeger, when they were generally admitted to be human teeth; one was even sent to Owen, who agreed with the Wiesbaden meeting in pronouncing them to belong to man. The discovery of several almost perfect skulls has set the matter finally at rest; there was a race of men living simultaneously with the mammoth and other huge antediluvian animals.

The sectional meetings were well attended. In the Section for Chemistry and Pharmacology, there were Fehling, Schlossbergher, Leube, Babo, Weidenbusch, Ammermuller, Fresenius, Weltzen, H. Rose, &c.; Fehling and Rose alternately presided. In the Section for Mathematics, Physic, and Astronomy, Wolfers, Osann, Reusch, Dove, Holtzmann, Gugler, &c.; Dove and Osann presided. The Section for Medicine and Surgery counted the largest number of members. On the 24th of September the meetings were finally closed. Gottingen was chosen as the place of meeting for 1854, and Professors Listing and Baum, were elected Presidents of the Society.

The Scientific Congress of France held its twentieth annual session at Arras, under the Presidency of the Baron de Sassart, President of the Academy of Belgium.

The sixth annual meeting of the American Medical Association, took place in New York, in May, 1853. Dr. Knight, of New Haven, presided, and about five hundred members were present. The prizes offered at a former meeting for the best original essays, were awarded to the authors of the two following: "On the Cell, its pathology," &c., by Dr. Waldo J. Burnett, of Boston; "Fibrous Diseases of the Uterus hitherto considered incurable," by Washington L. Atlee, of Philadelphia. For the premiums so awarded, there were fifteen competitors.

The Ray Society held its tenth annual meeting at Hull, during the meeting there of the British Association. The cause of delay in the issue of the last part of Messrs. Alder and Hancock's work "On the Naked Mollusca," was stated to be, the wish of the authors to add as large a mass of new matter as possible. Of two works for 1852,— one containing a translation of Braun "On Rejuvenescence in Nature," Kohn "On Protococcus," and Menighini "On Diatomaceæ,"—was nearly completed. The second volume of Mr. C. Darwin's "Barnacles and Sea Acorns," is in the press. For 1854, the Council propose to publish Prof. Allman's work "On the British Freshwater Polyzoa," with colored plates, in imperial quarto,— and the fourth and last volume of Agassiz's "Bibliography of Zoology and Geology." The Secretary, Dr. Lankester, stated that Prof. Williamson's and Dr. Carpenter's work "On the Foraminifera," was in progress, and would probably be published in 1855.

A maritime conference, composed of distinguished representatives of the nautical science of the great maritime nations of Europe and the United States, convened in Brussels in August last, for the purpose of devising a uniform system of nautical observations for the advancement of scientific navigation. The convention held its meetings at the residence of the Belgian Minister of the Interior, at Brussels, and was composed of delegates representing the following countries: United States, England, France, Russia, Sweden, Norway, Denmark, Holland, Belgium, and Portugal. M. Quetelet, the director of the Observatory of Brussels, was chosen President of the Convention, Lieut. Maury having declined that honorable post. Lieut. Maury opened the labors of the body with an *expose* of the wants of nautical science in its present state, of his own past labors for the supply of those wants, and of his plan for effecting completely the reforms needed by the co-operation of the marines, merchant and military, of all civilized nations. Having heard the *expose* of Lieut. Maury, the Convention first bestowed its attention upon the instruments in general use among seamen for making their observations; and it was resolved that efforts should be made to improve several of them. The marine barometer especially, was recognized to be very deficient. So faulty is it, said Lieut. M., that meteorologists in their investigations into the laws of atmospheric pressure, find themselves almost constantly unable to give any value to barometrical observations made at sea. The Conference then prepared a model journal for the use of sea-captains in recording their observations. The first column of this journal, indicates the number and kind of observations which the United States Government requires of sea-captains in order to entitle them to gratuitous participation in the advantages anticipated as the result of the system. They are required to record once a day, the position of the ship, the direction and force of currents, the height of the barometer, and the temperature of the air and water. The force and direction of the winds must be given three times a day, and the variations of the needle must be noted whenever observed. The succeeding columns of the journal are intended particularly for the use of vessels of war, and are to contain complementary observations, the making and record of which require more time, care, and skill. When the observations shall have been made and recorded in the manner prescribed, they are to be forwarded to a bureau organized *ad hoc*, where they will be examined, and the information they contain made use of for the discovery of the general facts and laws, the knowledge of which is necessary for the advancement of the science of navigation. The King of Sweden caused to be announced to the Convention that he had already given orders that the journals kept by the Swedish naval officers should be transmitted to the Royal Academy of Sciences at Stockholm. The Governments of Holland, of Belgium, and of Portugal, have taken similar measures, and the Admiralty of Great Britain will order meteorological observations to be made in the royal navy. Lieut. M. announced that the merchant marines of other nations would be placed, in the prosecution of this work, upon the same footing with that of the United States; that is to say, every sea-captain who would keep during his voyages a journal upon the plan prescribed by the Convention, and forward a copy of the same to the American Government, should be entitled gratis to a copy of the Navigator's Guide, and of the charts of winds and currents which it was intended to publish. Having settled these various matters, the Convention adjourned *sine die* on the 8th of September, after voting thanks to the Belgian Government for the liberal spirit with which it had concurred in the views of the delegates, and furnished all needful facilities for the prosecution of their labors.

A project of a popular geographical institution has been organized in London, and a prospectus issued under the auspices of Sir Francis Beaufort, Mr. Layard, Lord Stanley, and others. It is proposed to purchase Mr. Wylde's "Great Globe" in Leicester-square, and to surround the present building with rooms and galleries, devoted to museums, libraries, lecture theatres, and other apartments. The Prospectus states as follows:

"Whilst it is intended to maintain the large model of the earth in its present position, it is proposed to add to the present extensive collection of ancient and modern maps, charts, and books, all the maps, charts and geographical works published throughout the world; and to invite the assistance of foreign governments and societies (many of whom have already kindly offered their publications,) to contribute all their maps, charts, and geographical works, published under the sanction of the state, so that proprietors and the public may have immediate access to the best sources of information on every subject connected with geography, hydrography, and the allied sciences.

"It is further proposed to maintain a competent body of demonstrators and lecturers, who shall deliver regular courses of lectures upon physical and political geography and ethnology, not only within the model, but also in the theatres of the Institute, so as to embrace all the requirements of a great geographical school; to hold meetings of the members, at which scientific papers shall be read and discussed; and to uphold a library and reading-room, where the most important newspapers, English, Foreign, and Colonial, will be filed, where the maps, charts, engravings, books, and transactions of learned societies, can be conveniently consulted, and where the latest information bearing upon geographical discoveries, and all matters especially relating to new shoals, rocks, and harbors, will be regularly exhibited."

At the meeting of the American Association, Cleveland, a communication was made by Lieut. E. B. Hunt, U. S. A., proposing the establishment of a geographical department of the Library of Congress, but having at the same time a distinct and separate organization. In this library, under the supervision of Congress, it is proposed to collect and preserve the following materials and sources of geographical information. 1. A first-class terrestrial globe. 2. All materials illustrating the early and recent geography of the United States, both its sea-coasts and interior, including traced copies of all valuable maps and charts in manuscript and not published. The materials for illustrating the past and present geography of each State, County, Township and City, should be gathered by purchase, correspondence, and tracing. 3. All maps and charts on the remainder of America. 4. The Admiralty or sea-coast chart of all the European and other foreign States, and the detailed topographical surveys of their interiors, where such have been made. 5. The most approved maps published from private resources whether as atlases, nautical charts, or mural maps, including publications on physical geography, guide-books, railroad-maps, and city hand-books. 6. A complete collection of all the narratives of voyages of discovery and exploration, especially those undertaken by the English and French Governments. 7. Geographical, geodetic and nautical manuals, and treatises, with all the requisite bibliographical aids to the amplest geographical investigation.

It was also proposed that this department should be placed in charge of a suitable person, who should yearly present to Congress a report, on the geographical explorations by our own and foreign Governments, or by individuals, so far as their results can be learned; making it a synopsis of all the interesting and important geographical facts or publications for the year. Upon the same officer would also devolve the duty of maintaining a correspondence with persons having special geographical knowledge, of keeping a list of persons who could be addressed for additional information on foreign and domestic localities. Also corresponding relations should be maintained with foreign geographical societies, and their publications secured with promptness. At present no collection in the United States approaches the completeness or efficiency here contemplated. The Harvard collection, so excellent in old maps, is very deficient in those great works of interior and exterior survey which characterize the last fifty years. No collection exists in our land which furnishes full materials for extensive investigations, such as are now more and more demanded by questions of history, science, commerce, and policy. There is no probability that such a collection can soon be formed anywhere except in the Congress Library. In the facilities which such a library, located at Washington, would furnish the State Department, the Engineer and Topographical Bureaus, the Coast Survey, the National Observatory, and the several Navy Bureaus, the Government would derive a full equivalent for all its cost. The value of such a collection in its relations to legislation; in its illustration of river and harbor questions; in its prospective use for illustrating history, and generally as a means of enlarging and correcting our geographical knowledge, gives it most truly the character proper for a national enterprise.

The Association approved of the plan presented by Lieut. Hunt, and a committee of five was appointed to prepare a plan for the organization of the Department, and to memorialize Congress on the subject.

An Academy of Natural Sciences has been formed at San Francisco, California, and regular meetings holden. An address has been published, setting forth the objects of the society, and an addendum giving directions for preparations of specimens to be donated to the institution. This society, if properly maintained, cannot but be of great assistance in giving to the world a knowledge of the natural history and resources of California. The field of the State is new, almost untrodden by the naturalist.

A University for Australia has been founded and endowed by the Legislature of Sidney. "This step," says the London Athenæum, "is one of great public interest, not only so far as every extension of the machinery of education is of interest, but also as a preliminary step towards the educational independence of the colonies settled by the English across the line."

By the recent death of M. Jassieu, the Botanist, M. Combes, Vice-President of the Paris Academy of Sciences, has succeeded to the Presidency of that body, and M. Roux, the eminent surgeon of the Hotel Dieu, has been elected Vice-President.

For the purpose of placing on a more permanent foundation the Professorship of Morbid Anatomy, in Harvard College, Dr. George C. Shattuck, of Boston, has given the sum of fourteen thousand dollars; in consequence of which, the professorship is to be hereafter distinguished by the name of the donor.

A prize of five thousand rupees, offered by the Agricultural Society of India, some years since, for the best cotton-gin, has, by the decision of a committee, been awarded to Messrs. Bates, Hyde, & Co., and Messrs. Carver & Co, of Massachusetts. The machines were adjudged to be of equal excellence, and the amount divided between the respective parties. Gold medals were in addition presented to each firm, and the machines purchased at the price of construction.

Under the direction and through the assistance of the Government, Schools of "Art and Design" have been established or projected during the past year in various parts of Great Britain. In a circular recently issued, the object of these institutions is clearly set forth, as follows:—"It is now the object of Government to make those national Institutions, the Schools of Art, useful to all classes of the community, and therefore, whilst the existing provision for the education of the working classes in a knowledge of Art is to be maintained, new arrangements have been made to provide instruction in various branches of Art for the middle and upper classes of society; besides which a system is now being organized for the general diffusion of instruction in elementary drawing throughout the country. It is the desire of Government that the industrial classes should be educated in a knowledge of Art in the most complete manner which can be devised, at a charge within their means. To effect this important object, an attempt is about to be made to disseminate elementary instruction in parish and in other schools, and to make elementary drawing a part of general education, concurrently with writing."

Encouragement of the fine arts, however, and an adaptation of their principles to the wants of every day life, are not confined to the refined and enlightened nations of Europe and America. During the past year, that munificent Parsee, Sir Jamsetjee Jeejeebhoy, has given £10,000 to Government, for the purpose of endowing a school of design at Bombay.

The committee of the American Institute, appointed to award the premiums offered by Mr. Ray, of New York, for improvements in railroad mechanism, have reported as follows: — There were four prizes offered; two of which only have been decided upon, viz., "the railroad brake," for which the prize of $400 has been awarded to Mr. T. A. Stevens, of Burlington, Vermont; and the prize for a "night seat for cars," $300, which has been awarded to Samuel Hickox, of Buffalo, N. Y. The prize of $1,500, for the best invention to prevent railroad collisions, and the breaking of railroad axles, and the prize of $800 for the best invention to exclude dust from cars, they did not decide upon.

At the Annual distribution of prizes at the French Academy of Sciences, the Lalande prize for astronomy was divided between Mr. Hind, of London, M. Gasparis of Naples, M. Luther of Blik, near Dusseldorf, M. Chacornac of Marseilles, and M. Herman Goldschmidt of Paris. The prize for experimental physiology was awarded to Dr. Budge, an English physician, and Prof. Wallon, of Bonn, for discoveries establishing with certainty facts of a nature to throw light on the functions of the ganglionary system.

At the Annual meeting of the Royal Society, London, November 30, 1853, the Copley Medal was awarded to Prof. Dove, of Berlin, for his work on the distribution of heat over the earth's surface; and the Royal Medal to Mr. Charles Darwin, the well-known naturalist and traveller, for his works on Natural History and Geology. The Earl of Rosse was re-elected President of the Society, and Col. Sabine, Treasurer.

A National Exhibition of the Industry of All Nations was opened at Dublin, Ireland, in May, 1853, and continued throughout the season. This Exhibition owed its origin principally to the efforts of Mr. Dargan, an Irish gentleman, who advanced, in aid of the same, nearly £100,000. The whole affair was entirely successful, and reflects much honor on all concerned in the work.

A Universal Exhibition of Manufactures, as well as an Exhibition of Fine Arts has been determined upon by the French Government, to take place at Paris, in 1855. The construction of a Crystal Palace, of great magnitude and splendor, has already been commenced in the Champs Elysees. Its length will be 256 yds., breadth over 118 yds., height nearly 115 ft. The exterior wall will be of a circular form, flanked with six towers, and having 360 arched recesses. The access to the interior of the palace will be by four large entrances, and there will be additional ones by some of the towers. The principal front will be on the Champs Elysees, and the roof will consist of only iron and zinc, glazed similarly to the London Crystal Palace. The plans for ornamenting the building both inside and out are very costly. The area of the whole of the building will cover a surface of about seven acres and a quarter.

An interesting Exhibition is about to open at Amsterdam, Holland. The citizens of this commercial depot have resolved to hold in their most picturesque and interesting town a series of public exhibitions, illustrating the past and present state of the great departments of industry. Each year will be devoted to a particular subject: — sculpture, painting, architecture, shipbuilding, manufactures of various kinds, and so forth. The subject of the first exhibition is Architecture. It is proposed to exhibit specimens of building materials, instruments and utensils, machines for raising masses to great elevations, plans of structures, ancient and modern, fancy designs, models of all sorts of edifices, churches, temples, mosques, palaces, pagodas, ornaments used in decorating, and the like. The enterprise is said to have won the general approbation of the Hollanders.

The Geographical Society of St. Petersburg is about to despatch expeditions to make scientific researches in Eastern Siberia and Kamtschatka, in the Caspian Sea and the neighborhood, and in different parts of the least-known European and Asiatic provinces of Russia. The expedition to Siberia excites the greatest interest, and it is expected that it will make some important additions to the different branches of science. Twelve young men are to accompany it for the express purpose of taking astronomical, magnetic, and meteorologic observations.

The United States Expedition sent to Japan, under the command of Commodore Perry, reached these Islands in August last. The Commodore succeeded in obtaining an interview with two princes of the Empire, and delivered the letter from the President of the United States, as also his own credentials. It was arranged that, as the subject matter required the consideration of the Emperor and the great Ministers of State, an answer should be called for next spring. The expedition was received in a friendly manner by the Japanese, and there are strong grounds of expectation that a treaty favorable to commerce and intercourse may be arranged with this exclusive people. No scientific observations of any moment were mad at this visit of the U. S. Squadron.

The American Exploring Expedition to the North Pacific, sailed in May, 1853. The fleet consists of the sloop of war Vincennes, the steamer John Hancock, the brig Porpoise, the schooner Fenimore Cooper, and the clipper John Kennedy. These five vesssls are placed under the command of Commodore Cadwaller Ringold, and are fitted out with the best instruments procurable in the United States or in Europe. The expedition is expected to be absent about three years. The scientific observers who go out with it have orders to explore as minutely as shall be found convenient the shores of Asia and America bordering on the Northern Pacific and Behring's Straits. The surveys will also extend to the Japan Islands and Waters, the Gulf of Tartary, the shores of Kamtschatka, the Sea Okhotsk, and all the isles and islands in those latitudes, including the Aleutian Islands and the Sandwich Islands.

Commander Lynch, U. S. Navy, despatched by Government during the year 1852, on a preliminary expedition of observation to Western Africa, preparatory to an exploring expedition, has returned during the past year. He was on the coast of Liberia and that vicinity from early in January to late in March, and explored all the rivers of the region. He found none navigable more than 21 miles above the mouth. He is possessed of no very exalted idea of the feasibility of white colonization of the West Coast of Africa, even in a temporary way, and for commercial purposes only. Capt. L. intimates that there is but a single Englishman known to have survived the climate of Sierra Leone for five years, at the end of which time the fever carried *him* off. It will be recollected that perhaps 40 years since the Portuguese colonized an island in the immediate vicinity of Guinea, sending thither 7,000 souls. At this time there is but a single individual living in whose veins the blood of any of these colonists is believed to course. This is a fact making stubbornly indeed, against the idea of a much more profitable trade with Africa, as the result of any possible effort of our Government to compass that end.

An expedition for the exploration of the interior of Australia, has been projected by the British Government. It is placed under the direction of Mr. Ernest Haug, and the party accompanying him will be provided with every requisite necessary to insure a successful result. It appears that the great unknown interior of this continent can be most safely reached by making a starting point from the mouth of the great navigable river, the Victoria, on the north-west coast, where Capt. Stokes, of H. M. S. the Beagle, so far explored it as to arrive at within about 500 miles of the centre of the continent. Capt. Stokes was obliged to return for want of sufficient resources; but he ascended far enough to satisfy himself of the

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fair prospect of success for any future explorer. He say, — "Its direction continued to the southward, and far away could be traced the glistening green valleys of its course, as it flowed on in *undiminished magnitude;*" and his last "regretful view," as he describes it, was taken in lat. 15° 36′, long. 130° E., at a distance of 140 miles from the sea. As yet, however, no explorer has successfully passed over the coast range to the south, — where Mr. Haug hopes to find large grassy fields extending far towards the interior. Dr. Blundell thinks that the hitherto so greatly dreaded "Central Desert" of this strange continent may ultimately prove to be *no desert at all*; for desert and fertile spots border each other so closely in Australia as to make that circumstance one of the most striking peculiarities of the land. The expedition may thus not only hope to solve the mystery of the interior of Australia; but traversing, as it proposes to do, the only hitherto *great* unknown portion of the continent, it will at any rate furnish the means of making a rough map of the whole, — determining to the colonists of the eastern, southern, and western provinces whether or not the interior is to remain to them and to the rest of the world an impassable territory and "a sealed book."

Dr. Sutherland, who was attached to the Arctic Expedition under Capt. Penny, in 1851, is about to undertake a journey of exploration in South-eastern Africa, under the auspices of the London Geographical Society.

Dr. Harvey, the well-known Botanist of Dublin, is also about to visit Australia, under the joint auspices of the University and of the Royal Dublin Society, for the purpose of exploring the natural history of the southern coasts of that continent. Dr. H. will give especial attention to the collection of Marine Algæ, and will be absent until 1855. He also proposes various subscription sets of Algæ, at the rate of 2l. 5s. per 100 species, properly prepared and delivered in Europe.

Accounts have reached the French government that M. Emile Devile and M. Duret, two of the gentlemen employed by it to explore the central parts of South America, have been carried off by the yellow fever at Rio Janeiro; M. Lefebvre Durufle, the third member of the expedition, though attacked with the malady, escaped. The loss of M. Devile is a great one; as, though extremely young, he was well known for his attainments in natural history and other branches of science, and as a very enterprising traveller. He was, in fact, the very man that could be wished for to explore the immense centre of the South American continent, which is at present as little, if not less known than the central parts of Africa.

Dispatches have reached her Majesty's government from the expedition now conducted by Drs. Barth and Vogel in two different parts of Inner Africa, the former pushing his way towards Timbuctoo, the latter to Lake Tsad, to supply the vacancy left by the death of Dr. Overweg, and to complete the survey which the latter began. There never was an exploring expedition conducted with greater perseverance than this. Travellers across the Great Sahara know on their outset that they have a difficult and dangerous journey before them; but to brave these difficulties and dangers year after year for four consecutive years, with an heroic endurance and undiminished courage, solely for the sake of science, as is the case with Dr. Barth, is an occurrence unparalleled in the history of geographical discovery. That traveller, after losing his only two comrades, undertakes, alone, his journey from Lake Tsad to Timbuctoo, one of the most difficult attempts that could well be imagined. When he wrote his last letters, at the end of November, he was just about to leave Lake Tsad on that tour. The communications now received bring up the intelligence three months beyond the last date — namely, up to the beginning of March last. We find that at this time he had gained between 400 and 500 miles in his journey, and entered the Fellatah province of Kashna, where he was well received. An escort of 200 horse is necessary to insure his safety in crossing the next districts towards that celebrated place, the goal of his journey; and a very circumspect management, backed by a certain amount of means, is necessary to obtain all the assistance required from the Fellatahs. The supplies already sent off last year have not yet reached him, and the great encouragement, which the news of Dr. Vogel's coming to his assistance would be, is still denied him. Nevertheless, with unbroken spirits he pushes onward. May he successfully return, and, united with Dr. Vogel, accomplish still greater results. Meanwhile the last traveller has very successfully performed the most trying portion of his journey to Lake Tsad, in having crossed the Desert of Tripoli to Murzuk; a region which, during the summer, is almost entirely waterless. But so successfully was their journey performed, that neither Dr. Vogel nor any person in his caravan suffered any indisposition; and out of thirty-three camels only one was lost, the caravan arriving in Murzuk in the best order. At that place Dr. Vogel will be occupied partly in reducing his numerous astronomical and hypsometrical observations made on the way, and transmit them by next courier. He hopes to start for Lake Tsad in the beginning of September.

A new Arctic expedition under the charge of Dr. Kane, U. S. N., fitted out by private liberality sailed from New York during the spring of 1853, for the purpose of making a renewed search for Sir John Franklin, and for exploring some parts of the Arctic territory hitherto unvisited.

The Secretary of the Navy, in his annual report, takes occasion to express his regret that in certain charts uttered from the English Admiralty Hydrographic Office, on the 4th of October, 1853, an error has been committed, and credit given for certain new discoveries of lands to officers of the British Navy, whereas in truth the lands were discovered and named by the American expedition under command of Lieut. De Haven, which passed the English vessels, and led the way up Wellington Channel in February, 1850.

The Naval Observatory, under the superintendence of Lieut. M. F. Maury, is doing much for the service and navigation, and much for the benefit of mankind and the honor of our country.

The operations of the Coast Survey have been prosecuted with vigor during the past year. The operations in the field or afloat, and in the office, have extended to all the States and Territories of our vast coast on the Atlantic, the Gulf of Mexico, and the Pacific. On the Atlantic the triangulation reaches, with an interval of 22 miles, from the mouth of the Kennebec River, Maine, to Boyne Sound, North Carolina. It is commenced in South Carolina, Georgia and Florida, and extends from Mobile nearly to New Orleans, and from the head of Galveston Bay to Matagorda Bay, in Texas. The other operations follow it closely. A hydrographic reconnoissance of our western coast has been made from San Diego to Frazer's River, and preliminary surveys of most of the harbors, with charts of them, have been published, or are in progress. It is believed that the history of such surveys does not present a parallel to the promptness with which the execution and publication of the work on that important coast has been made, keeping pace with the development of a commerce itself without a parallel. One hundred and forty-three maps and charts have already been issued from the Coast Survey Office, including sketches of examinations of dangers on the coast where the regular surveys have not yet reached the localities. The report of the Superintendent for the past year is accompanied with fifty-five maps and sketches, showing the progress of the work, and giving information important to navigation and commerce.

The great work of constructing the Pacific Railroad, which will place a stamp upon the enterprise of the nineteenth century, may now be looked upon as fairly undertaken. Four expeditions of survey have been organzed under an appropriation of $150,000, in order to present the most practicable line for the track. The first, under command of Governor Stevens, of the territory of Washington, late of the corps of U. S. Topographical Engineers, left St. Paul, Minnesota, in June, and followed the most northerly route, moving westward across the upper branches of the Missouri, through the the South Pass, thence to the Columbia River. The report of this expedition has been received. Three new passes in the Rocky Mountains have been discovered; one of which, according to the barometer, is two thousand five hundred feet below the famous South Pass; the ascent in both directions is gentle, and it would seem that the whole range had been sunk at this point for the express purpose of allowing the passage of a Railroad. The great difficulty in exploring these passes and the territory west arises from the dense forests and luxuriant vegetation.

The second expedition, under Lieut. Whipple, of the Topographical corps, is under instructions to survey the route from Memphis by way of Vicksburg, Fort Smith, Arkansas, and Albuquerque, New Mexico, and thence to the frontier line of California. Lieut. Williamson is directed to leave San Diego with a surveying party, and meet Whipple at Wilkins' Pass, in Sierra Nevada.

The fourth party was under the charge of Lieut. Gunnison, who was ordered to rendezvous at Council Bluffs, and explore the central route taken by Col. Fremont, in his last expedition, the termination of which was so disastrous. This last is the favorite route of Col. Benton, and the expedition will be accompanied by Mr. Kerr, one of Col. Fremont's men.

These various expeditions were fully equipped and provided with men of science and artists, as well as the usual accompaniments of bushmen and outliers, and are furnished with scientific instruments, &c. A mounted escort of thirty-five U. S. troops accompany each party.

Since the preparation of the above notice, intelligence has been received of the massacre, by the Indians near the great Salt Lake, of Lieut. Gunnison and the Engineer, Mr. Kerr, with several others of the party. The notes of the survey, as well as the instruments and journals have been recovered.

The brig Dolphin, Lieut. O. H. Berryman, has recently returned to the United States, having been profitably engaged in special service, under Act of March 3, 1849, in taking new routes, and perfecting the discoveries made by Lieut. Maury, in the course of his investigations of the winds and currents of the ocean. Much credit is due to the officers employed in executing this law.

Lieut. Gilliss is actively engaged in the publication of the result of his astronomical observations, at Santiago, Chili. The report of Lieut. Herndon, presenting the result of his exploration of the river Amazon and its tributaries, is nearly ready. The report of Lieut. Gibbon, who was of the same party, but explored a different section of the country and returned later, is nearly completed.

Lieut. Mackai, who accompanied Lieut. Gilliss, returned to the United States last summer, having made a series of magnetical observations very successfully at all the elevations and at distances of 100 miles entirely across the Pampas. Soon after leaving Mendoza he had the misfortune to break his barometer and injure his chronometer by falling from his horse so that he was unable to obtain the longitudes of his magnetical stations and the barometric profile of the country. Being desirous to complete his work, he volunteered to retrace his ground, and left the United States for this purpose some months since, taking with him a declinometer and dip-circle, two Bunten's barometers, and apparatus for determining altitudes from the boiling point, and some smaller instruments. Should the Argentine Provinces have become sufficiently quiet, Lieut. Mackai will first cross the Andes at the Planclan Pass (lat. 35° 20′), next at the Portillo Pass, which is the most elevated (lat. 33° 40′), and finally at the Cumbre and Uspalata Pass (in lat. 32° 50′); from whence he will return to the United States.

A full chart of Lake Erie has been compiled from surveys made under the direction of the U. S. Government, by officers of the corps of Topographical Engineers. This chart shows Lake Erie divided into three sections; the first extending downward from the head of the Lake to Point Pellee Island; the second from that island to the base of Long Point; and the third below that point to the Niagara River. The first section is the shallowest, and presents a general plat or level, with an average depth of thirty feet water. The second division presents another and much more extensive plat or level, with no obstructions to navigation, with a depth of water from sixty to seventy feet. The third section is the deepest, as well as the most uneven portion of the Lake, ranging from 60 ft. to 204 in depth.

At a recent meeting of the Royal Geographical Society of Berlin, M. Mædler, of Dorpat, announced that the Russian Government is about to have measured the degrees of the meridian from the North Cape, in 72½° North latitude, to the mouth of the Danube, in 45½° of the same latitude:—that is, on a line which traverses Europe in its whole length, and forms about a fourteenth part of the entire circumference of the earth. This measurement will exceed by three degrees the largest ever before executed,—that which the English carried from the Himalaya to the southern point of British India.

A new company, under the title of the Mediterranean Electric Telegraph Company, destined to unite England with Africa, the East Indies, and Australia, by way of France, Corsica, Sardinia, and Algeria, has been formed in France and England. The capital stock is £300,000, divided into 30,000 shares. The work is to be immediately commenced.

The construction of a sub-marine telegraph between England and Belgium, and also between England and Ireland, has been successfully accomplished during the past season, and both lines are now in constant operation. The length of the sub-marine wire across the Irish Channel, is sixty miles.

The subject of connecting England and America by a trans-atlantic communication, has been agitated to some extent during the past season in

Great Britain. One company has even advertised for proposals for the manufacture of the necessary cable.

The distance between Galway and British America is not far from 1,600 miles. Galway is already connected with London and all the great European towns by telegraphic lines. A company in New Brunswick has undertaken to extend the wires which now reach from New York to Halifax, as far as Cape Race, so as to leave nothing but the sub-oceanic line to be finished. Can it be finished? Is it practicable? With all the objections duly weighed—currents, icebergs, variable temperatures, whales and what not—is the balance of probabilities in favor of the scheme? The British Company certainly think so—two years' safe working of the line between the South Foreland and Sangatte, doubtless forming the ground of conviction.

The London Literary Gazette states, that the Rev. J. W. Koelle, of the Church Missionary Society, of England, has recently returned from Sierra Leone, where he has made extensive investigations into the African languages. There are a great number of liberated negroes at that place, from whom he has collected a comparative vocabulary of the languages of no less that 190 different countries, from almost every part of Africa, which will contain upwards of 100 distinct languages. Besides that, he has written a grammar of the Vei language, and one of the highly developed and most interesting Bornu language, which, together with the Fellah, constitute the most important languages of Central Africa. The Bornu grammar, it is believed, will throw new light on the character of the African languages. We believe that these results, which constitute the most comprehensive fund of philological information of that continent as yet collected, are to be forthwith published, with a new ethnological map, showing the localities of the various countries, a great proportion of which have hitherto been unknown, even by name.

Commissioner Bartlett, late of the Mexican Boundary Survey, has, by the aid of the Indian vocabulary published by Mr. Galatin, recently discovered that the harsh guttural language of the Apache Indians, our new South Western border men, is the same dialect as the Athapescan of the distant north shore of the American continent. Similar indications of ancient emigration may be expected at every point.

A review of the progress of mechanical, or any of the branches of physical science, during the past year, strikingly illustrate the fact, that many important inventions and discoveries whose reality was made known years ago, are but commencing an existence, through their practical application to the wants of every-day life. In this work of time, the transformation of that which was theoretically true into that which is practically useful, there is great and wonderful progress. This progress is silent, unmarked by any new discovery, and attracts little attention ; the application is, however, at last made in the right way, and now that which was a symbol, becomes an element, or an instrument of power.

The improvements recently made in the application and use of the screw propeller, are opening a new era in the naval and mercantile marine. As an indication of this, the management and evolutions of the great naval review of England during the last summer, may be quoted as an example. "We are now," says Mr. Fairbairn, "in a state of transition between the paddle and the screw, with nearly all progress in favor of the latter.

The most powerful locomotive hitherto constructed, has been built during the past year for the North Western Railroad, of England. The peculiarity of construction consists in the great length given to the fire-box, in which the greatest amount of steam is always generated, and in the comparative shortness of the tubes, which were only half the usual length. The steam generated by this boiler was sufficient for any engine of 700 horse power. This engine was intended for an express, to run on the London and Birmingham road.

In manufacturing machinery and processes, both in England and the United States, and as a gratifying feature of progress, the almost universal prosperity of the working classes should be noticed.

A new combing machine, of French invention, has recently excited some attention in England. It is applicable alike to cotton, flax, and wool, and combs the fiber instead of carding it, by means of a series of small combs applied in succession to the cotton or flax, by which means a much finer yarn can be produced from the same material, than is possible by former processes.

A great improvement in looms, known as "Eccle's Patent" for weaving checks, was exhibited at the New York Crystal Palace during the past summer. Among the other contributions exhibiting great mechanical ingenuity, made to this exhibition, was a machine for pegging boots and shoes. It is made almost entirely of iron, costs $150 to $200, and will probably weigh some two or three hundred pounds. It works very quietly and rapidly, and will peg a shoe or boot, two rows on each side (leaving a small space at the heel and toe) in three minutes, cutting its own pegs. One man only is required to operate it, without auxiliary power. A good workman will peg a shoe by hand in fifteen minutes.

A machine for making *cots*, or little leathern rolls used in spinning, and of which 20,000 per day, hitherto made by hands, are worn out in Massachusetts alone, was one of the most ingenious contributions of Connecticut to the Fair. The leather is drawn into the machine in the shape of a strap or belt, is cut off at the proper length diagonally, so as to form the best edges for gumming, is then rolled or doubled over so that the two edges, being gummed in the operation, exactly meet ; when they are pressed firmly together, and the now perfected cot dropped through the machine and another length drawn in, to undergo the same process.

That ingenious contrivance, the sewing machine, appears to be coming into universal use. Since the first invention, the machine has been greatly perfected and simplified, and has, we believe, nearly attained its greatest excellence, in a recent invention not yet made public.

The newly invented life-boat, to which the prize given by the Duke of Northumberland, Eng., was awarded last season, has unfortunately proved a failure. This boat, it will be remembered, was selected from a competing number of two hundred and eighty, which were urged on the Committee through plan or model.

Calvert, of Manchester, Eng., has recently introduced a valuable improvement in the process of smelting iron, by previously removing the sulphurous vapor from coal and coke. The results have been most satisfactory, the strength of the iron produced by this process being about 40 per cent. greater than that made in the ordinary way.

The subject of the artificial production of fish, started in France a few years since by MM. Sehin and Remy, has been taken up in England during the past year with great success. A little work, containing full instructions for multiplying fish of nearly every description to an almost incalculable extent, has recently passed through several editions in London.

The curious and useful applications which are now so frequently made of the improvements in photography, are strikingly illustrated by the following notice made to the French Academy by M. Milne-Edwards of an unpublished book of MM. Rousseau and Deveria : Photographie Zoologique. This *wonderful* book does not introduce any new processes of photography, but presents an extremely important application of the art of photography to zoology. The plates which compose this work present as yet only incomplete essays, which, however, partly realize the advantages hoped from the application of this new art to zoological studies. M. Milne-Edwards remarked that the zoologist has often occasion to represent a multitude of details which escape the naked eye, and yet which it is necessary he should show. To show them the draughtsman is obliged to magnify them, as if they were seen through a magnifying glass, and the objects thus represented rarely have their natural aspect ; consequently, the zoologist always takes care to use two sorts of images ; figures *d'ensemble*, not magnified, and figures of certain characteristic parts, more or less magnified. In the plates presented to the Academy by M.M. Rousseau and Deveria, such as those representing the Euryale, the Agaricie, &c., the details of structure can be perceived by the naked eye no more than in nature ; but if the observer uses a magnifying glass, they appear to the observer's eye as they are in nature. The advantages of photography over engraving are considerable, when the naturalist wishes to represent a body of a very complex structure ; but in another regard it has much more important advantages. When the zoologist draws, he represents only what he sees in his model ; he brings out, as it were, only what goes to confirm the ideas he has formed upon the structure of the body : while photography, bringing out everything, allows every one disposed to dispute the system of the author, liberty to do so, and places in their hands all the elements of the controversy. Another naturalist may even make discoveries upon these faithful images of nature, as he could have done upon *nature itself.*

A valuable manual of all the recent processes in photography has recently been published in New York, by Mr. Humphrey, the editor of the Daguerrian Journal.

"Stellar Astronomy continues to manifest a vigor and activity worthy of the lofty interest which attaches to it. Bessel had made a survey of all stars to those of the ninth magnitude inclusive, in a zone lying between 45° of north, and 15° of south declination. Argelander has extended this zone from 80° of north to 31° of south declination. It comprises more than 100,000 stars. Last year was published also the long-expected work of Struve, containing a catalogue of stars observed by him at Dorpat, in the years 1822–43. They are principally double and multiple stars, which had been previously micrometrically observed by the same distinguished astronomer. Their number amounts to 2874 ; the epoch of reduction is 1830. The introduction contains the discussion of various important points in stellar astronomy.

"Notices have been brought before us, from time to time, of the nebulæ observed through Lord Rosse's telescope. This noble instrument, so unrivalled for observations of this kind, continues to be applied to the same purpose, and to add yearly to our knowledge of the remotest regions of space into which the eye of man has been able to penetrate. Almost every new observation appears to confirm the fact of that curious tendency to a spiral arrangement in these nebulous masses of which mention has so frequently been made. To those persons, however, who have neither seen the objects themselves, nor careful drawings of them, a mere verbal description must convey very indistinct conceptions of the spiral forms which they assume.

"The refinement of modern methods of astronomical observation has become so great, that astronomers appear very generally to think that a higher degree of refinement in the calculations of physical astronomy than has yet been attained is becoming necessary. Mr. Adams has been engaged in some important researches of this kind. He has corrected an error in Burckhardt's value of the moon's parallax ; and he has also determined to a nearer approximation than that obtained by Laplace, the secular variation in the moon's mean motion. The former investigation is published in an appendix to the Nautical Almanac for 1856 ; the latter has been very recently presented to the Royal Society ''—*Hopkins' Address before the British Association.*

At the sitting of the Academy of Sciences at Paris, November, 1852, M. Faye announced the publication by M. Struve, of his new catalogue of stars, at Dorpat, in Russia. In it he states that, for 100 years last past, the motion of the double star, 61 Cygni, instead of being in orbits one around the other, has been in fact only a right line movement. Bessel and other distinguished astronomers had entertained no doubt of the orbital movement, although the semi-major axis did not subtend an angle exceeding (16″) *sixteen seconds.*

The first report on the Geology of the State of Illinois, has been made to the Legislature during the past year, by Dr. Norwood. The results of the Survey have already had the effect of diverting mining capital to the counties of Pope and Hardin, where it is reported that very large veins of lead and iron may be had for the digging. The only iron furnaces in Illinois are in operation in the latter county. They are two in number, and make iron of excellent quality. Of coal and the ores of iron, there are believed to be inexhaustible supplies. Dr. Norwood has explored the State in various directions. Reconnoissances were made of all the principal points in twenty counties, principally along the southern tier. The work, however, has but fairly commenced, and many years will be required to carry it to a satisfactory completion.

Dr. Norwood, in his report, discusses at some length the formation of the bed of the Mississippi river and its tributaries. His theory is similar to that contended for by Mr. Phillips and some others, viz : that the Mississippi line traverses a ridge, and not a valley, and that the strata dip from the river, sloping respectively east and west. In other words, that the bed of the Mississippi traverses a line of anticlinal axes, or upheavals.

In 1837, by an Act of the Legislature, a Geological Survey of the State of Ohio was commenced, and continued in 1838, by Prof. Mather, and an able corps of assistants. Eleven counties only were examined, when the Commission was obliged to relinquish its labors, in consequence of the failure of the appropriations. At the last meeting of the State Board of Agriculture, at Columbus, it was resolved to petition the Legislature for the further continuance of the work. Similar action has also been taken by the American Association for the Promotion of Science.

Since the publication of Dr. Owen's Report on the Geology of Iowa and Wisconsin, in which attention was particularly directed to the extraordinary fossils of the *Mauvaise Terres*, or Bad Lands of Nebraska, three expeditions have been despatched to these regions for scientific purposes. The first of these parties has been organized by Prof. Hall, of Albany, N. Y., assisted by the American Fur Company. It was under the direction of Messrs. Hayden and Meek, the former of whom is an accomplished draftsman. The second expedition was under the charge of Dr. Evans, the geologist attached to the surveying party of Gov. Stevens. The collections made by Mr. Evans, will be deposited in the Smithsonian Institution. The third expedition was from Prussia. All of these expeditions were successful, and returned richly laden.

A report from President Hitchcock, under a resolve of the Legislature of Massachusetts, authorizing some new geological surveys, has been published during the past year. It embraces two subjects, viz., the coal fields of Bristol County and Rhode Island, and the marks of ancient glaciers in Massachusetts, upon both of which, valuable and interesting information is given. President Hitchcock thinks he has discovered traces of ancient glaciers in the Western part of Massachusetts similar to those exhibited in Wales and Switzerland. The three characteristics which are there observed, viz., the rounding of ledges, the scratches in rocks, and the accumulation of boulders or *moraines* are all visible here, particularly the two former; but they have been somewhat modified by the subsequent action of water.

WE present to the readers of the Annual of Scientific Discovery for 1854, a PORTRAIT OF EDWARD HITCHCOCK, President of Amherst College,—Geologist to the State of Massachusetts, &c., &c.

All communications intended for the Editor of the Annual, should be sent to the care of Gould & Lincoln, 59 Washington Street, Boston.

THE

ANNUAL OF SCIENTIFIC DISCOVERY.

MECHANICS AND USEFUL ARTS.

THE AMERICAN INDUSTRIAL EXHIBITION OF 1853.

The decidedly great event of the year 1853, so far as relates to the progress of science and the useful arts in the United States, has been the Exhibition of the Industry of all Nations, in New York. This great enterprise, conceived by a few public-spirited citizens of New York soon after the close of the London Exhibition, was incorporated on the 11th of March, 1852, when operations were immediately commenced. The co-operation and countenance of the Federal Government was very early secured, and the building for the reception of goods, was made a bonded warehouse in which goods intended for exhibition might be admitted duty free. The officers intrusted with the management of the Exhibition, consisted of a board of Directors, who elected Theodore Sedgwick, Esq., President of the Association, and William Whetten, Esq., Secretary; Mr. C. E. Detmold was also appointed Architect and Engineer. In the mean time steps had been taken to obtain a proper plan for the building to be erected. And here serious difficulties had presented themselves. The matter of iron construction on a large scale was, and is, almost entirely new in this country. No edifice entirely of iron yet existed in the United States, and the want of experience on the part of both architects and engineers, presented serious obstacles. Many ingenious plans were offered. Sir Joseph Paxton, with great liberality, furnished one of singular beauty, but the peculiar shape of the ground to be occupied rendered it impossible to use it. The late Mr. Downing offered another of striking ingenuity, but this was also excluded by the terms of the grant of land from the City, which peremptorily required that the building should be exclusively of iron and glass. Mr. Leopold Eidlitz presented a plan with a suspension roof, intended to obviate the difficulty of spanning great widths by arches. Mr. James Bogardus submitted one of a circular building, consisting of successive colonnades, placed one over the other, somewhat resembling the Colosseum at Rome, and involving a new mode of joining, for which he has obtained a patent. Mr. Julius W. Adams presented one of a great octagonal vault or dome, supported by ribs made of fasces or clusters of gas pipe. Several other plans were offered, of great beauty and originality. The task of selection was difficult and delicate; the Board, however, after much consultation, finally determined on one submitted by Messrs. Carstensen and Gildemeister, of New York. These gentlemen are both foreigners, the latter having arrived recently in the United States, from Copenhagen, where he was well known as the designer of some of the principal public works of that city.

The plan was adopted on the 26th of August, 1852, and no time was lost in putting the work under way.

The piece of ground on which the building stands, Reservoir Square, granted by the city, was somewhat unfavorable for architectural purposes. In other respects no better location could have been found in New York, it being easily accessible from several great thoroughfares running in different directions.

The main features of the building are as follows: It is, with the exception of the floor, entirely constructed of iron and glass. The general idea of the edifice is a Greek Cross, surmounted by a dome at the intersection. Each diameter of the cross is 365 feet 5 inches long. There are three similar entrances each 47 feet wide, and approached by flights of steps. Over each front is a large semi-circular fan-light, 41 feet wide and 21 feet high, answering to the arch of the nave. Each arm of the cross is on the ground plan 149 feet broad. This is divided into a central nave and two aisles, on each side; the nave 41, each aisle 54 feet wide. The central portion or nave is carried up to the height of 67 feet, and the semi-circular arch by which it is spanned is 41 feet broad. There are thus in effect two arched naves crossing each other at right angles, 41 feet broad, 67 feet high to the crown of the arch, and 365 feet long; and on each side of these naves is an aisle 54 feet broad and 45 feet high. The exterior of the ridgeway of the nave is 71 feet. Each aisle is covered by a gallery of its own width, and 24 feet from the floor. The central dome is 100 feet in diameter, 68 feet inside from the floor to the spring of the arch, and 118 feet to the crown; and on the outside, with the lantern, 149 feet. The exterior angles of the building are ingeniously filled up with a triangular lean-to 24 feet high, which gives the ground plan an octagonal shape, each side or face being 149 feet wide. At each angle is an octagonal tower 8 feet in diameter, and 75 feet high.

Ten large, and eight winding stair-cases connect the principal floor with the gallery, which opens on the three balconies that are situated over the entrance halls, and afford ample space for flower decorations, statues, vases, &c. The building contains, on the ground floor, 111,000 square feet of space, and in its galleries, which are 54 feet wide, 62,000 square feet more, making a total area of 173,000 square feet, for the purposes of exhibition. There are thus on the ground floor two acres and a half, or exactly 2 52-100; in the galleries one acre and 44-100; total, within an inconsiderable fraction, four acres.

There are on the ground floor 190 octagonal cast-iron columns, 21 feet above the floor, and eight inches diameter, cast hollow, of different thicknesses, from half an inch to one inch. These columns receive the cast-iron girders. These are $26\frac{1}{3}$ feet long and 3 feet high, and serve to sustain the galleries and the wrought-iron construction of the roof, as well as to brace the whole structure in every direction. The girders, as well as the second story columns, are fastened to the columns in the first story, by connecting pieces of the same octagonal shape as the columns, 3 feet 4 inches high, having proper flanges and lugs to fasten all pieces together by bolts. The number of lower floor girders is 252, besides 12 wrought-iron girders of the same height, and 41 feet span over a part of the nave. The second story contains 148 columns, of the same shape as those below, and 17 feet 7 inches high. These receive another tier of girders, numbering 160, for the support of the roofs of the aisles, each nave being covered by 16 cast-iron semi-circular arches, each composed of 4 pieces.

The dome, noble and beautiful in its proportions, is the chief architectural feature of the building. Its diameter is 100 feet, and its height to the springing line is nearly 70 feet, and to the crown of the arch 123 feet. It is the largest, as well as almost the only dome hitherto erected in the United States. It is supported by 24 columns, which rise beyond the second story, and to a height of 62 feet above the principal floor. The system of wrought-iron trusses which connect them together at the top, and is supported by them, forms two eccentric polygons, each of 16 sides. They receive a cast-iron bed-plate to which the cast-iron shoes for the ribs of the dome are bolted. The latter are 32 in number. They are constructed of two curves of double angle-iron, securely connected together by trellis-work. The requisite steadiness is secured by tie-rods, which brace them both vertically and horizontally. At the top, the ribs are bolted to a horizontal ring of wrought and cast-iron, which has a diameter of 20 feet in clear, and is surmounted by the lantern. As in the other roofs of the building, the dome is cased with matched deal and tin sheathing. Light is communicated to the interior through the lantern, and also in part from the sides, which are pierced for 32 ornamental windows. These are glazed with stained glass, representing the Arms of the Union and of its several States, and form no inconsiderable part of the interior decoration.

The external walls of the building are constructed of cast-iron framing and panel-work, into which are inserted the sashes of the windows and the louvres for ventilation. The glass is one-eighth of an inch thick, and was manufactured at the Jackson Glass Works, N. Y., and afterwards enamelled by Cooper & Belcher, of Camptown, N. J. The enamel with which the whole of it is covered is laid upon the glass with a brush, and after drying, is subjected to the intense heat of a kiln, by which the coating is vitrified, and rendered as durable as the glass itself. It produces an effect similar to that of ground glass, being translucent but not transparent. The sun's rays, diffused by passing through it, yield an agreeable light, and are deprived of that intensity of heat and glare which belongs to them in this climate. In the absence of a similar precaution in the Crystal Palace of Hyde Park, whose roofs, as well as walls, were enclosed with transparent glass, it was found necessary to cover the interior of the building with canvas, to produce the required shade.

The rapid and unexpected increase of the applications of exhibitors induced the Association to erect a large addition to the building already described. It consists of two parts, of one and two stories respectively, and occupies the entire space between the main building and the Reservoir. Its length is 451 feet and 5 inches, and its extreme width is 75 feet. It is designed for the reception of machinery in motion, the cabinets of mining and mineralogy, and the refreshment rooms, with their necessary offices. The second story, which is nearly 450 feet long, 21 feet wide, and extends the whole length, is entirely devoted to the exhibition of pictures and statuary. It is lighted from a sky-light 419 feet long, and eight feet and six inches wide.

The decorations of the building were intrusted to Henry Greenough, Esq., of Cambridge, Mass. The leading idea in the plan of decoration, has been to bring out the beautiful construction of the building — to decorate construction, rather than to construct decoration. The result has proved surprisingly beautiful. The colors employed on the exterior are mixed in oil, the base being white lead. The exterior presents the appearance of a building constructed of a light-colored bronze, of which all features purely ornamental are of gold. The interior has a prevailing tone of buff, or rich cream color, which is given to all the cast-iron constructive work. This color is relieved by a moderate and judicious use of the three positive colors, red, blue, and yellow, in their several tints of vermilion, garnet, sky-blue, and orange, (certain parts of the ornamental work being gilt) to accord with the arrangement of colors employed in the decoration of the ceilings. The only exceptions to the use of oil colors are the ceiling of the American lean-to and the dome; these decorations are executed in tempera on canvas.

The effect of the interior of the dome, is particularly splendid. The rays from a golden sun, at the centre, descend between the latticed ribs, and arabesques of white and blue, relieved by silver stars, surround the openings.

The whole quantity of iron employed in the construction amounts to 1,800 tons, of which 300 tons are wrought and 1,500 tons cast iron. The quantity of glass is 15,000 panes, or 55,000 square feet. The quantity of wood used amounts to 750,000 feet, board measure.

The general mode of erection by base pieces, columns, connecting pieces and girders, is the same with that of the great Hyde Park building; but the construction of the arched nave, and of the dome, is of course entirely peculiar, and the general effect of the building is completely different. The London building was certainly deficient in architectural effect. The form of the New York edifice affords the requisite scope for a pleasing variety of embellishments, by which all monotony is avoided, and allows a very economical use of the ground.

It was the intention of the officers of the Association, that the building should be finished and the Exhibition opened by the first of May, 1853. Many delays necessarily intervened, and the opening was consequently deferred until the 14th of July, on which day the Exhibition was formally opened with appropriate services, in the presence of the President of the United States, and many distinguished men of America and Europe.

The details of the Exhibition, with the collecting and arranging the various departments, was intrusted to the following gentlemen :— General Superintendents, Capts. Dupont and Davis, U. S. A.; Secretary, J. M. Batchelder, Esq.; Arrangement of Space and Classification, Samuel Webber, Esq.; Department of Mineralogy and Chemistry, Prof. B. Silliman, Jr.; Director of Machinery, J. E. Holmes; Director of Agricultural Implements, B. P. Johnson, Esq.; Director of Sculpture, Felix Piatti; Director of Textile Fabrics, Edward Vincent.

The total amount of space on the floor, occupied by different countries for exhibition, exclusive of the naves, was about 152,000 square feet, of which 94,102 is on the ground floor, and 59,000 is in the gallery. The total amount of space occupied by foreign exhibitors was 98,749 square feet. The total number of exhibitors from abroad was about 3000. In the United States Department the number of exhibitors was about 2000, the largest proportion of whom were included under the following classes: Mineralogy, Metallurgy and Mining; Machinery and Tools; Agricultural Implements; Hardware; and the Fine Arts. The number of persons contributing was about one-fourth that of the London Exhibition.

NOVELTIES OF THE NEW YORK INDUSTRIAL EXHIBITION.

To attempt to describe, or briefly notice a majority of the multitude of new, ingenious and useful inventions exhibited within the New York Crystal Palace, would be impossible within the limits of the present work. The following notices, however, abridged from the reports given in the New York Tribune, Scientific American, Putnam's Industrial Record, and various other publications, will be found to include the most important of the mechanical novelties exhibited.

One of the most interesting features of the Exhibition, was the number and variety of the machines and implements intended for perfecting or economizing the various processes of agriculture. A like collection has never probably been seen before, the whole presenting a striking illustration of the great employment of the American people, and of the amount of ingenuity and skill which has been made subservient to this branch of industry. In no other department was the Exhibition more National and American than in this.

The following inventions were among those deemed particularly worthy of notice.

Improved Feed Mill.—This invention of Sherlock and Blackbill, Penn., is designed for the use of farmers, or those who desire to crush corn, or grind oats, wheat or other grain, sufficiently fine for feeding to any kind of domestic animals, or for cracked hominy for the table. The grinding buhrs of this mill are blocks of wood 15 inches diameter, 4 inches thick. These are faced with strips of soft iron $\frac{3}{8}$ inches thick, 1 inch wide, with spaces between, $\frac{3}{4}$ inches wide, which are driven full of cut nails, made for that purpose. The buhrs are placed in a sheet-iron case 18 inches in diameter, and 14 inches high, at the bottom of which is the discharge spout for the meal. This case is set in a frame 3 feet high and 18 inches square. The upper buhr is bolted fast to the upper part of the frame, which is fastened to the posts by bolts, so that by unscrewing, all lift off together when the buhr needs sharpening, which is done by cutting with a cold-chisel. The lower buhr is moved by a pully on the lower end of the shaft, which stands in a step-block, and that block rests on a screw by which the buhr is set to grind fine or coarse. With four horse-power it will grind four to six bushels per hour, and will require about fifteen minutes dressing for every 150 bushels ground. It has no gearing, and in use cannot wear one grinding surface upon the other, so that a hopper holding 20 bushels may be filled and ground out without the least attention, and shonld it run empty, no injury will result.

Machine for Picking up Stones.—This machine, the invention of J. S. Foster, of N. Y., is constructed as follows: Suspended to an axle is a movable rake, with half-circular fingers, which gathers all the stones in its path; and these are taken up by teeth fixed in a drum, and carried up over and dropped into a hopper that conducts them into a cart-body at one side. As these teeth come round with their load, a trigger on the drum throws them back inside, so that stones getting between the teeth do not stop or break them. It can be made to pick up apples, potatoes, or any other vegetable from the size of a hickory-nut to that of a peck measure. It can be used also to remove loose earth.

Pennock's Wheat Drill.—This machine is mounted upon a pair of wheels like the low wheels of a small wagon, on an axletree $6\frac{1}{2}$ feet long between the shoulders. It has eight hollow teeth, which are attached to a movable frame, so that all or any one may be raised out of the ground. The grain is put in a box on the axle, divided in four parts, each of which holds half a bushel. As the wheels roll forward, they move machinery in the bottom of these boxes, which lets the grain down in just such quantities as the farmer desires to plant per acre, and this is conducted down through the hollow teeth and deposited at the desired depth in the previously well-pulverized soil. It has been proved by experiment that wheat put in by a drilling machine will produce ten per cent. more than broad-cast sowing of the same land, while the saving of seed is full twenty per cent.

Improvements in Grinding Corn.—This English improvement in the construction of corn-mills, is the invention of Mr. Barnett, and consists of an application of wire gauze inserted in cavities in the millstone, which serve the purposes of ventilating the corn during the process of grinding, and of liberating those portions of the flour which are sufficiently ground before reaching the peripheries of the stones. By this contrivance, it is asserted that a much larger proportion of gluten is retained in the flour,—consequently, there is much less waste; and the same quantity of wheat is capable of being converted into a larger quantity of food. This saving is stated to exceed 5 per cent.

Moffat's Patent Grain Thresher and Cleaner.—This machine, invented by Mr. Moffat, of Piqua, Ohio, has some novel features of construction. The cylinder is 30 inches long and 16 diameter. It is made of eight flat bars of iron, ½ inch by 2 inches, fastened upon iron heads with four strong iron bands. In each of these bars are 17 flat teeth, fastened by nuts on the ends, on the back side of the bars. The teeth pass between one row of teeth in the concave, which is made of bars of iron, open so the grain may fall through. The shaft of the cylinder is 34 inches above the ground, and is driven by a spur wheel on the left hand side of the machine, which works into a pinion on the cylinder shaft. On the right of the machine is a bevel pinion, upon the end of the shaft which supports the spur-wheel, which is driven by a wheel set at right angles upon a short shaft, to which the power is connected by a universal joint. The width of the frame is 40 inches; height over top of cylinder, 42 inches; height of straw carrier at extreme end, 6½ feet; extreme length of machine, 19 feet. The straw carrier is made of round rods and iron links, so as to form an endless band. Underneath the straw carrier, there are two screws 6 feet long, and 8 inches diameter, running in sheet-iron troughs, which carry up the grain and chaff that falls through the concave and short of the straw carrier, and drops it upon the screen of the fanning-mill, which is under the back end of the machine. On the left side of the frame there is another similar screw on the reverse angle, which brings back from the fanning-mill the unthreshed heads, and drops them into a spout which leads them back to the threshing cylinder. There is another screw running across under the fan-mill screen which brings the clean grain out through a spout on the right side of the frame, to which a bag may be attached. There is a wheel over the straw-carrier that assists to push up the load. The fanning-mill is in the usual form, similar to those constructed to work by hand.

Zimmerman's Threshing Machine.—This machine differs in some respects from the other recent inventions. It has a spiked cylinder, 30 inches long, 18 inches diameter, made of six wooden bars, with 13 spikes in each. The concave has 45 teeth, which are movable, so as to allow part to be taken out. The cylinder is 5 feet above the ground, and the edge of the feed-apron 6 feet, rendering it necessary for the feeder to stand on a platform, which is suspended by rods. The fanning-mill is placed under the cylinder. The straw-receiver is a level board 12 feet long, 3 feet 3 inches wide, bored full of holes, and made to shake like the sieves of a fanning-mill; the grain falling through the holes is received in a zinc trough, and carried back to the fanning-mill. The grain is all shaken out of the straw while it is on the carrier, and as it leaves the fanning-mill it is driven over slats, through which a current of air is forced up, blowing back into the screen all chaff and light grains, so that none but clear wheat enters the bag.

Palmer's Threshing Machine.—This machine differs in all respects from any heretofore invented for threshing grain, and in some particulars is as greatly in advance of all others, as the ordinary kind is in advance of the flail or trampling of cattle. It does not thresh by a spike-toothed cylinder working into a spiked concave, like the ordinary machine, which is fed by a man who stands in front, feeding it with wheat and himself with dust, to which is sometimes added a flying tooth or other death-dealing object. The grain is put into this machine upon aprons on both sides, as fast as four men can handle the unbound sheaves, which pass through a hole upon each side of the case, which is circular, about four feet in diameter and six inches thick, the hole being about the size of a bundle of grain, and situated at the outer edge of the circle, about half the height from the ground. Here the heads of the grain are struck by four iron arms of $1\frac{1}{4}$ inch round iron, which are firmly set in a hub that is made to revolve with great speed. This blow or blows, falling rapidly upon the heads as they project from a square corner, knocks out a great portion of the grain; the straw is then carried forward by the arms through the lower half of the circle, the sides of which are waved plates of iron, which give the straw a tortuous motion, whipping it from side to side until every kernel is whipped out. The straw is all carried forward by arms over the upper part of the circle and thrown out at the same side it entered, a little above. These plates are adjustable, so as to be set close for timothy, or wide for coarse straw, either wheat, rye, oats, rice, buckwheat or peas; all of which it will thresh perfectly clean. It is claimed for this machine, and apparently with justice, that with the same power it will thresh more grain than any other.

A valuable improvement has also been made by Mr. Palmer upon the old fashioned spike cylinder threshing machines, to prevent danger to the person tending them when a stone or other hard substance happens to be in the sheaf. This is simply by cutting off the apron just before it reaches the cylinder, so that all heavy substances drop down. There is also a roller in front of the cylinder to prevent whole sheaves from passing, or the feeder getting his hand caught.

Farmer's Labor Saving Machine.—This machine, known under the above title, was invented by G. S. Snyder, Jefferson Co., Va., and is designed to thresh, clean and put the wheat in bags, ready measured for market, all at one operation. It is intended to be operated by two horses, and is represented as being capable of threshing and cleaning 100 bushels of wheat per day.

The same inventor has also exhibited, at the Crystal Palace, a model of a machine which is much needed in many of the Southern States. It is intended to separate garlic from the wheat, which no common cleaner will do. In this the wheat is washed and the garlic taken out, and the grain dried by hot air or steam. It can be operated by hand, horse, or any other power.

Clover and Timothy Seed Harvester. — This machine, the invention of Mr. J. A. Wagner, of Steuben Co., N. Y., is essentially a simple frame and box mounted on wheels, in front of which is a cylinder set with spiral knives, acting in concert with curved spring teeth, in combination with a straight knife, which forms a perfect shear, that severs the heads from the stalk, which are at the same moment discharged in the box. The teeth being made to spring and vibrate, it matters not how thick or stalky the clover is, not a particle can escape being cut, or allow the teeth to become clogged. The machine is so constructed that it can be adjusted to the height of the clover and timothy. With the aid of one boy and a horse, this machine will harvest from ten to twelve acres per day.

Salmon's Improved Grain Cleaner. — This machine is very unlike the ordinary fanning mill, though answering the same purpose, and even effecting much more, for by slight changes in the force and direction of the blast, wheat can be separated from chess, cockle, garlic, smut, white-heads, and other impurities, as well as from grass seed, saving that and separating the different kinds of grain and grass from one another. The wind-wheel is made of iron, 16 inches diameter, 18 inches long, and is placed in an air-tight iron trunk at the bottom of the frame, which is 3 feet 10 inches high, 2 feet wide, and 2 feet 10 inches long. The wind-wheel is driven by a cog wheel 2 feet diameter, which gives the fan great velocity, sending the air up a tight trunk through which the grain is falling from the sieves, which are not shaken sideways, like the common fan-mills, requiring a good deal of extra room, but are jogged in front by a cam on the shaft of the driving wheel. The sieves, five in number, for different grain, are made fine at the end where the grain first strikes them, to let through fine seeds, and coarse at the other end, through which the wheat falls on the inclined plane, and through the wind-spout into a receiver at the bottom, The wind-spout at the back of the mill can be closed in part, or wholly, by which a little blast is allowed, or all turned out through the sieves.

This machine is very simple in its whole construction and operation, and quite portable, weighing only from 125 to 135 pounds. It was patented in July, 1853, and originated in the great wheat region of Northern Illinois, where the want of a perfect grain cleaner has long been felt — the wheat from Chicago being generally several cents below that of New York, on account of the very imperfect manner in which it is cleaned.

Child's Grain Separator. — The principal improvement of this machine upon the old fanning mill is an attachment which causes the grain to fall through a draft of air, created by suction of the fan, so strong that the grain is held in suspension until all the light particles are separated and blown out another way.

Hargrave's Corn Husking Machine. In this machine the ears of corn are placed in little troughs of a horizontal wheel placed on the top of a frame, and turned by a crank. As they pass round, a chisel comes down, separates the stalk from the cob and pushes out the ear and returns ready for another, as it comes around. Another contrivance throws out the husk. In this way, says the inventor, 200 bushels a day can be shelled, or with a large power machine, 1,200 bushels in ten hours. The price of a hand machine is $18 to $25.

Corn Hulling Machine.— This machine is a frame 5 feet long, 2½ feet high, 1½ feet wide, supporting a wooden case lined with sheet iron in the form of a cylinder about a foot in diameter, 4 feet long. This is made in parts, so that the top lifts up to get at the interior. In the cylinder runs a wooden shaft 4 inches diameter, armed with three square files in four rows, thirteen in a row, which project four inches from the shaft. A band being applied to the pulley on the end of the shaft, it is made to revolve rapidly, and the grain being fed slowly through a hole in the top of a cylinder, has all the hulls filed off and blown out through openings.

Archimedes' Root Washer— This is a frame and water box, holding a barrel made of open-work staves. It is 4 feet long, 2½ feet diameter, and about 4½ feet high. There is a hopper at one end, and a discharge-spout at the other. The internal arrangements are such that, when the barrel is turned one way, the roots remain in the water, but when it is reversed, they are screwed up and out of a hole in one end and discharged into a spout, that deposits them in a basket.

Ramsey's Improved Harrow.— This new pattern of harrow, is made of three wooden frames, say four feet square, with thirty-two teeth. The forward frame is placed cornerwise to the team, the two outside bars of the frame projecting back about a foot beyond the side pieces. To the inside of these projecting bars the outside bars of two similar frames are hung by the end of the bar projecting about six inches forward. The two inside corners of these frames are also hinged together, so that each frame is drawn cornerwise forward, and being fastened together by universal joints, adapt themselves to the most uneven surfaces.

Atkins' Automaton Raker.—This machine was one of the most simple, ingenious and yet effective pieces of mechanism exhibited at the New York Crystal Palace. It was invented by Jearum Atkins, of Chicago, a bed-ridden cripple, who had not been in a harvest-field for years, and who has never yet been able to witness the operation of his ingenious and useful invention. The raker is intended to be attached to any of the ordinary reapers, by means of a bevel-wheel, about twenty-three inches diameter, upon a spur of which, on the inside of the rim, is a knob, working into the hollow end of an arm, and by the mere turning of that wheel, without any other means, that arm in its circular motion creates a motion of the rake, which is exactly what the two hands of a man would be if he stooped down and scraped up the grain with his hands which the reaper has cut and laid upon the platform. The rake then turns round, opens its fingers, lays down the wheat ready for the binder out of the way of the next through, stretches out its arms, turns back to the platform and takes up another load, and thus goes on its ceaseless round, the motion of the reaper keeping the raker performing its work with unerring certainty.

Gibbs' Rotary Spade.—This spading-machine is composed of two cast iron circular plates, about two feet four inches diameter, and one inch thick. These are fastened upon a shaft, about two inches apart, and working between them are eight stout, narrow, wrought iron teeth, somewhat like the old-fashioned cultivator teeth. These teeth are hung, and have a trigger to throw the tooth out as the machine revolves. Two sets of these plates and teeth are set in a stout frame, and look like a pair of toothed wheels, of a very formidable appearance, the teeth projecting about nine inches. The operation is thus: A pair of oxen, which are sufficient upon ordinary soil, are hitched to the frame, and, as it is drawn forward, each tooth in succession is pressed into the earth by the weight of the machine, and as it rolls forward the weight falls upon the trigger, and that throws the tooth out with its load, turning and pulverizing the earth as though spaded, or, more properly, forked over. The two wheels cut a furrow about two feet wide and nine inches deep, which can be increased by an enlarged machine to any desirable width or depth. It requires no holding, yet is provided with handles so fixed as to throw the teeth out of the ground by the weight and motion.

Pratt's Rotary Drill Digger.—This machine, invented by R. C. Pratt, of Canandaigua, N. Y., is all iron, the frame about five feet high, with twelve spades arranged around a circle, which revolves as it is drawn forward. Each blade, which is eight inches wide and twelve inches long, enters the ground and takes up its load, carrying it round to the center on top, where it is discharged upon conductors which carry the dirt off upon each side.

Arnott's Improved Road Scraper.—The working of this new road scraper, invented by Mr. Arnott, of Iowa, is the same as in the ordinary scraper until it comes to the unloading. As the handles are raised, the hind part of the shovel opens by ingeniously arranged hinges, and lets the great bulk of the load out behind: doing apparently as much work as the old-fashioned scraper, or ox shovel, with less labor to the operator.

Patent Pig Pen.—Among the other curious inventions and devices exhibited, was a model of a *Patent Pig Pen*, consisting mainly of an improved plan for feeding swine. Instead of a feeding trough, there are a series of cast iron basins set in a bench about a foot high, over each of which is an iron frame to keep every pig in his own dish. Over these basins there is a roof, and the side of the pen in front of them is hung upon pivots, so it can be pushed back at the bottom, shutting the pigs in the pen and the troughs out. When they are filled the bolt is withdrawn, and the force of hunger pushes it back to its original position.

Patent Broom.—This improvement is described by the N. Y. Tribune as follows: There is no twine, no wire, no stitching, about the patent broom. There is a flat steel spring, 6 inches long, with a T head, inserted in the handle, and over that is a hinged socket, which being opened, the broom corn is laid upon the spring, with the butts in the socket, which, as well as the cross head of the spring, is covered with teeth, which holds the corn. To keep it in place, now shut down the hinge of the socket, and slip a ring down over the corn to about the point where the twine is generally stitched through, and the broom is done. One handle will last for years, and is not very expensive. There is a very decided advantage in these brooms in this, that the handle does not project down into the broom, but the steel spring gives it a pleasant elasticity, until it is completely worn out.

Mumma's Corn Sheller.—This corn sheller is a box, some 2 feet long, 1½ feet wide, and 2 feet high. In the bottom is a concave-shaped cylinder, 10 inches by 17, of wood, faced with iron staves, teethed. The ears thrown in upon a board serving as a hopper, are held up to the cylinder by wood springs, so that the butt and points have equal bearing as they pass out, the cobs one side, and the grains dropping below; it is doubled-geared for hand, with a fly-wheel and pully for horse-power.

Center Balanced Gate.—This gate is made to open by shoving back alongside of the fence, somewhat as a railroad gate works on rollers. It is not, however, provided with rollers, but is sustained on a new principle of most singular construction. Suppose it is half open, between two posts, then the four supporters are seen upright, two of which are attached to work on a pin inside of the posts, one on each side, and two on pins at the bottom of the center batten of the gate. Each of these last is fastened by another pin in the center to the slat attached to the posts. The upper part of the two slats on the gate are fastened together by a guide-pin, which works in a slat attached to the posts, so that as the gate is shoved forward or back, the supporters take the form of braces, opening and shutting like a pair of shears, and reversing position, the weight of the gate being all the time equally sustained. It is said to work well.

Seeley's Improved Straw Cutter.—This straw cutter, invented by C. W. Seeley, of Albany, is a frame 3 feet high and 1 foot wide, supporting a box to hold the straw to be cut, 3½ feet long, 5 inches deep, 13 inches wide at one end, and 8 inches at the other. At the narrow end is a pair of fluted feed-rollers, which are driven by ratchets and pinions moved by a crank on the fly-wheel shaft under the box. The fly-wheel is of iron, 2½ feet across, the rim an inch and a quarter in diameter, weighing perhaps 40lbs., and is driven by a spur-wheel 8 inches across, on the end of the crank-shaft; the crank, which is 13 inches long, is on the right-hand side of the box, the fly-wheel on the left. From the fly-wheel crank a rod 8 inches long extends down to a lever 16 inches long, hung by the center to the bottom pieces of the frame. From the other end of this lever another rod extends up to the cutting-knife frame, which is of cast-iron, and supports a knife which is of the shape of letter W inverted. As the crank is turned, the straw or corn-stalks are drawn forward by the rollers, and held over a square iron edge, when the knife comes down with its shearing cut, and with power enough to cut a good-sized walking-stick in two. The point in the center of the knife is the great feature of the improvement. The straw being crowded into a compact mass by a triangular knife, not having that point, would perhaps cut hard. In this shape the point begins to enter and cut with but little effort at the precise spot where, without it, the machine would require the greatest power to make the cut. There is another advantage in this knife. The point is so strong and the momentum so great that a seasoned root or stock would be split and cut in two without checking the machine.

Parker's New Straw Cutter.—This is a straight knife, 15 inches long, screwed on the front part of the feeding-box, and the cut is given by turning a crank and fly-wheel, upon the shaft of which is a crank that lifts a frame which brings up the straw so as to give it a diagonal stroke upon the knife.

Daniel's Patent Straw Cutter.—This is powerful machine, and for horse or steam power is the most effective of any of the recently invented cutters. Tne frame and box are in the ordinary form, similar to that of the one first described. The crank is upon the arm of a heavy fly-wheel, 3 feet diameter upon one side, and forming part of which is a driving-pully. Upon wings on the shaft of this are four straight knives, ten inches long and two inches wide. The straw is brought up to them by a spiked roller, geared by spur-wheels to the main shaft, and the cut is made by the knives upon the straws resting across the edge of a piece of iron, set so that the cut is diagonal.

The following notice of recent improvements in plows and cultivators, and the exhibition of the same at the New York Crystal Palace, is abridged from the columns of the New York Tribune.

The number and variety of these implements on exhibition was very large, and from their examination it would seem as though there was no limit to the inventive genius of man, as applied to the construction, alteration and adaption of the form of cast iron to all shapes, sizes and kinds of plows, possible to conceive, thus lessening the labor of preparing the ground, or cultivating every variety of crops grown between tropical Florida and the barley fields of Lake Superior.

Many will doubtless remember the old Cary Plow, with its clumsy, wrought iron share, wooden land-side and standard, and wooden mold-board, plated over with a piece of tin, sheet-iron, or old saw-plate, requiring the strength of a man to hold it by the two pins in its upright handles, and at least double the strength of team now required to do the same work. Then there was the old Bar-share Plow — a flat bar forming the landside, with a thick clamp of iron like the half of a lance-head for the point, in the top of which the coulter was clumsily locked, and of course a wooden mold-board without any pretensions to making a fit with the iron part.

The Chinese plow is similar, and the effect is similar to what it would be if a man should hold a sharp pointed shovel, back up, with the handle at angle of 45°, and it should then be drawn forward with the point in the ground.

The plows in Continental Europe have undergone but little change for centuries. The ancient Roman plow is still in general use in France. It has a beam, a share and a handle. The share is a triangular shaped piece of wood with an iron point, and sometimes a coulter. There is a mold board, and the point is shaped like the head of a lance. The first step toward improvement in this rude implement was the addition of a mold-board, to turn the earth over. This was made of wood, and maintained its place until very recently. The iron plow is a modern invention.

No plow can be adapted to all kinds of work, and no good farmer will attempt to do all with one, or with those of the same shape. Some land should be plowed flat, some in ridges, some stirred, some with the furrow all one way, and some both ways. Some prefer a plow which turns to the right, some to the left, and for successful side-hill plowing, one is wanted which can be changed so as to plow back and forth.

One of the most useful and least known, is the sub-soil plow. The use of this is to follow the turning plow, entering the bottom of the furrow and performing one of the most useful operations upon the farm, stirring and loosening up the sub-soil. All these, of all sizes, from a few pounds weight up to a load for one yoke of oxen, without entering the earth, can now be had at prices extraordinarily low, when compared with those made by hand; for skill, science and machinery have been applied to the manufacture of these implements, within a few years past, to an extent but little thought of by those who use them.

The shovel plow, still in almost universal use throughout the cotton-growing States, is still more rude in its construction. It is usually made of a roughly hewn stick for a beam, about 2 inches square and 3 feet long, about midway of which another stick about 15 inches long is framed in, upon the end of which a piece of iron, much resembling a sharp-pointed shovel, is fastened by one or two short screw bolts. Two rough handles pinned to the side of the beam and supported at the proper angle by a wooden support, with a clevis, or a piece of bark, withe or loop of raw hide at the forward end of the beam, completes the tool by which more than half the cotton fields of America are plowed. The whole may weigh fifteen pounds — the iron part from two to four, and its shape may be imagined by putting your two hands together edgewise a little curved, with the backs up. The action as it is drawn forward, rooting through the loose soil, is to stir the surface about 2 inches deep; it does not turn it over, though there is an implement called a turning shovel, made with a sort of twist to the share, which has the effect to give the dirt a slight roll like a small mold-board.

There is another modification of this tool called a bull-tongue, the share being of the shape of that article, and fixed upon the same kind of a stock as the shovel. This is a slight advance upon the form of the first plow of which we have any account. As represented on ancient coins and monuments, it is probable it was little else than a crooked stick, afterward improved by sharpening with iron. The implement now in use in Hindostan is little better than the original, and even in this country some of those above described as now in use, are but slightly in advance of the Hindoo article, which consists of a slight beam, a narrow share and a corresponding stick with a handle to guide it.

In connection with this notice of the plows exhibited at the New York Exhibition, it will be profitable to all thinking minds to take a retrospective view of the history of the cast-iron plow, and the slow steps with which improvement has made its advance toward perfection, which certainly does seem as though it had been nearly reached.

The first patent of which we have any notice, was granted in 1720, to Joseph Foljambe, of Rotherham, England, and for many years afterward, all similar plows bore the name of that place. It was a great improvement upon those previously in use ; the mold-board and land-side were wood, sheathed with iron plates, the share and coulter, wrought iron with steel edges, just such as were in universal use in New England in the forepart of the present century, and similar to those now in use in the South-western States. This plow was intended to be worked by one man and two horses — much larger than our common horses — and turn over an acre to an acre and a quarter a day. Some twenty years after this plow was brought out, the center draft rod or chain was added, just like that now used, and supposed by some to be a very recent invention.

The first cast-iron mold-board we find mentioned, was invented by James Small, of Berwickshire, Scotland, about 1740. He continued to manufacture them for fifty years, still using the wrought-iron share; cast-iron for that purpose having been first applied by Robert Ransom, of Ipswich, England, in 1785. Eighteen years afterward, he made a valuable improvement, still in use among all good plow-makers, that of chilling the iron in the molds, by using bars of cold iron, upon which the cutting edges of the share are cast, making them harder than steel.

The inventive ingenuity of England had advanced thus far in eighty years. But the cast-iron plow was not yet complete. A Suffolk farmer added the land-side, making three distinct pieces of casting to each, to which wrought or cast iron beams and handles were afterward added in various parts of England and Scotland. The first cast-iron plow in America was made by Charles Newbold, of Burlington, N. J. His first patent bears date, June 17, 1797, and is for a plow combining mold-board, share, and land-side all in one casting. Objections being made to the cast-iron share, probably because it was not chill-hardened, he substituted wrought-iron shares. Great as these improvements were upon the old wooden plows, such was the prejudice against them — some even affirming that cast-iron poisoned the ground and prevented the growth of crops — that after spending, as the inventor alleged, $30,000 in a vain effort to gets his plows into general use, he gave up the business in despair, leaving American farmers wedded to their idols, the old wooden plows.

In the year 1800, Peter J. Curtemas, a merchant of New York, advertised plows for sale, made of cast iron. In 1807, David Peacock, another Jerseyman, taking his idea from Newbold, for which, however, he paid him a thousand dollars, patented a plow, the mold-board and land-side cast separate, to which he attached a wrought-iron steel-edged share. Thomas Jefferson wrote a treatise in 1798, upon the form of the mold-board, insisting that it should be constructed on scientific principles. These principles were probably first applied by Robert Smith, of Buckingham, Pa., about 1804-6, as he obtained a patent for a cast-iron mold-board, and wrote upon the subject about that time. In 1814, years after cast-iron plows had been in successful use in England, and partially so in this country, Jethro Wood obtained a patent for a cast-iron plow, in three parts, similar to one said to have been in use previous to that time in Virginia. In 1817, Edwin A. Stevens, of Hoboken, N. J., took up Newbold's plow, with a view to improve its form, so as to make the draft easier. He took his patent in 1821, included in which was the process of cold-chilling the cutting edges and parts of the share most likely to wear out. His plan was so perfect that it was highly approved of, but other engagements prevented him from extending what he had so successfully begun.

In 1810, Josiah Dutcher, of New York, commenced a series of improvements which are to be found upon nearly all the cast-iron plows now in use, and which have been of immense benefit to the farmers of this country.

Finally, we would not omit to mention the name of Joel Nourse, of Massachusetts, as one who, in connection with his partners, has probably done more toward making the cast-iron plow a perfect implement than any other individual, though many others are entitled to high praise for doing, to the extent of their ability, so much to lessen the labour of tilling land.

Among the plows on exhibition at the Crystal Palace, the following presented peculiarities worthy of notice.

One of an awkward, unique appearance, was constructed as follows: Two common cast-iron shares, with small mold-boards, are attached by two rods, about two feet long, to each share, to the side pieces of a wooden frame, made to expand so as to increase the width of the furrows apart, and upon the cross pieces of the frame, are placed the handles, and a short neap, to which the horses are attached, both made to raise or lower to suit the hand of the holder or the height of the team. These shares can be readily shifted so as to turn furrows out or in, and by straddling a row of corn, both sides can be plowed, and dirt turned from or to it, at once going through.

One of the most beautiful of the agricultural implements exhibited, was a new "horse hoe," by Ruggles, Nourse, & Mason. This neat little tool weighs only 63 pounds, and will cut a furrow 20 inches wide. It is made of $2\frac{1}{2}$ inch square timber, the beam or center-piece 3 feet 9 inches long, with a slightly crooked wing-piece on each side. On the forward end of the beam, a regulating draught circle is placed, and a depth-guage wheel underneath. A little further back is a cutting tooth, and at the hind end a double-sided share or hoe, running flat, making a cut thirteen inches wide. On each end of the wing-pieces a hoe of smaller dimensions and different shape is placed, which is easily shifted so as to turn little furrows in or out, as may be desired. It is a very effective tool, and in some respects preferable to the ordinary triangular wooden-framed five-toothed cultivator, being so light and yet so strong that it can be easily operated by one small mule or horse, and guided by any boy big enough to reach the handles.

Another implement which promises to be very useful, is called the double plow, or sod and sub-soil combined: known in some parts of the country as the Michigan Plow. Its peculiarity consists in this: upon the beam about where the cutter, or coulter is usually fixed, there is a common cast-iron plow-share, which cuts and turns the sod any required depth, while the main share takes up the earth from the bottom of the furrow, four or five inches deeper, and lays it in a completely pulverized state on top of the inverted sod.

Among other improved plows exhibited at the New York Exhibition were two patterns "side-hill plows." The first is so contrived that by unhooking a stout hook and a little exertion of the plowman, while the team is coming about, the whole share, mold-board and all together is rolled over, and again fastened with the hook, so that the furrow is turned the other way. These are made of different sizes, turning a sod from 5 to 7 inches deep and 10 or 12 inches wide, and notwithstanding their awkward appearance, work equally well on level or hill side land. The same scale of proportions and carefully laid down principles, in regard to curved lines, is preserved in all the plows coming from this manufactory; so that all work alike as to tractile force, whether great or small, according to the work required of each kind. With a side-hill plow the plowman may commence on the lower edge of a hill-side, turning all the furrows down the slope, going back and forth, changing his plow to the right and left at the end of each furrow, or in the same way he may plow a level field.

The other side-hill plow is made of iron, and has this striking peculiarity, that the beam and handles together turn round upon a pivot formed of the top of the standard. The share has a straight land side, 2 feet 10 inches long, with a point at each end exactly alike. Suppose you are turning a right hand furrow, and wish to change to the left, you give a rod under the right handle a little jog, which unlooses a catch, and you walk round with the handle in your hand till the beam points directly the other way; now pull the rod and close the catch, stoop over and give the mold-board a flap and it turns back bottom up, disclosing another under it exactly like the other, also bottom up and pointing forward; turn this also, and you have before you as neat a looking plow as you will find in the Exhibition, the reversed mold-board lying under the other, quite out of the way, and the reverse point forming the heel of the land-side. The length of the beam is 4 feet; handles, 4 feet 6 inches; width of share, 9 inches; length from point to upper angle of wing, 2 feet 9 inches; length of wing from the joint to upper end, 1 foot 7 inches; height of standard, 1 foot 2 inches; height of fin-cutter, 9 inches. This plow has been recently invented by L. Hall, of Pittsburg, Pa. His construction completely obviates the objection to the other side-hill plow, that is, that it requires a very strong man to hold it, or rather to shift the share which rolls under, in changing from side to side.

The sub-soil plow is so little known, to a majority of those who till

American soil, that a more particular description and slight history of its introduction will be found interesting. In the year 1840, Messrs. Ruggles, Nourse, Mason & Co. imported from Scotland, the first sub-soil plow ever seen in the United States. It was a complicated, expensive, cumbersome affair, as most of the Scotch plows are, and could not be patterned after with any hope of successful introduction among farmers. Feeling satisfied of the benefits that would result to them from the use of a good sub-soil plow, that good genius of the American farmer, Joel Nourse, set his mind to work and produced one, more simple, lighter and cheaper than the imported article. It was tried, proved satisfactory, and the manufactory of various sizes, suited to a team of one to six horses, soon introduced this new farm implement to the notice of many farmers who never had seen or heard of the thing before, but soon learned how to profit by its use. This plow has no mold-board; the use of it is to enter the bottom of the ordinary furrow, and stir up and pulverize the hard sub-soil from 4 to 24 inches deep. Upon this the next round of the turning plow lays its usual thickness of furrow slice, thus doubling the depth of tilth. It is especially valuable in land which has a natural hard pan, or in which one has been formed by the tramping of the plow team, or the sliding of that instrument for a hundred years, on the bottom of furrows always plowed just the same depth. Some idea can be formed of the shape of this plow, by supposing the land-side of the common cast-iron one continued in a smooth plate up to the beam, the handles being riveted upon that, like those of a common shovel plow. On the mold-board side of this plate, there is a shelf projecting a couple of inches, running in a gently inclined plane from the lance head like point to the heel, producing exactly the effect that a wedge would do if drawn through the earth, lifting it up and dropping it over the butt, which is 2 to 4 inches high. Such is the sub-soil plow, in use in most of the Northern States, and from its efficiency, strength, ease of draft, and cheapness, from $5 to $15, it was thought that perfection had been obtained in that farm implement. Not so. For this very season these great plow-makers have brought out a new sub-soil plow, as much more simple than their first one, as that is more simple than its Scotch prototype, and yet more effective, and not requiring more than one half the force to propel it; besides which, it is a self-sharpener.

A perfect idea of the shape of this plow can be got in the way it was first obtained by Professor Mapes, to whom the manufacturers are indebted for the original, by taking a piece of paper twice as long as wide, and folding it first end to end, then side to side, then cut off the corners from side to end fold, now make a slight lap at the side folds and lay it down upon the table, the edges will touch all round, while the middle is slightly elevated. Now fancy a smooth piece of hardened cast iron of this shape, 20 inches long and $7\frac{1}{4}$ wide, with an upright part, 18 inches high, made broad and thin, with edges alike so that it makes no difference which goes forward, screwed to a beam 5 feet long, with handles 4 feet long, bolted upon the sides of the beam, held in place by an iron supporter, with a center draft rod and dial clevis, movable 4 or 5 inches up or down, or upon either side, and the whole only weighing 84 pounds, and yet strong enough for two yoke of oxen, but not of too heavy a draft for one yoke, when run up to the beam in the ground, producing such an effect as to shake the plants several feet upon each side, and you will have some idea of a new sub-soil plow, now publicly exhibited for the first time.

The great desideratum of the day is to contrive a machine that shall have the efficiency of the spade and the capability of the plow. Many attempts have been made, but, until recently, without anything like successful results. The Marquis of Tweeddale, Scotland, recently adapted a plough, or rather frame of ploughs, for carrying out a system of deep ploughing. In this case two engines are employed, one at either end of the field, the plough-frame travelling by means of traction-chains between them, and doing the work some twelve to fifteen inches deep, in a most efficient manner. There appears to be a question as to whether, all things considered, there is much gained by the application of steam thus limited to the traction merely of the implement. In most cases where steam has successfully supplanted labor, it has demanded that the old processes be laid aside, and new ones, suited to the advanced requirements, be adopted. The plough, itself universally acknowledged to be a defective implement, has no claims to exception to this rule, and certainly the small amount of success attending the steam traction plows would be evidence in favor of it. An attempt has been made by Usher, of Edinburgh, to construct a machine that shall, by one operation, satisfy all the requirements of cultivation. This has been tried in the field with favorable results, and it certainly possesses more of the elements of success than any other that has hitherto been brought out. The old plow is thrown aside, and only the share and mold-board been made use of; some three to six rows of them are arranged round a large cylinder which is attached to a locomotive engine. When at work in the field the power is applied to this cylinder, which, by its revolution, drives the plows (or other instruments, as the case may be) into the soil, and thus acts as the propelling agent to the whole machine. The soil is left in a broken condition, as by the fork or spade, and arrangements exist by which the three operations of moving the soil, sowing, and covering in the seed are done at the same time. It travels at the rate of three miles an hour, equal to nine acres a day, or, allowing for turning, stoppages, &c., say seven acres, which it has done in its various trials, for an expenditure of seventeen and sixpence, or two and sixpence per acre. It travels well on common roads, ascending acclivities of one in ten, and turning round in a circle of sixteen feet diameter, and is adapted for any other purpose to which steam power is applied. Let us see what would be the result of the substitution of the steam plough for our present systems of ploughing. In England, taking Caird's estimate, there are 14,000,000 acres in tillage; these are ploughed certainly once every year. The cost of the operation averages at least ten shillings per acre — thus giving a total of 7,000,000*l.* per annum. This first machine of Usher does the work better than by the plow for two and sixpence an acre, or at seventy-five per cent. less cost. The saving would consequently be about 5,250,000*l.* per annum. The labor of 50,000 men and 100,000 horses required for this one operation would be replaced, and a saving in the consumption of corn effected to at least 1,500,000 quarters, which would be thus rendered available for the more direct wants of the community.

Barker's Hinge Fastener. — This invention consists simply in casting a solid square on the top of the round nipple of the hinge, and having a square cap to fit over the same; its object is to hold open window shutters, and thereby dispense with the use of fastenings. The cap can be put on and taken off from the inside, which is an important thing in stormy weather, as it removes the necessity of thrusting the head and arms out of the window.

Dickson's Sled-lock. The object of this invention is to prevent the sled or sleigh from crowding against the horses in descending a hill. It is formed by attaching a couple of bars turned downward at the end, firmly to the roller, and connecting the tongue to them at their front ends by a hinge joint, so that when the sled crowds forward, the back end of the tongue will fly up, throwing the dogs downward into the ground.

Clark's Static Regulator for Steam Boiler Fires is intended to equalize the heat of the fire and thus produce a steady pressure of steam. This is accomplished by causing an undue pressure of steam to operate a damper and thus lessen the draft, and consequently the amount of combustion.

Eastman's Stone Dressing Machine. — The cutters of this machine are a series of chisels arranged on a shaft, each one on a small eccentric or crank placed a little out of line with its fellow, so that by revolving the shaft, the chisels act upon the stone placed beneath and fed forward to them, with a reciprocating motion identical with the hand method of hewing stone. The whole arrangement of the machine is very simple, and the chisels endure as long as those used by hand, are as easily made, and require no more sharpening. The chisels can be set to dress stone facing, reeding, fluting, and moulding.

Canvass House. — Another curiosity — something entirely new, and which has been brought into existence in verification of the adage that necessity is the mother of invention — is a canvass house. It is twelve feet square, six feet high at the eaves, and seven and a half feet in the center; has four windows and a door, all upon hinges, and so constructed that it can be folded together upon hinges into a flat bundle, six feet across, carried by two men a mile and set up again in one hour. It also has four frames, canvassed for berths, which also fold up quite out of the way. The canvass is painted waterproof, and the whole appears substantial.

A fine display of Cotton Cordage, an article of recent manufacture in this country, was made at the Crystal Palace, by the American Cordage Company, of New York. The method of rope-making adopted, is as new as the use of cotton for this purpose. A machine is made to answer all the purposes of a long rope-walk. The advantage of using cotton is, that it is capable of a tighter twist; that it is less liable to injury by friction than hempen cords. The old cotton rope will be worth considerably more than the old hempen rope. The rope of cotton is found to run with greater freedom through the blocks, and is altogether more pliable than ordinary ropes. It has been successfully applied to rigging for vessels; to hoisting-tackle; bow, stern, and tow-lines for canal-boats; fishermen's lines, &c. The description of cotton used is a long-staple "Macon, Georgia." The fibres of the cotton are laid together far more compactly, and with more perfect tension, by this process than by any other made known; consequently, the rope possesses greater strength than when laid in the ordinary way. It is lighter than Manilla, so that although its price per pound is a few cents more than that of Manilla roping, it is no more expensive when regarded according to length, while it is believed to be capable of lasting three times as long.

IMPROVED MACHINES FOR PREPARING FLAX.

Chichester's Flax and Hemp Brake. — This machine is furnished with a feed-table, over which the material is spread out, and entered into the bite of a pair of iron calender rollers, which flatten and split the stalks lengthwise, as they are carried forward through a pair of iron fluted rollers into the bite of a pair of large breaking cylinders, which form the body of the machine, from which the material is delivered on to a receiving apron in a wide mass or sheet of fiber.

These breaking cylinders are each formed by securing near the opposite ends of a shaft, a pair of iron heads or flanges, perforated with radial slots, into which are inserted breaking plates, or ribs of iron (wrought to a smooth edge on top), which are free to move in and out towards or from the center of the cylinder heads, as they are guided by cams and springs, arranged in such a way that the ends of every other plate or rib in each cylinder project through the radial slots in the cylinder heads, and rest upon stationary cams, placed outside of the heads, and all the intermediate plates or ribs rest upon spiral springs, supported by circular flanges, keyed on the shafts just inside and close to the cylinder heads. These flanges are perforated with holes forming sockets on their periphery, to receive and support the spiral springs, and admit the iron pins which pass through and sustain the springs, and are fastened or locked to the under edge of the pressure plates or ribs.

As the cylinders revolve together (one being placed over the other), the cam-plates or ribs of the lower cylinder are guided upwards, and meet and carry back the spring or pressure plates of the upper cylinder: and at the time the cam-plates or ribs of the upper cylinder are in the same manner guided downwards, and meet and carry back the pressure plates of the lower cylinder.

These cylinders, in their operation and action upon the materials were designed to copy the movement of the hands when pressing a stalk of flax between the thumbs and fingers, then slowly moving the hands backwards and forwards in opposite directions, allowing the flax at the same time to slip through the thumbs and fingers under pressure, breaking, and at the same time rubbing the fiber, so as to completely separate the woody from the fibrous portion of the plant, and preserve each line of the fiber perfect throughout its entire length.

Chichester's Flax Dresser. — This machine, intended for dressing the flax with greater efficacy and economy of material, consists of two conical cylinders, formed on parallel shafts, driven by a pair of gear-wheels fastened outside of the frame. These cylinders are each formed of four spiral blades of wood, secured to flanges of iron, which are keyed on to opposite ends of the shafts, and placed one over the other, revolving towards each other, the blades of one cone being opposite the spaces between the blades of the other. A slot is cut through the front casing, along the bite of the cones through which the operator first introduces the flax to the action of the dressing blades. These blades draw in the mass, striking first on one side and then on the other, nearly at right angles with the line of the fiber, beating out the wood and impurities which pass off through the opening behind. The mass is then moved along the slot towards the other end of the blades, to be finished. The conical and spiral form of the blades cause a gradual change in the direction of the blows from the feed end, where the blows fall at right angles to the mass, towards the finishing end of the cones, where the direction of the blows is nearly lengthwise with the line of the fiber. At the feed end, the blades are left very blunt and rounded off. This, also, changes gradually to a sharp edge at the finishing end. The severity of the blows is also increased as the radius of action increases, towards the larger end of the cones. With this arrangement, also, a larger space is left at the feed end for the mass when filled with shives, which gradually diminishes as the mass is cleaned and diminished in bulk.

The flax and hemp brake above described, is a durable machine, and by its peculiar mechanical arrangement, takes but little power to operate it (one horse power being more than sufficient). The movements are all very slow, but continuous in their action — the working parts being distributed over the surface of the large cylinders, which make but three or four revolutions per minute to brake a ton of straw in a day.

Flax Pulling Machine.—In addition to the flax brake and dresser, Mr. Chichester has also invented a flax puller, designed to pull flax and lay it on the ground as rapidly as grain is gathered with the present reapers.

A horse is harnessed into the machine, moving it before him, and the flax is laid in such a manner on the ground as always to give him a pathway, and also leave a track on each side for the wheels.

In the forward movement of the machine, the flax is separated and collected between long wedge-shaped projections, forming a breast or front near the ground, and is pulled by means of vertical rollers, furnished with arms, reaching forward underneath the branches or seed tops of the flax, which is thus, at each revolution, bent over nearly at right angles with its growth, bringing the lower portion of the stalks into the bite of the vertical rollers, ranged just back of the angles formed at the base of the wedge-shaped projections, and delivered on the ground in rows to be bundled. The rollers are driven by gear-wheels, on a shaft receiving motion from the two large wheels, to which the whole frame is adjusted.

CLEMENS' FLAX DRESSING AND BREAKING MACHINE.

This machine, invented by Mr. S. A. Clemens, of Springfield, has been gradually perfected, and introduced during the past year into the flax growing districts with great success.

The apparatus is about eight feet in length, by four feet in width, and three feet high. The entire weight is nearly one ton. It can be driven by a horse power machine, or otherwise, as is convenient.

In operating the machine, the flax straw is spread in successive layers upon a feed apron, which advances it lengthwise upon the bite of feed rollers, which carry it to a vibrating beater of peculiar construction, by the action of which, aided by currents of air from a fan blower, the woody parts of the stalks are broken into minute fragments, and separated and blown away from the machine on one side. From the beater, the fiber without waste passes outward from a discharging apron in successive layers, which are removed by an attendant and finished upon a scutching wheel, attached to one side of the machine, in a position convenient for the purpose. This rapidly removes any remaining woody fragments, and the fibers are laid and condensed, which completes the process of dressing. By the best modes of dressing flax with labor-saving machinery, hitherto employed in this, and European countries, the straw is first repeatedly passed between rollers deeply and sharply fluted. The broken stalks are then rough scutched, which removes the greater part of the shives, and along with them, a large quantity of coarse tow. The flax is afterwards finished on the scutching wheel, which removes the remaining shives, and the tow produced is of cleaner quality. Aside from the expenditure of time and labor, from the necessity of repeated handling, it is obvious that by this process a great waste of material results from the peculiar action of the rotary breakers, the deep sharp flutes of which not only operate to crush the woody parts of the stalks, and make the shives of the long slender form which adhere so tenaciously to the fibers, but the fibers themselves, being comparatively non-elastic, are greatly strained, bruised and broken by the same action. From this arises the great amount of tow produced, when the flax is submitted to the action of the scutching knives and the heckle.

In Clemens' machine, each stalk is broken at regular intervals of about one thirty-second of an inch, and the woody fragments as they are broken off, are forced from their fibrous envelope and thrown off, with comparatively no injurious strain upon the staple. As the layer of broken flax passes between the beating surfaces, for the space of several inches it undergoes a violent whipping action, due to the rapid vibration of the double beater upon an axis parallel to its biting and breaking edges; and aided by the strong currents of air, the shives are still farther removed. The efficiency of the mechanical arrangements of the machine, is shown in the fact that the breaking and whipping action is repeated quietly and safely, at the rate of more than three thousand blows per minute. Such is the perfection of the result, that good well-conditioned flax is delivered from the beater upon the discharging apron, in ribbons of fiber, perfect in length and strength, and almost wholly free from woody fragments. The attendant at the discharging end of the machine, gathering two of these layers into a medium sized hand of flax, and favored by the peculiarity in the form of the shives, and the condition in which the fiber is left by the beater, rapidly finishes it upon the scutching wheel. In this process much less tow is made than by the old modes, and it is of better average quality, while the condition of the dressed fiber ensures that it will produce less tow on the heckle when manufactured. The machine when worked at a moderate speed, and attended by two hands, will finish from three hundred to four hundred and fifty pounds of flax per day, according to the skill of the workmen, and the quality and condition of the material. Aside from the saving in tow, this is fully equal to the average product of the labor of five hands using the common machinery, and, at the rate of speed necessary to accomplish this, about three horse power is sufficient to operate the machine. At a higher speed, from fifty to seventy pounds of fiber can be run though the machine each hour, but it will then require more hands to attend it. The price of these machines is stated to be about $400.

HOLYHEAD HARBOR.

One of the most stupendous works of modern times, is the great breakwater now constructing by Government for the protection of Holyhead Harbor, on the iron-bound coast of Anglesea, Great Britain, under the direction of Mr. Rendel, C. E. It was commenced in 1849, and is intended to secure a total area of 300 acres for the purpose of a harbor, two-thirds of that space having a *minimum* depth of seven fathoms at low water. Accommodation will thus be provided for about 400 vessels of all classes, including 70 men of war as large as the *Duke of Wellington*. The north or great breakwater will be 5,000 feet long and 170 feet wide, and of this immense work 4,000 feet have already been completed to low water mark — 3,500 feet of it being from 14 to 15 feet above high water. The depth at low water thus filled up is from 45 to 48 feet, and some idea may be formed of the magnitude of this mole from the fact that the stonework which surmounts it is about 80 feet above the foundation. The smaller, or eastern breakwater, which protects the harbor on the landward side, will be 2,100 feet long, and 1,000 feet of it have already been formed, in a depth of 30 feet at low water, and to a width of 100 feet. Since 1849, when the works were begun, 2,400,000 tons of stone, in blocks varying in weight from 10 tons downward, have been deposited in the sea, and the rate at which this gigantic operation is carried on is said to be from 22,000 to 27,000 tons per week, and from 4,000 to 5,000 tons per day.

The quarries which have been opened to supply so prodigious a demand for material wherewith to control the waves are hardly less remarkable objects of attention than the undertaking to which they are subordinated. They realize the fabulous stories of mountains removed and cast into the sea. As much as four tons of powder is frequently exploded in them at one blast, or (more properly expressed) in one mining operation, and thus 20,000 and 30,000 tons of stone are often at once set free for the construction of the breakwaters. The plan adopted is to blow away a huge section of the base of the mountain, when the superincumbent mass of rock, 150 feet high, being unsupported, tumbles down after it. The reader may form some conception from these details of the manner in which the works are carried on; but it will quicken his appreciation to state that the rate of progress is 250 times greater than it was in the Plymouth breakwater. This great economy of time has been effected by the use of piled stages carrying railways, which, projecting boldly into the sea, present a mechanical arrangement for conducting the operations at once simple, convenient, and independent both of tides and wind. Mr. Rendel was scouted as a visionary when he first proposed so daring a plan for facilitating the work, and it was confidently predicted that rails thus supported on scaffolding would never answer. Nor is it wonderful that persons less experienced than Mr. Rendel should have such misgivings, for the piles which support the stages are 89 feet long, being built of short lengths of the timber commonly used for building purposes. Thus, resting upon a precarious framework of wood, with water more than 40 feet deep below, and required to carry long trains of heavily loaded trucks, the railways of the Holyhead breakwater do not impress an unprofessional mind with any extraordinary confidence in their security. There is, however, no answer to the successful experience of four years in this matter, during which time thousands of tons of stone have been daily brought down from the quarries and deposited in the sea. A large proportion of the material thus removed consists of fragments of rock weighing from 5 to 10 tons each, and calculated by their weight to overcome, with the least possible delay, the momentum of the ocean. It may therefore be readily conceived how severely Mr. Rendel's bold plan for carrying on the works has been tested, and how complete his triumph has been. The contract under which the harbor is being constructed contemplates an expenditure of about £800,000, and the outlay so far is under £400,000.

NEW BREAKWATER.

A new system of floating breakwaters, especially adapted for the Goodwin Sands, has been invented by Admiral Tayler of England.

The disasters continually occurring at this place have given it a melancholy name in English history. Scarcely a year passes in which there are not above 1000 lives lost at these treacherous quicksands, and the number last winter was 1500! Every attempt to moor a vessel or floating beacon over the sands has hitherto failed. The present light was fixed only after reaching the chalk, eighty-two feet down. Admiral Tayler's plan is to moor his refuge in deep water, not over, but near the sands, and to keep life-boats and a supply of every necessity for giving aid in case of shipwrecks, and for sheltering the saved sailors. Two or three hundred persons could receive temporary shelter, and there is every accommodation and comfort provided for the keepers of the refuge. The refuge, with its boats, stores, and materials, rests on a frame-work of piles, with strong transverse beams, the longitudinal piles floating about nine feet above water and twenty-seven below. The water in this framework, along with the surrounding eddy, effectually breaks the force of each advancing wave, the water being perfectly smooth under the lea of the refuge. The piles rise and fall with the tides, but are otherwise firmly moored at the stern beam.

IMPROVEMENTS IN SHIPS AND STEAMERS.

A VESSEL is now in the process of construction at Green Point, in the vicinity of New York, under the direction of William Norris, Civil and Mechanical Engineer, and John W. Griffiths, Naval Architect, which it is anticipated will perform the transatlantic voyage within six days in the winter season. The dimensions of the vessel are as follows:—

Length on deck............225 ft.	Draft of water........... 6½ ft.
Depth of hold.............. 21 ft.	Displacement.... ..... 750 tuns.
Diameter of paddle-wheels. 36 ft.	Power ....1,200 horses.
Beam amidships............ 37 ft.	Accommodations for 80 passengers.

The following advantages in the improvement introduced in the construction of this steamer are claimed by the builders: — 1. A perfect security against fire or water. 2. Less risk to life, and greater comfort to passengers. The boilers will be placed within walls of iron, with iron beams over the same. Air chambers, of sufficient sustaining capacity, will extend the whole length of the ship. The sudden shocks of head and beam seas, to which all ships of the present construction are liable, are obviated by these improvements, while the gentle undulating motion always maintained, will tend to prevent sea sickness, and at the same time keep the decks dry except from spray. The full power of the engine will be reserved for combatting heavy gales, while ships of the present construction are compelled to slacken their steam as the gale increases in severity. These new improvements enable more steam to be applied, the harder the gale blows. The machinery of this ship will consist of one walking-beam engine with two tubular boilers, all of the most improved construction, but without anything new in their principles. The power of the engine, in proportion to the size and draft of water, will be very great, about five times that of the steamers of the Cunard line. In an ordinary vessel such power cannot be applied, as it would tear the hull to pieces. In the present case, however, it is made practicable by the peculiar internal structure as well as by the novelty of the mode. As will be seen by the figures given above, the floor of the vessel is unusually flat, and its draft of water exceedingly small. At the same time the bow is unusually sharp. In fact, the model is the result at once of a great deal of practical experience, as well as of laborious and careful mathematical calculations, and it is believed that its lines and form are such as to produce *the least possible resistance* in passing through the water. Here, then, we have the grounds for the estimate that an average speed of 20 miles an hour will be attained in storm as well as calm:

1. Sharpness of bow, perfection of curves, and light draft and buoyancy.
2. Enormous power of engine.

The daily consumption of coal will be about 90 tons, and the stock for a passage about 300; no freight is to be taken. The vessel will carry no masts, but will be arranged with jury-masts to rig in cases of necessity.

The Clipper Ship Great Republic.—During the past summer a gigantic clipper, bearing the above title, has been constructed and launched by Donald McKay, Esq., of East Boston, Mass. This vessel is the largest merchantman ever constructed, has a capacity of about 4,000 tons. She is 325 feet long, 53 feet wide, and her whole depth is 37 feet. The keel, for 60 feet forward is gradually raised from a straight line, and curves upwards into an arch, where it blends with the stem so that the gripe of her forefoot, instead of being angular like that of other vessels, is the complete arch of a circle. This arch, both inside and outside is formed of solid oak, and binds all the joints together, so that the greater the pressure the more firmly will the arch be knit together. Strength, however, is only one reason for adopting the arched form for her forefoot: the other reason is, to facilitate her working, and at the same time to make her entrance as clean as possible, to obviate resistance. She has vast surface of floor, with about 20 inches dead rise, and a very long and clean run, which, however, as it rises, is spread out to prevent her settling aft. Her lines are concave forward and aft up to a few feet above the load displacement line, but become gradually convex as they ascend and form her outline on the planksheer. The angular form of her bow, however, is preserved entire. Her sides are arched, or swell somewhat like those of a ship of war, but not so much in proportion to her size; and her sheer is graduated her whole length, with just sufficient rise forward, to impart ease and grace to the bow. She has a waist of nine narrow strakes defined between the mouldings of the upper wale and the planksheer, and every line and moulding is graduated to correspond with her sheer. Her stern is semi-elliptical in form, and corresponds well with her after body. She has four complete decks.

The height between the upper and spar decks is 7 feet, and between each of the others, 8 feet. Abaft the foremast is a house 24 feet long by 16 feet wide, the forward part of which is designed for a workroom in wet weather, or as a shelter for the watch on deck in stormy weather. Abaft the fore hatchway is another house 25 feet long, 16 wide, and 6½ high, which contains the galley; and abaft the galley is the blacksmiths shop and an engine room, where there is a steam engine of 12 horse power. This engine is designed to do all the heavy work of the ship—such as taking in and discharging cargo, setting up rigging, working the fire engine, hoisting top sails, pumping ship, &c., and connected with it is an apparatus for distilling fresh water from salt water. Abaft the mainmast is another house, 40 feet long by 12 wide, which contains a messroom for the officers, and has a stair case in its forward part, which leads to the quarters of the petty officers and boys, on the deck below. Farther aft there is still another house, 17 feet long by 11½ wide, and the same height as the others. It protects a stair case which leads to the vestibule of both cabins below, and contains lockers, &c., and aft near the topsail, is the wheel house. Like a ship of war she has a double wheel, an iron tiller, and a gun tackle purchase as her steering apparatus. She has four large boats on the spar deck, two of them of 20 tons each, and 30 feet long, 10½ feet wide, and 5 feet deep, fitted with sails and all the other appliances necessary to preserve life, in the event of disaster to the ship. She also carries four quarter boats of 26 feet length, and a captain's gig of 22 feet. Notwithstanding the space occupied on the spar deck by the houses and boats, such is her vast size, that the deck looks comparatively clear fore and aft, and is more roomy for a working ship than that of a ship of the line. There are 4 working hatchways, the main one 11 by 14 feet in the clear, which is large enough to take down an omnibus, if required. Her heavy spare spars are stowed on the deck below, and in the spar deck each side is an oblong square opening to admit of the spars being taken up or sent down. The materials of which the Great Republic is constructed, are of the very best quality. Her keel is of rock maple in two tiers, which combined are, side 16 inches, and mould 32. Her frame is of selected seasoned white oak, and she is as strong as wood, iron and copper can make her.

She has four masts, the after one named the spanker mast, which is of a single spar; the others are built of hard pine, the parts dowaled together, bolted and hooped over all with iron. The bowsprit is also built and hooped in the same style, and the topmasts and jibbooms are of hard pine. She has Forbes's rig, and is square-rigged on the fore, main, and mizzen masts, and fore and aft rigged on the spanker mast. The main yard is 120 feet square, and the lower main top aft yard, 92 feet. Excepting these, all other yards above are alike, on the fore and main masts, and the lower foretopsail yard is of the same dimensions as the crossjack yards, and all the yards above are alike on both masts. She will spread 16,000 yards of canvass in a single suit of sails. Her sails were made by E. F. Southward, and Richard Friend, Jr., upon the recently patented improvements of Mr. Southward. She will be the first vessel ever furnished throughout with these improved sails, and it is believed that their peculiar cut will enable her to attain a greater rate of speed. A portion of the sails were stitched by machinery, and their cost will be from eight to ten thousand dollars.

Harris' lightning rods are applied to all her masts. She has four anchors. Her best bower is 8500 lbs. weight; her working bower 6500 lbs.; her small bower or stream anchor 2500, and the kedge 1500. Her bower chains are each of $2\frac{1}{4}$ inch, and each 120 fathoms in length.

New Mode of Ship Building. — A late French paper has the following notice of a new mode of ship building, in which an entire change in the construction has been adopted:

"The public were gratified on Tuesday last with the launch of the Peninsula and Oriental Company's new Steamship *Vectis*, of 1000 tons, the first of them being built on the new principle, without timbers, being all solid planking. She was constructed by Messrs. John and Robert White, on their 'patented improved diagonal principle;' and is intended to form one of a fleet of steam-packets, upon the new contract, to carry mails between Marseilles and Malta, and *vice versa.* As the *Vectis* is the first which has been constructed on an entirely new principle, destined to form a complete revolution in ship building, some few remarks will be necessary as regards the method on which she has been constructed. It would appear that the introduction of iron ships into our leviathan steam companies, as well as into the navy, threatened for a while the annihilation of wooden ships altogether. To meet the requirements and reasonable demands of the various steam companies, and to counterbalance the advantages which iron ships possessed over those of wood, some improved method in the construction of the latter was absolutely necessary, in order to render them stronger and more buoyant, and carry a larger cargo in proportion to their tonnage, with equal speed, to attain which objects the Messrs. White were induced to turn their attention; and after successfully making a series of experiments and models, at no inconsiderable cost, they at once satisfied themselves of the practicability of their plan, and undertook to build ships of any magnitude and any degree of sharpness, combined with all the requisites of speed and internal capacity — and this by a combination of planking, without the necessity of ribs or frame timber. Their new mode of construction enabled them to produce vessels whose sides were only as thick as an iron ship with ribs and ceiling. The frame being entirely dispensed with, greater buoyancy was produced; and the ships were consequently enabled to carry from 10 to 20 per cent. more cargo in dead weight, with equal speed; or the same quantity of cargo as an ordinary built ship, but with greater speed, in consequence of being enabled to have finer lines. In the mode of construction, viz.: two thicknesses of diagonal planking, and longitudinal planking outside, greater durability and safety were effected over the old method; and by the exclusion of vacant spaces, where foul air generated from the bilge-water or dirt collected in the openings, the plan was rendered more healthy. Moreover, in the new method, there is freedom from rats and other vermin, and above all, the plan is particularly adapted to men-of-war, from there being no iron strapping or iron knees, and the sides being solid, there would be consequently less splinterings from shots, and particularly healthy in warm climates."

Messrs. Scott, Russell & Co. of England, have the contract to build for the Eastern Steam Navigation Company the largest ship ever heard of in the world, which is to carry sufficient fuel for the entire voyage to and from India or Australia. Her length is to be 680 feet; breadth, 83 feet; depth, 58 feet; with screw and paddle engines of aggregate nominal horse-power of 2600. In addition to taking from 4000 to 6000 tons of coals, she will be able to carry 5000 tons measurement of merchandise, and will have 500 cabins for passengers of the highest class, with ample space for poops and lower class passengers. The whole of her bottom, and up to 6 feet above the water line will be double and of a cellular construction, so that any external injury will not affect the tightness or safety of the ship. The upper deck will also be strengthened on the same principle, so that the ship will be a complete beam, similar to the tube of the Brittania bridge. It will be divided into ten water-tight compartments. She will have separate sets of engines, each with several cylinders; and separate boilers will be applied to work the screw, distinct from those working the paddle wheels, so that in the event of temporary or even permanent derangement of any one of the engines, or of either the paddle wheels or the screw, the other engines and propellers would still be available. It is computed that her great length will enable her to pass through the water at the velocity of fifteen knots an hour, and by the great speed, combined with the absence of stoppages for coaling, the voyage between England and India, *via* the Cape, may be accomplished in thirty or thirty-three days, and between England and Australia in thirty-three or thirty-six days. It is said that the ship will become, by its construction, a beam of sufficient strength to meet any strain to which it can be subjected, and will consist of so many distinct compartments that no local injury, however serious, will affect its buoyancy to any dangerous extent.—*Journ. Soc. Arts.*

Improvements in Propellors.—In a patented improvement by J. Burch, of England, the propulsion is not effected by a disc, but by vanes or helical sections, which he calls "fins," set in the circumference of a disc, or wheel, to which the corresponding lines of the vessels are prolonged, so as to form a kind of cylindrical-shaped projection, from the position of the disc tapering aft to the stern post, and forwards forming a continuation of this *quasi*-cylinder, or trunk, to a little abaft the beam. Above and below the disc are apertures for the passage of the fins. Six vanes are set upon the disc, and, revolved by the motive power, propel the vessel. The advantages alleged are, that the truncated lines act in the manner of Griffith's globular center, in nullifying the central resistance, which chokes the ordinary screw, an object which is a grand desideratum, if attainable. "The advantages," says the inventor, "gained by this arrangement, consists in shielding the ineffective surface of the propeller from the passing current, and leading the water upon the fins at such a radial distance from the axis as will secure the whole power applied in the right direction. By this alteration of the locality of the screw, the current is thrown direct on the helm."

IMPROVEMENTS IN THE CALKING OF VESSELS.

In the construction of vessels the process of calking the seams so as to exclude the water, forms an important part of the operation. This has heretofore been done by chamfering the outer edges of the planks, and then driving oakum or other similar material between them. An objection to this mode of calking is the well-known fact that the working and straining of the vessel has a tendency to throw the oakum out, and render re-calking necessary, while, at the same time, as the planks are not driven so close together, and consequently cannot form a close joint, the hull will be less stiff and rigid than is desirable.

An improvement recently devised by Mr. B. F. Cook, of Boston, consists in rendering the seams water-tight by placing between the edges of the planks some adhesive elastic substance or material, such as india rubber, gutta percha, or compound of both. This may be done by forming a groove in the centre of the edge of each plank, and placing in the said groove a strip of india rubber, gutta percha or other elastic material, and then driving the planks closely together, the edges of the planks not being bevelled but square, so that they will form a close rigid joint. This strip of calking may be round and tubular, or of any other required form, so as to fill the channel, which may also be of any shape desired — the planks thus grooved or plowed are then driven together, with a coat of elastic cement between them if it is thought advisable. By the above method of calking a vessel, it will be seen that the necessity for chamfering the edges of the plank is entirely obviated, and by cutting the edges square, and placing between them an adhesive elastic substance, the joint will be impervious to water, and at the same time the hull remain extremely stiff and firm, while the calking cannot be worked out by the straining or working of the vessel, as frequently occurs in the method of calking heretofore practised.

EXPERIMENTAL INVESTIGATIONS ON THE PRINCIPLES OF LOCOMOTIVE BOILERS.

The following is an abstract of a paper recently read before the Society of Civil Engineers, (England) by Mr. Clark of Edinburgh. It commenced with some historical facts in locomotive progress, showing that the general design of the locomotive was matured, immediately after the trials on the Liverpool and Manchester Railway in 1829 — combining the multitubular horizontal boiler, the horizontal cylinders, and the blast pipe. Reference was made to the various systems practised in working out the general design, and to the necessity for fixed principles in proportioning the locomotive to the work for which it was destined. For the proper discussion of the question it was indispensable to distinguish the three elements of the machine: —the boiler, the engine, and the carriage; and to consider them separately, with respect to their proper functions, as the mixing up of one with the other had caused much of the confusion with which many of the recent discussions on the subject had been invested. The paper was chiefly devoted to the discussion of the physiological principles of locomotive boilers. It was argued, that the combustion of coke in the firebox was, in practice, very completely effected; that it was quite independent of the strength of the draft, being equally complete with fast and slow drafts; that expedients for improving the combustion were superfluous; and that the combustion of coal might also, in practice, be perfected by a judicious use of the ashpan, damper, and the firedoor. The evaporation of 12 lbs. of water per pound of pure coke was found, by careful laboratory experiments, to be the maximum evaporative performance; in the best ordinary practice, an actual evaporation of 9 lbs. of water per pound of coke, or 75 per cent. of the possible maximum, was readily obtained, the balance being lost by leakage of air and by waste; and it was adopted, by the author, as the ordinary standard of practical economical evaporation. It was shown, by numerous examples, that the question of the relative value of firebox and tube surface was of no practical importance, as the efficiency of boilers was not sensibly affected by their relative amounts; that the superiority of firebox surface was due merely to its greater proximity to the fire; and that the distinction of radiant and communicated heat was merely circumstantial, that what was gained in radiant heat was lost in communicated heat, and that whether it was all radiating, or all communicated, mattered not to the total efficiency of the fuel. On these grounds the author regarded with indifference the use of such expedients as extended fireboxes, midfeathers, corrugated plates, and combustion-chambers; and it was asserted, that where the addition of midfeathers had been found advantageous, there had been a deficiency or mal-arrangement of the tube-surface. A minute analysis was made of the results of numerous authenticated experiments on the evaporative power of locomotive boilers, of very various proportions, comprising several, made by the author, on the engines of the Caledonian, Edinburgh and Glasgow, and Glasgow and South Western Railways. It was concluded, that the economical evaporative power of boilers was materially affected by the area of the fire-grate, and by its ratio to the whole heating surface; that an enlargement of the grate had the effect of reducing the economical evaporative power, not necessarily affecting the quality of combustion in any way, but governing the absorbing power of the boiler, as the lower rate of combustion, per foot of grate, due to a larger area, in burning the same total quantity of fuel per hour, was accompanied by a reduced intensity of combustion, and by a less rapid transmission of heat to the water, in consequence of which a greater quantity of unabsorbed heat must escape by the chimney. An increase of heating surface, again, reduced the waste of heat, and promoted economy of fuel, and added greatly to the economical evaporative power. In short the question resolved itself into the mutual adjustment of three elements: — the necessary rate of evaporation, — the grate-area, — and the heating surface, consistent with the economical generation of steam, at the assumed practical standard rate of 9lbs. of water per pound of good coke. An investigation of the cases of economical evaporation, in the table of experiments, conducted the author to the following very important equation, expressing the relation of the three elements of boiler-power: in which c was the maximum economical evaporation, in feet of water, per foot of grate per hour, h was the total heating surface, in square feet, measured inside, and g was the grate-area in square feet:—

$$c = .00222 \frac{h^2}{g}$$

From this it followed: 1st that the economical evaporative power decreased directly as the area of grate was increased, even while the heating surface remained the same. 2nd. That it increased directly as the square of the heating surface, when the grate remained the same. 3rd. That the necessary heating surface increased, only, as the square-root of the economical evaporative power. 4th. That the heating surface must be increased as the square-root of the grate area, for a given economical evaporative power. It was contended thence, that the heating surface would be economically weakened by an extension of the grate, and would be strengthened by its reduction; and that whereas large grates were commonly thought to be an unmixed good, and being generally recommended were usually adopted; still they might be made too large; not that their extension affected the quality of combustion, but that the economical evaporative power might be reduced. Concentrated and rapid combustion was, alike, the true practice for the largest and the smallest boilers; and in locomotives where lightness, compactness, and efficiency were primary objects, the boilers should be designed for the highest average rates of evaporation per foot of grate, that might be followed, in good practice, consistently with the highest average rate at which coke could be properly consumed; as, in this manner, the smallest grate, and the smallest amount of heating surface, consistent with good practice, might be employed. It was stated, that 150lbs. to 260lbs. of good sound coke could be consumed, per foot of grate per hour; and, allowing for inferior fuel, an average maximum of 112lbs. per foot of grate, per hour, was recommended as a general datum. This determined the average maximum of economical evaporation to be 16 feet of water per foot of grate per hour, allowing 9lbs. of water per pound of coke; for which 85 feet of heating surface per foot of grate should be provided. It was accordingly recommended, that a heating surface at least 85 times the grate-area should be adopted in practice. It was also shown, by examples of inferior economy of evaporation, that the clearance between the tubes, for the circulation of water and steam, was in many boilers much too small; that the clearance should be in proportion to the number of tubes, and that for good practice, a clearance at the rate of one-eighth of an inch for every thirty tubes should be allowed.

DU TREMBLEY'S VAPOR ENGINE.

During the past season, several practical experiments have been made in France, by M. Du Trembley, for the purpose of testing his new vapor engine, which has now been for several years before the public. His motive power, as is well-known, is derived from the expansion of the vapors of sulphuric ether and of water, and the engine, which is similar in all its appointments to a double-cylinder steam engine, is driven by the combined vapors, which act singly, each in its own cylinder, and without any intermixture.

The condensation of the aqueous vapor is accomplished by the evaporation of sulphuric ether, and the condensation of the latter, by means of a current of sea-water, which constantly laves and cools the surfaces of a condenser, into which the vapor passes after its escape from the cylinder. These two condensations take place in close vessels, and the exhaust-pumps return the liquids each into its proper generator, so that they are alternately evaporated and condensed. If it were possible to make such accurate adjustments as to prevent any escape, one supply of the two fluids would serve indefinitely. To obtain this perfection of adjustment seemed to be required by the nature of things, and to this point the inventor has devoted his attention mainly. Every one knows how extremely volatile ether is, and how penetrating its vapor. So successful has M. Du Trembley been, that in the engine room one can scarcely detect the presence of ether, notwithstanding the considerable quantity which is supplied to the cylinder by the generating apparatus.

The following details of the experiments are taken from a recent French publication:

As soon as Du Trembley considered his machine in good working order, he placed it at first on a screw propeller, engaged statedly in traffic between Marseilles and Algiers. The vessel was of 500 tons burden.

In the first experiments, the vacuum obtained in the condensers was 62 centimetres for the aqueous vapor, and 23 centimetres for the vapor of ether; the pressure of the two vapors was two atmospheres for the vapor of water, and 2 1-5 for that of ether; the cylinder of the former was 65 centimetres in diameter, and of the latter, 80 centimetres; their stoke of 75 centimetres. The two vapors were introduced only during the half of this stroke. The number of revolutions obtained with a light breeze ahead, was from 36 to 38, which gave from 72 to 76 turns to the screw, and a speed of six knots to the vessel; but if it is duly observed that the force developed by the machine has been calculated at no more than 60 horse power, it will be seen what entire reason we have to be satisfied with the velocity communicated to the craft, which we have already stated to be of 500 tons burden.

These results were obtained on a trip from Marseilles to La Seyne, where the vessel was taken to complete its outfit.

Upon the return trip, the vessel achieved nine knots and a quarter with a gentle breeze astern, and with the same inconsiderable power of 60 horses, applied to a burden of 500 tons. This more than confirmed the first anticipations. The average consumption of coal was 112 kilogrammes, or 240 lbs. per hour; while for an equal speed, the ordinary steam-engine would require 350 kilogrammes, or 750 lbs. per hour.

During a trip subsequently made to Algiers, results equally flattering were obtained. Assailed by a storm during the voyage, the vessel rolled fearfully, but the engine, feeble as it was, in proportion to the tonnage of the vessel, never exhibited a moment's hesitation, nor suffered a notable abatement of velocity; notwithstanding the shocks it experienced, no escape of the fluids or vapors was observed; and upon the subsidence of the gale, the propeller completed its voyage without, from first to last, enjoying the aid of its sails. Frequently the speed was seven knots, with the consumption of only 77 kilogrammes, or 165 pounds of coal per hour, or *two tons* for the whole distance, instead of an average of ten tons, previously consumed for the same transit. It must not, however, be disguised that the use of ether, owing to its inflammability, is exposed to much danger, more especially on marine vessels than on shore. The vapor, indeed, is heavier than air; and on land, in low places, we have always the expedient of exciting a powerful current of air, which will dissipate the vapor, and remedy the evil; but on shipboard and down in the hold, it is much less easy, if not quite impracticable. Ether mixed with air, in the proportion of 1 to 4, is explosive, as is observed in the mines. The most minute precautions, therefore, become imperative; and we are confidently assured that M. Du Trembley has given the subject the fullest consideration.

In regard to the practicability of the other engine, Mr Rennie, the eminent English engineer, stated at the Bristol association, that he had been requested to investigate the efficiency of the engine, and for that purpose he made a voyage in the vessel from Marseilles to Algiers and back, accompanied by his son. The steam-boiler is adapted only for an engine of thirty-horse power, and during the return voyage Mr. Rennie placed the coals under lock and key, so that he might ascertain exactly the quantity consumed. The result of his investigations was, that by the additional action of the ether vapor there was a saving of from 60 to 70 per cent.; and the amount of gain had been reported by a French commission, appointed to examine the engine, at 74 per cent. The loss of ether by leakage did not exceed in value one franc per hour during the voyage, and that might be greatly reduced by improved construction in the machinery. The French Government have paid the inventor a very large sum for the invention, and there are now several ships in course of construction to be propelled by engines of this kind; one of which is to be 1,500 tons burthen, and the engines are to be of 150 horse power. Mr. Rennie said that arrangements are made for dispelling the ether vapor that escapes, so that there is no danger of its ignition. Mr. Sykes Ward observed that good ether does not corrode iron; therefore no objection to its employment could arise from that cause. Mr. Fairbairn said that $2\frac{3}{4}$ lb. of coal per horse power are consumed in the best Lancashire engines, worked expansively, whilst the steam-boats on the Humber burn about 10 lb. of coal per horse power; and as it appeared from Mr. Rennie's report of the working of the combined steam and ether engine that the duty was greater than that of the best Lancashire steam-engines, the advantage of the combined action compared with that of the marine engines on the Humber was very important.

ERICSSON'S ENGINES.

The *Scientific American* states that the following alterations and improvements have been made in the Ericsson engines, since the last trip of the vessel. Immediately above the fire is placed six layers of cast-iron pipes, nine feet in length and three and a half inches in diameter; above these pipes are two heaters, 9 feet in length, and 2 feet 5 inches in diameter. These heaters are filled with tubes 2 inches in diameter, through which pass the flame and smoke from the fires. The cylinder is 5 feet 2 inches bore, and about 7 feet stroke. He also employs a *cooler* 10 feet in length, and 3 feet in diameter, filled with tubes $1\frac{1}{2}$ inches in diameter; among these tubes circulates a supply of *cold water* for the purpose of condensing the air after it has passed from the cylinder. These various parts communicate with each other, but not with the external air — the cold air from the cooler passing in the heaters, then through the cast-iron pipes immediately over the fire, then into the cylinder and back to the cooler again.

A late number of *Silliman's Journal* contains an investigation of Ericsson's Caloric Engine, by Prof. Norton. The conclusions of the author are thus summed up: —

1. That Ericsson's Hot Air Engine, as compared with the condensing marine steam engine, in its most economical operation, has shown the ability to do the same work with the use of from one-sixth to one-third less fuel; and, that if its full estimated power should hereafter be developed, the saving effected would be 70 per cent.

2. That for the same actual power, its weight is about three times as great as that of the marine steam engine, and that in case its estimated power should be obtained, its weight would be as much as thirty per cent. greater.

3 That in respect to the space occupied with the engines and coal, the advantage is decidedly in favor of the steam engine.

4. That the great weight of the engine, in proportion to the power developed, must prevent, for the present, the realization of a high speed in the propulsion of vessels. At the same time it is to be admitted that the full estimated power is adequate to the production

of high velocities. Time alone can decide the question, whether or not this maximum power is really obtainable.

5. The great weight of the engine, and space occupied by it in its present form, will in all probability, prevent its adoption for the purpose of inland navigation and railroad locomotion, in preference to the steam engine. If used as a land engine, the features will be less objectionable; accordingly it is only in this form of application, and in those cases of marine navigation in which speed is likely to be sacrified to economy of fuel, that the caloric engine may be confidently expected to achieve decided triumphs over the condensing steam engine.

Although this discussion has brought us to the conclusion that the new motor is not likely to equal the extravagant expectations which are so widely entertained with regard to its capabilities, still it must be freely conceded that the invention of a new engine in respect to which a just claim to superiority over the steam engine can be asserted, in any particular, is a great achievement, and that the ingenuity and mechanical skill displayed in the invention and construction of the Caloric Engine cannot be too highly extolled.

REGULATING THE SPEED OF STEAM ENGINES.

Luther R. Faught, of Macon, Georgia, has invented a very ingenious and original improvement for regulating the speed of steam engines, by cutting off the steam in the steam box when it exceeds the established velocity. The speed of the engine is regulated by the "cut-off," which consists of a plate of metal placed to fit and work on the back of the slide valve, which is furnished with certain openings through which the steam must pass into the cylinder while the cut-off plate is in a proper position. The form of this cut-off is not new, but the method of operating it is peculiar: the cut-off is caused to move with a slide valve by means of friction produced between them by suitable means, and by attaching the rod of the former to a pendulum axis or other device, capable of offering resistance to its movement, which causes it, when the velocity increases, to move a shorter distance than the slide valve and thus close the steam openings of the valve, and cut off the steam before the termination of the stroke of the piston. The steam passages of the slide valve are closed earlier or later, according to the velocity of the piston, by the action of this governor valve, to regulate the speed of the engine. The governor valve is therefore operated by resistance which increases as the undue velocity of the engine increases, to cut off the steam early when necessary.— *Scientific American.*

LOCKING AND COOK'S ROTARY AND VALVE ENGINE.

In this engine a metal disc, with three apertures, slowly rotating on a flat surface, with corresponding openings connected with the boiler and the cylinders, supplies the place of the ordinary slide valves.

Rotary motion is given to the valve by a vertical shaft, on which there is a pinion that is worked by a cog-wheel on the shaft of the engine. The two bearing surfaces are ground steam-tight, and an outer casing serves to confine the steam, as in the common slide valve. The advantages said to be gained by this arrangement are the diminution of friction and a more ready means of cutting off the steam and of reversing the engine. As the rotary valve has a continuous slow motion, the inconvenience and friction occasioned by the rapid reciprocating action of the slide valve is avoided. Among other advantages of this contrivance it is stated that it costs less, is less liable to get out of order, and occupies less room.

BRISTOL'S ROTARY ENGINE.

This rotary engine, invented by Richard C. Bristol, of Chicago, and exhibited at the New York Crystal Palace, is very simple in all its parts, and it embraces features which remove many objections to the heretofore economical working of such steam motors. The description of the rotary engine to which these improvements relate, consists of an outer fixed annular case with open ends, and an inner wheel so fitted to it as to close its ends and leave a channel or steam way within it, outside of the wheel, the outer case having one or more abutments which project from its inside and fit to the periphery of the wheel, the latter having sliders or wing pistons, upon which the steam acts for the purpose of giving rotation to the wheel, by admitting the steam between the sliders and the abutments spoken of.

The outer case is so supported that it is capable of yielding in any direction necessary to enable it to preserve, at all times, the proper position in relation to the wheel inside and the working parts of it, notwithstanding any inequality of their wear, or any other cause which might induce them to work out of line.

The sliders are pushed out against the concave face of the annular case by means of small pistons attached to them and acted upon by the steam, but only at such times as the sliders or wings are acted upon themselves by the steam, the pressure of the said pistons ceasing as soon as the exhausting commences at the back of the sliders to which they are attached, and before the withdrawal of the latter to pass the abutments, so that no resistance is offered to their withdrawal or back stroke.

This engine cuts off the steam at any point desired; the packing consists of adjustable metal rings, and is not liable to wear uneven or quickly, as the friction is small. — *Scientific American.*

NEW BOILER FEEDER.

The nature of this invention, by Aaron Arnold, of Troy, N. Y., consists in having a small hollow closed metallic vessel, which is hung on a balance outside of the boiler, and has communication at the top with the steam, and at the bottom with the water of the boiler, and is connected with the throttle valve or cocks in the feed pipe. The object of this apparatus is to regulate the quantity of water to be supplied to the boiler by a pump, so as to maintain the water in the boiler at a proper level. As the small vessel spoken of communicates with the steam chamber and the water in the boiler, it receives both steam and water, the latter being always at the same level as that of the boiler. It is balanced on a centre in such a manner that when the water in the boiler is at the proper line, it remains poised on its centre, and keeps the throttle valve in the feed pipe open to the exact width that will supply the boiler with water commensurate to the steam used. When the water in the boiler falls below the proper line, the water in the small outside vibrating vessel diminishes, which causes it to rise and open the throttle valve somewhat wider, and letting more water to the boiler. The reverse action takes place when the water in the boiler rises above the proper line. The vibrating outside vessel is guided by the amount of water in the boiler to regulate the throttle valve.—*Scientific American.*

RAILROADS OF THE UNITED STATES, AND OTHER COUNTRIES.

The number of miles of railway now in operatiou upon the surface of the globe, is 29,606; of which 15,436 miles are situated in the Eastern Hemisphere, and 14,170 are in the Western, and which are distributed as follows:—

	MILES.		MILES.
In the United States,.........	13,586	In France,....................	1,831
In the British Provinces,.....	173	In Belgium,...................	532
In the Island of Cuba,.......	359	In Russia,.....................	422
In Panama,...................	22	In Sweden,...................	75
In South America,...........	30	In Italy,.......................	170
In Great Britain,............	6,976	In Spain,......................	60
In Germany, ...	5,340	In India,......................	30

The longest railway in the world is the New York and Erie, which is 467 miles in length.

The total number of railways in the United States, in operation and in course of construction, is 372, constructed at a cost of $400,713,907. *Merchants Magazine.*

RAILROAD IMPROVEMENTS.

French's Improvement for overcoming Grades.—This invention consists of a common wooden superstructure, with a flat bar-rail: the ends of the cross-timbers are cut off flush with the sleepers, and the flat bar resting on the sleepers projects over on the outside of the track, forming a clear continuous space on each side of the road for friction rollers, or small wheels to revolve up against the projecting edge of the rail. The cranks are attached to the ends of the driving-axle, and between these and the driving-wheels is suspended from the axle, on each side, a friction roller, or wheel, which is made to drop at pleasure directly under the driving-wheels. Using the driving-axle as a fulcrum, by means of a compound lever, these friction rollers or wheels are pressed up at pleasure, and to that extent press down the driving-wheels, producing instantly whatever amount of adhesion may be required. The tread of the driving-wheels is as wide as the rails, and the friction rollers revolve just under them, with flanges to prevent their rubbing the sides of the road. These friction rollers or small wheels, when not required, are instantly thrown up some eighteen inches above the track, where they remain until they are again required, when they are instantly thrown into gear.

New Car Wheel and Truck.—An improvement in the construction of car wheels and trucks has been effected by Mr. J. T. Deniston, of Lyons, N. Y., by making the rim of the wheel somewhat thicker than is used, and forming the flange in the centre of this rim, thus forming two treads, one upon each side of the flange. The circumference of the tread upon the inside of the flange being larger than that upon the outside. When the curve is turned, this inner tread takes a new rail, placed near the outer rail of the curve, and thus causes the cars naturally to run in a circular direction. It will be observed that the outer wheel, in turning curves thus instantly, becomes larger than the inner wheel, which gives the curvilinear motion.

Improved Car Break.—Draper Allen, of New York, has invented and taken measures to secure by patent, an improved mode of constructing the brakes for rail cars, more particularly intended for the horse-cars of city streets. It consists in constructing the shoes of brakes in such a manner as to bear not only on the periphery of the wheel, but on the flange also, thus distributing the friction over a greater amount of surface, and at the same time preventing the unequal wear of the wheel, rendering necessary its frequent renewal. *Scientific American.*

Babcock's Railroad Track-Supporter.—This arrangement is intended to obviate entirely the noise, jar and dust now produced by the passage of trains, enabling each passenger to read or converse as freely and comfortably as though seated by his own fireside, while immensely diminishing the wear and tear of rails and machinery, and the consequent danger of accidents. It is entitled "Babcock's Railroad Track-Supporter" and "Track-Spring," and the plan is briefly as follows: Lay the ties firmly on blocks of stone, where these are to be had, and on any solid substitute where they are not, so as to obviate the perpetually recurring necessity for raising one side of the track here, lowering the other there, and leveling it every where, but which cannot now be avoided because a certain elasticity in the track rapidly traversed by a train has been proved indispensable. This elasticity Mr. Babcock supplies by means of air-tight metal boxes, each enclosing a circular piece of India-rubber, say $2\frac{1}{2}$ inches in diameter and $\frac{1}{3}$ of an inch thick — a box being set into each end of every tie, just under the rail. Thus the required elasticity is obtained, not in the track, nor in the rail, but in the Indian-rubber spring; the rail merely settling a little on each spring as the train presses upon it and rising again when it has passed, leaving the track entirely unaffected. The entire cost of this apparatus is estimated by the inventor at some $1,200 to $1,500 per mile, and he calculates the average saving thereby in the wear of track and rails alone at $350 per mile per annum.

Gardner's Compound Car Axle.—In this new car axle, each wheel is shrunk upon a sleeve which has a loose inside flange upon it and a small rim on the inside of the flange. The axle has a fixed flange upon it, inside of the wheel, and it extends through the sleeves. The sleeves of the wheel, therefore, run upon the axle, and are like long boxes which are secured by screw bolts. By this arrangement of the axle, an independent motion is given to opposite wheels without affecting the relative lateral action. The excessive strain upon the common axle in turning narrow curves is obviated and the danger of breakage removed.

In turning curves of average radius, and with ordinary trains, a large portion of the motive power may be saved. With the common axle, owing to the greater distance to be traversed over in the same time by the wheel on the outer rail, all the wheels on one rail must slide to compensate for the natural tendency to a difference in velocity. With this axle, each wheel moves with a velocity due to the length of rail to be traversed.

In the application of the brakes the torsion of the axle is also obviated — each wheel turning with the velocity due to the pressure of the brake on itself, and not affecting or being affected by the other.—*Scientific American.*

Cast-Iron Driving Wheels. — Henry A. Chase, of Boston, Mass., has invented an improvement in cast-iron driving wheels for locomotives, which consists in casting the "counterbalance" in a double-plated chilled wheel opposite the crank-pin in the inner face of the tread, between the two sides, but not touching them. It is cast on the tread, and stands up from it in the hollow part of the wheel, like a plate, but is not attached to the hub. The plates of the wheel, therefore, are made of equal thickness throughout, and consequently when cast they contract equally. The counterbalance, or solid plate, cast opposite the crank pin inside of the wheel, is therefore free to contract without affecting the side plates after being cast. — *Scientific American.*

NEW WAY OF CHECKING RAILWAY BAGGAGE.

The following method of checking baggage has recently been adopted with great satisfaction on two or three of the English railways.

When a train, say a down train, arrives at any particular station, a porter attends with a book. It contains tickets of stiff card board bound in the book. Each ticket is about 3 inches long and 1 inch wide. It is partly cut. So that two separate parts of it can be easily torn off. The tickets are numbered differently, but each of the three parts of a ticket has the same number. The outer part of the ticket has a loop of tape gummed to it. Suppose a person arrives at a station and is not going on by a train for an hour or two, or a day, and is desirous of leaving a carpet-bag or trunk at the station. He pays one penny, and in a moment the taped portion of a platform ticket is fastened to the handle of the carpet-bag. This portion bears, as has been already stated, a printed number also; the words "deposited at Winchester," or whatever the station may be, and likewise the words, "for down train." Another portion of the ticket, with the same number as the last, is torn off and given to the owner of the carpet-bag, to be presented at the station when the article is wanted. The words "for down train" are omitted on this portion. The portion of the ticket that is left in the book corresponds with that given to the passenger, and is a check on the money taker. The company then becomes responsible for the safety of the property. Luggage is divided into three class — that for down train, up train, and to be left till called for, and should be sorted into three different compartments at the station. For each division there is a separate book of tickets. If a person were to find or steal a ticket, and apply for property, he would be instantly detected, because he would first have to say whether the luggage was for up or down train, or to be left till called for, which he could not do unless he owned it. There is no necessity for any address to be on the luggage. One penny per package per diem is charged for a platform ticket.

IMPROVEMENTS IN THE CONSTRUCTION OF WATER WORKS.

At the last meeting of the British Association, Mr. J. F. Bateman described at length some recent improvements introduced in the water works of Manchester, England. The magnitude of the Manchester Waterworks was stated to be greater than that of the Croton Aqueduct at New York, which has hitherto been considered the largest of modern times. The three principal reservoirs will contain 500,000,000 of cubic feet of water, and there are two smaller reservoirs which hold 100,000,000; so that the total quantity stored up for the consumption of Manchester and the neighboring mills is 600,000,000 cubic feet. The furthest reservoir is 20 miles distant from Manchester, and is 420 feet above the level of the upper part of the city. The daily consumption of the inhabitants is 30,000,000 gallons, which are supplied immediately from a service-reservoir 150 feet above the level of Piccadilly, at the highest part of Manchester. The valves of the main pipes which open and cut off the supply are 40 inches in diameter, and, with a pressure of 150 feet on that area, it would have been impossible, without great labor or complicated machinery, to have opened and closed the valves had they been of the ordinary construction. Mr. Armstrong, of Newcastle, suggested, as a means of overcoming the difficulty, that the large valve should be divided into three, and this plan had been found to act remarkably well. A small compartment of the valve was first withdrawn, and the rush of water through it having filled the pipe, the pressure was counteracted, and the other and larger divisions of the valve could then be easily lifted. By this contrivance the mains could be opened and closed by one man. Another object to be accomplished was to arrest the flow of water in case the large pipes with such a pressure upon them should burst and flood the neighborhood. This was successfully effected by introducing into the main pipe a kind of flood-gate, which was opened at a certain angle by the ordinary flow of the water, and at that inclination it held suspended, by means of a lever, a heavy weight connected with a throttle-valve. When the rush of water greatly exceeds the ordinary flow, a catch that retains the lever is withdrawn, and the fall of the weight closes the throttle-valve and stops the flow. This self-acting machinery has more than once prevented serious damage that would have arisen from the bursting of the pipes. Another contrivance deserves mention. The water in the reservoirs is generally beautifully clear, but during heavy rains it becomes turbid, and would be unfit for the consumption of the inhabitants without being filtered. To avoid the inconvenience and expense of filtration, Mr. Moore suggested a plan for separating the turbid water from the clear. A weir was constructed, over the edge of which during dry weather the water in the reservoir flows perpendicularly into a drain-pipe immediately below, which conveys the clear water to the service reservoir ; but in heavy rains, when the water is turbid, the extra flow shoots it over the first drain into the second, to convey it to the reservoirs that supply water power to the mills. By this simple arrangement the turbid and clear waters are separated, and it is calculated that a saving of 100,000*l.* has thus been effected. In supplying Manchester with water, a new kind of fire-plug has been adopted, consisting of a gutta-percha spherical valve, which closes the apertures, and when the water is required to escape, an instrument is introduced which forces down the valve. The great water pressure in the pipes forces it so high that there is no necessity for fire engines ; and the effectual manner in which fires are extinguished by the torrent of water that can be thus applied has greatly diminished the cost of insurance in that city. Mr. Bateman stated, that in large establishments the diminished premiums on fire-insurances, produced by the increased facility of extinguishing fires, are sufficient to pay the water-rate.

WATER METERS.

Improvements in apparatus for measuring the flow of water and other liquids, have been made by S. R. Wilmot, of New Haven, Conn. The improvements relate to that description of fluid meters, consisting of a piston made to move reciprocally within a cylinder of known capacity, by the admission of the water on opposite sides alternately, and by which the flow of liquid is measured by registering the number of reciprocations of the piston. These kind of meters work with great accuracy, and the only objection to their use, is the great amount of friction — the piston, when tightly packed, requiring a considerable pressure of water to move it. The object of the new improvements is to remove the great amount of friction, and enable the piston to be moved with a low head of water. One improvement consists in forming an air seal or packing, to separate the water above from the water below the piston, by extending the piston upwards at its sides, in the form of an open topped tube or cylinder, to enter a narrow open bottomed but close topped chamber, which is formed around the upper part of the interior of the vertical working cylinder, and always contains a quantity of air, which cannot be expelled by the water. As there is no communication between the spaces above and below the piston, except this chamber, the air forms a seal or packing, and admits of the piston being made to fit so loosely to the cylinder as to produce a very small amount of friction. Another improvement is, that the piston is fitted with an air float, so proportioned to its weight, that it will preserve an equilibrium with the water, and offer no resistance to its entrance upon either side. All the mechanism through which the piston operates upon the valves is enclosed within the cylinder itself, or a water chamber above or below the cylinder, having free communication therewith, whereby the necessity for stuffing boxes and other packing, is obviated.— *Scientific American.*

Kenedy's Water Meter. — In this meter the fluid is passed through an adjustable valve, working in connection with an arrangement of clockwork, the combination being so contrived that the exact flow of the liquid shall be indicated by apparatus worked from the clock movement. In one arrangement, the valve on the supply-pipe consists of a small bored cylinder, fitted with a piston, and having a narrow longitudinal slot on one side. Then the water being admitted to this cylinder beneath the piston, escapes through this slot into an outer cylinder, communicating with the service-pipe or delivering stop-cock, at a rate proportioned to the extent of slot left open to the water by the piston. When placed vertically, the piston-rod is loaded with a weight, to keep it steady upon the water, the rod being passed through a stuffing-box at the top of the outer cylinder, above which it is connected to a traversing pulley, which is kept constantly revolving by contact with a cone pulley, driven at a continuous uniform rate by a common clock. The result of this combination is, that as the piston rises in its cylinder, admitting an increased flow of water, it draws the traversing pulley towards the larger end of the cone; and this pulley being connected to the indicating mechanism, at once points out the quantity of water passing through, as it is driven at a more or less increased speed, from its position nearer to, or further from, the large end of the cone.

IMPROVEMENTS IN BEARINGS.

M. Decoster, at Paris, has lately invented a novel method of lubricating bearings, especially applicable to light shafting, and which is thus described in the London Artisan: — The bearing is made rather wider than usual, and a small disc is fitted on the shaft, which dips in a reservoir of oil in the base of the hanging carriage or plummer-block, and by its revolution, raises the oil and distributes it over the bearing. A tight fitting cap covers in the whole bearing, and prevents the access of dust. Bearings of this description, we are assured, will run for more than a twelvemonth with one supply of oil. M. Decoster is replacing all his line shafting with shafting of a much smaller diameter, but running at a higher speed. This arrangement saves great expense in constructing mills, and is attended with no inconvenience, if the system of lubricating just described is adopted.

T. S. Minniss, of Meadville, Penn., exhibited at the Crystal Palace, a lubricating box, for the journals and shafts of machinery of a decidedly novel character. The arrangement for vertical shafting is constructed as follows: The foot of the shaft is expanded into a hollow cylinder of sufficient capacity to contain a weight of water equal to the entire weight of the shaft and all resting upon it; this hollow cylinder is water-tight, and being filled with air it is evident that when plunged in a vessel of water it will support the shaft, and at the same time will be in contact with the water only. Its motion is however made steady by a pivot in the center, and by the water vessel, the size of which is reduced to but a trifle more than the diameter of the sustaining cylinder.

GIGANTIC MANUFACTURING ESTABLISHMENT.

The largest single manufacturing establishment in the world, has recently been opened at Saltaire, Yorkshire, England, for the manufacture of alpaca cloth. The vastness of this great work will be seen from the following statement, which yet applies to only one department. The weaving shed will contain 1,200 looms. The length of the shafting will be 9,870 feet, or *nearly two miles*, and weighing between six and seven hundred tons. The steam engines to work these shafts are equal to twelve hundred and fifty horse power, and the looms in this one weaving shed will be capable of producing thirty thousand yards, or nearly *eighteen miles* of alpaca cloth every day, and an aggregate length of *five thousand six hundred and eighty-eight miles of cloth annually*. The building covers six acres of ground, and the floors in the several buildings, including warehouses and sheds, cover an extent of eleven acres and a half. The south front of the building is exactly the length of St. Paul's, 545 feet. It is six stories high. The top room is unbroken in its length, and is one of the longest in the world. The roof is of iron, and the windows vast squares of plate glass. Around this model mill is growing up the town of Saltaire. The town begins with seven hundred houses, built on the best principles, and including every convenience necessary to the health and comfort of its inhabitants. It will consist of spacious squares and streets, grounds for recreation, schools, a place of worship, baths, and wash-houses. The air is not to be polluted with smoke, or the water to be deteriorated by any impurity. The alpaca wool has been known in England for about forty years; but its manufacture to a large extent is comparatively recent. It was introduced by Mr. Salt into Bradford, in 1836. For the first five years the average annual imports were five hundred and sixty thousand pounds. In 1851, they were 2,186,480 pounds; the increase being principally owing to the great demands of Mr. Salt and a few other Yorkshire manufacturers. The mohair or goats' wool of Angola was introduced about the same time as the alpaca. The quantity of mohair imported in 1841, was 1,011,780 pounds; in 1851, it was 1,943,280 pounds.

FOREMAN'S PROCESS FOR RAISING SHIPS.

In this arrangement for raising sunken vessels, cast-iron generators containing wet gunpowder are employed. These are connected with a cast-iron retort or purifier filled with water, from which passes a coil of cast-iron tube. The whole apparatus is placed in a box about 6 feet square and two feet high, which is filled with water. From the end of the coil a hose, dividing in two parts, passes to casks lashed to the sides of the vessel to be operated on. The powder in the generators is then ignited, and the gases generated by its combustion pass by means of the hose and pipe into the casks, and displace the water with which they are filled, holes having been made in the bottom of the cask. The buoyancy of the confined air raises the vessel.

IMPROVED SYPHON.

W. Lover, a Dublin surgeon, has invented an ingenious syphon, which promises to be useful for philosophical purposes. It consists in adding an elastic bag to the longer leg of the instrument, communicating freely with it a little above the extremity. When intended for use, the air is to be expelled from the bag by pressing it with one hand, and the end of the tube close to it is to be shut by a finger of the other, if there be no cock upon it. Upon plunging the shorter leg of the instrument into the fluid to be drawn off, and releasing the bag without removing the finger from the end of the tube, the partial vacuum which will be created within it will raise the fluid over the bend of the tube, and fill the longer leg. It will then only be necessary to remove the finger, or to open the cock, to set the syphon in action. This is evidently a convenient means of filling the instrument, far preferable to suction, or to pouring fluid into it beforehand.

IMPROVEMENT IN PICKERS AND GINS.

A new picking machine has been invented by R. Kitson, of Lowell, which possesses some features of novelty. The object of the machine is to get rid of the impurities contained in the cotton or rags to be picked, by blowing them out at the time of picking, instead of subjecting them to a second operation for this purpose; and also consists in a new mode of attaching the picking teeth to the cylinder. The machine contains two cylinders, having within them fan blowers creating a strong blast, which pass through openings in the periphery of the cylinders, and forces the dirt and dust through other openings in the concaves. The shanks of the teeth are shouldered even with the face of the cylinder, and after they are driven home, a metallic plate having notches of the same size as the teeth above their shoulders, is screwed firmly upon them, thus rendering it wholly impossible for them to escape until all the screws in the plate give way.

An improvement in the cotton-gin, devised by L. Campbell, of Columbus, Miss., consist in the employment of a concave, constructed with a series of passages, in which the ginning saws work; the sides of said passages being covered with bristles or other elastic subtances, for the purpose of more effectually freeing the cotton from impurities as it is drawn through the passages by the saws. This concave is also provided with a series of brushes which, in combination with the brush fan of ordinary gins, spread the cotton evenly upon its discharge.

WEAVING OF BROCATELLES.

The weaving of this elegant sort of tapestry goods by power-looms has been introduced at Humphreysville, Conn. *The Journal and Courier* (New Haven) thus speaks of the enterprize:

"The adaptation of heavy machinery to the production of silk goods, is a stride in manufactures which only those can appreciate who are familiar with the business. During three years of patient toil, in the face of difficulties which seemed insurmountable, and surrounded by discouragements which would have broken the spirit of ordinary men, the projectors of this enterprize have moved steadily forward with an unfailing confidence in their ultimate success; and we are rejoiced to learn their labors are being crowned with a rich reward, exceeding their most sanguine expectations. The fabric they manufacture has been brought to great perfection, and a large demand, greater than their present facilities can supply, is pressing upon them from the larger marts of trade. Bigelow's celebrated power-loom, the use of which is confined to this company, has been adapted to this work by the ingenuity of Mr. J. P. Humaston, to whom alone the credit is due for the introduction of this new branch of manufacture; and so nicely is the machinery balanced, that the breaking of a single thread, though scarcely larger than a twisted spider's web, throws the whole machinery out of gear, and all the wheels, shuttles and pullies are brought to a dead stand, that the thread may be mended. Indeed, so ingenious is the adaptation, it seems almost to possess human intelligence. This company are using only original designs, and so complicated are some of these, it requires eight thousand cards, each perforated with from twenty to seventy holes, every one of which is worked through the harness of the loom to represent a few inches of the fabric correctly. Mr. Humaston has invented a card cutter, with which a child can perform as much labor in a week, as two men can in a month without it; and this enables them to be prodigal in new designs. For a hundred years these goods have been made in Europe, but only on the old-fashion hand loom, and one yard per day is considered a fair day's work there, even at the present time. On these power-looms a girl can weave six yards per day, of better fabric than any German goods imported, and almost equal to the best French Brocatelles."

"MUNGO, SHODDY, OR DEVIL'S DUST."

The New York Tribune in an article on the woolen fabrics at the Great Exhibition of New York, gives the following graphic explanation of the above terms (frequently used in English political debates) and of the peculiar manufactures to which they apply. The writer says: We do not introduce this explanation because we wish to encourage the use of these articles in America, as we are aware that they are getting into use without such encouragement. We believe, however, that if carefully selected and used in moderation, that shorter nap, of which we have spoken as desirable in American goods, will most probably be secured. We are aware, too, in speaking of these articles, we may be considered as exposing the secrets of the trade; but as we write for public enlightenment, and the advancement of our domestic manufactures, we are sure that we are justified in saying what we know of English manufactures in this respect.

In the somewhat hilly district of Yorkshire, between Huddersfield and Leeds, stand on two prominences the pretty little towns of Dewsbury and Batley Car. The stranger on alighting from the railway-car, is struck with the unusually large warehouses, built of stone, by the Railway company. For such small stations these are mysterious erections. But if he enter the principal warehouses, he will probably find piled up hundreds of bales, containing the cast-off garments of Great Britian and the Continent of Europe. Here, in fact, from all parts of the world, are brought the tattered remains of the clothes, some of which have been worn by royalty in the various Courts of Europe, as well as by peers and peasants. The rich broadcloth of the English noble here commingles with the livery of their servants and the worsted blouses of French republicans; while American undershirts, pantaloons, and all other worsted or woolen goods may there be found, all reduced to one common level, and known by one common appellation of "rags."

The walls of the town are placarded with papers announcing public auctions of "Scotch Shoddies," "Mungoes," "Rags," and such like articles of merchandise, and every few days the goods department of the railway is besieged by sturdy looking Yorkshiremen, who are examining, with great attention, the various bales; some of which are assorted into "whites," "blue stockings," "black stockings," "carpets," "shawls," "stuffs," "skirtings," "linseys," "black cloth," &c. A jovial looking man of doubtful temperance principles, at last steps forward and puts the goods up to auction. The prices which these worn-out articles fetch is surprising to the uninitiated. Old stockings will realize from £7 to £10 a ton; while white flannels, will sometimes sell for as much as £20 a ton and even more. The "hards," or black cloth, when clipped free from all seams and threads, are worth from £20 to £30 a ton. There are common mixed sorts of coarse fabric, which can be bought as low as from £3 to £5 a ton; whilst the "rubbish," consisting of seams, linseys and indescribables, are purchased by the chemists for the manufacture of Potash Crystals for from £2 to £3 a ton.

It will be seen that *assorting* these old woolens is equally important with the assorting of the different qualities of new wool; and there is the additional consideration of colors to render assorting still more necessary. It is surprising, however, with what rapidity all this is accomplished. There are some houses where old woolen rags are divided into upward of twenty different sorts, ready for the manufacturer. The principal varieties are flannels, of which there are "English Whites," "Welsh Whites," "Irish Whites," and "Drabs." Each of these command a different price in the market; the English and Welsh being much whiter than the Irish and of finer texture, are worth nearly double the price of the Irish. The stockings are the next in value to the flannels, on account of the strength and elasticity of the wool. The peculiar stitch or bend of the worsted in stocking manufacture, and the hot water and washing to which they are submitted during their stocking existence, have the effect of producing a permanent elasticity which no after process destroys, and which no new wool can be found to possess. Hence old stockings are always in great demand, and realize for good clean colored sorts as much as £16 a ton, in busy seasons. The white worsted stockings are the most valuable of the "softs," and when supplied in sufficient quantity will sell for as much as £28 a ton. Carpets and other colored sorts are generally, owing to their rapid accumulation, to be had at very low prices. The rag collectors and merchants of America would be sure to find a good market for flannels and stockings in England, but the common articles would scarcely pay for the transit.

The "hards," consisting of old superfine cloth, will generally realize good prices in England, and should be stripped of their seams and sifted free from dirt, before exporting. We have seen from 20 to 30 Irish women in a room cutting the seams from old cloth. This is in fact an important branch of the business, and in Liverpool, Manchester, and nearly all large towns, it finds employment for many hundreds of hands. They are generally paid by the weight of rags they cut.

"Shoddy," so well understood in Yorkshire, is the general term for the wool produced by the grinding, or more technically, the "pulling" up of all the soft woolens; and all woolens are soft except the superfine cloths. The usual method of converting the woolens into shoddy, is to first carefully assort them so as to see that not a particle of cotton remains on them, and then to pass them through a rag machine. This consists of a cylinder three feet in diameter, and twenty inches wide, with steel teeth half an inch apart from each other, and standing out from the cylinder, when new, one inch. This cylinder revolves 500 times a minute, and the rags are drawn gradually close to its surface by two fluted iron rollers, the upper one of which is packed with thin stuff or skirting, so as to press the rags the closer to the action of the teeth. The cylinder runs upwards past these rollers, and any pieces of rag which are not completely torn into wool, are, by their natural gravity, thrown back again upon the rags which are slowly creeping into the machine. The rollers are fed by means of a creeper or slowly moving endless cloth on which a man, and in some instances a woman, lays the rags in proper quantities. One of these machines is commonly driven by a seven-inch strap, and requires at least five horse power. Half a ton of rags can be pulled in 10 hours by one of these machines. The dust produced, subjects the work people, who first commence this occupation, to what is there called the "rag fever." But after a time the immediate effects are warded off, and although it no doubt shortens life, the remuneration being considerable, (two English shillings for every 240 lbs of rags pulled,) there is never any difficulty in obtaining work-people.

The "Mungo" is the wool produced by subjecting the hards, or superfine cloths to a similar operation as that above described. The machine, however, for the mungo trade is made with a greater number of teeth, several thousand more in the same-sized cylinder, and the cylinder runs about 700 revolutions in a minute. The rags, previous to being pulled in this machine, are passed through a machine called a "shaker." This is made of a coarsely-toothed cylinder, about two feet and a half in diameter, which revolves about 300 times in a minute, in a coarse wire cylinder. This takes away a large portion of the dust, which is driven out at a chimney by means of a fan. The mungo pulling is, therefore, a cleaner business than the shoddy making, and, as a general rule, is more profitable. The power required for a mungo machine is that of about seven horses.

Both the better kinds of shoddy and the mungo have for some years been saturated with oil; but when we were last in Yorkshire, we found that milk had been applied to this purpose, and found to answer exceedingly well. The consequence was, that milk had risen 100 per cent. in price, and even in that district, where cows are kept in large numbers, it was feared there would be a great scarcity of milk for the supply of the town.

When well saturated with oil or milk, the shoddy or the mungo is sold to the woolen manufacturer. There are scores of men who attend the Huddersfield market every Tuesday to dispose of their mungo. It is as much an article of marketable value there, as cloth is here. It is not unusual for good mungo to realize as much as eight English pence per pound, while the shoddy varies in price from one penny to sixpence per pound according to quality.

The common kinds of shoddy require, of course, to be subjected to the scouring process, for which large wooden beaters, or "stocks," are employed. The dung of hogs is largely employed in this purifying process, as well as human urine, which is extensively used in the blanket manufacture of Yorkshire.

The white shoddy is capable of being used either for light-colored goods, or for the common kinds of blankets, while the dark colored shoddy is worked into all kinds of coarse cloths, carpets, &c., which are dyed any dark color, so as to hide the various colors of the old fabrics. It is mixed in with new wool in such proportion as its quality will permit without deteriorating the sale of the material.

The mungo is used in nearly all the Yorkshire superfine cloths, and in some very extensively. It produces a cloth somewhat inferior, of course, to the West of England goods in durability, but for finish and appearance, when first made up, the inferiority would only be perceived by a good judge of cloth.

The great English slop-sellers, Moses and Hyam, are among the largest purchasers of Yorkshire broadcloths.

The effect of shoddy in the cloth of an overcoat in the wear, is to rub out of the cloth and accumulate between it and the lining. We have seen a gentleman take a handful of this short wool from the corners of his coat.

The grounds on which this shoddy and mungo business can be justified, are the cheapening of cloth, and the turning to a useful purpose what would be otherwise almost useless. The business in Yorkshire is dignified by the title of the "Dewsbury trade." And to it Dewsbury certainly owes its wealth, and we might also say its existence. In twenty years it has grown from a village to a town of some 30,000 inhabitants, and some immense fortunes have been made by this extraordinary transformation of old garments into new.

Considerable quantities of white shoddy have been sent from England and Scotland to this country, and a machinist informed us that he had sent several of his rag machines, so that the trade is not entirely unknown here, and it is probable there will one day arise a Dewsbury in the New-England States, which will render it unnecessary to send old woolens to England, to be pulled into wool, and then returned here again at a cost of some 300 per cent. above the price given for the woolen rags.

The Dewsbury trade is somewhat fluctuating, being affected very much by the state of the wool market. So great is the competition in the English markets, that as soon as a rise takes place in the price of new wool, the small manufacturers, instead of raising their prices, commonly regulate their expenditure by using a larger proportion of the old material, and they are thus enabled to compete, in prices at least, with the larger manufacturers, who can lay in a large stock of new wool when the prices are low.

MACHINE FOR CLEANSING VAULTS AND CESSPOOLS.

The Pneumatic Draining Company, of New York, have in their employ an ingenious arrangement for the cleaning of vaults, &c., without creating the effluvia nuisance usually accompanying such operations.

The apparatus consists of a strong iron cylinder, with all the appurtenances of valves and stop-cocks mounted on four wagon wheels.

From this cylinder the air is exhausted by a steam engine. It is then taken to the premises, where the sink is to be emptied, and a large air-tight hose, with one end screwed to the machine in the street, is carried through the house, if there is no alley-way, and the other end inserted in the sink. When all is ready the valve is opened, and as "nature abhors a vacuum" she makes haste to fill it. The hose is then unscrewed, and a cap put on; the full cylinder is driven off, and an empty one takes its place, which in five minutes is full and ready to give place to another, and so on till the sink is exhausted of all its liquid contents, and with it nearly all the effluvia, the force of the suction being so strong that if the vault is pretty tight it will be completely exhausted of its fetid air, so that if necessary to remove the contents which are too solid to be taken up through the hose, the work can be done in a few minutes.

The Pneumatic Company have daily, or rather nightly, in operation six of the above described machines, which average about nine loads a day, of 45 cubic feet each, making 54 loads, or 2,430 cubic feet of the semi-liquid contents of privy vaults; every gallon of which ought to go to the country and be sprinkled upon the cultivated fields; instead of which it is all discharged off the end of piers into the Hudson River.

To show the amount of fertilizing materials collected, and for the most part wasted, within the city of New York, we quote from a report of the City Inspector. In a communication to the Board of Aldermen, he stated, "that within two months, of the spring of 1853, six thousand nine hundred and fifty loads of night soil were removed from the various parts of the city and emptied overboard from the four piers used as dumping places; and I am informed that besides seventy-six thousand eight hundred and forty-five loads of dirt, fifty-five thousand four hundred and ninety-three loads of manure have been collected by the Street Department, during the same period.

TOBACCO PRESSING MACHINE.

An ingenious machine for the compressing of Tobacco into plugs, was exhibited at the New York Crystal Palace, by Mr. A. A. Parker of St. Louis. The tobacco is received into a hopper, then carried forward, and fed into moulds or cells in a rotary disc box, in which it is pressed into plugs by toggle jointed levers, and from which it is discharged in plugs, into a receiving long pressure box, where all the elasticity of the compressed tobacco is destroyed, and the plugs rendered incapable of swelling again, and from which they are discharged, firm and permanent in packing shape and size. Means are also employed in this press to keep the moulds or cells, and all the contact parts of the machine, clean and free from the gum and liquorice of the tobacco. The compressing box into which the plugs are discharged from the moulds or cells, embraces a principle essential to the success of a tobacco-pressing machine. If the tobacco was freely discharged when quickly pressed into plugs, it soon would lose its form and compactness. This receiving compressing box has its bottom, top, and sides, composed of endless belts, and it is of such a size as to hold the plugs under pressure while confined for about a half an hour, during which time the plugs lose their elasticity, and always retain their form after they are discharged. This machine presses about 20 plugs per minute, and the receiving compressing box contains a great many plugs, as it is somewhat long. When full, as one pressed plug is thrust in by the lever, another is discharged, ready to be packed up, and so on continually.

INDIA RUBBER WASHING MACHINE.

The nature of this invention by E. L. Evans, of Hartford, Conn., consists in constructing two rubbers, which are secured on arms suspended from two standards; one of the rubbers is secured to the lower end of one arm, while the other is suspended to a similar arm secured to the main one, by a hinge, which allows the rubbers to be drawn together or forced apart by the operator, at pleasure. The rubbers spoken of, act so as to rub the cloth to be washed between them and fluted wash-boards placed under them, one of which is stationary and the other movable — sliding — being moved by a treadle operated by the foot, to draw the cloth through regularly, to present new surfaces to be rubbed. The movable rubbers are of prepared india rubber, and are made to be of a nature like the human hand — something like a cushion, whereby the cloths are well rubbed, with as little injury as possible to their texture. — *Scientific American.*

MANUFACTURE OF UMBRELLAS AND PARASOLS, IN NEW YORK.

The manufacture of umbrellas and parasols in the city of New York is chiefly confined to seven different firms, who by the aid of machinery manufacture annually about $1,500,000 worth. One of the largest firms employs 325 persons, including 250 girls. During a considerable part of the year, from 1,200 to 1,500 umbrellas and parasols are turned out daily, and $75,000 worth of silks and ginghams are sometimes consumed in the course of three months. There are in an umbrella 112 different parts, and before being perfected the umbrella passes through nearly as many hands. The average wages received by the sewers of umbrellas is $4 per week.

RICHARDSON'S ATMOSPHERIC TELEGRAPH.

This arrangement brought forward during the past season and exhibited in model by Mr. J. S. Richardson, of Boston, is constructed as follows: — The apparatus consists of a tube connecting the places between which communication is to be maintained, in which a sort of piston called "the plunger" is fitted with a loose leather packing. The matter to be sent is enclosed in a bag attached behind this plunger. Its propulsion is secured by the pressure of the atmosphere of ordinary density behind it, that in front being rarified by means of an air pump, producing a partial vacuum. As the air is exhausted from before the plunger, it is evident that the plunger is driven with atmosphere pressure at the rate that *air rushes into a vacuum*, barring the loss of velocity by friction. *In all the atmospheric telegraphs heretofore proposed, the motion of a long column of air behind the ball or carriage has presented an insuperable obstacle to its operation on a long line.* To obviate the evil of working on a long column of air behind the piston, new air is admitted at different stations along the line behind the plunger, and the long column is cut off so that the *action is like a succession of short effectual efforts.* This is done in an *ingenious* manner, by valves hanging in the main tube connected with the atmosphere, which are acted upon by the plunger as it rushes through the tube, when the air is *cut off* a short distance behind the plunger, and a *new column commences to act, to force the carriage through.* This propelling power is so great as to produce an apparently instantaneous motion of the plunger with its load from one end to the other of the model tube on exhibition, which is about 30 feet long and 1 ½ inch in diameter; indeed the plunger issues forth with so much force, when not confined, as to knock down violently a heavy billet of wood placed opposite the end of the tube, if it is left open. The speed is estimated at about 1000 miles in an hour. The apparatus is so arranged that there can be intermediate stations upon the line, at which the progress of the plunger can be arrested, or, if preferred, it can pass directly through to the terminus. The inconvenience of the sudden shock occasioned by the arrival of the plunger at the end of its journey is avoided by an arrangement by which a portion of the air in front of it is compressed and allowed to escape, but gradually, forming a sort of cushion to ease the jolt.

For the purpose of carrying the above described invention into effect, it is proposed to build a line of atmospheric telegraph 2 feet in diameter, from Boston to New York, for the conveyance of letters and packages to and from the said cities and intermediate places, allowing fifteen minutes for each transit; sending from Boston to New York at every hour, and from New York to Boston at half-past every hour, twelve hours each day. The cost of laying it down is estimated at $2,000 per mile. There will be supply valves as often as once in 25 miles, and intermediate stations at suitable points; for instance, at Worcester, Springfield, &c. There will be air pumps at all the stations.

SMOKE CONSUMING FURNACE.

The London Mining Journal describes and praises very highly a smokeless furnace, invented and patented by Mr. John Lee Stevens. The invention consists in the combination of two sets of fixed fire-bars, the first of which is chiefly fed by the scoria and cinders voided from the second or upper set of fire-bars, with a caloric plate, the face of which may be protected by a few fire-bricks; by which arrangement the current of air entering at the lower part of the furnace passes through two strata of fire, and thence between the caloric plate and the bridge, and is thus so intensely heated as continuously to produce the entire combustion of the gaseous products of the fuel, and to prevent the ordinary formation of smoke.

Smokeless Chimneys.—Major Browne, of London, has recently patented an apparatus for preventing the egress of smoke from the tops of chimneys. The invention is applicable to old chimney shafts, or in the construction of new ones the height might be very considerably reduced. The top of the chimney is closed in, and at about half-way up in those of present construction an opening is made in the side as large as the structure will allow. Outside of this an iron box is firmly secured, in which is a foliated revolving cylinder, its axis placed horizontally, having a grooved pulley geared to the motive power by which it is set in motion. The leaves of this cylinder are curved downwards in the direction of its rotation, to facilitate collecting and carrying downwards the solid particles of carbon, and the denser vapors into a tank beneath, containing water, and in which it partially revolves. This tank has two openings, one to insert fresh water, the other to withdraw the collected matters. When the smoke reaches the opening it comes within the immediate action of the draught caused by the rapid revolution of the vanes, and is quickly condensed in the cold water trough.

A new law for the abolition of the smoke nuisance in London went into operation in August, 1853.

There are eight sections in the law, and it enacts that from and after the 1st of August, furnaces in the metropolis shall consume their own smoke, under penalties described. The act extends to any mill, factory, printing-house, dye-house, iron foundry, glass-house, distillery, brewhouse, sugar refinery, bakehouse, gasworks, waterworks, or other buildings used for the purpose of trade or manufactures, within the metropolis. From the same day steam-vessels on the Thames above London bridge are to consume their own smoke, under penalties to be recovered in a summary manner before a magistrate. The words, "consume or burn the smoke." are not to be held in all cases to mean, "to consume or burn all the smoke;" and the justice before whom any persons shall be summoned may remit the penalties if they are of opinion that such person has so constructed or altered his furnace as to consume or burn, as far as possible, all the smoke arising from it, and has carefully attended to the same, and consumed or burned the smoke arising from the furnace. Constables may be empowered to enter and inspect furnaces and steam engines.

IMPROVEMENTS IN CRUSHING AND PREPARING ORES.

Machine for Separating Ores.—An important apparatus for separating ores and other substances of different specific gravities and of different magnitudes into their constituent parts, has been invented by Victor Simon, of Nerviers, Belgium; the inventor, Mr. S., accomplishes the desired object, by passing a current of air through a long trunk or tube placed horizontally, or nearly so, with a series of recesses arranged in the bottom of the tube for the reception of the ores, or other substances; these substances, after being pulverized, are fed to one end of the tube from a hopper placed above it, and are subjected to the uniform current of air above the recesses; the heaviest particles fall immediately to the bottom of the tube to the receiver prepared for its reception, and those lighter to the adjoining recesses, and so on, in proportion to their specific gravities, the lightest being found in the receiver farthest from the feed opening. The particles of matter received in any one receiver of the series will have a specific gravity so much greater, compared with that of the other particles, as their volume is less, and vice versa. When thus classified, the perfect separation of the different substances may be easily affected, and, at the same time, the removal of any impurities which may exist in the pulverized material. This easy and simple classification and separation of particles of matter is a most desirable result, and will very much facilitate the analysis of ores and other substances submitted to its action. The improvement has been already tested in Belgium, and is believed to be one of utility.—*Scientific American.*

New Method of Crushing Ores.—A new method of crushing ore, invented by Capt. Sharpnell, of London, is thus described in the London Mechanics Magazine:

"The invention consists of a chamber about ten feet long, eight feet high, and six feet wide, the back of which is made of inch and a half wrought iron, and the sides of sheet iron. The sides are riveted and strengthened with ribs. The whole rests upon a bed of timber strongly framed. A short railroad track is placed in front of the box for the cannon to run upon. The gun is charged with powder, and a wad rammed down upon it, and all above the wad is charged with broken pieces of ore, and the whole covered with another wad. It is now moved forward upon the rails, against the front of the chamber, in which there is a circular hole, rather larger than the muzzle of the gun. The muzzle is just introduced within the thickness of the plate, the piece is primed and fired, when the charge is projected against the strong thick plate forming the back of the box. To relieve the sides of the box from the concussive force, the roof is formed in doors upon hinges, which suddenly fly up when the explosion takes place, and act as safety valves, after which they immediately fall. The reduced ore is acted upon by a gentle blast, which sends off the lighter particles, and allows the heavier metallic to fall. A preforated false bottom allows the reduced ore to fall into a drawer, which is withdrawn with the dust, to submit the latter to the winnowing process."

Gardiner's Quartz Crusher and Amalgamator.—This invention consists, first, of a kettle or trough, which in the working machine is to be of cast iron, 8 feet long, and of sufficient width to admit a ball $3\frac{1}{2}$ feet in diameter. This trough is stationary, is set horizontally, and is firmly imbedded in a framework of wood. The ball which travels in this trough has a pole passing through its centre, serving as its axis or journals, to which is attached a horizontal shaft working on the journals of the ball; and that shaft is attached to a crank or to the piston of the engine, which when set in motion gives the ball an oscillating motion, causing it to travel back and forth the entire length of the trough in which the quartz is placed, at the rate of about 600 feet per minute. At one end of the trough are small apertures or slats, through which the quartz, after being crushed to the size of large peas, is forced by the motion of the ball, falling into a stationary cast iron kettle or mortar of about 3½ feet diameter. Into this kettle is inserted a tolerably close-fitting cast iron half-sphere, or perhaps more properly a pestle. By the operation of the machinery two motions, gyrating and rotary, are given to this pestle. As the crushed quartz passes from the trough into the mortar, it is (such is the theory of the inventor) pulverized to an impalpable powder, and passed out at the bottom into an amalgamator immediately beneath. The amalgamator consists of a cast or wrought iron cylinder of any given length and size, placed horizontally, with steam-tight heads at both ends, and resting on hollow journals cast on the heads, through which the pulverized quartz is received into and discharged from the amalgamating cylinder.

Berden's Quartz Crusher and Amalgamator.—In this machine, the crusher is an iron ball or globe, weighing five thousand pounds, and some thirty inches in diameter, which revolves in a mammoth cup, not unlike a potash kettle, which is obliquely suspended from and strongly secured to a heavy wooden framework, which should be firmly imbedded in the earth or fastened to an unyielding platform resting thereon. This cup or basin is made to revolve by an ordinary application of steam-power by means of a belt, and thus the ball, continually seeking the lowest position, revolves without changing its place, being attached by a pin to a stem in the centre of the cup. A stream of water is conducted into the cup from above, and forms a pool of some three or four pailfuls around and under the ball. The mercury is of course under the ball, and the quartz is shoveled into the pan or may be poured in from a hopper above. So far, gold-miners will recognize it as an improved Chilian Mill, of extraordinary power. But beneath the pan or cup — or rather in a cavity at the bottom thereof, formed expressly to this end, a small fire is made, which (being fed with air through half a dozen orifices at regular intervals surrounding it,) is fanned into lively action by the revolution of the cup, and *heats the quicksilver moderately without heating essentially the water*, continually pouring in above it, dashing about and running off, surcharged with the pulverized quartz. The effect of this contrivance is claimed to be the perfect amalgamation of the gold (or other precious metal) with the thus enlivened and expanded quicksilver without subliming that metal and causing it to pass off as vapor. By this means it is claimed that the very last particle of gold is extracted from the quartz and held by the mercury, ensuring a product per ton of quartz three or four times as great as has hitherto been secured; so that the owners of this machine may make money faster by washing the "tailings" or already pulverized and exhausted quartz at any gold-digging already worked, than can be obtained by other machines from rich quartz not previously exhausted.

COOKING BY GAS.

Some interesting experiments have recently been made in London, under the supervision of M. Soyer, to determine the question on the merits and economy of roasting by gas. The results of the first trial, which took place on the eighth inst., was, that 36 legs of mutton, weighing 288 lbs., were roasted at a cost of 1s. 2d. In order to arrive at more positive results in regard to its economy, a second trial was deemed requisite, which took place on the 11th inst., when equal weights of mutton were cooked—23 joints, weighing 184 lbs., were roasted by gas at a cost of 10½d, with gas supplied at four shillings per thousand feet; when cooked, the above weight of meat was found to weigh 146 lbs.; dripping, 19 lbs.; of gravy or ozmazome, 2¾ lbs.,—thus showing the actual loss to be 8¾ lbs. Twenty-three joints of mutton, weighing 184 lbs., were cooked in the usual way, namely, in one of Count Rumford's ovens, hitherto considered the most economical way of roasting. When taken out they were found to weigh 132 lbs.; dripping, 18 lbs.; *gravy none;* thus showing a loss of 34 lbs. The coke consumed by the oven weighing 102 lbs., coals 30 lbs., thus proving the great economy of gas over the oven by a saving of 13 lbs. of meat, 1 lb. of dripping, and 2¾ lbs. of gravy, the value of which saving is as follows: Meat, at 6d. per lb., 6s. 6d.; dripping, at 5d. per lb., 5d.; and gravy, at 1s. 6d. per lb., 4s. 1¼d., making a total of 11s. 0½d.

DUPLEX SAFETY REIN.

A striking and valuable improvement in bridle reins, was exhibited at the New York Crystal Palace, by W. A. Holwell, of Canada, designed either for riding or driving. He calls it the "Duplex Safety Rein." Ordinarily, there are two reins to every bridle, one of which connects with a curb, and the other with a snaffle. This improvement proposes to dispense with one of these altogether. A single leather rein is attached to the curb-bit. A short elastic connecting piece, or false rein, is attached at one end to the main rein, and at the other to the ring of the snaffle-bit. With this arrangement, so long as the horse moves gently, the driver or rider bears on the connecting piece only, and through it upon the snaffle-bit. If the horse is restive or hard-mouthed, his resistance stretches the connecting piece until the pressure is thrown upon the main rein, and through it upon the curb or stiff bit, thus bringing its lever power into play. The moment the animal becomes tractable again, the elastic piece contracts and transfers the natural pressure of the horse's mouth to the snaffle bit, the lever bit becoming instantly relaxed. The material used by Mr. Holwell, for his model, is a gum-elastic tube with a metallic hook at one end, to attach it to the snaffle or cheek-ring, and a little button at the other, for whose reception holes are punched along the main rein. The advantages proposed by this promising though simple invention, are a more natural, self relying movement on the part of the horse, and greater sense of security to the rider or driver. For women, or inexperienced and feeble persons, it promises an exemption from the common risk of getting hold of the wrong rein, amid fright and confusion.

IMPROVED SPRING MATTRESS.

Maurity & Demeure, of New York, have introduced the following improvement in the construction of spring mattresses. The springs are made of copper wire, set upon iron slats which are fixed at the bottom of an iron frame. At the top, the springs, instead of being connected together by wooden slats, rudely fastened, as is the case in the ordinary spring mattress, are united by smaller spirals, also of copper wire, which cross the mattress from side to side, and from end to end, connecting the several ranges of springs in each direction, and giving the most equal elasticity and yieldingness possible to every part. So firmly are the springs fastened, that it is not necessary to envelope the mattress in a tick; it has no cover, and offers no retreat for vermin. A thin mattress of hair or moss upon it is all that is necessary.

SELF LOADING CART.

A self-loading cart has been invented by Messrs. Parks & Rue, of Illinois. The cart is so constructed that two plows with mould-boards, turning in opposite directions, passing inside the wheel, and near its track, raise the earth and throw it into a series of buckets formed in the inside of each wheel near its periphery. The wheels, by their revolution take the earth, thus thrown within them, upwards, by their revolution, to the top of the box, into which it falls, over an inclination of the bucket, and an inclined slide plate upon the top of the box.—*Scientific American.*

IMPROVEMENTS IN PRINTING.

Several improvements in types and printing have been invented in London, England, by Mr. Beniouski, the most important of which is thus described. It consists in forming the letter of the type upon its feet and sides, by which the composition can be read as soon as set up, without the necessity of taking a proof. The letter formed upon the foot of the type is so placed that when the type is inverted in the composing-stick, with the embossed or printing letter removed from the eye of the compositor, it presents itself to his eye in the same relative position with regard to the other letters in the same line with itself as it occupies on the printed page. By this ingenious arrangement there is no occasion to turn the type to see the letters which have been picked up, and no occasion to be skilled in reading the surface of type. The back of the type presents letters to the eye in the proper succession for reading off, and if a mistake has been made, the foot-letter instantly discloses the fact. To make this arrangement perfectly effective, the foot-letter is always an intaglio, or sunken letter; and as the face in which it is sunk is hardened in the manufacture, and receives a stout coating of silver by electrical deposition, the metallic surface formed by the feet of the type presents the appearance of a neat but boldly-executed engraving of a page identical as regards matter with what a proof would present. By means of the letter on the side, which is also an intaglio, the type can be immediately distributed from pi, and with the greatest ease. When the distribution from pi is going forward, the spaces, which are of steel, being thin and light, will readily be attracted by the poles of a magnet, passed over the type, by the distributor, while the type-metal not being magnetic, will not embarrass the work by requiring separation.

The cases for the type are arranged in a crescent form, and the compositor stands in the centre—a pair of nippers being employed in composition for seizing the type. Another alleged improvement is in the use of "logotypes," or little blocks of type, representing words, prefixes and terminals. The use of logotypes is not, however, a novel one. Towards the end of the last century, one of the London newspapers was printed with these types; and efforts have since been made, with little or no success, we fancy, to introduce mixed founts into use in printing-offices. The frequent repetition of certain words — articles, conjunctions, and prepositions, more especially — would lead to the supposition, as a matter of theory, that a mixed fount would be useful; yet the additional size of the frames and the complication of elements appear to constitute a difficulty greater than the corresponding advantage.

Mr. Beniouski's improvements also relate to the use of india-rubber inking-rollers, in place of those ordinarily constructed of glue, &c.

Wilkinson's Cylindrical Rotary Printing Press. — The *New York Tribune* furnishes the following description of this new printing press, invented by Mr. J. Wilkinson, of New York. The press is of the most simple construction, and very compact. It is not more than 8 feet in length, by 4 breadth, and perhaps 5 in height. A secure frame-work supports two pairs of cylinders, each about 18 inches in diameter. Upon one of these cylinders are the types that print one side of the paper, and upon the other those that print the reverse, the printing-cylinder, which gives the impression, being below in the one pair and above in the other. A roll of printing paper is suspended on an iron rod or axle, on one end of the frame-work of the press, on a level with the cylinders, and but a foot or two removed from the nearest one. And this, with the inking rollers and the cutting apparatus, constitutes all of the machinery. The process of printing is commenced by taking the end of the paper from the roll and drawing it through the press on a nearly horizontal line, passing it under one of the type cylinders and over the other. The power is then applied, and the cylinders revolve, causing a corresponding revolution of the roll of paper which is thus passed between the cylinders, receiving its impression on either side as it goes. As it passes out at the opposite end of the machine, it is cut off at regular intervals, and the separate sheets fall regularly into a pile. The cutting apparatus is of admirable simplicity and beauty, and cuts wet paper as infallibly as dry.

It will be seen from this description how remarkably simple is the machine. There is no backward or "reciprocating motion," as it is termed by the mechanics; nothing but a simple forward revolution of the type and printing cylinders. The speed at which these cylinders may be made to revolve would seem to be only limited by the rate at which the printing paper may be unwound from the roll; and this is obviously very great. At the experimental trial observed by us, the papers were thrown off at the rate of seventy-five per minute. This number we judged could be easily doubled, and it was the conviction of the inventor that it could be quadrupled without difficulty. If so, the machine would print at the rate of eighteen thousand newspapers per hour.

But whatever may be found to be the exact capacity of this press in its printing power, its cheapness and simplicity of construction, and its ability to perform an uncommon amount of work with the attention of a single man, are very remarkable. If it shall turn out that there are no hindrances or inconveniences arising from the new mode of setting type upon small cylinders, and in the mode of unrolling the paper adopted by Mr. Wilkinson, we do not see but this press must mark an era in the art of printing. When the paper can be taken from a roll revolving with the utmost rapidity, and printed upon *both* sides at a rate limited only by the revolutions of the roll, it would seem that the art of printing could go no farther as respects rapidity of action.

Montague's Improved Press. — A new press has also been invented by Mr. Montague, of Pittsfield, Mass., which is highly recommended on account of its cheapness of construction and effective working. It is a cylinder press with an oscillating motion to the bed, and prints two sheets to each revolution of the cylinder, the motion of which is suspended while the bed passes back. It will run off from 600 to 800 sheets per hour, and is sold from $500 to $700, depending on size.

Improved Lithographic Press. — An improved press for lithographic printing has been invented by H. C. Spaulding, of Hartford, Connecticut. The object accomplished by the improvement consists in giving a uniform and forcible impression to all parts of the stone with the expenditure of but a very small amount of power. The arrangement of Mr. Spaulding for effecting this object is this:—a wood or metallic air-tight chamber or tub, containing water or other fluid, with its bottom or one side composed of india rubber, or some other water-proof elastic or pliable material, is used to give the impression; said chamber being furnished with a tube and plunger, and the pliable bottom or side of the chamber serving as a tympan. By applying pressure to the plunger, an equal amount of pressure is transmitted by the water or fluid to every part of the tympan, and by using a small plunger an immense pressure may be obtained with a small expenditure of power.

Lewis' Improved Press. — This is a hand press invented by Dr. John Lewis, of Buffalo, N. Y. One of suitable size to print a half sheet of letter paper weighs 115 pounds, is 9 inches wide, 14 long and 12 high.

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A lever about two feet long projects from beneath the bed, where the machinery which gives the pressure is fixed. It is very simple and ingeniously arranged. The platten is hinged to the edge of the bed opposite the lever, and in lifting, spiral springs at the hinges act in counterbalancing the weight. The frisket is hinged to the platten. When the platten is down upon the form there is an iron bail working upon the top of the platten upon a center-pin. Underneath the bed there is a reverse of this bail, supported upon a spiral spring. Now the first movement of the handle trips a trigger at the further end of the lever, which throws the upper bail around and locks the two together; then, as the pressure of the handle is continued, the effect is to carry down the lower bail, and of course the upper one being locked into it must come down equally, and that resting upon the platten, which is suspended by the springs over the form, it must come down so as to give any amount of pressure, which is regulated by the clothing of the platten. For many purposes, both in printing offices and in private establishments, this press will be useful. The press and a fair assortment of job type in cases can be packed in a moderate size traveling trunk.

New Composing Machine. — This machine, invented by William Mitchell, of New York City, for the purpose of setting type, is thus described by the New York Tribune: — It has keys like a piano, with a number of endless tapes, kept in motion by machinery, to carry the types to the spot where they are set up. The types are laid with the nicked side up, in little brass cases or galleys, some 15 or 18 inches long, and just wide enough to admit a type crosswise. Of these cases there are as many as there are small letters and punctuation marks, and they are fixed at an inclination of about 45° over the types, so that when a key is touched a type drops flat upon its tape, and is instantly conveyed to another larger tape, to which all the types are carried, and which conveys them all to a little metallic throat, down which they drop upon a table all set up, but requiring to be divided into lines, or justified, by hand. Capitals and italics have to be laid on the tapes by hand, there being in the machine no keys or galleys for them. Two persons are required to attend the machine — one to work the keys, and one to justify and remove the matter composed. It is a very ingenious invention. All its parts are simple, and we judge that it would not easily get out of order. It occupies rather more space, perhaps, than a piano.

Delcambre's Type-Setting Machinery. — A machine for setting and distributing type, invented by M. Delcambre, of Paris, has been exhibited at the New York Crystal Palace. The compositor sits down before a finger-board, on which is arranged all the letters of the alphabet, small and capital, with the customary pauses, &c. These are placed upon keys communicating by wires with the case at the top of the machine. This is formed by placing thin strips of metal in a vertical position, leaving sufficient space between them for a single type. Between these the type are arranged in columns, with their faces in one direction. From each of these columns of type passes a groove or channel down an inclined plane at the rear of the machine, all these uniting in one at the bottom, where, by a simple contrivance, the type, as it passes down, is shoved into the composing stick.

NEW WHEELBARROW.

At the last meeting of the British Association, Capt. F. Wilson presented the plan of a new wheelbarrow, in which the wheel is placed under and is sunk into the bottom; so that the weight rests on the wheel and not on the hand, and there is less oscillation. By means of this barrow it was stated that twice the usual weight can be wheeled.

VACUUM SUGAR PANS.

J. Walker, of Wolverhampton, England, has taken out a patent for a new sugar pan. The improvement consists in introducing into the body of the vacuum pan a series of vertical tubes, through which steam is admitted to facilitate the operation of evaporation and crystallization. The tubes are inclosed within a cylindrical casing; between the sides of the pan a vacant space is left. This arrangement causes an upward current of the solution in the pan, at the center of the series of tubes, whilst a gentle descending current is produced between the cylinder and pan, by which compound motion the contents in the pan are prevented from burning.

IMPROVEMENT IN FIRE ARMS.

Marston's Improved Gun and Cartridge.—Mr. Marston's invention consists in a breech-bolt or slide which, by *drawing the lever forward*, is brought back from the breach end of the barrel a sufficient distance to allow space in the breach in which to place a ball cartridge. When the cartridge is placed in this chamber through an opening on the right hand side of the gun, the lever is drawn back, and the ball cartridge is forced by a pressure of some 40 or 50 lbs. into its seat in the barrel. The piece is now loaded, and by placing a cap on the nipple it is ready to be discharged. The fire is communicated to the rear end of the cartridge by a small hole running through the nipple to the breech-bolt and thence to the cartridge, which is perforated in the center, as will be presently described. The most ingenious part of the construction is at the top of the lever, where there is a slat or slide in the shape of a knee-joint, in which the pin of the breech-bolt works. When the lever is brought forward in drawing back the breech-bolt, the top of the lever slides along on the pin connecting it with the bolt the whole length of the slat, and the lever then hangs at right angles with the breech-bolt, and offers no resistance to the backward motion of the breech-bolt. But as soon as the lever is drawn back, and the cartridge driven into its seat, the lever and breech-bolt being at an angle of 135 degrees, and formed at their connection so as to fit at that angle, the resistance to the backward force produced by the fire is complete, the two pieces of metal fitting each other in a similar way to that of the keystone of an arch fitting the stones on each side. A small round bush enters the breech end of the barrel, and surrounds the cartridge and breech-pin at their junction so as effectually to prevent the leakage of smoke or fire when the piece is discharged.

The cartridge deserves special attention. It is composed of the usual materials with a conical ball cemented into it. The rear end, however, has a leather button or disc attached to it, of somewhat larger diameter than the bore of the barrel. This is why a lever is employed to force it into the barrel. This leather button is perforated in the center to receive the flash from the cap, as above described. The first fire of the gun will leave this leather button (which is previously greased,) in the large end of the barrel, and the second fire will force the button through the barrel, thoroughly cleaning it for the discharge which immediately succeeds. The result of this is, that the gun is kept constantly clean. However, as the leather button is left in, every time, it would seem to be necessary to expel it, or draw it out by some other means than by firing, when it is intended to lay by the gun, otherwise the effect of the last shot would still remain in the barrel. A ramrod is furnished with each gun for this purpose, or for uncharging, or for loading the gun at the muzzle in the old way.

The lock is a slight improvement upon the ordinary locks: the lever hangs upon a pin with an elongated hole, which allows it to rise and fall so as to avoid the necessity of another piece of metal between it and the piece which works the tumbler, simplifying that which has always been the most complex portion of fire-arms.

Gibbs' Patent Revolver.— This invention differs essentially from Colt's Revolver, in having no center-pin to the cylinder, which revolves on two raised bearers inside a fixed brass case, covering two-thirds of the cylinder above, and a slide bearing the weight of the cylinder below. This slide is easily withdrawn when it is desirable to take out the cylinder. The slide is so constructed as to continue under the barrel in the shape of a stock, leaving space sufficient between the slide and the barrel to permit of the exit of all the balls at once, should they all go off, without danger to the person, the covering above the cylinder protecting the eyes and face, and the slide below protecting the hand from the effects of such an accident. The inventor declares that he has fired five cartridges and balls at once, without harm. The cylinder is revolved in the most simple manner by a slide similar to a trigger, working in a slat in the under side of the case or breech, formed by the brass slide already described. This trigger is worked by touching it with the left hand, every motion of which acts upon the cylinder within, by means of a catch, of which there are seven round the cylinder.

Porter's Patent Rifle.— One of the most recent and important improvements in fire-arms, is the self-loading rifle, invented by Mr. P. W. Porter, of Tennessee, which in its construction and use is as sure as it is commendable. The barrel and stock of this gun are not very different from the ordinary rifle, the invention being confined to the lock alone. That which composes the lock of the present rifle is fastened forward, with a hinge, to the barrel of the gun, and a spring or latch fastens the other end of the lock to the stock. This latch being turned, the lock swings forward like a gate, and to it are attached all the principal appliances of the invention. The guard of the hand over the trigger of the ordinary gun, swings with the lock on Porter's rifle, and upon it depends the evolutions and works for firing. The barrel is fastened to the stock upon the side opposite the lock, by a long steel arm, (a continuation of the barrel,) between which and the lock, when closed, is an open space, about three inches in length, and a half or three quarters of an inch in width. At the front of this space is the open butt of the rifle barrel, and at the other end is the wooden termination of the stock. A cylinder, about three inches in circumference, in which are the charges, fits tightly in this aperture, and completes the invention. Around the edge of this cylinder are nine holes running towards its centre, in which are placed the powder and ball; at the lower end of each charge, into the side of the revolving cylinder, are the touchholes, which successively fall under the hammer of the lock and communicate with the cap. The latch of the lock being opened, the lock is thrown forward, and this nine charged cylinder is set edgwise into the aperture, at the foot of the barrel, with its axis on one side reaching through its steel arm, and the axis on the other side fitting into the lock, which is now closed. The guard of the trigger being furnished with a handle is pressed forward, and thrusts a spring into a niche in the side of the cylinder, and as the guard is brought back to its place, it raises the hammer of the gun, and revolves the cylinder, bringing one of its charges in direct connection with the barrel. Under the hammer of the gun, on the lock, is a spring cap box, which constantly throws a cap over the touchhole of the cylinder, when the hammer is raised. The gun being fired, the guard is again pressed forward, a simple metallic spring pushes away the exploded cap, and when the guard is again brought back, a new charge is under the cap, and before the barrel, ready to fly upon its mortal errand. When the nine charges are fired, the lock is unlatched, a new charged cylinder takes the place of the one used, and the firing is renewed with great rapidity. If it is not desired to add new cylinders, it is but the work of a moment to revolve the one used, and load it while in the barrel. An iron ramrod, about twelve inches long, is fastened in its centre upon the top of the barrel, with one end reaching over the cylinder; and as the charges revolve, one end of it is raised, which gives a lever power at the other for pressing down the load. This gun has many superior merits over any other known. It is water-proof, all the touchholes being perfectly air tight while revolving against the lock. The rifle barrel can be supplied by that of any other species of fire arms — either by a shot gun or pistol. It will shoot forty times per minute, and with as much accuracy as any other rifle. It is well guarded against accident, there being no cap over the touchhole until the hammer is raised. This gun has attracted the attention of several legislative bodies, and the States of Tennessee, Louisiana, and Florida, have adopted it for their State militia.

New Primer. — A. N. Newton, of Richmond, Ind., has invented an improved self-acting primer for fire-arms. The invention consists in a light lever furnished with suitable fingers to hold a percussion cap, and connected by suitable mechanism with the cock of the gun, the movement of which will cause the fingers to take a cap from one of a series of studs on a revolving cylinder or its equivalent which is fitted to the side of the gun-lock for this purpose. To this lever a fork is so attached that when the fingers before mentioned seize a cap, the said crook or fork will partly encircle the nipple, and the movement of the lever will cause it to withdraw the exploded cap from the nipple. — *Scientific American.*

A correspondent of the *N. Y. Tribune* furnishes the following information relative to the improvements in fire-arms recently effected in Europe, especially in France. He says: —

Since the completion of the models at the great Exhibition of London, and the opening of the New York Exhibition, a great deal of attention has been directed to the subject of *small arms*, in both the United States and Europe. Our people have gained a certain amount of notoriety in the manufacture of revolvers; and for sharp-shooting, they are very apt to believe there is no arm to be compared to the American rifle, and no marksman equal to the rifleman of the backwoods. In a certain sense this is perhaps true. But the Americans are not the only people at this moment engaged in the study of the perfection of small arms; and it would be well to look at what others are doing, in order to ascertain the position in which we stand. If a man were to present himself before a Western log-cabin with one of the "*balle-a-tige*" guns now in use by the *Chasseurs de Vincennes* of the French army, and were to propose to shoot for a wager at a distance of from 1,000 or 1,200 or even 1,400 yards, he would be, perhaps, only laughed at for his proposition. And yet with the gun now in the hands of over 15,000 men in the French army, and as soon as possible to be in the hands of all, it is perfectly practicable for an ordinary shot to be sure of hitting within the square exhibited by the front of six to eight men at the distance of 1,200 and 1,300 yards, while a little practice will enable him easily to hit a single man at the same distance. The ball is as sure of hitting the target, if properly directed, as if only sent the distance of two or three hundred yards; and the explanation of this fact lies in the construction and weight of the ball, and not in the gun, as many suppose.

There is, moreover, great misapprehension in the United States as to the arm used by the Vincennes Chasseurs, it being generally termed the "Minie rifle," without any distinct knowledge of what the Minie rifle is. The fact is, there is no Minie rifle; but there are two kinds of balls, of which one is known as the *balle-a-tige*, introduced into the French service by the French Commission of the School of Practice, and the Minie ball, which is the invention of Major Minie. The *balle-a-tige* is the one used in the French service; the Minie ball has not yet been adopted, either in the French or any other service. The effect of the two balls is quite the same, the Minie ball being only preferable from the fact that it may be shot from any gun whether rifled or not, (though better rifled than otherwise,) while the *balle-a-tige* can only be used as a *balle-a-tige*, by having a pin-*tige* inserted in the chamber (center of the breech-pin $1\frac{1}{2}$ inches long,) in order to receive the ball and produce the operation of slugging by the force of the rammer — an arrangement which will be described further on.

The *balle-a-tige* is of the immense range of 1,000 to 1,200 metres (1,080 to 1,300 yards,) with an elevated "back-sight" perfectly within the command of the marksman, and just as easily used as any short-range or point-blank sight. The "back-sight," placed just in advance of the lock, is about two inches high, open in the centre, and graduated with a scale, so that the angle at which it throws the ball above the range of the target may be easily known at all distances. The usual target range of the *Chasseurs de Vincennes* is 650 yards; and then, as their practice improves, they retire a hundred yards at a time, their eyes in this way growing well accustomed to the distance, and their practice being consequently good.

On a recent occasion, some American officers were invited by Major Minie to take part in some experimental firing at Vincennes. The gun used was of rough construction, rifled half a turn, and percussion. The balls used were the Minie balls, weight 50 grammes, ($1\frac{1}{2}$ oz. about,) the charge of powder 5 grammes, or one-tenth the weight of the ball; the cartridge so constructed that the ball is encased in paper, and greased by dipping the ball end of the cartridge in tallow, which then slips into the barrel easily, without the aid of the rod, until it arrives at the charge. A great saving of time in loading is thus gained. How, then, is the windage stopped, and the ball *slugged* so as to make it shoot correctly? Here is the great desideratum and the great peculiarity in the Minie ball. These important points are gained by the shape of the ball, which is cast oblong, with a conical point, with its base hollow for two-thirds the length of the ball. Into the opening of this internal cylinder, there is placed a small concave section of iron, (cut out by power-press,) which the powder, at the moment of firing, forces into the ball powerfully, spreading it open, and causing it to fit tightly to the cavity of the barrel in its course out, thus giving it a more perfect direction than any other form of slugging can do, while at the same time it stops windage, or rather destroys it. This is the entire secret of the success of the Minie improvement.

With the gun and cartidges above described, the shooting began at 400 metres, equal to 432 yards. The target was of board, six feet square, painted white, with a black spot a foot diameter in the center. Major Minie placed three balls in the black, which is a most extraordinary feat. Only think of driving three balls into a mark the size of a man's hat, three times in succession, at a distance of three-quarters of a mile, off-hand! and Major Minie says he can do as well all day, and teach any other man of ordinary capabilities the same accuracy.

On a late occasion Major Minie hit a "but" seven times out of ten at the immense distance of 1,804 yards! with sufficient force to pass through a cuirass and kill. The "but" was 100 feet in length and 18 feet high, representing, for example, though not perfectly, thirty mounted men. It is frightful to think of the havoc which a well-trained army, equipped with these guns, might make on an enemy equipped after the old style.

The reason why the Minie ball has not been adopted is simply because the *balle-a-tige* was invented first, and thus obtained precedence. The results obtained with each are similar. The gun required for the latter ball, as mentioned before, requires to be of a peculiar construction, which may be described in a few words: a steel pin, 3-16 inch in diameter, is screwed into the breech-pin, upon which the ball strikes when put into the barrel, (the powder being first put in,) and rests there, sustained on the pin, not on the powder. The consequence is, that when the heavy iron ramrod, made with a concave but, strikes down on the ball, the pin is driven upward into the substance of the ball, spreading it out on all sides firmly against the walls of the barrel, which slugs it more perfectly, and consequently directs the ball with more accuracy than is possible to obtain with any other slugging. The same principle of slugging, therefore, is used in both balls, but produced by different methods: in the ball just described, being produced by ramming, while with the Minie ball it is produced by the explosion. The balls are both of precisely the same exterior form and of the same weight; when the ball weighs 40 grammes, the charge of powder is 4 grammes, and when the ball weighs 50 grammes the charge is 5 grammes. By this principle of slugging, therefore, it will be seen that the old uncertain musket is at once converted into a close shooting rifle of a most extraordinary range, before which no field artillery known to science could sustain itself. It is the opinion of the most distinguished French officers that heavy cavalry can be no longer used with effect, and that artillery must be restricted to siege operations and the defence of fortified places.

To show more forcibly the difference in power and execution between the old musket with round ball, and the improved musket with *balle-a-tige*, I may cite the following experiment, which I did not see, but for the truth of which I have the best evidence. Four regiments of French soldiers (not picked,) fired, at the Polygone of Vincennes, 300,000 balls, one-half out of the old regulation musket with the usual round balls, and the other half with the improved rifle-musket, with *balles-a-tige*. To make the experiment fair each man fired the same number of balls from each kind of gun. The following was the result:

From 30 to 100 yards — superiority rather in favor of the new gun. (Distinguished British officers have objected that the new French gun was not adapted to a short range, and therefore less efficient than the old musket. These experiments disprove the assertion.)

150 yards — The improved gun twice as good as old musket and round ball.

200 yards — Thrice as good.
300 yards — Seven times better.
400 yards — Eleven times better.
500 yards — The improved musket rifle hit nearly as often as at 150 yards, but no musket ball hit.
600 yards — The new gun hit nearly the third of what hit at 150 yards' distance.
700 yards — Hit nearly the same as at 600 yards' distance.
800 yards — Hit nearly one-fifth as at 150 yards' distance.

It will be seen, therefore, from these experiments, that if 150 men of any of these four regiments were armed with the improved gun and *balle-a-tige*, that at distances of from 300 to 600 yards, they would in one minute do more execution than 525 men at similar distances and the same time with the old muskets and amunition; consequently 1,500 men can be made equal to 5,250 men, or 15,000 American soldiers can now be drilled and armed to do as much execution as could have been done by 50,000 of the veterans of the revolution.

ORNAMENTING METALS.

Fertile, varied, and peculiar, as are and have been the various processes devised for the purposes of ornamenting objects made of metal, we are not aware of any which, in simplicity and beauty, at all equals one that has recently been brought into operation. It emulates in economy the application of transfer-printing, to the adornment of japan and papier-mache objects, or the same to china, when in its biscuit state. In all probability the accidental phenomenon of a comparatively soft substance leaving, by pressure, its impress on a harder material, may have been noticed; it has, however, been reserved for Mr. Sturges, of Birmingham, to apply the same to a practically useful purpose in manufactures, and to devise through its means a style of surface-ornamentation, limited only in versatility by the illimitable resources afforded in the results of the machines of the lace-makers, or the endless forms and devices which may be suggested by human fancy. The process in its simplest form will be best described by stating that, if two or more plates of metal are taken, and between these is laid a piece of wire-webbing, thread lace, perforated or cut paper, and the two sheets of metal, with the pattern of thread lace, wire-web, or paper between them, be passed through a pair of ordinary rolls employed for the rolling of metal — the two sheets of metal being thereafter separated, an impression of the pattern will be found on each, corresponding to the compressibility of the material out of which the pattern is formed, or the hardness of the sheet of metal to be so ornamented. The known delicacy of such a material as thread lace, opposed to the hard and comparatively unyielding metallic substance to be ornamented, and yet by its agency indenting the latter, will doubtless be productive of matter of wonder to the uninitiated; we can, however, inform our readers that we have seen the same piece of lace employed in ten successive operations in Britannia metal ornamentation, and with a manifest improvement in each operation, until the cohesive property of the fibre out of which the lace was made became destroyed by the pressure.

Ornaments in lace or paper will also leave their impress upon a steel plate most distinctly, and in very considerable relief or incision; this has been proved by actual experiment. The fitness of thread lace for the purpose is much improved by its immersion in a starchy liquid, and thereafter drying the same on heated cylinders, viz., such as are used by lace or ribbon manufacturers. Lace net, and sewed work on muslin, appear to be best fitted for giving impressions upon tin or Britannia metal in the indented manner. A style of ornamentation in relief is produced by the substitution of cut-out or perforated paper, or metal; thus the employment of perforated zinc as a medium resulted in one of the most perfect of specimens yet produced. When paper is to be used, the design is to cut out as a stencil pattern, or such as is used in poonah-painting, or as the metallic perforated or cut-out plates for marking cases; this paper or sheet of metal, occupies the same position as the lace, viz., between the two sheets; the three thicknesses being then passed through the rolls, interstices or perforations in the paper appear with a raised surface, bright — the surrounding metal being dead or matted. The durability of such a tender substance as paper will excite astonishment, when we say that eighteen salvers were ornamented with a single piece of perforated paper. In using paper for the purpose of a pattern, its usefulness and durability are considerably increased by immersion in a liquid metallic solution — such as sulphate of copper or tin — rolling the same on hot cylinders, or subjecting it to the action of a powerful press; this serves to render the paper tough, compact, and prevents elongation from taking place between the metals. Ordinary sand-paper produces the most perfect dead matted surface imaginable; though the softest of the materials already specified as being used for the purpose of producing the ornament, leaves its impress upon tinned iron, German silver, sheet brass, copper, or Britannia metal.

It will readily be understood that the depth, as has been explained, varies according to the hardness of the metal which is desired to be ornamented; thus lace, which gives a comparatively deep impress upon the alloys of tin, gives one of a shallower kind on nickel silver. To secure the requisite depth of ornamentation on the harder metals, it became necessary to devise a means by which delicate lace formed out of metallic wire could be produced. It is one of the peculiarities of our country, that on a difficulty or a want being suggested, there are thousands of active brains and hands ready, at a moment's notice, to try to obviate the difficulty or supply the want; the result in the present instance has been the adaptation of a lace machine for the production of a gossamer, web-like lace, formed of wire, which, when applied so as to take the place of the thread lace, or the metallic saturated paper pattern, (viz., between the sheets of metal to be ornamented,) on German silver, brass, or copper, leaves a deep, clear, and distinct series of reticulations or indentations, corresponding to the simplicity or complexity of the pattern of the lace, &c. This lace is produced with equal facility, plain or figured; and for the purpose of blinds for windows, or for bird cages, the repeated pressures to which it is subjected, in rolling between the plates of metal to be ornamented, much improve its quality for such applications.

In the present state of the invention, it appears very difficult to place any limit to the nature of the materials out of which patterns may be made; as, for instance, the writer of this notice picked up, in an afternoon ramble in the country, two or three specimens of what Coleridge has so poetically described as —

> "Brown skeletons of leaves that lag
> My forest brook along."

These placed between plates of previously rolled soft metal, and subjected to pressure, on the separation of the plates each disclosed the delicate markings of the tender frame work upon which the vegetable matter that makes up the leaf had been stretched; not a single spar or rib was wanting. These impressions could be printed from with ease, and would serve as illustrations of the structural form of leaves for the use of those interested in the study of the science of botany. Very excellent impressions may, in like manner, be procured from lace, and the lace manufacturer has thus at his command the means of producing a pattern book of his designs without the trouble or expense of engraving the same; the depth of the indentation is sufficient to hold the necessary quantity of ink to produce an impression by means of the ordinary copper-plate press, or by surface-block printing. As, however, in the first instance, it is intended to use the process more particularly for the purpose of ornamenting those portions of the surfaces of manufactured objects in electro-plate, which have hitherto been left plain, it is unnecessary to enter more minutely into the description of the same, as applied to printing; its perfect applicability has, however, been sufficiently clearly demonstrated, and, in the present instance, has been indicated in order to show to what extent one invention may affect or assist other departments of trade than the individual one for which it was originally intended. No doubt can exist as to the present invention superseding, to a great extent, in the production of an universal class of goods, the method of ornamentation by means of engraving. The delicate reticulations of the lace markings gives a richness of appearance hitherto unattainable without a corresponding addition of cost for engraving and embossing, and which placed them beyond the reach of an ordinary class of purchasers.

Objects may be manufactured from ornamented Britannia metal sheet by the process of "spinning," a mode of production which entirely throws into the shade, all others employed for securing, in the objects produced, elegance of outline; the pressure of tools used in the process does not remove the markings produced by the various mediums employed to produce the ornamental metal. The ordinary method of raising the metal into shape by the stamp and die may also be taken advantage of with the most perfect confidence, as the indentations on the metal do not appear to suffer thereby. Elegantly formed tea services, salvers, cruet-frames, dish covers, drinking cups, urns, and other objects produced in electro-plated and gilt metals, are so many evidences of the utility, economy, and ornamental character of the invention as applied to the art of the worker in electro-plate and Britannia metal goods. The process illustrates a philosophical truth, viz., the compressibility, yet indestructibility of matter, in connection with the cohesion of the several particles, forming the substances out of which the patterns are made.—*London Art Journal.*

CHRONOMETRIC LOCK.

A contrivance has been invented by Mr. W. L. Bass, of Boston, for locking the doors of bank vaults, &c., in such a manner that they cannot be opened before an hour fixed upon beforehand. The apparatus is extremely simple, but appears to be entirely sufficient for the purpose designed. There is no key-hole to the door, the bolt of the lock being turned by means of a handle upon the outside. Upon the inside there is a catch which holds the bolt fast, except when withdrawn by the operation of a simple clock-work, which can be set, like an alarm-clock for any hour. The absence of a key-hole precludes attempts to blow up or pick the lock.

Lest there should be any fear that the disarrangement of the works at some time might prevent the opening of the lock, even at the prescribed hour, there is attached an additional piece of apparatus, contrived with much ingenuity, by means of which, in case of the stoppage of the works, the catch upon the bolt may be lifted by turning for some time a key at the side of the door; but this is powerless except in case of the stoppage of the works. As the clockwork is without dial or hands, there is, however, much less danger of stoppage than in a common clock.

DESCHAMP'S OMNIBUS REGISTER.

The following description of a new omnibus register, invented by Mr. F. O. Deschamps, is taken from a report of a committtee of the Franklin Institute:

The instrument is placed in front of the omnibus, between the lamp and the hole by which the fare is passed up to the driver. It resembles in appearance the dial of a common clock with a single index.

It is the duty of the driver upon the receipt of each fare, to pull a handle, which rings a bell inside the instrument, and at the same time causes the index to move forward on the dial one division, while a similar record is made by a second dial, which is placed upon the same arbor as the center wheel and the hand or pointer, and is concealed behind the face of the first dial. When the index in the first dial, and consequently the index in the second dial, have made an entire revolution, by means of a toothed wheel, notched cylinder and click, a second concealed dial is moved forward one division, corresponding in the instrument examined by the committee, to 36 divisions on the first dial. By this means any number of fares desired may be registered on the concealed dials. In the instrument examined by the Committee, the record exceeded 10,000.

The outer dial is examined by the agent at the terminus of the route at the end of each trip, the number of divisions passed over by the index noted, and the hand returned to zero. Each dial may be turned back without affecting the record upon that which enumerates the higher numbers.

The second and third dials are concealed behind the first, and their index numbers are brought into view by a key, in the possession of a second agent. This key slides back portions of the face or first dial, covering the indicating part of each; thus enabling them to be read, but not moved.

The concealed dials can only be reversed by means of a third key, which is in the hands of the proprietors alone. When they are exposed, the ringing apparatus is locked, and they cannot be moved forward.

Hence it may be seen that if the driver neglects to pull the bell, his dishonesty becomes apparent to all within the coach, among whom may be a secret agent of the proprietors, and the knowledge of this fact will tend to prevent any such attempt being made on his part.

The first agent who inspects the dial at the end of each trip, can only open the glass covering its face, and cannot expose the concealed dials. The second agent who inspects the concealed dials at the end of the day, cannot alter them, but acts as a check upon the driver and the first agent, while it is in the power of the proprietors to satisfy themselves, at any time, of the correctness of his records, by examining for themselves the concealed dials.

IMPROVEMENTS IN SEWING MACHINES.

During the past year, a number of sewing machines, involving new principles of construction, or action, have been invented and patented. Since 1843, the whole number of these machines for which patents have been granted, is believed to be upwards of thirty, which number will undoubtedly be greatly increased during the present year. These machines, the use of which is now becoming extensive, are rapidly approaching perfection; and the work that they already accomplish, seems to the inexperienced, as bordering on the marvellous. The peculiar principle of the best sewing machines, consists in the use of two threads, the one being fed by a needle, and the other — the wrong side thread, or as it has been termed the auxiliary thread— being supplied by a shuttle and bobbin. The needle is secured to a stock, whose movement, caused by arms and levers, drives its point through the material to be sewed; the eye of the needle at a moderate distance from the point, carries the thread through and then retires leaving a loop, through which loop a shuttle is passed, on the under side of the material to be sewed; this shuttle carries a quantity of thread upon a spool, which it supplies as the seam progressess. The needle on retiring draws up the loop, and thus closes the seam, which on the upper or face side of the work presents the appearance of what is called a "row of stitching," and on the under, a close resemblance, but differing slightly. The return, or rotation of the shuttle in its orbit, is a matter of course, and the work thus goes on continuously and with great rapidity.

The feed, or the progressive movement of the material to be sewed under the needle, is accomplished in various ways:—generally, however, by means of the friction of a feeding wheel, whose roughened surface creates sufficient adhesion to move the material forward at the requisite intervals. This feed is effected by the ordinary means of a racket-wheel and click or paul, the latter being capable of adjustment through shifting levers, so as to give a longer or shorter stitch, at the will of the operator, or the requirements of the work.

The superiority of machine sewing over hand sewing is evident from the following statement. Whenever a "needle-full of thread" is employed, either by machine or by hand, it is passed into the work with the needle, and drawn through until it closes up the seam, and this operation is repeated, stitch by stitch, until the "needle-full" is used up, and has been worn in exact proportion to the number of stitches taken, and must then be fastened off. It is then renewed to undergo the same operation, the "fastening off" not unfrequently being carelessly done, the unequally worn, and sometimes worn out thread being incapable of producing work bearing any comparison with the work of a machine, which wears only as much of thread as is necessary to make the stitch, and goes on without "fastening off" until the seam is finished, whether it be the "side seam" of a pair of pants, or the main sail of a man-of-war.

The sewing-machine, although its use has become general within a comparatively recent period, is an old invention. The needle with the eye in the centre, and double-pointed, is beautifully employed in the embroidery machine, which is an old French invention. This machine worked upon cloth as many as sixty similar figures or flowers at the same time; the whole being directed by one hand, who by the aid of a pentagraphic guide on a prepared pattern, pointed the needles to their appropriate place of entrance, and returned them with unerring certainty and exactitude. The earliest form of stitch made use of was the "chain stitch," which is still employed for ornamental purposes, but is not approved of where strength or durability is required, as it will "run" if the thread breaks, and may be all "run out" by drawing upon one end of the thread. The next stitch in order was the "running stitch," and was accomplished by means of a needle having an eye in the middle and points at each end. It has been extensively used for the cheaper kinds of work, such as bags, &c., but cannot be with propriety employed where durability is required, as it does not draw the work well together, and if a thread breaks, it runs each way to a ruinous extent. The next form of stitch is that already described, as formed by means of two threads, with a needle and a shuttle. A machine also exists in which two needles are used, the one working horizontally and the other vertically. A machine has been invented by Mr. J. P. Martin, which by an highly ingenious arrangement is self-regulating, and stops whenever the thread breaks, or a loop is missed. The credit of inventing the essential parts of this double thread sewing-machine, is claimed by several parties. It is, however, generally believed, and has been so reported by a Committee of the Franklin Institute, that the employment of a double, or auxiliary thread, as well as the use of the needle with the eye near the point, or at the center, and of the shuttle, are not patentable, but are open to public use.

The sewing machines which are now in most extensive use, are those known as Singer's of New York, Grover & Baker's of Boston, Wilson's, and Avery's. A new sewing-machine is now manufactured by the Ames Manufacturing Co., at Chicopee, Mass, which combines in one machine the principles of several different patents, which are controlled by the Company.

Among the machines patented, or first described during the past year, none appear to be possessed of any very new or striking features, with a single exception. This is a machine recently invented by Tilly Haynes, Esq., of Springfield, Mass., and which for effectiveness, simplicity, and economy of construction, appears to approach nearer to perfection than any other machine yet brought before the public. Like the other most approved machines, this uses two threads, and is capable of making with the greatest exactness from 600 to 800 stitches per minute. We see no reason why this invention should not hereafter become an indispensable appurtenance of every household.

IMPROVEMENTS IN THE MANUFACTURE OF INDIA RUBBER.

This is an abstract of the specification of a patent recently granted to Charles Goodyear and Robert Hearing for improvements in the manufacture of India Rubber. "The improvements made are in the moulds which give form to the vulcanized rubber, &c.; heretofore metal moulds have been used without good results. The invention consists in using or employing sand, pulverized soapstone, plaster, or some similar granular or pulverized substance, and when put together form porous matter, or moulds made of porous substances, to sustain and keep the form of moulded articles composed of caoutchouc or its compounds, and other gums susceptible of vulcanization, during the process of heating or vulcanization. We take articles composed of compounds of caoutchouc or other gums susceptible of vulcanization in the green state. We cause them to be pressed or otherwise formed into the exact shapes which they are required to have, after being vulcanized; we then cover the surface of the articles with pulverized soapstone, or plaster, or other similar non-adhesive powder. We then place the articles in a box filled with sand, the finer the sand the better, or pulverized soapstone, or other similar equivalent granular or pulverized matter, so that each article shall be completely surrounded and covered by the sand or pulverized soapstone or plaster, &c., and imbedded in the same, and thereby sustained. When it is desired to give a very smooth surface to the article, we cause it to be completely surrounded with a layer of soapstone, even though sand may be employed about the layer of soapstone. We sometimes use moist sand or pulverized soapstone. When the articles are thus properly placed in the box, we subject the sand or other material to pressure, so that the box shall be solidly filled; we then by means of a cover, or sometimes by pressure, confine the sand or other material so that the articles shall be at all times in contact with and pressed upon by the sand or other material during the process of heating. We then place the articles surrounded with and sustained by sand or pulverized soapstone or other material, in an oven or heater, and subject the same to a high degree of artificial heat, moist or dry heat, say from 260 to 300° Fah., for a period of from three to seven hours; and upon taking the articles out of the sand or other material, the articles will be found to be vulcanized in the same form in which they were when put into the sand; we are thus enabled to produce economically great variety of objects. Among them, embossed, or indented, or plain sheets or plates or masses of regular or irregular forms, convex or concave, such as pieces of furniture, book covers, buttons, toys of various kinds, &c.; or we make the moulds of plaster of Paris, (best calcined), or other substance, which, when dried will be porous and permit the escape of gases evolved from the matter under treatment, and all contained air, and thereby prevent the expansion of confined air and other gases from injuring the surface of the moulded substance; or we mould the article in a mould which is to produce the figure, and pack in sand, or pulverized soapstone or other like granular pulverized substance to support the other surface or surfaces of the article to be produced, and thus keep the face, which is to be figured in contact with the partial mould of metal or plaster, or other material, and thus afford a free discharge for air and gases, whilst at the same time the moulds are greatly cheapened. The moulds or outer casing may be made of glass instead or iron or other metal, but we prefer the first mode of procedure, as it avoids entirely the use of moulds during the process of vulcanization. The sand or other pulverized or granular material, having the effect thoroughly to support and retain the form previously given to the article by moulding or modelling. The prepared caoutchouc, gutta percha, &c., if it is to be imbedded in moistened plaster should be previously varnished, and to keep the surface of such articles to be thus vulcanized in sand, smooth India paper should be interposed between such surface and the sand.

STEREOTYPE MOULDS.

At a late meeting of the Scottish Society of Arts, Mr. Wilson described and exhibited the new process introduced by him to the notice of the Society, which consists in taking the casts of the types, not in gypsum or stucco, but in blotting paper, overlaid with a thin layer of whiting, starch and flour-paste, covered with a sheet of tissue paper, and impressed on the types by means of beating it with a fine brush. It is then dried on a hot steam-chest, while still adhering to the types; and by this means a matrix is produced, and the types are again ready for distribution by the compositors within an hour. The advantages, he said, of the new process are: 1st. The greater certainty of the process; the new matrix not being liable to warp or break, as the stucco is, or to remain in the smaller interstices of the types, so as to require revision by the picker. 2d. The greater rapidity, the process being completed in one hour by it, which could not be done in less than six by the other. 3d. The practicability of using the matrix in certain cases for casting several plates; whereas, the stucco mould is always destroyed in a single casting. 4th. The much greater simplicity of the apparatus required; which, added to the economy of time, and the consequent diminution of the quantity of type required for the compositors, give the important economic results which form the great merit of the new plan. A mould was made, and a cast taken, in presence of the meeting. — *Edinburgh Courant.*

IMPROVEMENT IN OIL LAMPS.

Nathan Buchanan, of Johnston, R. I., has invented a new mode of supplying the wicks of lamps with oil. The improvement is the employment of additional wicks placed by the side of the burning wick, and in close contact with it at the top, for the purpose of supplying it with a greater amount of oil than it is capable of taking up itself. The burning wick is thus rendered less liable to char, and consequently needs less attention.—*Scientific American.*

IMPROVEMENT IN SCALES.

Mr. Burnap, of Hartford, Ct., has devised a new arrangement of scales for weighing light or heavy weights. The principle employed differs from that of the ordinary scales in this respect — the weight is indicated by fluid, which is forced upwards through a transparent glass tube on which the different figures for pounds, ounces, &c., are marked, like those of a thermometer. The fluid is introduced through a small aperture (which regulates the force of the pressure) to a flat, shallow cavity beneath the platform on which the weight descends, and a remarkable degree of precision is obtained by the employment of vulcanized India-rubber as a covering to the fluid.

HICKOK'S IMPROVED CIDER MILL.

In the arrangement of this mill, invented by W. O. Hickok, of Harrisburg, Pa., the labor is divided by arranging a cutting cylinder to break the apples, and then deliver them to the lower cylinders to be reduced to pomace. By this arrangment the work is performed faster and with much less labor. The press is arranged with a much larger screw than formerly, and by a very ingenious device the use of the bag is dispensed with and the tub made to open at will to deliver the pomace, while at the same time the cider is left clear and the work can be done with much less labor than by the old method. The cylinders are covered with heavy sheet zinc, both on their peripheries and ends. The machine is made to run by horse, steam, or hand-power, and when the apples are ground, a small boy can press the pomace with all ease.

In former times it was supposed that a large quantity of cider could only be made by using a ponderous machine, that slowly crushed the apples without grinding them fine. They were then made into a massive cheese in straw, and a most severe and long pressure was required to extract a portion of the cider, a considerable quantity being absorbed by the straw and the mass of pomace, and to obtain this unsatisfactory result the farmer had to take all his hands, and perhaps his six horse team, and devote a whole day that could have been more profitably employed, to make from six to eight barrels of cider. To obviate the difficulty the farmers have heretofore labored under, this machine has been invented. The apples are grated up into a fine pulp, so that it requires but a comparatively light pressure, and that but a minute or two, to extract all the cider; it being ascertained by practical experiment that one-fourth more juice can be obtained, than by the old process. Besides this, it only requires two hands to grind up and make into cider a larger quantity of apples, than can be possibly done on the old fashioned machines. On this press, owing to the compactness of the pomace in the tub, and the complete manner in which it is ground, a pressure of from 3 to 5 tons — that can easily be obtained — will produce a more favorable result than fifty tons pressure on the ordinary cider press, even if the apples were ground as finely.

NEW TUNNEL EXCAVATOR.

A new machine for the boring or excavation of tunnels in rock, has been invented by Mr. E. Talbot, of Hartford, Ct. It is intended to be operated by an engine of sixty horse power, which is to drive four piston rods, horizontally, and these turn four half-circle plates, of stout proportions, on which circular revolving blades are set. These four plates are turned with exactness about one-fourth of a circle and back, and are all set upon a revolving plate, of about ten feet in diameter, and as thus set, cut a circle of 17 feet in diameter. The machine weighs about 80 tons, and is of stout proportions throughout. The motion obtained by this invention is novel—entirely new. By it, the revolving knives, each running its quarter circles, cut completely from the center to the circumference, and they do their work surely, cutting a round hole as they are turned by the large or center plate.

Improved Tunneling Machine.—A very ingenious apparatus has been devised to facilitate the progress of the Piedmontese railroads, in which tunnels have to be cut under mountains. The excavating machine cuts the channels in the rock, by means of several series of chisels placed one beside the other, in straight lines; these lines of cutting tools are so arranged as to be capable of a slight motion in the direction of the grooves after every stroke; the object of this is to bring the chisels to bear upon all the spaces lying between the several cutting tools situated in the same line, so as to produce not a succession of holes, but a continuous channel similar to a very wide saw-cut. This lateral shifting of the lines of chisels, which takes place alternately from right to left, and from left to right, is caused by a corresponding motion given to the frames in which they are fixed. Each chisel is driven against the rock by a spiral spring coiled round it. This spring, driving the chisel forcibly against the rock, obliges it to act efficaciously, notwithstanding the slight inequalities at the bottom of the channel, arising from a want of uniformity in the resistance of the stone. When the machine is in operation, the several lines of chisels are all drawn back simultaneously, by means of a species of cam, or moveable bar. The apparatus is arranged so as to enable each chisel to strike 150 blows in a minute. The machine at the same time sets in motion a pump, which forces a constant supply of water into a reservoir, the upper part of which is filled with compressed air. By this means the water is driven out in jets, through small pipes placed between the chisels, and is thus made to play upon the grooves, where it performs the double office of preventing the cutting instruments from becoming heated, and removing the dust and broken stone, which would otherwise accumulate in the grooves, and thereby prevent the effectual working of the excavator.

IMPROVEMENTS IN MODELLING IN PLASTER.

During the past year a patent has been granted to Hiram Powers, the sculptor, for improved files, to be used in connection with certain improvements in modelling, which he has lately invented. These improvements are described as follows in a letter from the inventor to the editors of Putnam's Magazine.

The principal tools used in the work consist of chisels, scrapers, and trowels, the blades of which are of gutta percha set in metallic backs, and elastic, so that the plaster can be put on with them somewhat as with a brush, and perforated or open files — every tooth having an opening in front of it, through the body of the instrument, so as to allow the dust and filings to pass through and escape, leaving the teeth unclogged and free to act. The files are of various forms and sizes, being curved, round, flat, &c. The material used is common plaster of Paris.

In projecting a human figure, a pair of irons, reaching nearly as high as the hips, and corresponding in general direction to the bones of the legs, must be set up on a platform, and around these a base must be formed, to hold them firmly, by pouring a sufficient quantity of mixed plaster to produce it. With these for a nucleus, the statue is then commenced to be built up with cores and mortar. The cores are made by pouring a quantity of plaster on a piece of oil cloth, and as it begins to harden, scoring it deeply with a knife or chisel, so that when quite hard it may be easily broken into fragments of a desirable size. Courses of these cores are built up around the irons, and above them, until finally the entire body is finished in this rough manner, the layers being cemented together by plaster mortar. The chisels are then brought into play for the purpose of roughing the figure (consisting of legs, body, and head) into the general human shape. A long core is then dipped in fluid plaster and the end applied to the shoulder. It soon adheres and forms the nucleus of the upper arm. To it another core is attached to form the fore-arm. When these are filled out with plaster, the whole body is covered with a coating of the same, and the files brought into use, which soon produces an even surface, taking off all irregularities.

The advantages of these models over the ordinary clay models which are generally constructed, are, first, a clay model cannot be changed materially after it has once been commenced, for the iron skeleton which sustains every part of it is a fixture; but in the plaster work the iron frame is only in the legs, and all the rest can at any time be cut apart and varied from the original design in accordance with any after-thought of the artist. The plastering neither shrinks nor swells from exposure, and does not require wetting or covering with cloth to keep it in order. The process is less tedious than clay modelling, for by means of the open files more can be accomplished in a day than with clay in several days. And again, no moulding is necessary to transform the form from clay to plaster; the plaster figure, as it came from the artist's hands, is itself the model. Mr. Powers says modelling in plaster is not new; he only claims his way of doing it as new. He considers the chief merit of his contrivance to consist of the open file, which is an instrument of his own invention, and by aid of which a high perfection of finish can be easily attained.

ENCAUSTIC TILES AND CLAY MOSAICS.

Among the collections of porcelain and pottery exhibited at the Great New York Exhibition, were samples of encaustic tiles, and mosaics of clay, intended for flooring, and exhibited by Minton & Co., Stoke-upon-Trent, England. These tiles, now extensively used for the flooring of churches and other buildings, are made in the following manner:

The encaustic tiles are made from the wet or slip clay, pressed into blocks, and faced with a finer clay, colored to the desired tint. The whole is then put in a box-press, and a plaster slab, containing the pattern in relief, brought down with force upon the face of the tile: upon this deeply indented surface, clay, in a semifluid state, is poured. This clay is generally of a deep color, and after lying twenty-four hours on the tile, becomes hard. The superfluous clay is scraped off, and the surface mechanically cleaned and smoothed, and the tile is then baked in the oven. This process is almost similar to the mediæval one, and Mr. Minton is entitled to the credit of having revived it with increased beauty and utility.

The mosaics are made from stained dry clays, which are pressed and baked, and afterwards formed into moulds by mixing with plaster or Roman cement. The pressure exercised to form these dry tiles is immense, being, in the steam machine working by Prosser's patent, equal to 400 tons. Each machine can make 5000 tiles an hour, and but one man is required to take out the finished article.

Lava Ware.— This is the name of a new article of manufacture, exhibited at the Crystal Palace, made from iron-slag, the waste of smelting furnaces. After the iron is drawn off, the melted sand and clay, mixed with iron, which remains as waste, greatly in the workmen's way, can be cast into tiles, urns, bowls, table-tops, and various useful things, at a very small cost.

RANSOME'S ARTIFICIAL STONE.

THERE has been introduced of late years a new kind of artificial stone, which, although perfectly plastic at one stage of the manufacture, is of perfectly uniform composition, entirely free from all shrinking and contortion during the process of kiln-drying, and bears exposure to winter temperatures and a moist atmosphere without any deterioration. This important immunity from so serious an evil, it owes to the fact that no part of the material used in the construction consists either of lime or clay. It is, in fact, a silicious or flinty stone, the particles of which it is made up (fine pure sand) being united together by a fluid which, after exposure to the kiln, becomes changed into a kind of glass. By the very nature of the case, therefore, this stone is secured from all injury from soot, acid, or other vapors, or disintegration by weather; and, in many cases where it has been actually exposed for several winters, it retains all its sharpness and surface perfectly. This material is called "Ransome's Patent Silicious Stone;" and is tolerably well known by most architects and builders, as well as those engaged in ornamental stone-work. The chemical fact on which the discovery of this stone is based is the perfect solubility of flint, or any silicious material, when subjected to the action of caustic alkali (soda or potash) at a high temperature in a steam boiler, or in cylinders communicating with such boilers. On being heated with caustic soda at a very high temperature, there is formed a thick, jelly-like transparent fluid of pale straw color, which is a hydrated silicate of soda, containing 50 per cent. of water; and which, if exposed to the air for a time, or heated, loses a part of its water and solidifies into a substance capable of scratching glass.

The history of the silicious stone will now be readily understood. The fluid silicate of soda having been obtained as described above, it is mixed with sand and other material, which may vary according to the required result, and thus forms a kind of thick paste, moulded readily into any shape. Exposed for a time to the air, this gradually hardens by the evaporation of part of the water, and when put into a kiln the water is more rapidly and completely given off, the result being a perfectly solid mass, the original particles of sand being now cemented together by a kind of glass, formed by the silicate of soda raised to a red heat. The whole amount of water in any given quantity of the unburnt stone does not exceed one-tenth part of its volume, but the total amount of contraction is extremely small, and scarcely perceptible in any case. On the other hand, the contraction in terra-cottas is not only very considerable, requiring allowance to be made in moulding, but is also extremely irregular.

In consequence of the peculiarly simple composition of this new material, it has been found easy to manufacture of it porous as well as compact stone, and also such articles as grindstones and scythe-stones (all of which enter into competition with natural stones) at a considerable advantage, both in texture and price. The porous stones are peculiarly useful as they make admirable filters, and by the simple precaution of placing a coating of fine pure white sand upon them they can never become choked. They are now extensively used, and are found to succeed admirably. For pavements. balustrades, terrace works, vases, and generally for all purposes of garden decoration, it is well adapted by its cleanliness, sharpness of outline, color, durability, and cheapness. For ornamental flooring in halls, churches, and public buildings, it possesses many advantages, and could be put down at little more than half the price of encaustic tiles of similar patterns. For quoins, cornices, battlements, chimney-pots, and many other building purposes, it seems equally well adapted: while for filters it is invaluable, and might be used to any extent in preference to any known natural filter stones.—*London News.*

PATENT OFFICE REPORT FOR 1852.

The Patent Office Report for 1852, published during the latter part of the year 1853, contains the following notices of several new inventions, which have not heretofore been made generally public.

New Reverberating Furnace.—A novel form of reverberating furnace, which is designed to dispense with the labor usually expended in stirring and balling materials exposed to the action of the fire in this species of furnace. A grate, fire chamber, ash-pit, &c., are, with the fire bridge, constructed of brick in the ordinary manner; and at the usual distance therefrom is built a chimney and horizontal passage leading into the same, also in the ordinary way. The body of the furnace, the roof, and working bottom are omitted; and their place is supplied by a cylinder of cast-iron lined with fire-brick, and free to revolve upon metallic rollers. This cylinder has an area about equal to that of the ordinary working chamber, is provided with a door fitted like a man-hole or a hatch, and has revolution imparted to it by means of a cog-wheel or a belt. The materials, broken pig for instance, are introduced through the door, which is then closed; motion is now communicated to the horizontal cylinder, and each portion of its periphery in turn becomes the bottom, while the contents are rolled, or turned over and over, and continually exposed to the flame which passes through the cylinder on its way from the grate to the chimney.

It is obvious that every portion of the surface of each fragment will be exposed to the action of the flame, and that the mass, when melted, will be continually stirred or agitated as if acted upon by the ordinary rabble. I am not informed as to the fact of this furnace having been practically tested, but see few difficulties in the way of its successful operation, and these of such a character as may be easily remedied. Another furnace of the same class, and having in view the saving of the same kind of labor, has been patented by another inventor, favorably known as a practical metallurgist. The bottom of his furnace is a cast-iron table, circular in its contour, covered with brick, and revolving on a vertical axis under the ordinary fire brick roof of the reverberating furnace. Through the ordinary working door projects into the furnace and over the revolving bottom a rabble connected at its outer end to a slide, actuated by machinery which gives to the rabble a reciprocating motion. This slide runs upon a guide whose angle to the side of the furnace may be changed by the operator, and the rabble is thus forced to stir over every portion of the working bottom.

Improved Trip Hammer. — An improved method of lifting the ordinary trip hammer deserves notice, as by means of it any different degree of blow within the range of the lifting cams can be attained with a facility almost equal to that afforded by the steam hammer. In this contrivance the cam, instead of acting directly upon a lifting leg, acts upon the end of a lever, vibrating in a vertical plane, which embraces that leg. This lever is provided with a sort of toggle catch, which grasps the leg firmly whenever the lever is raised, but has no hold thereon when the lever is falling. A wedge enables the attendant to regulate the point to which this lever shall fall. The cams in their revolution strike it sooner or later, according to the distance it has been permitted to drop; and the instant that the lever commences to rise, it clasps and holds the leg, forcing the hammer up a distance proportioned to its own ascent only.

Improvement in Anvils. — A simple improvement in anvils bids fair to obviate an important practical difficulty in their construction. This difficulty has its origin in the heat retained for a long time in the immense mass of metal behind, or rather below, the centre of the steel face in the process of hardening, which heat prevents the rapid cooling of the steel face, and generally leaves a soft spot near its center. By forming the body of the anvil with a cavity of some size extending from its bottom nearly to its face, a portion of the metal at the centre is dispensed with, and facility for the introduction of a stream of cold water into the centre of the mass, and almost upon the bottom of the face, is afforded during the process of hardening. The center of the mass is therefore cooled almost as rapidly as its exterior, and a sound and equally hard face is, in consequence, a matter of easy attainment.

Machine-made Nuts. — Good nuts, which shall at the same time be cheap, and machine-made, have long been a desideratum; several inventions have been recently brought out which finish and turn out nuts much cheaper and better than any that are manufactured by hand. The following description of one machine will serve as a type of the others.

A heated iron bar, about the width and thickness of the intended nut is advanced over a die-box of the exact shape of the periphery of the nut to be made. A die then descends, severs a blank from the bar, and forces it into the die-box. The die is bored out precisely to the same size as the aperture required in the nut, and, as it carries the blank along, forces it still enclosed in the box, against a cylindrical punch, which punches out the hole, carrying the disk it severs, and finally entering itself into the aperture in the die. This die, with the nut now punched out, and upon the punch in front of it, still advances until it brings the nut in contact with the face of another die, which like itself fills the die-box, and commences to move in the same direction as the first die is travelling, but with a less velocity. The nut is therefore submitted to powerful pressure between these two dies while still on the punch, and all cracks incident to the cutting or punching of it are thoroughly welded up, while the exterior of the nut is forced so strongly into the moulded faces of the dies that, when discharged from the machine, it is nearly equal in smoothness to a nut that has been planed. Actual experiment has proved that the compression is an essential part of the operation, and that nuts merely severed and punched are not only rough in appearance, but are so filled with cracks as to be unable to withstand the strain to which they must be subjected.

File Machines. — An improvement in file machines, presenting an easy method of giving different amounts of feed to the carriage which supports the blank at certain times firmly on its bed, while at others it gives it free motion to adapt itself to the chisel, has also been patented. Machines of this class have long occupied the attention of the inventor, and have lately come into actual use; good coarse files made by one lately patented being in the possession of the Office. It does not appear, however, that any of them have, in the manufacture of *fine* files, been able to compete with that exquisite sense of touch which is the unfailing guide of the file cutter, and which, in many instances in this branch of manufacture, puts the blind workman on even a better footing than his comrade who has full possession of his sight. Many of these machines have apparatus which actually set the chisel by feeling. Complication, however, must result from such a basis of action, and the present successful machines perhaps owe their efficiency, in no small degree, to the simplicity of movement which disregards inequalities in the texture of the blank, and, while it may spoil some files, is yet unfailing in its own power to produce, and does produce, a good article whenever a blank approaching to perfection is submitted to its action.

Threading Wood Screws. — Among the many improvements in machinery for threading wood-screws, has been patented one whose cutter is somewhat like the fusee of a watch, with the difference that the grooves are in three sections, parallel to its axis, counterparts of the threads of the screw to be cut, and that these grooves are deeply notched or serrated, so as to form a series of cutters. This cutter has a swift revolution on its axis, and its periphery revolves in contact with a blank, properly supported and presented to it; the blank also, revolving in the same direction as the cutter, and having a slight motion in the direction of the axes of the cutter, is gradually pressed against its periphery, so as first to mark, then to deepen, and finally to finish, its thread. These are the main characteristics of the machine, which is provided with many other ingenious contrivances, subordinate, indeed, to the general principle, but essential to its prompt and correct action. The rapidity with which this machine performs its work, and the accuracy and beauty of the screws made by it, are equally wonderful.

Thimble Machine. — A machine which forms perfectly the thimbles, so termed, used in large quantities in the rigging of vessels, has been patented. These thimbles are metallic rings, or short cylinders, whose outsides are grooved, and whose insides are convex to the same extent that the exterior is concave. In the machinery for making them, two shafts are so arranged as to revolve at the same time and in the same direction, and have a common axis. They are also so fitted that, while revolving, they can be made to approach or recede from each other. The contiguous ends of these shafts are each provided with a forming disk, whose diameter is least upon that side of it which is at the end of the shaft, and gradually increases in a concave curve to the other side, which is of a diameter equal to the greatest inside diameter of the thimble to be formed. Each disk exactly fills one half of a finished thimble, and when their adjacent sides are, by the motion above ascribed to the shafts, brought in contact, they entirely fill a finished thimble. A hammer, whose face is an exact counterpart of about one quarter of the outside of the thimble, is arranged in such manner as to strike repeated blows upon a piece of iron sufficiently heated, and thrust in between it and the disks above cited.

In the working of the machine a lever is moved which brings the disks in contact. A piece of iron, in length equal to the circumference of the thimble to be made, is then introduced between the disks and the hammer. The disks then revolve, and the hammer forces the iron into the groove, and at the same time bends it into a circular form.

As the disks revolve, new surfaces are brought under the action of the hammer, and a thimble is finally formed, closely enclosing the two disks. These are then separated by the action of the lever, and, as they revolve on horizontal shafts, the finished thimble drops down between them.

The thimbles formed by this machine are not only cheaper, but better finished, smoother, and more regularly shaped, than those made by hand.

In another machine, emanating from the same inventor, the forging of iron into a certain class of shapes, is performed with expedition and certainty. In this machine a roller is mounted upon a carriage, in such a manner that a large portion of its periphery projects outwards, free from the carriage.

Two such carriages, each with a roller, are located opposite to each other, and are capable of being moved by machinery back and forth through a certain distance; each roller being opposite to the other, and located between its own and the other carriage. These carriages are, by means of guides, forced to move in curved lines of any given shape, and these guides can, while the machine is in motion, be forced to approach or recede from each other.

An iron rod properly heated is, while the carriages are in motion, placed in a check or tongs capable of revolution on a centre in such manner that the rod passes between the two carriages and their rollers. The carriages are now caused to approach, and as they approach they reciprocate, and their rollers touch the rod; the latter commence to revolve and draw out the iron. The rod is also revolved continuously or through a given arc, and then stopped and moved again. By a continuation of these motions, figures of revolution, generated by various curves or figures of polygonal cross section, and regularly irregular longitudinal section, are forged out with great speed and precision.

Improvement in Locks.—The following interesting notice of several improvements in locks is given by Mr. Renwick, the examiner of this Department: —

The lock exhibited by Mr. Hobbs at the World's Fair, which, in connexion with the lock-picking achievement of the same gentleman, created so great sensation in this country and in England, was patented in its most approved form in 1851; its great feature of security having, however, been invented by, and patented to, the same inventor several years since. The following is a brief description of its construction and arrangement:

In an ordinary tumbler lock and bolt, which is a sliding piece of metal which has projecting from it a pin, this pin, when the lock is on the door, usually projects horizontally towards the face of the lock. Between the bolt and this same face lie one or more thin metal plates which slide up and down vertically, but cannot move horizontally. One edge of each of these tumblers abuts directly against the pin above named when the bolt is shot. Now, it is clear that, to move the bolt back, one must either break the pin or move the tumblers out of the way; but these are so long that they cannot be moved up sufficiently far to let the pin pass below them, nor down far enough to let the pin pass above them; the top or the bottom of each tumbler, in the one case or the other, striking the lock-rim, or some firm stops, which prevents its further motion. Each tumbler has, therefore, cut in it a long, nearly horizontal, slit of the precise width of the pin, and if by any means each tumbler can be moved so that its slit comes opposite the pin, then will the pin enter all the slits at once, when the bolt is pushed back, and may be unlocked. If any one tumbler is lifted up too far, or not far enough, it will bar the passage of the pin, and the lock cannot be opened. The right key is so shaped that, when turned, its bits perform the duty of lifting these tumblers. When a person skilled in the art, for so it may be termed, attempts to pick such a lock, he first, by some means, (a sharp-pointed, crooked wire, for instance, introduced through the key-hole,) shoves the bolt back until the pin bears forcibly against the faces of the tumblers. By means of another wire, he then shoves up or moves each tumbler separately until the sense of feeling tells him that the notch therein is opposite the pin. An increased facility of motion in the tumbler is one certain guide of this point being reached; or if the tumblers be weak and the pressure on the bolt strong, a click will be heard, and the tumbler may remain resting precisely at the proper point. As the proper position of each tumbler is ascertained, it is carefully measured and noted down. When all the positions are discovered, each tumbler is lifted and held at the right height, and the bolt is moved, the pin enters the slits and the lock flies open. This operation as described may seem easy, and it is so to those who, to a delicate touch and mechanical dexterity, add perfect knowledge not only of the principles of locks, but also of the construction of the precise kind of lock they intend to pick. Those who undertake to pick a lock without these requisites will find their task not only difficult, but absolutely unaccomplishable.

Another lock patented is powder-proof, and may be loaded through the key hole and fired until the burglar is tired of his fruitless work, or fears that the report of his explosions will bring to view his experiments more witnesses than he desires.

In it the pin on the bolt does not abut against the tumblers, but against other sliding pieces which cannot be reached through the key-hole, having between it and them strong steel partitions. These pieces may be termed secondary tumblers, and are furnished with slits like the tumblers first named in this section. These secondary tumblers are connected with the true tumblers, through the agency of slender springs, in such manner that the true tumblers will raise the secondary just as they themselves are lifted, when no obstacle obstructs the movement of the secondary tumblers. Now if the lock be locked, and the proper key applied and turned, it first lifts the true tumblers to the proper height; these, while being raised, lift the secondaries by the springs until their slits are at the proper height, when the pin enters, and the bolt is retracted by the further turning of the key. If the lock be locked, and an attempt is made to pick it, the bolt is first forcibly shoved back until its pin strikes the edges of the secondary tumblers; its pressure upon these prevents the light springs from moving them, and the burglar may move the true tumblers up and down, amusing himself as long as he desires, without altering at all the position of the secondary tumblers, or obtaining any indication as to the locality in which they must be placed before the bolt can be moved. The partitions above named prevent any direct application of force to the secondary tumblers, and unless the former can be blown or drilled away, which many years' test has proved impossible, the lock stands impervious to any instrument except the proper key.

Another lock is so constructed that when the key-hole is open no access can be had to the tumblers. When the key, which is merely a series of bits without a pipe, is introduced, a knob is turned, which revolves a disk inside the lock which covers the key-hole, and as it revolves further, the key-hole remaining shut, uncovers the passage to the tumbler. A cam on the spindle of the disk then lifts the bits and carries them in contact with, and finally lifts the tumblers. The bolt may now be withdrawn, and a further turning of the knob repeats these operations in reverse direction and order, finally leaving the bits under the now open key-hole in such a situation that they may be withdrawn. It appears to me that this lock cannot be picked, and that its construction is such as to bring into play the doctrine of chances, which Bramah and Chubb have both claimed, fallaciously, as being the true exponent of the difficulties of opening their locks by other means than the true key.

An improvement in the tumblers, or rather the manner of supporting the tumblers of the locks, has been patented. In ordinary tumbler locks, each tumbler moves in a certain determined plane and no other, and must be moved by a pick or key to a fixed and certain point, neither beyond it, nor short of it, before the bolt can be moved.

In the present lock each tumbler is free to swing, and can be moved in many planes, but must be moved precisely to the right spot, and in a certain plane, before the bolt can be operated. A lock-picker must therefore, by repeated trials, find the proper plane of motion of each tumbler, and, by some instrument, hold each in that plane, before he can proceed to pick the lock in the ordinary manner. It is evident that longer time and increased skill will be required to pick this lock, when contrasted with the ordinary tumbler lock.

A very curious, novel, and it appears, unpickable lock has also been patented. The key-bit of this lock is composed of a series of closely packed cylindrical disks of different sizes. The key-hole is a small cylindrical cavity, closed at the bottom, and when open has no connexion with the tumblers or any part of the interior of the lock. The key-bit is attached to the handle by a spring connexion, and when the operator introduces them and commences to turn the key, the first operation of the lock is to separate the bit from the handle; as he turns, the former is carried in the cylindrical opening away from the handle; a solid metal block occupies the place of the cylinder; the key-hole is entirely closed; the bit moves on and lifts the tumblers, and, by a continuation of the turning motion, the bolt is finally retracted. A reverse motion of the handle shoots the bolt, drops the tumblers, carries the key-bit beneath the handle, reattaches it thereto, and, when the latter is withdrawn, the key aperture is again in its place and exposed.

Powder enough to fill the cylinder is all that can be introduced into the lock, and its explosion therein damages it no more than it would a pistol barrel of the same size.

This latter lock has attracted much attention. It is simple in its details, has no long trains of motions depending on each other, is not liable to get out of order, and has, when locked and unlocked by those unacquainted with its operation, been productive of no little mirth. It, as I have attempted to describe, fairly steals the bit away from the handle, and leaves the latter only in the grasp of the astonished experimenter, who, as he turns, finds the lock unlocked, but the key proper gone, and every aperture in the lock completely closed. Until he is undeceived, he is apt to imagine that the whole affair is some juggler's apparatus, constructed for his mystification, and not for legitimate use as a door fastener.

Either of the three locks thus noticed, when placed on doors which have also been patented, and will now be described as intelligibly as is in my power, appears to me to afford perfect security against all known methods employed by burglars.

The door first patented is constructed as follows, namely: by supporting, at some fixed distance apart, and attaching to each other, two plates of sheet iron, with a rim between them, which, with the plates, completely enclose a space and form a sort of iron box. Into this space No. 3, or white pig, is poured when melted, which fills the space, encloses the bolts which connect the sheets, and enters apertures left in either of them. The whole forms a door in which the sheets firmly support, and prevent the breaking of the thoroughly chilled and hardened interior, while it in turn forms a complete stopper to all drills and cutting tools which may, by burglars, be made to preforate the outer sheet.

In another door, invented to meet the same requisites, and to present a bar to that class of ingenious operators whose acquisitiveness has generally contrived ways to circumvent the utmost ingenuity of the lawful dealing workman, pig-iron of the same character is cast around a wrought iron gauze or net-work. This net-work is made of the size of the intended door, with meshes about one and a half inch square, and is constructed of bars of small round iron. All attack by drilling is prevented by the chilled cast iron, and when the door is assailed by a heavy sledge, this iron breaks into small pieces, each of the size of a mesh, the fracture being along the centre line of the iron rods, and each fragment being firmly held in place by the groove formed by its junction with the bars which surround it. The door, by repeated blows, becomes pliable, yielding, and is bulged in here and there, but the strongest man has not yet been able to make any absolute break therein.

Improvement in Propellers. — An improvement in propellers has been patented by a French inventor, whose object was partially to remove the resistance to the progress of the vessel under sail only, which is occasioned by the ordinary screw propeller. This plan has no relation to those which permit of alteration of the pitch, or admit of the propellers being hoisted out of water, and is somewhat different from any hitherto essayed. The wings of this propeller are arranged in pairs, and are each of no greater width than the dead wood of the vessel in which the propeller is located. The first pair, if there be six wings, is attached to a hollow shaft; the second pair is fastened to another hollow shaft, concentric with and inside of the first-named one; and the third pair is secured to a solid shaft, also concentric to the first and located within the second hollow shaft; each pair lies a little behind the former in the direction of the length of the vessel, and their shafts are fitted with gearing and clamps, or their equivalents, in such a manner that the various pairs of propellers can be made to alter their angular distance with respect to each other, or be clamped at any specified relative position. This gearing is within the vessel, and by means of it the various blades are, when the propeller is to be used, spread around the whole periphery of a circle, so that each acts in turn and in the same position as in an ordinary propeller, where the wings have no motion with respect to each other. When, however, the propeller is no longer to be used, and sail is to be employed, then, by means of the gearing, the blades are revolved so as to fold the one behind the other, like the leaves of a shut fan, and the whole set are turned so that they lie in the line of, and are covered by, the dead wood, thus offering little or no resistance to the progress of the vessel. The engine is connected to the outer shaft in such a manner that it drives the whole of the shafts, without altering their angular position with respect to each other; the motion to produce this latter result being entirely independent of the former.

Improvement in Canal Boats. — A method of fitting canal boats to be used for the conveyance of coal, &c., appears to present features of utility, and will probably lead to a material saving in the discharge of cargoes of that article. Beams are secured along the inside of the boat's ceiling for its whole length from stem to stern, forming a species of continuous bracket round the interior of the vessel, at a distance of some two or three feet from the bottom. Along the bottom are laid rails, upon which a small car may be moved, and immediately over the car's top, from beam to beam, crosswise of the boat, are laid planks, which form the cargo deck, on which the coal, &c., are loaded. In the process of unloading, one plank at a time is lifted up by crowbars, and the cargo runs by degrees into the car underneath. This car, when full, is run along the track until free of the floor and then hoisted out as a bucket and emptied, replaced, run back, and filled again. All shovelling of the coal is saved by this contrivance; and it will probably be adopted in boats which, after their passage through canals, discharge their coal for further transport into the hold of sea-going vessels.

Improvement in Harpoons. — A harpoon, which forces the point deeper and deeper into the whale as he draws the boat after him, has been invented and patented. In this contrivance the flukes are hinged, and so arranged that they can be latched to the point, or can slide away from it. The whale line is forked or split, and each part thereof is rove through a pulley or sheave attached to the flukes, and is thence led and attached to the socket or staff which is firmly fixed to the point.

When the harpoon is thrown and enters the whale, and strain is brought upon the line, the flukes spread out and take firm hold in the blubber, detaching themselves by such motion from the point. The pulleys, or sheaves they carry, are now fixed in the whale, and the strain upon the line passing through them forces the shank and its point to slide between them, penetrating deeply into the whale.

Gas Regulator. — Three patents have been granted for three several modifications of this instrument. The instrument consists of an enlarged chamber in the service pipe, where it enters the consumer's building, and is generally placed near the Gas Company's meter. Each of the modified regulators is designed merely to equalize the size of the flame, while the number of burners is varied. This enlarged chamber in the pipe has a valve, which controls the amount of gas going to the burners, and thus divides the chamber into two compartments — one being on the side towards the street main, and the other on the side towards the burners. The valve is at one end of a small scale beam or lever, and counterpoised at the other by an inverted cup in a vessel of mercury. It is easily seen that if we vary the pressure on the external surface, of the inverted cup, or on the internal surface, we increase or diminish the opening of the valve, and thus admit more or less gas. In the first of these devices patented, the internal part of the inverted cup communicates with the side or compartment of the chamber towards the burners; in the second, it communicates with that towards the street main; and in the third, the construction is such that it communicates with both at the same time, and thus modifies and controls the amount of gas received through the valve in three several ways.

Geometrical Measurement. — A geometrical instrument has been patented, which is termed by the inventor a center-square for finding the center of a circle, designed for the use of mechanics. The general principle upon which the instrument is based is well known to geometricians, viz: that if two tangents (or straight lines touching the circumference of a circle) be extended until they intersect each other, a straight line bisecting the angle between them will pass through the center of the circle. The instrument consists of two arms, placed together at right angles to each other, in the manner of a carpenter's square, but of equal thickness, and having their surfaces "flush;" upon the upper surface of which arms a straight ruler is fixed at its end in such a manner as to have one of its edges at the inner angular point of the arms, and that edge extending midway between them, or bisecting the angle between them. This ruler can be braced firmly by a bar running across between the extreme ends of the arms. If the mechanic wishes to find the center of a circular wheel he places the instrument upon it, with the two arms both resting against its circumference, in which position the edge of the ruler will run across its center. A straight line is marked in this position, and the instrument is applied again to another part of the circumference, so as to mark in the same manner another line intersecting the first. The point of intersection is of course the center of the wheel.

New Spring Balance for Time Keepers.—The ordinary chronometer or watch-balance, it is well known, plays on points at the ends of its axis, and its motions or vibrations are governed by the tension of a coiled spring, which in watches is called the hair-spring. This balance, which has been called the most beautiful invention in mechanics, has, of late years, to a considerable extent, taken the place of a pendulum in larger time-pieces; and in such cases the points of the axis of the balance have been made to rest upon friction wheels to reduce their friction. In the present instance, however, the points and the spiral-spring are thrown aside, and a long, straight, thin, and narrow steel spring is made to perform the office of both. The spring is secured to the clock-frame at both ends and strained tight, and the balance itself, consisting, in this instance, simply of a straight bar, loaded with a ball at each end, is suspended at or near the middle of the spring; the spring passing through the middle of the bar at right angles. The spring is thus made to serve the double purpose of a frictionless suspension for the balance and a governor of its motions.

The force of torsion, as it is called—that is, the force with which a twisted wire or thread of glass tends to untwist itself—has been used before in certain instruments for philosophical purposes, as in some magnetic instruments where the magnetic bar is suspended at the lower end of the wire; and, when used for such purposes in this manner, the force of torsion of the wire has been measured by removing the magnet, putting a given weight in its place, and counting the number of vibrations it accomplishes in a given time; and such an arrangement as this has even been applied to a time piece. But in the present arrangement, where the flat spring is secured at both ends, and strained tight, so that the time piece can be moved about like a watch, the governing force of the balance is not derived from the simple torsion of the spring, but is also due in part to, and can be varied by, the force with which the spring is strained. The exact adjustments for time are made either by an adjustable slot, through which the spring passes near its end, or by a screw adjustment of the balls, or both.

Improvement in Turbine Wheels.—In this improvement the orifices of discharge from the buckets in the wheel are capable of adjustment for different heads of water without changing the curvature of the buckets. This is effected by attaching to the bucket a sliding plate of the same width and curvature as the bucket; the moving of this plate outward extends the curvature of the bucket and diminishes the orifice of discharge.

NATURAL PHILOSOPHY.

IMPROVEMENT IN ELECTRICAL MACHINES.

M. Provenzali, of Rome, has found that by covering a part of the conductor of an ordinary electrical machine with a thin sheet of gutta percha, the sparks that may be drawn from the part thus covered greatly exceed in length, those which can be obtained from the part uncovered. It appears that this effect depends upon the obstacle which the insulating sheet offers to the dispersion of the electricity, which dispersion tends to take place from the asperities of the surface of the conductor, and which discharge in part at a distance this same conductor, whenever it is approached with a non-insulated conductor for drawing the sparks. M. Provenzali proposes to cover the whole conductor of the machine in this way, to see if it will not protect it from the action of moist air, and give always a considerable quantity of electric fluid. In order to obtain the largest sparks, it is necessary to have the insulating sheet strongly electrified.

ELECTRO-CALORIC MACHINE.

In 1844, M. Andrand put in action on the railroad from Paris to Versailles, an air locomotive, in presence of a commission named by Government. Although with some points of resemblance, it was not precisely a caloric engine like that of Ericsson, against whom, M. Andrand enters no claim of priority. The locomotive acted through air at first compressed in a heater and then dilated by the heat. The air acted at high pressure, and the generator consisted of a worm plunged in a fire for the purpose; on passing through this spiral tube, the air was dilated; then on reaching the water cylinders it underwent additional dilatation, for the concave bottom of the cylinders were furnished with plates of cast iron, which were at white heat. The dilatation thus obtained, increased three fold, according to M. Andrand, the power of the condensed air; whence he concluded that in order to arrive at a practical solution of the problem, the previous compression could be dispensed with, and obtain at the same time the condensation of the air by using for this purpose part of the expansive force of the caloric. M. Andrand has not put this idea into practice; but in the course of his trials he has several times remarked an unexpected fact which we here mention.

Before making his air locomotive public, M. Andrand had it in operation within his workshop. When the reservoir was well filled with condensed air, the fire of the dilatator was made, and the iron plates of the bottom of the cylinders were brought to a white heat. This done it was only necessary to open the stop cock of the reservoir to set the machine in motion, and cause the two driving wheels to revolve. But while the apparatus was heating up, and before the valve was opened, it happened several times that the machine started spontaneously and communicated to the two wheels a frightful velocity. The phenomena continued from 30 to 40 seconds, then ceased, without his discovering how it was produced, or why it stopped. M. Andrand has not succeeded in repeating it at will. Already, some three years previous, the same motion, spontaneous and violent, manifested itself two or three times in a small hot-air car, which this mechanician had made to move on rails.

What may be the cause of this singular phenomena? Those who explain everything by a word, who know the precise cause of the cholera, steam-boat explosions, the potato disease, &c., do not fail to reply that the cause is "electricity," and without looking much to the why, or the wherefore, they can easily solve many other difficult problems the same way. M. Andrand, who has as a mechanician, a well-merited reputation, does not hesitate to assign the same cause; and his explanation is not without a shadow of foundation. The two motor cylinders, which act independently on the driving wheels, are of different kinds, one wholly of bronze, the other, by chance partly of cast-iron, and partly of bronze. But the phenomena does not appear to be produced in this last cylinder, and never in the cylinder of one metal. The two cylinders of the locomotive, in which the spontaneous movement was reproduced, also consisted of two metals, the cylinders being of cast-iron, and the pistons and bottom of bronze. From this to the phenomena of Galvani, is but a single step; and M. Andrand is convinced that he has been witness of the mechanical work of the electricity excited by the heat. Setting aside an explanation which elucidates nothing, and which may mischievously make one believe that the problem is resolved when it is hardly presented, we may conclude with M. Andrand, who says: It will be a conquest, both scientific and industrial of the first order, when we shall succeed in producing at will, this new motive force, and give it a continued action; then two ordinary motor cylinders, moderately heated and fed successively with a very small quantity of air, will suffice to generate an enormous force, which M. Andrand estimates at 10 or 12 atmospheres, and this with an expense of heat altogether insignificant. We shall have then, says he, electro-caloric engines which shall leave far behind steam-engines, however perfect, and shall realize under volumes of small extents, the marvels attributed to the apparatus of Ericsson.

Finally, M. Andrand closes his memoir by the following considerations: "Steam-boilers are found, as regards electricity, in conditions analagous to those of our hot-air chambers. It is probable even, that with equal volumes they contain a much larger quantity. Is it not natural that the phenomena which I have observed, as a matter of chance, in our hot-air cylinders, should be sometimes reproduced in steam-boilers? It is known that explosions are more violent the greater the amount of electricity; and on the other hand, that the quantity of electricity is greatest when the steam is of moderate tension, as in steamboats of low-pressure engines. And these low-pressure engines, are the ones which often explode, while the locomotives which are high pressure, very seldom explode. In support of these considerations, M. Andrand says, that he has more than twenty times tried to burst vessels of thin sheet iron by compressing in them air at a high temperature, and has not been able to succeed in tearing them, except when the pressure was raised to 50 or 60 atmospheres; twice only has he produced an explosion; and those with vessels of copper when other metals were present.—*Silliman's Journal.*

ELECTRICITY AND HEAT.

M. Gaugain, of France, as the result of carefully conducted researches, has recently informed the Academy of Sciences, that he does not think the curremts developed in thermo-electrical batteries, viz., in electrometers formed by the association of two different metals, whose points of junction are maintained at different temperatures, should be attributed to the motion of heat. He consequently suspects all experiments, upon which experimenters have endeavored to found the doctrine that the propagating motion of heat in the interior of bodies disengages electricity. One of these experiments, however, is celebrated; it constantly succeeds, but M. Gaugain interprets it differently from every one else, and he especially prevents the fundamental phenomenon appearing by changing the experimental data, without, however, so changing, as to prevent the propagation of heat. This is the experiment: A platina wire, with one extremity inserted in the interior of a glass tube, closed with the lamp and blowpipe, is placed in connection with the plate of a condensing electroscope by its other extremity. The glass tube is surrounded in the interior with a second platina wire, rolled spirally, and which communicates at one end with the earth. If the experimenter heats considerably by a lamp's flame the metallic spiral, and the parts of the tube enveloping it, it will be found that the plate of the electroscope is charged with positive electricity. According to the theory of M. Becquerel, the author of the experiment, the heated spiral is the seat of an electromotric force; the negative fluid goes towards the ground, following the same direction as the heat, and the positive fluid, moving in an inverse direction, traverses the glass tube, which has become a conductor in consequence of the elevation of the temperature, and is conducted by the interior wire to the instrument which indicates its presence. To make this celebrated experiment fail completely, and to destroy, or, at least, place in abeyance the explanation given of it, M. Gaugain only introduce into the tube a few drops of alcohol, which rising in vapor, should in nowise hinder the heat from playing its usual part, but which operates so as to place the two wires in the same chemical positions; for the flame of the spirit-lamp really forms around the exterior wire an atmosphere of alcohol. It is consequently very probable that in the already mentioned experiment, the disengagement of electricity was due to an especial chemical action, which cannot be well defined, but whose effect is annulled by opposing to it a similar chemical action. M. Gaugain thinks a gaseous couple, analagous to that discovered by M. Grove, may play a part in the matter. The idea is ingenious, but it does not furnish a complete explanation, for in Grove's battery there is a conducting liquid, while there is nothing analagous in the data of M. Becquerel's experiment.

RUHMKORFF'S ELECTRICAL APPARATUS.

It is not the least brilliant of Mr. Faraday's claims to high scientific rank, to be *the* discoverer of that singular influence exercised on distant points by electrical currents, the influence which he called *induction*. Before him no one had succeeded in obtaining with the battery, electricity of tension like that furnished by the electrophore and the old fashioned plate electrical machine. The battery does not of itself give the spark which flashes between two points, but the current it produces can act and influence a neighboring conductor and produce there all the signs of static electricity. The current of induction, (so called to distinguish it from that of the two electricities accumulated in the exterior and interior foil coatings of the Leyden jar) does not manifest itself in a complete circuit, except under the influence of another current subject to variations of intensity. Suppose the current of a battery is passed through a metal wire, wound around a hollow bobbin, in whose interior a second wire is wound, just the same as the wire on the outside; if the communication of the battery with the exterior wire be frequently interrupted, the exterior wire will excite in the inside wire currents of induction, properly so called, and which are generally endowed with a great degree of tension; the introduction of a bar of soft iron in the centre of the bobbin, increases to a still higher degree the intensity of the phenomena. The inducted current then becomes so powerful, that to prevent the wire discharging itself on itself, it is necessary to separate the different coils by a resinous and insulating substance. To insure the action of the apparatus without the intervention of any person, an interruptor, (according to the method suggested by M. de la Rive) is placed in a proper position, and the magnetized iron suffices to agitate it. Such is the apparatus invented by M. Ruhmkorff; it is an excellent machine, giving forth brilliant sparks, powerful shocks, and which may be advantageously substituted for the electrical machine, in all experiments relative to static electricity. M. Fizeau, when about making some experiments with this new machine, desired to augment the tension of the electricity it furnishes. A very decided increase of effect is obtained by employing a stronger battery to put the apparatus in activity, and the electricity developed at the poles acquires a marked increase of tension. But this method has an inconvenience which makes the instrument lose its principal advantage, which consists in the regularity and duration of its effects. When in operation very brilliant sparks are produced between the surfaces of the interruptor; yet, notwithstanding these surfaces are of platina, they are soon melted and deformed when the current is made more intense, the vibrations of the interruptor consequently become less constant, and the production of electricity soon ceases to take place with regularity. The same inconvenience would doubtless manifest itself, if an attempt was made to give to the apparatus of induction superior dimensions to those adopted by M. Ruhmkorff; for the force of the sparks, which appear at the points of contact of the interruptor, is especially due to an inducted current, which is also produced in the inducting wire itself; and if the dimension of the wires, and the number of spiral windings, be augmented, the current will necessarily become more intense, and the sparks stronger. But a careful study of the peculiarities of the apparatus, suggested to M. Fizeau a very different method of increasing the energy of the effects produced. This consists in disposing a condenser, formed of two plates of tin, each isolated from the other by a coating of varnish, and to connect each of these plates with each of the extremities of the inducting wire. So that the two electricities may spread themselves upon the two surfaces of tin where they will lose, in a great degree, their tension from the effect of the mutual influence exerted through the isolating coating of varnish. When the condenser presents a sufficient surface, (two or three square feet,) it will be seen that communications are immediately established, the light becomes weaker at the point of interruption, and, at the same time, the machine receives a remarkable increase of energy; the poles then give much stronger sparks, which strike at distances much greater than they could attain before. The condenser may be placed conveniently in a horizontal position, a little above the electro-magnet, and supported by glass feet.

APPLICATION OF THE TELEGRAPH AND ELECTRICITY TO MILITARY PURPOSES.

At a recent grand review at Olmutz, Austria, at which the Emperors of Russia and Austria were present, a sham fight on a grand scale, the siege of the citadel, including the application of electricity on the most recently approved principles of ignition and combustion, constituted the most important of the manœuvres which were practised. A Vienna paper describes three omnibus-looking vehicles, which were in the camp, each containing a complete electric apparatus, with a contrivance for laying an insulated wire along the ground by the mere locomotion of the vehicle, the wire being so protected as to remain uninjured by the pressure of the heaviest artillery passing over it. By this means orders are to be instantaneously conveyed from the Emperor's station, and that of the chief commander to troops at almost any distance on the field of the manœuvres.

WEAVING BY ELECTRICITY.

The *Commerce Sericole*, a French commercial paper, gives an account of the remarkable invention by which it is proposed to utilize the electric current in the process of weaving. In the Jacquard loom, as is well known, the regulation of that particular order of the threads which determines the distinctive character of the fabric, and which was formerly effected by children crouched under the loom pulling cords, is at the present produced by the movement which the weaver gives himself to a treadle. This invention, however admirable, is not without difficulties and certain defects, which it would be satisfactory to overcome by still simpler means. At each passage of the shuttle, there must be a piece of card-board of a certain breadth, pierced with holes arranged so as to correspond with the design; and when we bear in mind that, for certain designs, as many as 40,000 of these pieces of card-board have to be used, and that 1,500 are required in ordinary cases for a design of the simplest coloring, and calculating that they cost about 15 francs (12s. 6d.) per hundred, it will be easily seen that these cards must be the cause of great expense, as well as inconvenience. There are other objections, of more or less importance; such as the noise which the loom makes in working, the space which it occupies, and its constant liability to derangements. All these inconveniences are about to disappear, by the introduction of electricity, the action of which is so powerful, so easy to be directed, and so prompt in its various operations. The treadle of the weaver lifts the threads and connects the extremity of each by means of copper wire, with a current of electricity either positive or negative at will, and the result is, that without any noise some of the threads remain suspended, and others descend, according as the current is directed. By this means as great a simplicity is effected in the weaving of fabrics of the most complicated nature, as in that of common cloth. To direct the electricity, there is no longer need of mechanism for transferring or tracing the design. A series of points are arranged in a line like the teeth of a comb, each point communicating with an electro-magnet. The weaver will only have to pass underneath these points the design, traced in varnish on a cylinder or on a metallic leaf, in communication with the battery. The current will pass only where the varnish is wanting, and it will be the corresponding threads only which will remain suspended, and which, by that means, will reproduce the design as it came from the hands of the artist, with a surprising exactitude. Instead of the expense of a design, through the means of complicated cards, you have only that of a simple design, and of the tending of the battery. Telegraphic experience proves how slight will be this last. There will be a saving in the most complicated designs of very nearly three-fourths of the expense, and in others certainly more than half. We shall be able, moreover, to correct and vary our designs by a few strokes of the brush; and their slight cost will permit a more frequent renewal.

IMPROVEMENT IN LIGHTNING RODS.

Two patents have been recently granted, for improved lightning-rods, both having for their object such a construction of the point as shall cause it to be left tolerably well pointed even after it has been partially melted by an electric discharge. The principle in both is the use of metals or metallic alloys of different degrees of fusibility; the most fusible forming the upper end or outer surface of the point. In one of these points the device consists in completely covering or coating the inner or main point with a pointed metallic sheath of a more fusible metal or alloy; and this again with another still more fusible; and this, if desired, with still another. In case of a stroke of lightning sufficiently powerful to melt the point, as not unfrequently happens, from its small mass and the great heat produced where the fluid passes from the air to the conductor, the external sheath is to act as a protector to the point of more infusible alloy within, by absorbing the heat as it melts off, leaving the latter sufficiently perfect still to act as a point.

The other plan is a modification in which the unequally fusible metals or alloys, instead of being formed as a succession of sheaths, are made solid, and connected one above another by oblique joints or faces, the inclination being towards the square or angular corner of the rod, so that when one section is removed the one next below will be left with a sharp point on that corner. — *Patent Office Report*, 1852.

ON THE ACTION OF ELECTRICITY UPON THE MAGNETIC NEEDLE.

There are several methods of measuring the intensity of electrical currents: the most common is the magnetised needle, which has the property of placing itself transversely to the direction followed by the positive electricity following the conductor placed near the needle. It was by making the discovery of this mysterious action, that Œrstedt, the natural philosopher, of Copenhagen, gained the brightest scientific glory achieved during this century; and it was his great good fortune to see before his death, this leading principle serve as the foundation on which the science of electro-magnetism is reared. The action of electricity in motion upon the magnetised needle is such, that if the observer would identify himself with the current (and suppose it entered his body at his feet and left it by his head,) he would find the needle form a cross with him, and point its south pole to the left. As the needle, however, is continually struggling with the action of the earth, it does not completely yield to the current, which, were the earth impotent, would place it at right angles with the current, but generally it takes an oblique direction, conformably to the result of the combined actions of the current and the earth. The more the action of the current predominates, the nearer this result approaches the perpendicular of the conducting wire; so that the greatness of the deviation produced by the influence of the current, serves to measure the current itself, provided the observer knows the law which determines the intensity, and its relation to the greatness of the deviation — two quantities which vary in the same sense, but which are never rigorously in proportion. When the needle and the current are placed in certain conditions (which will be presently specified,) the angular deviations increase less rapidly than the intensity of the current; but if instead of the angles of deviation, their trigonometrical tangents are taken, the experimenter will find values in proportion to the intensity he seeks to ascertain. To do this, the electrical current must move in a vertical circle, whose plane is parallel to the natural direction of the magnetic needle; in other words, the circular conductor must be placed according to the magnetic meridian; secondly, the magnetic needle placed in the centre of this circle, must be so small as not to move beyond the plane of the circle (during its oscillations from right to left,) where the maximum of the magnetic actions take place. Then, and only then, M. Pouillet's tangent compass gives, without need of correction, exact measures.

But, it is evident that a galvanometric compass, formed of a circle infinitely large, or of a needle infinitely small, is a pure fiction; and so soon as an experimenter wishes to realize it, and gives it such proportions as are necessary for convenience in experimenting, the circle is always too small or the magnetic needle too large. Then between the real and the theoretical deviation such great differences are found to exist [differences which augment in proportion to the strength of the currents] the experimenter is forced to choose, as recently happened with M. Despretz, between two equally inconvenient alternatives: to restrict the use of the compass to the measurement of small arcs of deviation, or to calculate greater deviations by a complicated formula, in which new terms are employed, charged with representing the characteristic data of the instrument. Besides, it will easily be conceived that all sensible increase of size given to the needle placed in the center of the circular current, militates against the exactness of the deviations; in truth, the principle of the compass-tangent supposes that in every position of the magnetic needle around its pivot, the sum of the distances of each of its points to all the elements of the circle remains the same. But it is clear that the moment the needle quits the plane of the circle in turning on its pivot, its extremities are removed from the majority of the points, which must then influence it at its then distance; and, consequently, this influence diminishing the deviation, must remain less than its theoretical value. Thus all tangent-compasses hitherto employed, are the more inert, as they are used to measure stronger currents.

Such was the state of the question when M. Gaugain, an engineer and *ancien eleve* of the Polytechnic school made an ingenious remark. He supposed that the needle, instead of being placed in the plane of the circle, should be placed completely outside of it, either on the one or the other side, but always perpendicular to the plane of the circle and by its center; he foresaw that, in these new conditions, the needle would be in the power of the circular current, and that it would be forced to make a greater deviation from its initial position, (parallel to the circle.) He saw that if the needle avoided by one of its extremities, the magnetic action of the current, it would go before this action on the other extremity; that what was lost on one side would be more than gained on the other, and consequently the violations of the law of tangents must, compared to the preceding case, be produced in an inverse sense; he observed that in the conditions where the ordinary tangent-compass became inert, this was endued with increased alacrity. But, by virtue of the great law of continuity, which regulates the phenomena of nature, as well as those connected with pure mathematics, there must exist upon that perpendicular to the centre of the circle, a point where the magnetic needle, avoiding both extremes, must necessarily follow a regular march.

To test his idea by experiment, M. Gaugain went to M. Froment, the celebrated instrument maker, and ordered a tangent-compass, whose circle could at will be made to move parallel to itself and be placed at different distances from the centre of the needle. By means of this arrangement, he has been enabled to ascertain what is for every position of the circle the corresponding value of the difference between the real and theoretical deviations, which he sought to annihilate. He attained these results: when the circle is of a small diameter and occupies its ordinary position, or when its center coincides with that of the magnetic needle, the value of the difference is very great, when the deviation itself is somewhat great; but if the circle is removed from the center of the needle, it is found that the difference corresponding to a determined deviation decreases as the circle is removed from the needle; when it has reached a certain distance, the difference is *nul* for all the deviations. Beyond this distance, the difference begins to re-appear with a contrary sign, and its absolute value continues to increase with the distance, (at least with quite extensive limits.) M. Gaugain next operated comparatively with two different circles, and he observed for both of them that the true place of the center of the needle is outside of their planes, at a distance equal to one quarter of their radius. The analysis applied to this question by M. Bravis, confirms the result of this experiment.—*Proc. French Academy.*

SELF-REGISTERING COMPASS.

M. Deleuil has presented to the French Academy a new self-registering compass. Its object is to register the changes of direction in a vessel for every three minutes during the twenty-four hours. The marking is made upon a compass card; and it enables the captain to control with certainty the direction followed by his ship, and to overlook most effectively the manœuvres of the steersman and pilot. This self-register consists of three principal parts: 1st, a clock movement placed at the center of the apparatus for causing the point or pivot carrying the needles to move up and down at regular intervals; 2d, an endless screw furnished with a nut carrying the point for piercing the paper; 3d, the compass-card, made of three needles fixed to a sheet of mica, a material as little hygrometric as possible. The mica is covered with a desk of velvet firmly glued to it by means of strong glue, and whose tissue has been saturated with a kind of glue that is soft when cold. On cooling, the glue has an even surface pierced with an infinity of pores, into which the point will readily penetrate after having pierced the paper compass-card. Owing to this addition, the process of puncturing does not stop the movement of the needle, a principle essential to the success of any method of self-registering. When the needle is fixed towards the north, the axis or diametral line of the compass-card is placed in the line of the axis of the ship, and the punctures made every three minutes, will indicate the deviation of this axis with reference to the magnetic needle. The succession of points, or the nearly continuous line which they trace, shows to the eye the course of the route.

IMPROVEMENTS IN GALVANIC BATTERIES.

Some new and improved galvanic batteries have been described by M. Kukla, of Vienna. The combination used in one of these, is antimony or some of its alloys, for a negative plate, with nitric acid of specific gravity 1.4, in contact with it, and unamalgamated zinc, for a positive plate, with a saturated solution of common salt in contact with it. A small quantity of finely powdered per-oxide of manganese is put into the nitric acid, which is said to increase the constancy of the battery. The alloys of antimony which Mr. Kukla has experimented with successfully are the following: Phosphorus and antimony, chromium and antimony, arsenic and antimony, boron and antimony. These are in the order of their negative character, phosphorus and antimony being the most negative. Antimony itself is less negative than any of these alloys. The alloys are made in the proportions of the atomic weights of the substances. All these arrangements are said by Mr. Kukla to be more powerful than when platinum or carbon is substituted for antimony or its alloys. In this battery a gutta percha bell-cover is used over the antimony, and resting on a flat ring floating on the top of the zinc solution, — this effectually prevents any smell, and keeps the per-oxide of nitrogen in contact with the nitric acid solution. When a battery of twenty-four cells was used, Mr. Kukla found that in the third and twenty-first cells pure ammonia in solution was the ultimate result of the action of the battery; but only water in all the others. This experiment was tried repeatedly, and always with the same result. A battery was put into action for twenty-four hours, — at the end of that time the nitric acid had lost thirteen-twentieths of an ounce of oxygen, and one-quarter of an ounce of zinc was consumed.

Now as one-quarter of an ounce of zinc requires only 0.06 of an ounce of oxygen to form oxide of zinc, Mr. Kukla draws the conclusion that the rest of the oxygen is converted directly into electricity; and this view, he says, is confirmed by the large amount of electricity given out by the battery in proportion to the zinc consumed in a given time. In the above battery each zinc plate had a surface of forty square inches. The addition of per-oxide of manganese does not increase the effect of the battery, but it makes it more lasting; — the per-oxide of nitrogen, formed in the bell-cover, taking one atom of oxygen from the per-oxide of manganese; — this is evident from only the oxide of manganese being found in the battery after a time: in the salt solution no other alteration takes place than what is caused by the oxide of zinc remaining in a partly dissolved state in the solution. For this battery Mr. Kukla much prefers porous cells, or diaphragms of biscuit ware, as less liable to break, and being more homogeneous in their material than any other kind. This battery is very cheap, antimony being only 5*d.* per lb., wholesale, and the zinc not requiring amalgamation. The second arrangement tried by Mr. Kukla was antimony and amalgamated zinc, with only one exciting solution, viz.: concentrated sulphuric acid. This battery has great heating power, and the former great magnetizing power. It, however, rapidly decreases in power, and is not so practically useful as the double fluid battery, which will exert about the same power for fourteen days, when the poles are only occasionally connected as in electric telegraphs. Certain peculiarities respecting the ratio of intensity to quantity when a series of cells is used, have been observed, which differ from those remarked in other batteries. Mr. Kukla, on directing his attention to the best means of making a small portable battery for physiological purposes, has found very small and flat Cruikshank batteries, excited by weak phosphoric acid (one of glacial phosphoric acid to twenty of water), to be the best. Phosphoric acid being very deliquescent, and forming with the zinc, during the galvanic action, an acid phosphate of zinc. A battery of this description does not decrease in power very materially until it has been three hours in action.

THE AURORA BOREALIS AND THE ELECTRIC TELEGRAPH.

A correspondent of the Boston Traveller furnishes the following results of six years' experience in determining what effect the Aurora Borealis exerts upon the telegraphic wires.

On the House, Morse, and other *magnetic* telegraphs, the effect produced by the Aurora is generally to increase or diminish the electric current used in working the wires; sometimes it entirely neutralizes it, so that in effect no fluid is discoverable on them. As, however, the Bain, or *chemical* telegraph, is much the best adapted for observing the precise effect produced by the Aurora, I shall confine myself principally to it. In this system, the main, or line wire, is brought into direct contact with the chemically prepared paper, which lies on a metal disc, connected with the ground; any action of the atmospheric current is therefore immediately recorded on paper

During a thunder storm, the atmospheric electricity attracted by the wires passes over them to the chemically prepared paper, and thence to the ground. As it passes from the wire to the paper, it emits a bright spark, and produces a sound like the snapping of a pistol. Atmospheric electricity never remains for any length of time on the wires; it will, however, sometimes travel many miles before discharging itself; I have seen discharges of electricity from the instrument, which emanated from thunder storms forty or fifty miles distant.

The effect produced by the Aurora Borealis on the wires, and the record on the paper, is entirely different from that of the atmospheric current. Instead of discharging itself from the wires with a flash and report, and without the aid of a conductor, as is the case with the latter, it glides along the wires in a continuous stream, producing the same result on paper as that produced by the galvanic battery. It is well known that only the positive pole of the battery produces the colored mark on the paper — the negative having the contrary effect of bleaching it; the same is also true of the two currents from the Aurora. The current usually commences lightly, producing a light blue line just perceptible on the paper — and gradually increases in strength, making a dark blue, and then a black line — till finally it becomes so strong as to burn through several thicknesses of it; it then gradually disappears, and is followed by the bleaching process, which entirely neutralizes the current from the batteries.

In my diary of September 29, 1851, I find the following account of the effects of the Aurora on the evening of that day: "All the lines leading from the city are so strongly charged with atmospheric electricity this evening as to prevent operation. The surplus current on the Chemical Line is equal to one hundred and fifty Grove's cups; and the same seems to be the case on the House and Morse wires. The weather is cloudy, but through the clouds we can occasionally see the brilliant scintillations of an Aurora Borealis." The next day I ascertained that the Aurora, as seen from Providence, New Haven, and other places, was very brilliant. February 19, 1852, I find the following description of the effects of the Aurora of that date, in my journal: "Toward evening a faint blue line appeared on the paper, which gradually grew stronger and darker, until at last it burned it; then gradually grew fainter until it disappeared, when it appeared again in a new form, bleaching instead of coloring the paper. This singular phenomenon continued until we closed, at a late hour in the evening. The Aurora was very brilliant in the evening."

Mr. Rowe, Superintendent of the Boston and Vermont Telegraph Company, showed me specimens of paper taken from instruments on that line, at 12 o'clock at night — three hours after the batteries were taken off — which were covered with light and heavy blue lines and bleachings. These were caused by the Aurora of the 19th of February.

Our troubles from the Aurora are not confined to the evenings entirely, though they are more frequent then. On several occasions I have predicted in the afternoon that we should have an Aurora in the evening, judging by the effect on the wires at that time, and I do not recollect that I have ever been mistaken in my predictions.

Thursday, April 22, 1852, were much troubled by an atmospheric current; sometimes preventing our working for half an hour or more, and then disappearing for about that time; the current was constantly changing during the whole evening. We had a very brilliant display of the Aurora.

The Aurora Borealis seems to be composed of a vast mass of electric matter, resembling in every respect that generated by the electro-galvanic battery; the currents from it change, coming on the wires, and then disappearing — as the mass of the Aurora rolls from the horizon to the zenith — sometimes so faintly as to be scarcely perceptible, and then so strongly as to emit one continual blaze of fire — yet very different from what we commonly term atmospheric electricity, and which we cannot relieve ourselves from, as in the latter case, by placing ground wire conductors in close proximity to the line wires.

TERRESTRIAL MAGNETISM.

No one has contributed more to the progress of Terrestrial Magnetism during the last few years than Col. Sabine, formerly President of the British Association. Heretofore we owed theories on this subject much more to the boldness of ignorance than to the just confidence of knowledge; but from the commencement of the systematic observations which Col. Sabine has been so active in promoting, this vague and useless theorizing ceased, — to be succeeded ere long by the sound speculative researches of those who may be capable of grappling with the real difficulties of the subject, when the true laws of the phenomena shall have been determined. These laws are coming forth with beautiful precision from the reductions which Col. Sabine is now making of the numerous observations taken at the different magnetic stations. In his address before the Association, in 1852, he stated that the secular change of the magnetic forces was confirmed by these recent observations; and also that periodical variations depending on the solar day and on the time of the year, had been distinctly made out, indicating the sun as the cause of these variations. During the past year the results of the reductions of the observations made at Toronto have brought out with equal perspicuity, a variation in the direction of the magnetic needle, going through all its changes exactly in each lunar day. These results with reference to the sun, prove the immediate and direct exercise of a magnetic influence emanating from that luminary; and also the same conclusion with regard to the influence of the moon. It would seem, therefore, that some of the curious phenomena of magnetism which have hitherto been regarded as strictly terrestrial, are really due to solar and lunar, as much as to terrestrial magnetism. It is beautiful to trace with such precision these delicate influences of bodies so distant, producing phenomena scarcely less striking either to the imagination or to the philosophic mind, than more obvious phenomena which originate in the great luminary of our system.—*Hopkins' Address, British Association*, 1853.

At a subsequent meeting of the Association, Prof. Phillips remarked that in terrestrial magnetism, magnetic and diamagnetic effects on a suspended needle ought probably to be looked for as a simple consequence of the superposition of the strata, and their pressure on one another. Looking at what had been done with magnetism, and considering what had been stated by Colonel Sabine, that the moon as well as the sun had effects on magnetism, he must say that he thought the day would come when we should be able, by magnetism, to arrive at the nature of those substances beneath the thin crust of the earth's surface, and that over the red sandstone of England we should be able to see into the condition of coal measures, without actually making a perforation.

FARADAY ON THE MOTION OF TABLES.

The following account of the method pursued and the results obtained by Prof. Faraday in the investigation of a subject which has taken such strange occupation of the public mind, both in America and Europe, was communicated by the author to the London Athenæum.

"I have been," says the Professor, "greatly startled by the revelation which this purely physical subject has made of the condition of the public mind. No doubt, there are many persons who have formed a right judgment or used a cautious reserve — for I know several such, and public communications have shown it to be so; but their number is almost as nothing to the great body who have believed and borne testimony, as I think, in the cause of error. I do not here refer to the distinction of those who agree with me and those who differ. By the great body, I mean such as reject all consideration of the equality of cause and effect — who refer the results to electricity and magnetism, yet know nothing of the laws of these forces — or to attraction, yet show no phenomena of pure attractive power — or to the rotation of the earth, as if the earth revolved round the leg of a table — or to some unrecognized physical force, without inquiring whether the known forces are not sufficient — or who even refer them to diabolical or supernatural agency, rather than suspend their judgment, or acknowledge to themselves that they are not learned enough in these matters to decide on the nature of the action. I think the system of education that could leave the mental condition of the public body in the state in which this subject has found, it must have been greatly deficient in some very important principle."

"The object which I had in view in this inquiry was not to satisfy myself, for my conclusion had been formed already on the evidence of those who had turned tables — but that I might be enabled to give a strong opinion, founded on facts, to the many who applied to me for it. Yet, the proof which I sought for, and the method followed in the inquiry, were precisely of the same nature as those which I should adopt in any other physical investigation. The parties with whom I have worked were very honorable, very clear in their intentions, successful table-movers, very desirous of succeeding in establishing the existence of a peculiar power, thoroughly candid, and very effectual. It is with me a clear point that the table moves when the parties, though they strongly wish it, do not intend, and do not believe that they move it by ordinary mechanical power. They say, the table draws their hands; that it moves first, and they have to follow it,— that sometimes it even moves from under their hands. With some the table will move either to the right or left according as they wish or will it,—with others the direction of the first motion is uncertain;— but all agree that the table moves the hands, and not the hands the table. Though I believe the parties do not intend to move the table, but obtain the result by a *quasi* involuntary action,—still I had no doubt of the influence of expectation upon their minds, and through that upon the success or failure of their efforts. The first point, therefore, was, to remove all objections due to expectation, having relation to the substances which I might desire to use:—so, plates of the most different bodies, electrically speaking,—namely, sand-paper, millboard, glue, glass, moist clay, tinfoil, cardboard, gutta percha, vulcanized rubber, wood, &c.,—were made into a bundle and placed on a table under the hands of a turner. The table turned. Other bundles of other plates were submitted to different persons at other times, and the tables turned. Henceforth, therefore, these substances may be used in the construction of apparatus. Neither during their use nor at other times could the slightest trace of electrical or magnetic effects be obtained. At the same trials it was readily ascertained that one person could produce the effect; and that the motion was not necessarily circular, but might be in a straight line. No form of experiment or mode of observation that I could devise, gave me the slightest indication of any peculiar natural force. No attractions, or repulsions, or signs of tangential power, appeared,—nor anything which could be referred to other than the mere mechanical pressure exerted inadvertently by the turner. I therefore proceeded to analyze this pressure, or that part of it exerted in a horizontal direction: doing so, in the first instance, unawares to the party. A soft cement, consisting of wax and turpentine, or wax and pomatum, was prepared. Four or five pieces of smooth, slippery cardboard were attached, one over the other, by little pellets of the cement, and the lower of these to a piece of sand-paper resting on the table; the edges of these sheets overlapped slightly, and on the under surface a pencil line was drawn over the laps so as to indicate position. The upper card-board was larger than the rest, so as to cover the whole from sight. Then, the table turner placed the hands upon the upper card, and we waited for the result. Now, the cement was strong enough to offer considerable resistance to mechanical motion, and also to retain the cards in any new position which they might acquire—and yet weak enough to give way slowly to a continued force. When at last the tables, cards, and hands all moved to the left together, and so a true result was obtained, I took up the pack. On examination, it was easy to see by the displacement of the parts of the line, that the hand had moved further than the table, and that the latter had lagged behind — that the hand, in fact, had pushed the upper card to the left, and that the under cards and the table had followed and been dragged by it. In other similar cases when the table had not moved, still the upper card was found to have moved, showing that the hand had carried it in the expected direction. It was evident, therefore, that the table had not drawn the hand and person round, nor had it moved simultaneously with the hand. The hand had left all things under it behind, and the table evidently tended continually to keep the hand back.

The next step was to arrange an index, which should show whether the table moved first, or the hand moved before the table, or both moved or remained at rest together. At first this was done by placing an upright pin fixed on a leaden foot upon the table, and using that as the fulcrum of a light lever. The latter was made of a slip of foolscap paper, and the short arm, about quarter of an inch in length, was attached to a pin proceeding from the edge of a slipping card placed on the table, and prepared to receive the hands of the table-turner. The other arm of 11½ inches long served for the index of motion. A coin laid on the table marked the normal position of the card and index. At first the slipping card was attached to the table by the soft cement, and the index was either screened from the turner, or the latter looked away: then, before the table moved, the index showed that the hand was giving a resultant pressure in the expected direction. The effect was never carried far enough to move the table, for the motion of the index corrected the judgment of the experimenter, who became aware that, inadvertently, a side force had been exerted. The card was now set free from the table, *i. e.*, the cement was removed. This, of course, could not interfere with any of the results expected by the table-turner, — for both the bundle of plates spoken of and single cards had been freely moved on the tables before; but now that the index was there witnessing to the eye, and through it to the mind of the table-turner, not the slightest tendency to motion either of the card or of the table occurred. Indeed, whether the card was left free or attached to the table, all motion or tendency to motion was gone. In one particular case there was relative motion between the table and the hands: I believe that the hands moved in one direction; the table-turner was persuaded that the table moved from under the hand in the other direction: — a guage, standing upon the floor, and pointing to the table, was therefore set up on that and some future occasions, — and then, neither motion of the hand nor of the table occurred.

A more perfect lever apparatus was then constructed in the following manner: — Two thin boards, 9½ inches by 7 inches, were provided; a board, 9 by 5 inches, was glued to the middle of the underside of one of these, (to be called the table-board,) so as to raise the edges free from the table; being placed on the table, near and parallel to its side, an upright pin was fixed close to the further edge of the board, at the middle, to serve as the fulcrum for the indicating lever. Then, four glass rods, 7 inches long and $\frac{1}{4}$ in diameter, were placed as rollers on different parts of this table-board, and the upper board placed on them; the rods permitted any required amount of pressure on the boards, with a free motion of the upper on the lower to the right and left. At the part corresponding to the pin in the lower board, a piece was cut out of the upper board, and a pin attached there, which, being bent downward, entered the hole in the end of the short arm of the index lever; this part of the lever was of cardboard; the indicating prolongation was a straight hay-stalk 15 inches long. In order to restrain the motion of the upper board on the lower, two vulcanized rubber rings were passed round both, at the parts not resting on the table; these, while they tied the boards together, acted also as springs, — and while they allowed the first feeblest tendency to motion to be seen by the index, exerted, before the upper board had moved a quarter of an inch, sufficient power in pulling the upper board back from either side, to resist a strong lateral action of the hand. All being thus arranged, except that the lever was away — the two boards were tied together with string, running parallel to the vulcanized rubber springs, so as to be immovable in relation to each other. They were then placed on the table, and a table-turner sat down to them; — the table very shortly moved in due order, showing that the apparatus offered no impediment to the action. A like apparatus with metal rollers produced the same result under the hands of another person. The index was now put into its place, and the string loosened, so that the springs should come into play. It was soon seen, with the party that could will the motion in either direction, (from whom the index was purposely hidden) that the hands were gradually creeping up in the direction before agreed upon, though the party certainly thought they were pressing downward only. When shown that it was so, they were truly surprised; but when they lifted up their hands and immediately saw the index return to its normal position, they were convinced. When they looked at the index and could see for themselves whether they were pressing truly downward, or obliquely so as to produce a resultant in a right or left handed direction, then such an effect never took place. Several tried for a long while together, and with the best will in the world; but no motion, right or left, of the table, or hand, or anything else, occurred. The result was, that when the parties saw the index, it remained very steady; when it was hidden from them, or they looked away from it, it wavered about, though they believed that they always pressed directly downward; and, when the table did not move, there was still a resultant of hand force in the direction in which it was wished the table should move, which, however, was exercised quite unwittingly by the party operating. This resultant it is which, in the course of the waiting time, while the fingers and hands become stiff, numb, and insensible by continued pressure, grows to an amount sufficient to move the table or the substances pressed upon. But the most valuable

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effect of this test apparatus (which was afterward made more perfect and independent of the table) is the corrective power it possesses over the mind of the table-turner. As soon as the index is placed before the most earnest, and they perceive — as in my presence they have always done — that it tells truly whether they are pressing downward only or obliquely, then all effects of table-turning cease, even though the parties persevere, earnestly desiring motion, till they become weary and worn out. No prompting or checking of the hand is needed — *the power is gone;* and this only because the parties are made conscious of what they are really doing mechanically, and so are unable unwittingly to deceive themselves. I know that some may say that it is the cardboard next the fingers which moves first, and that *it* both drags the table and also the table-turner with it. All I have to reply is, that the cardboard may in practice be reduced to a thin sheet of paper weighing only a few grains, or to a piece of goldbeaters' skin, or even to the end of the lever, and (in principle) to the very cuticle of the fingers itself. Then the results that follow are too absurd to be admitted; the table becomes an incumbrance, and the person holding out the fingers in the air, either naked or tipped with goldbeaters' skin or cardboard, ought to be drawn about the room, &c.; but I refrain from considering imaginary yet consequent results, which have nothing philosophical or reasonable in them.

Another form of index was applied thus: A circular hole was cut in the middle of the upper board, and a piece of cartridge paper pasted under it on the lower surface of the board; a thin slice of cork was fixed on the upper surface of the lower board corresponding to the cartridge paper; the interval between them might be a quarter of an inch or less. A needle was fixed into the end of one of the index hay-stalks, and when all was in place the needle point was passed through the cartridge paper and pressed slightly into the cork beneath, so as to stand upright; then any motion of the hand, or hand-board, was instantly rendered evident by the deflection of the perpendicular hay-stalk to the right or left.

I think the apparatus I have described may be useful to many who really wish to know the truth of nature, and would prefer that truth to a mistaken conclusion; desired, perhaps, only because it seems to be new or strange. Persons do not know how difficult it is to press directly downward, or in any given direction against a fixed obstacle; or even to *know only* whether they are doing so or not; unless they have some indicator, which, by visible motion or otherwise, shall instruct them; and this is more especially the case when the muscles of the finger and hand have been cramped and rendered either tingling, or insensible, or cold by long continued pressure. If a finger be pressed constantly in the corner of a window frame, for ten minutes or more, and then, continuing the pressure, the mind be directed to judge whether the force at any given moment is all horizontal, or all downward, or how much is in one direction and how much in the other, it will find great difficulty in deciding; and will at last become altogether uncertain: at least such is my case. I know that a similar result occurs with others; for I have had two boards arranged, separated, not by rollers but by plugs of vulcanized rubber, and with the vertical index: when a person with his hands on the upper board is requested to press only downward, and the index is hidden from his sight, it moves to the right, to the left, to him and from him, and in all horizontal directions; so utterly unable is he strictly to fulfil his intention without a visible and correcting indicator. Now, such is the use of the instrument with the horizontal index and rollers: the mind is instructed, and the involuntary or *quasi* involuntary motion is checked in the commencement, and therefore never rises up to the degree needful to move the table, or even permanently the index itself.

The subject of the table movement has been also brought before the French Academy, in a paper by M. Seguin, one of the members. The subject, as might be supposed, found no favor with Arago, who, after the reading of this communication, intimated, in brief but somewhat vague terms, that his belief was, that the movement of the tables is caused by muscular action. And he proceeded to say: "What is most extraordinary and most difficult to explain in the phenomenon is the circumstance, that with impulsions, so to speak, infinitely small, imprinted on the table with the fingers, we in time can communicate to it active movements, (*des mouvemens considerables*.") This, however, he alleged, is no novelty, as "Mr. Elliot, a watchmaker, relates in the 'Philosopical Transactions' of some years ago, that two clocks having been hung to a wall, a foot apart, one of which was going, the other standing, the latter after a while began going too, being set in motion by the imperceptible vibrations transmitted from the other through the solid body between them — and it even continued going after the first one was stopped."

INFLUENCE OF THE MIND ON MUSCULAR AND NERVOUS ACTION.

The following letter on the subject of magnetization, &c., was addressed to the illustrious savant, Ampere, by M. Chevreuil, a member of the French Academy, and was first published in the *Revue des Deux Mondes*, in the year 1833. It was in 1812 that several persons affirmed that a pendulum formed of a heavy body and a flexible string would oscillate when held by the hand over certain substances, although the arm should remain stationary, and they urged M. Chevreuil to make the experiment.

" The pendulum I used (says M. Chevreuil) was an iron ring suspended by a flaxen thread; it had been arranged by a person who was very anxious that I should verify for myself the phenomenon which appeared when it was placed over water, a block of metal, or a living being — a phenomenon which I saw appear in his hands. It was not, I confess, without surprise that I saw it reproduced when, having taken hold with my right hand of the pendulum's string, I placed it above the mercury reservoir of my air-pump, an anvil, several animals, &c. I concluded from my experiments that, as I was informed there were only a certain number of bodies apt to determine the oscillations of the pendulum, it might be that, in interposing other bodies between the former and the pendulum, the oscillations would cease.

"Notwithstanding my presumption, my astonishment was great when, after having taken with my left hand a plate of glass or a cake of resin, &c., and having placed these bodies between the mercury and the pendulum which oscillated over it, I saw the oscillations diminish in length and then wholly cease. They recommenced when the intermediate body was taken away, and again ceased upon its re-interposition. This succession of phenomena was repeated a great many times, with a really remarkable constancy, whether the intermediate body was held by me or by any other person.

"The more extraordinary these effects seemed to me, the more necessary I felt the importance of verifying that they were foreign to all muscular motion of the arm, as I had been informed they were, in the most positive manner. This induced me to lean my right arm, which held the pendulum, upon a wooden support, which at intervals I gradually advanced from my shoulder to my hand, and brought back from my hand to my shoulder. I soon noticed that in the first circumstance the motion of the pendulum decreased in proportion as the support was placed near the hand, and that it ceased when the fingers which held the thread were themselves supported, whereas in the second case the contrary effect took place.

"This induced me to think that it was very probable that a muscular motion which took place unknown to me determined the phenomena; and I was the more inclined to take this opinion into consideration as I had a souvenir, vague in truth, of having been in *a certain state* when my eyes followed the oscillations described by the pendulum which I held in my hand.

"I made the experiments spoken of above over again, my arm being entirely free, and I convinced myself that the souvenir just spoken of was not an illusion of my mind, for I felt very distinctly that, while my eyes followed the oscillations of the pendulum, there was in me a *disposition or tendency to the motion*, which, involuntary as it seemed to be, was the better satisfied as the pendulum described larger arcs; consequently, I thought that if I had repeated the experiments, first taking care to blindfold my eyes, the results would be very different from those observed. It happened so exactly. While the pendulum oscillated above the mercury, a blindfold was placed over my eyes; the motion soon diminished; but, although the oscillations were feeble, they were not sensibly diminished by the interposition of the bodies, which seemed to have arrested them in my first experiments.

"Lastly, from the moment the pendulum was at repose, I still held it for a quarter of an hour over the mercury without its moving. During this interval, and totally unknown to me, the plate of glass and cake of resin had been interposed and withdrawn several times by persons in the room.

"This is the interpretation I give to these phenomena: When I held the pendulum in my hand, a muscular motion of my arm, although insensible to me, moved the pendulum from its repose, and when once the oscillations had commenced they were soon augmented by the influence exercised by the sight, so as to put me in that particlar frame of disposition or tendency to the motion. Now, it must be acknowledged that the muscular motion, even when it is increased by this same disposition, is nevertheless weak enough to stop, I will not say under the empire of the will, but when it has simply the thought of trying to see whether this or that will stop it.

"So, then, there is an intimate connexion between the execution of certain motions and the act of the mind relative to them, although this mental act is not the will which commands the muscular organs. In this regard, it seems to me that the phenomena I have described is interesting in connexion with psychology, and even the history of sciences; they prove how easy it is to take illusions for realities, whenever we turn our attention towards a phenomenon wherein our bodies play a part, especially in circumstances which have not been sufficiently analyzed.

"In truth, if I had contented myself with making the pendulum oscillate above certain bodies, and with the experiments where these oscillations were arrested when glass, resin, &c., were interposed between the pendulum and the body which seemed to determine its motion, then certainly I would have had no reason not to believe in the divining rod, or any other thing of the same sort. Now, it may be easily conceived how honest and educated men are sometimes led to recur to very chimerical ideas to explain phenomena which are not in reality removed from the physical world we know.

"Consequently, I conceive without difficulty that an honest man, whose whole attention is fixed upon the motion a rod which he holds in his hands may take from a cause unknown to him, may receive from any the least circumstance the tendency to motion necessary to superinduce the appearance of the expected phenomenon. For example, if that man seeks a spring, and he has not his eyes blindfolded, the sight of a green plat of grass over which he is walking may, unknown to himself, determine in him the muscular motion capable of disarranging the rod by the established association between the idea of active vegetation and that of water.

"The preceding facts, and the interpretation above given of them, have led me to connect them with others which we may daily observe. From this connexion the analysis of them becomes both more simple and more precise than it was, at the same that time they form an *ensemble* of facts, whose general interpretation is susceptible of a great extension. But, before going further, let us distinctly remember that my observations present two leading circumstances:

"First. To think that a pendulum held in hand may move, and that it moves without our having the consciousness that the muscular organ gives it the least impulsion. *This is the first fact.*

"Secondly. To see this pendulum oscillate, and its oscillations become longer from the influence of the sight upon the muscular organ; and this, too, without our having the consciousness of it. *This is the second fact.*

"The tendency to motion, determined in us by the sight of a body in motion, is found in several cases. For example:

"1. When the attention is wholly fixed upon a bird flying, a stone thrown, running water, the body of the spectator is directed more or less towards the line of motion.

"2. When a billiard player follows with his eye the ball he has just put in motion, he places his body in the position he would see the ball follow, as if it was still possible for him to direct it towards the mark whither he sought to direct it.

"When we walk upon a slippery place, everybody knows with what promptness we throw ourselves on the side opposite to that whither our body is carried in consequence of losing its equilibrium; but a circumstance less generally known is, that a tendency to the motion appears even when it is impossible for us to move in the sense of this tendency. For example, in a carriage the fear of being upset makes us lean in a direction opposite to that which menaces us, and from it result efforts which are so much the greater as the fright and irritability are greater. I believe that, in ordinary falls, the falling is less painful than the effort made to prevent the fall. It is in this sense that I understand the justness of the proverb: *Il y a un Dieu pour les enfans et pour les ivrognes!*

"The tendency to motion in a determined sense, resulting from the attention given to a certain object, seems to me the prime cause of several phenomena generally ascribed to imitation. Thus when we have seen or have heard a person gape, the muscular motion of gaping generally takes place in us in consequence. I may make the same remark about the communication of laughter, and, besides, this example presents more than any other analogous one, a circumstance which seems to me to support the explanation I have given of these phenomena. For laughter, feeble at first, may, if kept up, become accelerated (pardon the word) as we saw the oscillations of the pendulum held in the hand augment in amplitude, influenced by the sight; and laughter, in being accelerated, may go to convulsions.

"I do not doubt but that the sight of certain actions proper, so act forcibly upon our frail machine, that the relation of these same actions animates with the voice or gesture; or, further, the knowledge communicated of them by merely reading about them does not induce some individuals to do these very same actions, in consequence of a tendency to motion, which thus mechanically determines them to an act of which they never would have thought, had not some circumstance, extraneous to their will, presented it, and to which they would never have been led, but by that which we call instinct in animals.

"In here terminating the exposition of facts which seem connected with my observations, I think I should make a remark which is certainly contained in the foregoing paragraphs, but which may escape some reader: it is, that this tendency to motion, to which I attribute the prime cause of a great number of our actions, takes place only when we are in a certain state, which is exactly that which magnetisers call *faith.*

"The existence of this state is perfectly demonstrated by my experiments. So long as I believed the motion of the pendulum which I held in my hand *possible*, it took place; but, after having discovered the cause of it, it was impossible for me to reproduce it. It is because we are not always in the same state, that we do not constantly receive the same impression from the same thing.

"Thus the gaping of another does not always make us gape; laughter is not always communicated from the laugher to his neighbor, &c. The great orator who wishes to make the crowd share his passion does not reach at one leap his object; he commences by disposing his audience to it, and it is only after he has made himself master of them, that he gives his last argument, his last trait. The great poet, the great writer constantly resort to the same artifice; they first prepare their reader for their final impression.

"Nothing is more curious in the study of the causes which determine man's actions, than the knowledge of the means employed by the shopkeeper to attract and fix the buyer's attention upon the qualities of the article he would have him take; or the knowledge of the means employed by the 'necromancer' to have one rather than another card drawn from a pack, or to divert the spectator's attention upon one thing so as to withdraw it from another, a diversion without which the 'necromancer' would cause no surprise, which is the great object of his art It results from these considerations that the most different professions employ quite analogous although excessively varied means to attain the same end, that of first fixing man's attention so as afterwards to produce on him a determined effect.

"I think my observations are connected with the history of the faculties of animals; that some of their acts attributed to instinct are really of the class just spoken of. This seems to me especially true of gregarious animals; and it seems to me that it would be very interesting to study in this regard the influence of their leaders upon the subordinate members.

"Do not the instances above mentioned throw some light upon the cause of the fascination one animal exerts over another."

ON THE NATURE OF HEAT.

WITHIN the past few years some new views respecting the nature of heat have been brought forward. They are highly interesting theoretically, and important in their practical application, inasmuch as they modify in a considerable degree the theory of the steam-engine, the air-engine, or any other in which the motive power is derived immediately from heat.

A theory which proposes to explain the thermal agency by which motive power is produced, and to determine the numerical relations between the quantity of heat and the quantity of mechanical effect produced by it, may be termed a *dynamical theory of heat*. Carnot was the first to give to such a theory a mathematical form. His theory rested on propositions which were regarded as axiomatic. The first embodied the conception of a perfect thermo-dynamic engine, and has been equally adopted by the advocates of the new theory of heat. Again, suppose a given quantity of heat to enter a body by any process, and thereby to change its temperature and general physical state; and then, by a second process, suppose the body to be restored exactly to its primitive temperature and condition, — Carnot's second fundamental proposition asserts that the quantity of heat which passes out of the body into surrounding space, or into other bodies, in the form of heat, during the second operation, is precisely the same as that which passed into the body during the first operation. This view does not recognize the possibility of heat being lost by conversion into something else, — and in this particular it is at variance with the new theory, which asserts that heat may be lost by conversion into mechanical effect. To elucidate this distinction, suppose a quantity of water to be poured into an empty vessel. It might then be asserted that, in emptying the vessel again, we must pour out just as much water as we had previously poured in. This would be equivalent to Carnot's proposition with respect to heat. But suppose a part of the water while in the vessel to be converted into vapor; then it would not be true that in emptying the vessel the same quantity of water, in the form of water, must pass out of the vessel as had before passed into it, since a portion would have passed out in the form of vapor. This is analogous to the assertion of the new theory with regard to heat,— which may be lost, according to that theory, by conversion into mechanical effect, in a manner analogous to that in which water may be said to be lost by conversion into vapor. But the new theory not only asserts generally the convertibility of heat into mechanical effect, and the converse, — but also more definitely, that whatever be the mode of converting the one into the other — and whether heat be employed to produce mechanical effect, or mechanical force be employed to produce heat, — the same quantity of the one is always the equivalent of the same quantity of the other. This proposition can only be established by experiment. Rumford, who was one of the first to adopt the fundamental notion of this theory as regards the nature of heat, made a rough attempt to determine the relation between the force producing friction and the heat generated by it; but it was reserved for Mr. Joule to lay the true foundation of this theory by a series of experiments which, in the philosophical discernment with which they were conceived, and the ingenuity with which they were executed, have not often, perhaps, been surpassed. In whatever way he employed mechanical force to produce heat, he found, approximately, the same quantity of heat produced by the same amount of force; the force being estimated in foot-pounds according to the usual mode in practical mechanics,— *i. e.*, by the motive power employed in raising a weight of 1 lb. through the space of 1 foot. The conclusion adopted by Mr. Joule is, that 1° Fahr. is equivalent to 772 foot-pounds.

These results are unquestionably among the most curious and interesting of those which experimental research has recently brought before us. When first announced, some ten or twelve years ago, they did not attract the attention which they deserved; but more recently their importance has been fully recognized by all those who cultivate the department of science to which they belong. Of this Mr. Joule received last year one of the most gratifying proofs, in the award made to him by the Council of the Royal Society of one of the medals placed annually at their disposal.

This theory is in perfect harmony with the opinions now very generally entertained respecting *radiant heat*. Formerly light and heat were regarded as consisting of material particles continually radiating from luminous and heated bodies respectively; but it may now be considered as established beyond controversy that light is propagated through space by the vibrations of an exceedingly refined ethereal medium, in a manner exactly analogous to that in which sound is propagated by the vibration of the air,—and it is now supposed that radiant heat is propagated in a similar manner. This theory of radiant heat, in accordance with the dynamical theory of which I have been speaking, involves the hypothesis that the particles of a heated body, or a particular set of them, are maintained in a state of vibration, similar to that in which a sonorous body is known to be, and in which a luminous body is believed to be. At the same time, there are remarkable differences between light and heat. We know that light is propagated with enormous velocity, whether in free space or through transparent media; sound also is propagated with great rapidity, and more rapidly through most media than through air. Heat, on the contrary, whatever may be the velocity with which it may radiate through free space, is usually transmitted with extreme slowness through terrestrial media. There appears to be nothing in light analogous to the slow *conduction* of heat. Again, the vibrations which render a body sonorous have no tendency to expand its dimensions, nor is there reason to suppose that luminous vibrations have any such tendency on luminous bodies; whereas, with the exception of particular cases, heat does produce expansion. It is principally from this property of heat that it becomes available for the production of motive power, as, for instance, in the expansion of steam. These phenomena of the slow conduction of heat and the expansion of heated bodies, are proofs of differences between light and heat not less curious than the analogies above indicated. They must, of course, be accounted for by any perfect theory of heat. Mr. Rankine has written an ingenious paper on a molecular theory of heat; but before any such theory can be pronounced upon, it will be necessary, I conceive, to see its bearing on other molecular phenomena, with which those of heat are in all probability intimately connected. Prof. W. Thomson has also given a clear and compendious mathematical exposition of the new dynamical theory of heat, founded on Mr. Joule's principle of the exact equivalence of heat and mechanical effect. This is not, like Mr. Rankine's, a *molecular* theory, but one which must henceforth take the place of Carnot's theory.

Some interesting speculations suggested by the new theory of heat have been recently brought out by Prof. W. Thomson. The heat of a heavenly body placed under the same conditions as the sun, must, it has been said, be ultimately exhausted by its rapid emission. This assertion assumes the matter composing the sun to have certain properties like those of terrestrial matter with respect to the generation and emission of heat; but Prof. Thomson's argument places the subject on better grounds, admitting, always, the truth of the new theory of heat. That theory asserts, in the sense which I have already stated, the exact equivalence of heat and motive power; and that a body, in sending forth heat, must lose a portion of that internal motion of its constituent particles on which its thermal state depends. Now we know that no mutual action of these constituent particles can continue to generate motion which might compensate for the loss of motion thus sustained. This is a simple deduction from dynamical laws and principles, independent of any property of terrestrial matter which may possibly distinguish it from that of the sun. Hence, then, it is on these dynamical principles that we may rest the assertion that the sun cannot continue for an indefinite time to emit the same quantity of heat as at present, unless his thermal energy be renovated from some extraneous source. The same conclusion may be applied to all other bodies in the universe which, like our sun, may be centers of intense heat; and, hence, recognizing no adequate external supplies of heat to renovate these existing centers of heat, Prof. Thomson concludes that the dispersion of heat, and consequently of physical energy, from the sun and stars into surrounding space without any recognizable means of reconcentration, is the existing order of nature. In such case the heat of the sun must ultimately be diminished, and the physical condition of the earth therefore altered, in a degree altogether inconsistent with the theory of non-progression.

Mr. Rankine, however, has ingeniously suggested an hypothesis according to which the reconcentration of heat is conceivable. Assuming the physical universe to be of finite extent and surrounded by an absolute *vacuum*, radiant heat (supposing it to be propagated in the same way as light) would be incapable of passing into the *vacuum*, and would be reflected back to foci corresponding to the points from which it emanated. A reconcentration of heat would thus be effected; and any of the heavenly bodies which had previously lost their heat, might, on passing through these foci, be rekindled into bright centres of radiant heat. I have alluded more particularly to this very ingenious, though, perhaps, fanciful hypothesis, because some persons have, I believe, regarded this view of the subject as affording a sanction to the theory of *non-progression;* but even if we should admit its truth to the fullest extent, it may be deemed, I think, entirely inconsistent with that uniformity and permanence of physical condition in any of the heavenly bodies which the theory just mentioned requires in our own planet. The author of this hypothesis did not possibly contemplate any such application of it; nor am I aware how far he would advocate it as really applicable to the actual constitution of the material universe, or would regard it as suggesting a possible and concievable, rather than a probable, mode of counteracting the constant dispersion of heat from its existing centers. He has not, I think, attempted to work out the consequences of the hypothesis as applied to *light*, — to which it must, I conceive, be necessarily considered applicable if it be so to heat. In such case the foci of the reflected heat would be coincident with those of the reflected light, proceeding originally from the same luminous bodies. These foci would thus become visible as the images of stars; so that the apparent number of stars would be constantly increasing with the increasing number of images of each star produced by successive reflexions. This will scarcely be considered the actual order of nature. It would be easy to trace other consequences of the application of this hypothesis to light; but I would at present merely state that my own convictions entirely coincide with those of Prof. Thomson.

In the year 1824, M. Carnot, of Paris, published a pamphlet entitled *Reflexions sur la puissance motrice du feu*, which contains ideas, (clearly expressed) which have long been *current*, and still maintain authority in some minds. This person advanced that in every fire machine the labor effected is due simply to the passage of heat through the moving power. The imponderable fluid acted somewhat like the water which feeds an hydraulic wheel, and whose motive power depends upon the difference of the level whence the water flows. As after having produced its effects the water may be found in the same quantity below as above the wheel, so, notwithstanding the fall of the temperature occasioned by its diffusion, the caloric was said to exist without loss when it came out of the fire machine. In reasoning in this manner about the steam-engine, the boiler was compared to the mill-dam basin, and the condenser represented after a fashion by the lower basin. To complete the analogy, the word "fall" was employed to express the passage of the heat from the boiler to the condenser, and the height of this "fall" corresponded to the differences of temperature. The greater was this difference or height of the fall, measured according to the degrees of the thermometric scale, the greater was the amount of heat which passed in the same time, and the more powerful was the machine. To submit this theory to a rigorous verification, it would have been necessary exactly to measure the quantities of heat really contained in the steam before and after it had performed its functions, and to see if in truth the equality was maintained. At that date an experiment of such great precision could not well be made. They contented themselves with reasoning *a priori*. And yet, if they had only thought of a very common phenomenon: caloric developed by percussion, they would have seen its weakness. The philosophical impossibility of the truth of this theory is escaped in a new theory, by considering the intervention of heat from another point of view. In the new theory, the quantity of heat communicated to the boiler, and which from that moment belongs to the machine, is not kept *in toto* in a state of caloric; a portion instantly disappears, and in its place they receive an equivalent quantity of motive power. This power is, in every case, in proportion to the quantity of heat lost; or rather, this heat is transformed into mechanical labor; it reappears so soon as the labor is employed, in the quantity of water beaten up by the steamship's paddles, &c., &c. According to Carnot, when the temperature fell, this "fall" was accompanied with the production of a certain amount of labor. In the new theory, the dilation of bodies by the penetration of heat, changes the nature of a part of the bodies, and the deficit which results therefrom is in proportion to the resistance to be overcome during the accomplishment of this dilation. The heat disappears, but a disposable labor is produced, and science conquers a new idea — that a weight raised to a certain height is the *equivalent* of a certain amount of heat.

M. V. Regnault, (the best experimenter in France,) is fast demolishing Carnot's theory by irresistable facts gathered in his laboratory. "The heat of the boiler," said Carnot, "must be found integrally on its egress from the cylinder." But according to the most precise measures, M. Regnault found that in a very close machine, (without condensation) into which steam penetrated 5 atmospheres, and left it under ordinary pressure, the quantity of heat possessed by the steam on its entrance, was about 653 unities, and at its egress about 637. In a machine with a condenser, the difference is still greater, the figure 637 is reduced to 619. There are 16 unities lost in the first, and 34 in the second case. In other terms, there is 1-40 or 1-20 part of the total heat transformed into available labor, which explains, by the way, clearly enough, the economical value of machines with condensers. It was also pretended that the quantities of heat disengaged or absorbed by the same elastic fluid, were equal when the fluid passed from the same initial state to a final identical state, whatever might be the sense in which the transition was made; in other words, it was admitted that these quantities of heat depended only on the initial and final conditions of temperature and pression, and that they were independent of the intermediate circumstances through which the fluid passed. If these were true, the same result would be obtained in these two cases: air is condensed to 10 atmospheres in a vase which is placed so charged in a *calorimetre*, or furnace; at a specified moment the capacity of the recipient is suddenly doubled, necessarily the pression descends to 5 atmospheres, and this dilation produces a cold which may be appreciated by the thermometer. On the other hand, place in the same furnace two reservoirs of the same capacity, exhaust the air in one, in the other condense the air to ten atmospheres. The apparatus having reached a state sufficiently stationary for a delicate observation, communication between the two reservoirs is suddenly made; the gas spreads, as before, in a double space, as the pression as before is reduced to 5 atmospheres. Who would not expect to witness, as in the other case, a decline of temperature? Yet no such thing takes place; the column of mercury in the thermometer remains perfectly stationary! This experiment, imagined by M. Joule, acknowledged to be exact by M. Regnault, is certainly very remarkable, and all natural philosophers will be greatly struck by it. If the initial and final conditions only were considered, the two experiments would seem to be the same, and the cause of the difference of the caloric effects produced in the two cases, would pass unperceived. But if inquiry be made of *available labor produced*, it would be found to be considerable in the circumstances where the temperature fell, while in the other case, it was *null*. When the capacity of the first vase is doubled in volume, the side which withdraws, undergoes an effort which would be capable of raising a weight placed outside of the furnace, while at the moment the two reservoirs are placed in communication, the escape of air can engender only currents of air, which die in the interior of the reservoir, without transmitting anything outside. No experiment could be made to demonstrate more clearly the close connection existing between heat and the result of its transformation into mechancal labor.

In a recent communication to the French Academy, M. Regnault continues the subject. In all fire machines heretofore employed, heat acts through the medium of an elastic fluid, gas or vapor, saturated or not saturated. This elastic fluid is only a vehicle to which heat is confided, for it has need of a substratum wherein to fix itself, and without which it would instantly escape in its radiating form; consequently it is necessary to ascertain the quantity of heat the different vehicles will take or leave in passing from one to another temperature. This quantity of heat, easily determined in solids and in liquids, may serve to characterize the different bodies in nature, and it has been felicitously named *specific heat:* water is in this regard characterized among all other bodies in a very remarkable manner; it possesses (to use the received phrase), the greatest capacity for heat; i. e. it can contain in the same weight a greater quantity of caloric than any other known body in nature. Consequently, if any one had to distinguish water in the midst of other liquids, all enclosed in sealed bottles, it could be discerned by this single characteristic: to raise its temperature ten, twenty, thirty degrees, more heat, and consequently more fuel would be required than for all the others. It is in consequence of its great capacity for heat that water is so convenient to fill heating apparatus in which the experimenter does not wish to make a fire. If the feet-warmers ladies place in their pews or carriages during the winter, were filled with alcohol or oil, or mercury, they would complain of the rapidity with which they cool, even more than they do now. It is also partly to the greatness of this coefficient that the sea owes its equality of temperature. Its mass taking a great deal of time to fill with heat, is also very slow in dischargement, so that winter comes before its reheating is concluded, and reciprocally summer returns before the cooling has made very great progress. The difference between the capacities of solids and liquids for the "storing" of heat must, according to all probability, also exist in gases, but as these may besides be treated in two different ways, as they are forced, during the change of temperature, to keep the same volume or the same pressure, there are two different specific heats to be considered in each gas, namely, specific heat *under constant pressure*, and specific heat *under constant* *volume.* The first definition alone coincides with that admitted for solid and liquid bodies, and it is also the only one which has been found practicable for a direct experimental determination. As to the second it seems accessible only to very indirect methods, of so difficult practice that an illustrious natural philosopher, the conscientious Dulong, died laboring at it.

Among all the researches made to determine the specific heat of gases, under constant pression, that of Delaroche and Berard, which was crowned in 1823 by the Academy, is still the most complete treatise on this subject; it is also that which the nearest approaches the results M. Regnault has just obtained. Delaroche and Berard have obtained to express the specific heat of simple gases, considered under the same volume, numbers which differ little each from the other. Besides, in augmenting by condensation the density of the atmospheric air, these two natural philosophers have remarked an increase of specific heat; but they thought they remarked the latter increased less rapidly than the former. Lastly, Delaroche and Berard admitted, according to theoretical considerations, founded besides upon the direct experiments of Gay-Lussac, that the specific heat of gases rapidly augmented with the temperature. Thus, at the same time that oxygen, hydrogen and azote had, under the same volume, the same specific heat, science had admitted as an inextricable complication of the mechanism of simple gases, that the specific heat of the same mass varied with the temperature and the density. In examining the new figures, obtained by M. Regnault, the student will find that invariability which aids the memory and satisfies the mind. We see that a *gramme* of air requires, say to elevate its temperature to 10 degrees, the same quantity of heat, whatever may be the space it occupies, whatever may be its initial heat. The physical atoms heat themselves each for itself, as if it were alone, and independently of the distance its neighbors may be. And yet, it may be said, when that air is dilated, cold is produced by its forcing outwards the sides which confine it in a vessel. This is an additional reason to regard this lost heat as a purely mechanical phenomenon — an additional reason to endeavor to find it merely in the labor produced. Let us renounce, then, this false idea that the gases possess so much the more heat as they occupy a larger space. The experiment of connected reservoirs demonstrates the contrary; it was an inexact notion, founded upon a gross assimilation of a gaseous mass to a sort of sponge, capable of absorbing or expressing the caloric fluid, according to the extension it was allowed to occupy.

SPECIFIC HEAT OF ELASTIC FLUIDS.

The following is an abstract of a paper recently read before the French Academy, on the specific heat of elastic fluids, by M. Regnault.

After a preliminary introduction and allusion to Ericsson's engines, he says: — For more than twelve years I have been occupied in collecting the data necessary for the solution of the following problem: What is, theoretically, the motive power which may be obtained from a given quantity of heat by applying it to the development and dilatation of various elastic fluids, under the various conditions which are practically realizable? At the time when I entered upon these researches, the question appeared to me more simple than it does at present. But, as is usually the case in sciences of observation, in proportion as I advanced in my studies, the subject has continually expanded. Within the last few years the mechanical theory of heat has occupied the attention of a great number of mathematicians. It has been assumed that heat may be converted into mechanical action, and reciprocally that mechanical action may be converted into heat. According to the old theory, the quantity of heat possessed by the elastic fluid at its entrence into the steam-engine is found undiminished in the elastic fluid which is discharged from it, the mechanical action being produced solely by the passage of heat through the engine. According to the new theory, the whole of the quantity of heat does not remain in the state of heat; a portion of heat disappears during the passage through the engine, and the motive power produced is in all cases proportional to the quantity of heat lost. According to my experiments, the quantity of heat possessed by the fluid at its entrance into a high pressure steam-engine is 653 units; that which it retains at its escape amounts to 637. According to the theory of which I am speaking, the quantity of heat rendered available for mechanical action would be 653 minus 637, or 16 units; that is to say, only one-fortieth part of the quantity of heat communicated to the boiler. In a condensing engine, the heat rendered available would be a little more than one-twentieth. In air-machines, where the motive force is produced by the expansion of the air in the machine by heat, the action should always be proportional to the difference between the quantities of heat possessed by the air on entering and escaping from the engine; in other words, equal to the loss of that heat by the air in traversing the engine. But as, according to Ericsson's system, the heat which the air possesses at the time of its escape is deposited in substances from which the fresh air in entering abstracts it, in order to convey it back again into the engine, it is evident that theoretically speaking, in these latter engines all the heat is rendered available for the mechanical action, while in the best constructed steam-engine only one twentieth of it is rendered available. It must, however, be remembered that I do not here take into consideration the exterior losses, from mechanical or industrial obstacles, which may present themselves in practice. Messrs. Joule, Thomson and Rankine in England, Messrs. Mayer and Chassius in Germany, setting out from different points of view, have developed mathematically the mechanical theory of heat. In the course of my researches I have encountered indeed at every step anomalies which appeared to me inexplicable in accordance with the theories formerly recognized. For the sake of illustration I will quote one instance. 1. A mass of gas under a pressure of 10 atmospheres is contained in a space which is suddenly doubled; the pressure falls to 5 atmospheres. 2. Two reservoirs of equal capacity are placed in a calorimeter, the one is filled with a gas under a pressure of

10 atmospheres, the second is perfectly empty. When a communication is suddenly made between the two reservoirs the gas expands to double its volume, and the pressure is reduced to 5 atmospheres. In these two experiments then, the initial and final conditions of the gas are the same: but this identity of condition is accompanied by calorific results which are very different — for while in the former experiment there is a reduction of temperature, in the second the calorimeter does not indicate the slightest alteration of temperature.

M. Regnault then gives a table of specific heats of various elastic fluids, the result of his own experiments. Some of these are widely different from the result hitherto obtained by other experimenters. The following are the more important:—

Specific heat of:	New Experiments.		Former Exp'ts.	Specific heat of:	New Experiments.		Former Exp'ts.
Water	1,000	....	1,000	Carbonic Oxyd	248	....	288
Atmospheric Air	237	....	267	Water Vapor	475	....	847
Oxygen	218	....	236	Alcohol Vapor	451	....	—
Nitrogen	244	....	275	Ether Vapor	481	....	—
Hydrogen	3,405	....	3,294	Chloroform Vapor	157	....	—
Carbonic Acid	216	....	221				

The specific heat of air has been found the same at different temperatures, from 30 deg. below zero to about 500 deg. above it, and under pressures varying from one to ten atmospheres. The specific heat of steam is given at about one half the number formerly assigned to it.

ON THE OSCILLATORY THEORY OF LIGHT.

In a paper on the above subject read before the British Association, by Mr. J. Rankine, the author endeavors, while retaining the whole of the mathematical forms of the undulatory theory of light, to render the physical hypothesis which serves as its basis more consistent with itself and with the known properties of matter. Light, according to the undulatory theory in its most general sense, consists in the propagation of some species of motion amongst the particles of the luminiferous medium, the nature and magnitude of which motion are functions of the direction and length of certain lines transverse to the direction of propagation. According to the existing hypothesis of *vibrations*, this motion is a vibration of the atoms of the luminiferous medium in a plane transverse to the direction of propagation. In order to transmit motions of this kind, the parts of the luminiferous medium must resist compression and distortion like those of an elastic solid body; its transverse elasticity being great enough to transmit one of the most powerful kinds of physical energy with a speed in comparison with which that of the swiftest planets of our system is appreciable, but no more, and its longitudinal elasticity immensely greater, — both these elasticities being at the same time so weak as to offer no perceptible resistance to the motion of the planets and other visible bodies. The author considers that it is impossible to admit this hypothesis as a physical reality. He also points out the difficulties arising from certain inconsistencies in the present theory, as to the relation of the direction of vibration in polarized light to the plane of polarization. The author then proposes what he calls the *hypothesis of oscillations*, which consists mainly in conceiving that the luminiferous medium consists of detached atoms or nuclei distributed throughout all space, more or less loaded with atmospheres of ordinary matter, and endowed with a species of *polarity*, in virtue of which three orthogonal axes in each atom tend to place themselves parallel respectively to the three corresponding axes in every other atom; and that plane-polarized light consists in a small oscillatory movement of each atom round an axis transverse to the direction of propagation and perpendicular to the plane of polarization. The square of the velocity of propagation of such a movement would be proportional directly to a co-efficient depending on the rotative force or polarity of the particles in a given space, and inversely to a co-efficient denoting the sum of the moments of inertia of the luminiferous atoms in a given space together, with their loads of atmosphere, round the axes of oscillation. The author shows that it is necessary to suppose that the co-efficient of polarity for transverse axes of oscillation is the same in all substances, and for all directions; and that the variations in the velocity of light depend wholly on the variations of the moments of inertia of the luminiferous atoms with their loads, in different substances, and round different axes. The co-efficient of polarity for longitudinal axes of oscilliation must be supposed to be very great compared with that for transverse axes. How powerful soever the polarity may be, which is here ascribed to the luminiferous atoms, it is a species of force which must necessarily be wholly destitute of effect in producing resistance to compression or distortion, so that it is no longer necessary to suppose the luminiferous medium to have the properties of an elastic solid. The author deduces from this hypothesis the known mathematical laws of the wave-surface, of the intensity and phase of reflected and refracted light, and its plane, circular, and elliptic polarization, and of all other phenomena to which the existing theory has been applied, the equations being identical in form.

RADIATION OF LUMINOUS BODIES.

On looking at a very brilliant light, it sometimes appears to be surrounded by brilliant luminous rays, clear, free from cloudiness, and which must not be confounded with those caused by the eye-lashes when the eyes are partially closed. These rays may be observed most distinctly by looking at an image of the sun reflected upon the surface of a convex glass, or still better upon a lens having considerable curvature. They may be most easily observed by looking at an image of the sun formed in the focus of a lens placed at the extremity of a tube blackened in the interior. If the observer place himself in a room into which the light penetrates only through a narrow opening, the phenomenon appears with great splendor, and it may even be said with extraordinary magnificence. The rays are either white, or present all the colors of the spectrum. In that case a motion appears to take place in their interior, which cannot be compared with anything better than that of a liquid circulating with difficulty in narrow channels, in which it meets with obstacles. There are also seen irregular concentric rings, which appear to move from their common centre. Whatever may be the circumstances in which the observer places himself, and whatever may be the precautions which are taken to obviate the complication of the phenomenon, the rays do not appear disposed as those in a circle; they have not all a common center, but form entangled bundles in a very peculiar manner.

At first sight I was struck with the resemblance which appeared to me to exist between the arrangement of these rays and that of the fibers of the crystalline lens; and I attempted immediately some experiments directed from that point of view. From among those which I have made I will quote the two following, which, if they do not prove that this apparent radiation is to be attributed to the crystalline lens, at least show completely that the phenomenon takes place in the eye, and depends upon the structure of that organ.

1. On looking at an image of the sun, produced in the circumstances above described, through a black screen, with a circular opening of five or six millims. diameter, the image is seen upon the surface which reflects it; while the rays are separated from it and appear to be super-imposed upon the screen, and this even when it is brought very near the eye.

2. If the head is inclined to the right or the left, the want of symmetry which is observed in the arrangement of the rays follows the movement of the eye, which under those circumstances turns upon its axis in the direction in which the head is inclined. — *M. Baudrimont*, *Comptes Rendus.*

ON TWINKLING.

The following paper, from the "Annuaire du Bureau des Longitudes,' 1852, one of the last that issued from the pen of M. Arago, has been translated and published in the 'Proceedings of the Astronomical Society." M. Arago commences his inquiry by giving an exact definition of the term scintillation. It is, he remarks, from not adopting a similar practice that astronomers and other physical inquirers have hitherto failed to arrive at a satisfactory explanation of the phenomenon. He affirms then that, in so far as naked-eye observers of the heavens are concerned, scintillation, or twinkling, consists in very rapid fluctuations in the brightness of the stars. These changes are almost always accompanied by variations of color and certain secondary effects, which are the immediate consequences of every increase or diminution of brightness; such as considerable alterations in the apparent magnitudes of the stars, and in the length of the diverging rays, which appear to issue in different directions from their centers. It has been remarked from a very early age that the phenomenon of twinkling is accompanied by a change of color. M.

Arago states, upon the authority of M. Babinet, that the name of Barakesch, given by the Arabians to the star Sirius, signifies the star of a thousand colors. He also cites various passages from the works of Tycho Brahe, Kepler, and other modern inquirers, indicative of a similar change of color attending the process of twinkling. M. Arago asserts further, that the twinkling of the planets is a well established fact. Thus observers generally, from Tycho Brahe downwards, have remarked that Mercury twinkles very strongly. Venus has also been observed to twinkle, and even Mars and Jupiter, though feebly. Tycho Brahe has remarked that Saturn never twinkles, but this opinion has been controverted by Scheiner and other observers, although it is generally admitted that the phenomenon is exceedingly difficult to be recognised in the case of this planet. An impression has generally prevailed that the stars do not twinkle in telescopes M. Arago, however asserts that this opinion is erroneous. Even a few years after the invention of the telescope Simon Marius remarked that, by removing the eye-piece of the telescope, the images of the stars and planets appear enlarged, and exhibited rapid fluctuations of brightness and color. In 1814, Nicholson showed that a similar phenomenon would be produced, if the eye-piece of an achromatic telescope was pushed out of focus. The same inquirer also gave an account of another experiment, which tended to illustrate the rapid fluctuation of color which the stars undergo during the process of twinkling. The telescope being adjusted to distinct vision, he applied to it a smart vibration, which caused the image of the star to be transformed into a curved line of light, returning into itself, and diversified by several colors. A similar phenomenon presented itself on the occasion of each successive vibration. He estimates that each color occupied about a third of the whole length of the curve, and assuming that he applied ten vibrations to the telescope in the course of a second, he hence concluded that the light of Sirius passes through thirty changes of color in a second of time. It follows, as a necessary consequence of this experiment, that the stars in general shine only by a portion of their light, the effect of twinkling being to diminish their brightness. It is easy to conceive, therefore, that a star which is estimated to be of the seventh magnitude, because it is usually invisible to the naked eye, might become distinctly perceptible if the phenomenon of twinkling were to cease.

After giving a detailed account of the circumstances which accompany the twinkling of the celestial bodies, and of the modifications to which they are subject, M. Arago next proceeds to explain his views of the physical origin of the phenomenon. He maintains that the only satisfactory theory which can be advanced on the subject is that which connects the phenomenon with the principle of the interference of light. He illustrates the latter principle by the well-known experiment, in which two rays of light emanating in different directions from a luminous point, are made to converge again by being reflected from the surfaces of two mirrors, and to combine together, or to destroy each other, according to the conditions of the experiment. If the light from which the rays issue be homogeneous, and if the routes severally traversed by them be made to differ in length by gradually displacing one of the mirrors, the point where they meet after reflexion will, in some positions of the movable mirror, exhibit a very vivid light, while in other intermediate positions it will appear quite black. The positions of the movable mirror, corresponding to which the two rays thus alternately conspire together or destroy each other, will vary with the color of the spectrum employed in the experiment. It results from this important fact, that when rays of white light emanate from the luminous point, they will exhibit at their point of concourse after reflexion a succession of prismatic colors, depending in each case on the position of the movable mirror. It is found that similar effects may be produced, if, instead of causing the routes of the two rays to differ in length, the refrangibility of the media through which they pass be subjected to a similar variation. It is upon these two facts that M. Arago has established his theory of scintillation. In the case of telescopic observations, he supposes that the rays of light which enter the telescope at opposite extremities of a diameter of the object-glass, may have traversed strata of the upper regions of the atmosphere, which, either from variations of density or temperature, or from hygrometic causes, may possess different refractive powers. It might happen from this cause that the red rays at the one extremity of the diameter might totally destroy those at the opposite extremity, and that the focus might pass from the normal color of white to that of green, the complementary color of red. In the next instant the green might be totally destroyed, and the color of the focus would, consequently, be red; and similar effects might manifestly be produced each successive instant, by the destruction now of one color and now of another color of the spectrum. Generally, the rays will only partially destroy each other by their interference; in which case the light will still be colored at the focus, although less intensely than if the destruction had been complete. M. Arago had already established by experiment, that if even the twentieth part of a pencil of light were extinguished by the interference of any of the homogeneous rays, the light at the focus would appear sensibly colored. It would, therefore, be sufficient that the strata of the atmosphere should, by reason of their unequal refrangibility, affect intermittently, and in a suitable degree, the twentieth part of the rays which the surface of a lens embraces in order that the focal point should acquire in succession the different prismatic colors. "Now," says M. Arago, "if we take into consideration the great length of the route traversed by the light from the superior limits of the atmosphere to the object-glass of the telescope; if we reflect, moreover, on the small difference of refrangibility which suffices to occasion the passage of two rays from the state of accord to that of destruction, on the effect of winds, however moderate, bringing incessantly new atmospheric strata before the telescope, it cannot excite any surprise that in observing Sirius, a star sufficiently low in our latitudes, as many as thirty changes of color in a second have been noted." Having thus explained, by the principle of the interference of light, the twinkling of the stars in telescopes, M. Arago finds no difficulty in applying the same explanation to observations with the naked eye. He then proceeds to show how the twinkling of the planets may be accounted for by the same principle, and he concludes the exposition of his views on this interesting subject by suggesting three different modes of measuring the scintillation of a star. We shall confine ourselves to a brief notice of the first of these scintillometres, as he terms them, which is unquestionably the most ingenious in its conception, and the most conclusive as regards the character of its results. It depends on an experiment, which is originally due to M. Arago himself, and which he first gave an account of in the year 1824. If a diaphram be placed before the object-glass of a telescope, so as to allow the light to pass through a circular aperture, and if a star be observed with the telescope when the eye-piece is in the position of distinct vision, the image of the star will resemble a vascillating disc of light surrounded by alternate dark and bright rings. If the eye-piece be now gradually pushed in, there is a second position, in which the luminous disk in the center will be replaced by a black hole surrounded by alternate bright and dark rings. By continuing to push the eye-piece towards the focus a third position will be found, in which the image will resemble that observed in the first instance; and thus a constant recurrence will take place as the eye-piece is pushed forward, the image alternating between a luminous center surrounded by dark and bright rings, and a central dark hole surrounded by bright and dark rings. Now, to determine the second position of the eye-piece, viz: that in which the image of the star exhibits a black hole in its center, instead of observing the star directly, the eye-piece may be placed exactly midway between the first and third positions. If the telescope be now directed to a star which twinkles, the phenomenon will manifest itself in a succession of accidental reappearances of a luminous point in the dark hole, and these reappearances will be more numerous as the twinkling is stronger.

M. Arago states, that although he feels convinced that in connecting the phenomena of scintillation with the principle of interferences, he has viewed the subject in its proper aspect, still he is far from being of the opinion that nothing further remains to be done. "For example," says he, "no one of my acquaintance has connected in an entirely satisfactory manner the planetary disks which the stars acquire, and the rings which surround them with the theory of interferences." He adds, that he had been informed that M. Schwerd, a geometer of Germany, had succeeded in this research; but he was told at the same time that according to the calculations, which were applied exclusively to simple lenses not achromatic, the diameters of the planets when seen in a telescope with a reduced aperture ought to appear enlarged like the stars, a result entirely contradicted by observation.

ON THE POLARIZATION OF ATMOSPHERIC HEAT.

The observations of M. Arago and Sir David Brewster have long since established, that the light by which our atmosphere is illuminated is polarized in certain directions. It might be supposed from analogy that the heat proceeding from the same source is endowed with similar properties; the following experiments place this supposition beyond the pale of doubt.

The means of polarizing a ray of heat, without greatly diminishing its intensity, are less perfectly known than those of polarizing a ray of light, and the result is a corresponding inferiority in the exactitude with which the calorific ray can be analysed. In the use of the thermo-electric pile, the experimenter must be on his guard against numerous sources of error. The blackened face of the instrument radiates into space, and is cooled to a degree which depends partly upon the transparency of the air, partly upon its temperature. The other face, although protected by a closed tube, is not entirely free from the influence of conduction in prolonged experiments. The thermometric state of the atmosphere changes capriciously every moment, owing to the unequal mixture of the ascending and descending columns of air. The variations in the transparency of the air, the calorific reflexions which proceed from the surface of the earth and from clouds, render, in general, the intensity of the heat radiating in any given direction extremely inconstant.

These obstacles being known, I endeavored to combat them by the following arrangements: — The thermo-electric pile of Melloni was placed in a capacious chest, so that its uncovered face was turned towards an opening in the center of one of the sides. This face is provided with its cone of polished brass fixed in a cylinder of wood, which is lined with a tube of paste-board. The extremity of this tube enters the circular opening in the side, and moves in it with strong friction; screens and diaphragms of various substances can be attached to it. At its extremity, the piece destined to contain the analyzer is fixed level. It carries a collar, to which the hand imparts a rotative motion by means of a strong handle, and which carries an index pointing to a dial, three decimetres in diameter, fixed against the chest. This piece is surrounded by a cylindrical case of white paste-board blackened in the interior, six decimetres long, open in front, and destined to circumscribe the portion of space to be examined, the oblique rays being arrested.

The analyser which I made use of in my first experiments was a pile of thin plates of mica. It would have been easy to render it movable round a line perpendicular to the axis of the thick paste-board cylinder which enclosed it; but I preferred arresting it at an angle of 35° with its axis, and placed a similar pile parallel to it and six centimetres in advance. This assemblage polarizes and analyses the heat completely; it prevents the currents of air from acting upon the solders of bismuth and antimony, and destroys the radiation of those metals so effectually as to render all other preservatives unnecessary. I afterwards replaced this portion of the instrument by a very large Nicol's prism constructed by M. Ruhmkorff. It is 0.086 of a metre in length; the greater diagonal of the base is 0.036 of a metre, and the lesser 0.028 of a metre.

The body of the pile is sheltered against variations of temperature by filling the entire chest with carded cotton. In the side opposed to that which contains the analyser is a rectangular glazed window, through which, by the means of a good thermometer, the temperature of the envelope can be read off. Finally, a little hole pierced in the bottom permits of the passage of two wires from the poles of the pile to the rheometer. The whole is preserved in a place less warm than the surrounding atmosphere, so that during the experiments the pile must necessarily be affected by any accession of heat. The sense of deviation of the rheometer serves to prove that this condition is fulfilled.

The chest furnished with axes of hard wood turns in a rectangular frame, which permits of the pile being retained at any angle whatever with the horizon, in the vertical plane which it describes. This angle of declination is estimated on an appropriate dial by means of a plummet and an index which follows the chest in its motion. The frame, in its turn, moves round a vertical foot, in which it is steadied by friction. The azimuths are read on a fixed horizontal dial, which permits of the adjustment of the apparatus. No magnetic metal ought to be used in the construction of the latter.

I have said that the temperature of the air is subjected to almost perpetual fluctuations, which cause the corresponding variations in the thermo-electric current. To lessen this grave inconvenience, the pile was caused to act near the window of a closed room. In the reading of the rheometric deviations, it is better to determine the arcs described by the index at each change of the plane of analysis, than the positions at which it tends to come to rest after a number of excursions, which become less rapid the more nearly astatic is the system of needles. The results agree exactly with those deduced from fixed deflections, in those rare cases when the atmosphere is calm and permits of the operation being carried on in the open air, as also within doors.

The success of these researches depends also upon the goodness of the rheometer. I have obtained an excellent multiplier from M. Ruhmkorff. It is composed of two short and thick wires rolled on a frame of bone. The dial is of pure copper, with its graduated circumference silvered. The needles, suspended from a fiber of silk extremely fine, and 0.15 of a metre in length, make only a single oscillation in twenty-four seconds. When the calorific radiations are weak, I found the compensator of M. Melloni to be of service, more especially as the object was not to obtain absolute measures, but the ratios of the deviations. Operating in the manner just described, it is found there are two positions of the analyser 180 degrees apart, at which the deviations are equal and maximum; and two other positions at 90 degrees from the former, and at 180 degrees from each other, at which the deviations are equal and minimum. The positions of the analyser, which for a given point of the heavens procure the maximum and minimum transmissions, correspond to those of greatest intensity of the direct bands and inverse bands of the polariscope of Savart. They are thus determined without much difficulty.

The atmospheric heat can be depolarized by means of a plate of mica placed near the extremity of the exterior tube, and perpendicular to the incident rays. The analyser being in the position of the minimum of transmission, the deviation of the index experiences no serious diminution when the principal section of the interposed mica coincides with the plane of polarization, while the deviation is augmented when the rotation of the mica in its own plane brings its principal section to an angle of 45° with the primitive plane of polarization.

The phenomena of the polarization of atmospheric heat are much less apparent in winter than in summer. The difference is doubtless due to the want of sufficient sensibility in the apparatus, to the greater difficulty of experimenting at low temperatures, and to the small proportion of polarized rays which on the most favorable days accompany the natural heat.

The serenity of the air exercises a marked influence on this proportion, which becomes probably null when the heavens are obscured. Finally, it is easy to satisfy one's self, particularly if the atmosphere be calm and without clouds, that the polarization augments from the environs of the sun up to a certain limit, from which forward it decreases. I have found it inappreciable in the regions occupied by neutral points.

NON-POLARIZATION OF THE AURORA BOREALIS.

Although the results which I have obtained are purely negative, it may be useful to record the fact that, having on several occasions during the last eight months, examined the light of the aurora borealis with a Nichol's prism, I have never detected any trace of polarization. To show that this did not arise from the faintness of the light, I may mention, that on the last occasion when I observed it, the polarization of the same light produced by reflexion from the surface of a river, was distinctly visible, although the direct light was evidently free from all sensible polarization.

This fact is adverse to the supposition that the light of the aurora borealis is reflected from crystals of ice. — *Prof. Rankine, Lond., Ed. and Dub. Phil. Mag.*

LONGITUDINAL LINES OF THE SOLAR SPECTRUM.

The following is an abstract of some recent investigations made by Prof. Ragona-Scina on the lines exhibited in the solar spectrum.

Heretofore the longitudinal lines of the solar spectrum have attracted little attention. It was believed by physicists that they were due to the minute imperfections of the glass of the prism, the little irregularities along the edge of the slit through which the light is admitted into the dark room, or to other similar causes; and that they were in no way related to the constitution of the light itself.

The numerous experiments which I have made in connection with this subject, have led me to the conviction that the longitudinal lines are not due to the irregularities alluded to, but are produced by interference. Whoever is accustomed to experiments on light, will find the mere inspection of these lines sufficient to convince him that they are due to no mechanical cause. The clearness and beauty with which they exhibit themselves, and their sharp and definite character throughout their entire length, distinguish them at a glance from those which might be produced by unevenness of the slit's edge, particles of dust, imperfections of the apparatus, and so forth.

In the first place, I have observed that the longitudinal lines are entirely absent when a large lens is not applied, and when it is placed close to the prism and at right angles to the rays issuing from the same. I have further seen, that the lens changes the breadth of the spectrum only, and not its length.

Thus in one of my experiments, which was conducted with an equilateral vertical prism and a biconvex lens of 90 centimetres focal distance, after ascertaining by trial the position in which the spectrum was most clearly shown, I found its dimensions to be—

Length	13·4	centims.
Breadth	3·2	"

The lens was then removed, and the position of the screen and prism remaining unchanged, the dimensions were found to be—

Length	13·4	centims.
Breadth	15·8	"

Hence the introduction of the lens caused the disappearance of 12·6 out of 15·8 parts of the spectrum; the light must have been compressed from a space of 15·8 to a space of 3·2.

In the latter space, the rays which had passed through the lens overlaid each other, as may be rendered evident by a very simple experiment. It is only necessary to move a bit of cardboard close to the lens from top to bottom, or the reverse, and thus to receive a portion of the rays passing through it. It is then seen, that no matter how great the portion may be which is thus intercepted, the dimensions of the spectrum remain unaltered, its brightness alone being more and more diminished as the intercepted portion becomes greater. This experiment establishes the fact of superposition, and the production of the longitudinal lines by interference is a simple result of this.

It is really interesting to observe how every line may be caused to vanish by moving the card in a proper manner before the lens. From these experiments it follows, that the phenomenon of the longitudinal lines is not peculiar to the spectrum, but that in every case lines of interference must exist in light which has passed through a convex lens.

I therefore removed the prism, and made the slit in the window-shutter wider. White light now passed through the lens. By moving the plane of projection backwards and forwards, a position was at length found where the whole breadth of the white image was intersected by splendid black lines which crossed it horizontally.

It is scarcely necessary to remark, that I made many experiments to convince myself, that in the production of these lines, no foreign influences come into play, which, however, is sufficiently proved by the mere inspection of them.

METHOD BY WHICH THE EYE JUDGES OF DISTANCES.

The London *Art Journal* says, that many opinions have been at various times advanced relative to the determination of proximity or remoteness of objects from the eye, but the most plausible hypothesis seemed to be that some time ago suggested by Hermann Meyer, of Zurich, namely, that proximity of an object was determined by divergence of the two optic axes. The reflective stereoscope has demonstrated the correctness of M. Meyer's hypothesis. If after having placed the two pictures in the stereoscope in such a manner that their centers correspond, and when, consequently, one single image in relief appears, the two designs be drawn simultaneously towards the eyes, the dimensions of the image in relief seem to grow less. If, however, the two designs be simultaneously removed from the eyes, then the image in relief seems to grow smaller than before. Now it is obvious that the convergence of the two optic axes increases in proportion as the two screens are brought near to the eyes, and decreases in proportion as they are removed.

NEW PHOTOMETER.

At the last meeting of the British Association, Dr. Price exhibited the plan of a new photometer. The author, by arranging two inclined mirrors in a box, contrived to reflect the standard light and the light to be measured, so as to cross each other at a piece of ground glass or oiled paper on the top of the box; then it was easy, he asserted, to adjust the distance of the standard light so as to make the two reflected lights appear equally intense, — and then, on the common principle, the illuminating power of the light to be estimated could be calculated.

CURIOUS OPTICAL PHENOMENON.

A work of art illustrating a curious optical phenomenon, has been recently exhibited at Cologne, Germany. It consists of a flat surface upon which appear a quantity of colored spots without the slightest trace of design or order in their arrangement; indeed they remind one more of the dried-up colors on a painter's palette than anything else. A cylindrical mirror being placed in the middle of the table, reflects a perfect picture of the elevation of the cross, a composition containing six figures, no less accurate in their drawing than beautiful in their coloring. One looks in vain for any method or design in the irregular and shapeless mass of colors smeared on the flat board.

DIRECT ACTION OF LIGHT UPON THE EYE.

The experiments of Lambert, Fontana, and Weber having shown that light, through the medium of the retina, and the nervous centers, acts upon the iris, it has been supposed to exert no direct action in contracting the pupil, but up to the present time this effect has been considered as a reflex action.

M. J. Budge has shown, *Comptes Rendus*, xxxv. p. 564, that the pupil contracts upon exposing the eye to light after section of the two optic nerves, or one only. If in a frog the trunk of the grand sympathetic is cut upon one side, below the ganglion of the pneumogastric, a section of the two optic nerves being made at the same time, the pupil contracts in an hour somewhat more upon the side upon which the section of the sympathetic is made; upon removal to a dark place the pupil which was contracted dilates, and again contracts upon exposure of the eye to light, but the light does not act as promptly upon it as upon the pupil of the other side, where only the optic nerve has been severed, without cutting the grand sympathetic. The results are the same upon cutting off the head of a frog, or removing the eyes entirely; in this case the pupil contracts under influence of the light, and dilates when taken into a dark place. This phenomenon may be observed for nearly an hour.

ON THE STEREOSCOPIC COMBINATION OF COLORS.

M. Dove's researches have reference chiefly to the stereoscopic combination of colors. In 1841 he showed that the stereoscopic combination of the complementary colors of polarized rays produced white light. He now makes use of drawings with colored outlines, the colors being dioptric or catoptric: the former he obtains by making drawings of white lines upon a black ground, and viewing the stereoscopic combination through a colored glass; in the second case, the figures are drawn upon white paper in the colors which are intended for combination.

The projection of a convex pyramid was drawn in red lines upon a white ground, and on the same base the projection of a concave pyramid in blue lines. On a second leaf the corresponding drawings were made in the same colors for the other eye. On viewing these drawings in the stereoscope, each pair combined in the usual manner, we should have a convex red pyramid and a concave blue pyramid, the axes of both forming one and the same straight line. But it is altogether impossible to obtain a relief in this case. A hexagon embracing a six-pointed star is always obtained, the sides of which all consist of red and blue lines running alongside each other in contact. When this complicated figure was viewed through a blue glass, the convex relief, bounded by red lines, started forth; when a red glass was used, the hollow pyramid with blue edges was observed. In the first case the blue lines vanished almost completely in the blue light; while the red, whose rays were intercepted by the glass, acted as black, and became subjectively colored red. In the second case the red lines nearly disappeared in the red light; and the blue, subjectively colored, combined themselves to a relief.

To understand what has here been said regarding subjective coloring, attention to the following facts is necessary. If the diffused daylight be completely shut out from the eyes, and a drawing in black outline on white ground be viewed through a colored glass, the relief is seen with black edges; but when the glass is held at some distance from the eyes, so that the diffused daylight shall also reach them, the black hues assume a vivid subjective coloring, which becomes stronger the longer the drawing is regarded. When the glass is colored blue by cobalt, the lines appear red; when the glass is a ruby-red, the outline appears bluish-green.

The result of the above experiment with the blue and red pyramids is remarkable. Each eye has two drawings presented to it, and a double combination is thus possible. When the identity of outline is preserved by the eye, and no regard is paid to the difference of tint, two plane figures composed of different colors must be observed. This is the case when the intensity of both colors is nearly the same. When, however, the intensity is very different, such, for example, as that brought about by the red and blue glasses in the case under consideration, the identity of the outline is overcome by the tendency to form a relief.

The projection for one eye was drawn in white lines upon a black ground, and for the other eye with black lines upon a white ground. A most remarkable result was obtained by the stereoscopic combination of both. The relief started into existence with surfaces which shone like graphite, having their edges formed of dazzling white and deep black lines which run parallel and in contact with each other throughout. When the black leaf with the white lines is placed before the left eye, and the white leaf with the black lines before the right eye, the white lines in the relief lie to the right of the black ones. When the leaves are changed, the relative position of the black and white hues is also changed; hence the lines appear always pushed aside cross-wise. Exactly as in the case of black and white, combinations of both of these with other colors are obtained, and combinations of the latter with each other. To obtain the combination of dioptric colors with white and with each other, drawings in white outline on a black ground are made use of. When white is to be combined with another color, a glass of the required tint is placed before one eye, while the drawing is viewed by the other eye naked. When different colors are to be combined, suitable glasses are placed before both eyes. The most beautiful result is obtained when the colors produced by a deep blue and a red glass are combined: the relief stands forth illuminated with violet light and with splendid edges of red and blue, which run alongside each other in contact. In the case of colors which nearly approach each other, the edges are also formed by those double and differently colored lines. One result is always observed — the lines appear pushed aside cross-wise, that is, the color observed by the left eye appears to the right, and that observed by the right eye appears to the left.

The following remarkable fact has been observed by M. Dove, and his observation has been corroborated by others. The projections of a convex and concave pyramid for the right eye were drawn upon the same base, and on a second leaf the projection of a convex only for the left eye. In the stereoscope, therefore, a convex pyramid was seen, and on the base of the same the projection of a concave one. When the ruby-red glass was brought before the left eye, while the former drawing was regarded by the naked right eye, both the pyramid and the projection were observed; but it depended entirely on an act of volition whether the pyramid was observed with red and white boundaries and the projection in red and white outline. It hence appears that a projection as contour can combine itself with another as color to form a relief.

The same phenomena which we have observed with objective colors exhibit themselves with subjective colors also. On viewing the drawings formed in black outline on white ground through the ruby-red glass with one eye, and through the glass colored by cobalt with the other, permitting the diffused daylight at the same time to strike the eyes, the relief is observed with colored double parallel lines as edges, as in the other instances: the crossed position of the lines is also observed here; so that when the red glass is held before the left eye, and the blue glass before the right, the bluish-green lines appear to the right of the red; — it will be remembered that the subjective tint developed by the red glass is bluish-green, and by the blue glass, red.

Why is it then, that the red and blue lines cannot be made to combine, but always lie alongside each other crossed in the manner indicated? M. Dove finds the explanation in the non-achromatic nature of the eye. That the eye is not achromatic has been known since the time of Fraunhofer; but a very simple way of proving the fact was discovered independent by M. Dove and M. Plateau about twelve years ago. If the flames of a candle be viewed through a colored glass which permits the ends of the solar spectrum to pass through it, but extinguishes the middle, at the distance of distinct vision a violet flame is observed. At a greater distance a red flame is observed within a larger blue one, which embraces the former on all sides and becomes wider the further we recede from the flame. Within the distance of distinct vision, on the contrary, the violet flame is encompassed by a sharp red rim. From a medium distance a long-sighted eye sees the latter, and a short-sighted eye the former. Hence the experiment furnishes us with a kind of optometer; to this purpose M. Dove has applied it in hundreds of cases, and never found a single individual whose eyes fulfilled the conditions of achromatism at all distances. Acquainted with this fact, and observing a certain analogy between it and his stereoscopic experiments, he naturally sought the cause of the phenomena presented by the latter in the non-achromatic nature of the eye.

A fine white line drawn upon a black ground was viewed through the glasses used in the stereoscopic experiments. It was ascertained that, to be plainly visible, it must be held at a greater distance from the eye when the red glass is used than when the blue glass is applied. Sir David Brewster has obtained an analogous result with pigments. A number of square pieces of gradually decreasing size was cut from the same vividly-colored card, and placed one upon the other so as to form a pyramid with ascending steps, all of the same height. Two such pyramids were built, the one beside the other; the squares were blue and red; one pyramid had a blue square for its base, the other a red one. It was always found that a blue square placed upon a red one appeared higher than a red square placed upon a blue one; so that in the building of the pyramids, each appeared by turns to exceed the other in height. From this experiment it follows, that at the distance of distinct vision the lines of convergence of both eyes enclose a smaller angle in the case of red light than in the case of blue. Hence, if an observer, who sees equally well with both eyes, have both colors presented to him in the stereoscope in the manner already described, the lines cannot coincide, but will project themselves in directions which cross each other upon a surface which does not pass through the point of intersection of both directions.

M. Dove next goes on to discover the cause of the glistening, which for example, is observed on the surface of varnished pictures, and which may be destroyed by quenching the polarized rays with a Nichol's prism. In every case in which a surface appears thus shining, there is a reflecting layer, more or less transparent, through which another body is viewed: the glistening owes its origin to the combination of the rays reflected from the surface and those which pass through the transparent layer from the body behind. This is increased when the number of the alterations of the layers increases. Thus mica assumes a metallic lustre, and layers of glass plates the appearance of mother-of-pearl. In the projection of a truncated pyramid intended for a certain eye, the section was colored with a saturated wash of blue; in the figure intended for the other eye, the section was colored yellow. At the moment of combination, when the resultant green appeared, it seemed as if one layer of color had become transparent and that the other was seen through it. When the colored section was viewed through a violet glass held before both eyes, the surface appeared like polished metal.

These experiments are intimately connected with the phenomena of irradiation. They established the fact, that the deportment of black and white towards the eye is exactly similar to that of two different colors. The lustre obtained by the combination of black and white is peculiarly strong, so decided, indeed, that some, and among others, the writer of this report, compared it to the lustre of lead glance, or of tin, although the component white and black were both perfectly dull and lustreless. According to the explanation already given, one of these surfaces must appear in advance of the other. the viewing of an object by the naked eyes by different degrees of illumination with white light is analogous to those experiments with colored light, where the object, to be distinctly seen, must be brought nearer in the case of blue light than with red. A dark object will, under the same conditions, appear further off than a white one, as the red surface appears more distant than the blue. At the distance of distinct vision, the flame of a candle, when viewed through the violet glass, which permits the ends of the spectrum to pass and extinguishes the middle, appears violet; that is, the red flame is as large as the blue. At the distance of distinct vision, a white object also appears of the same size as a black one; at a greater distance, the blue flame embraces the red; that is, beyond the distance of distinct vision the blue flame is larger than the red one; and so also beyond this distance, the white object on black ground appears larger than the black object on white ground. In this way the phenomena of irradiation are connected by a chain of experimental facts with chromatic phenomena, which directly point the way to the explanation of the former. The complete explanation is embraced by the proposition, that for a given distance the capacity of accommodation of the eye is different for white and black.

In a recent paper, M. Dove has added some proofs to those already given, of the fact that blue and red are plainly visible at different distances. Beyond the point of distinct vision, a micrometer drawn in black lines upon a white ground appears as a gray spot; when drawn in white lines on a black ground, it appears as a bright one. If a series of parallel white lines be viewed through a blue glass, the observer gradually receding until the lines run into each other and are no longer distinct, from this distance the lines, if observed through a red glass, will appear quite distinct. The reader may in this way easily satisfy himself that the distance of distinct vision is considerably greater for red than for blue. In the same way it may be plainly shown that the distance for white is also greater than for blue. It is difficult to obtain pigments of such equal intensity that their combination shall exhibit lustre, but the lustre can be readily obtained as follows: — A drawing in white lines upon a black ground is combined in the stereoscope with another in black lines upon a white ground and viewed through a colored glass held before both eyes. With the ruby-glass and bright light, the relief appears like polished copper. In this way we learn that the result, as regards lustre and irradiation, obtained with white and black, are also true for any colors whatever.

It is known that a green spot on a red field which is moved quickly hither and thither, appears to oscillate. Wheatstone has shown that a red heart on blue ground appears to oscillate still more quickly; hence the appearance is not to be referred to the action of complementary colors, but to a difference of refrangibility. Sir David Brewster was the first to observe on geological maps, that blue and red do not appear in the same plane; and the reason of this M. Dove considers to be rendered completely evident by his stereoscopic experiments. His explanation of the fluttering heart is as follows: — When the sheet is moved in its own plane, the heart and the ground on which it rests, describe tangents of the same absolute length, but with radii which the eye regards as different. The angular velocities of both thus appear to be different, and hence the object seems to oscillate upon the plane which bears it.

That yellow and red colors approach the nature of light more than blue, is an idea which may be traced throughout antiquity. In the common language of the Germans, this is expressed by the terms "screaming yellow," "burning red," in contradistinction to "deep blue." This notion is corroborated by photometric experiments. But with these well-known phenomena, another stands apparently in complete contradiction. It has often occurred to M. Dove, on quitting a picture gallery on the approach of night, when he happened to cast a parting glance upon the paintings, the red color had altogether disappeared, while the blue appeared in all its strength. Artists are well aware of this fact; at least, on questioning such, M. Dove has always found his own observation corroborated.

The stereoscopic experiments already described, furnish an accurate and beautiful method of observing this fact. On applying two glasses, one of which permits the homogeneous blue rays to pass, and the other the homogeneous red ones, the relief, as already stated, appears with beautiful edges of red and blue lines which run alongside each other. Although when the light is intense the red lines appear much the most vivid, the blue glass made use of being more than ten times the thickness of the red one, still as the twilight advances, the red becomes weaker and weaker; it finally disappears altogether, and instead of the relief formed by the combination of the red and blue outline, the blue alone is observed, as projection, upon its proper leaf. If two red glasses be now placed before the openings of the stereoscope, nothing whatever is seen; while with two blue glasses the relief appears in blue lines, and remains distinctly visible for a quarter of an hour longer. Thus the fact of the earlier disappearance of the red rays is placed beyond a doubt:—how is this to be accounted for?

It is known that weak impressions on the organs of sense singly may arouse no consciousness, but do so where they are quickly and uniformly repeated. On this account the string of the contra-basso must have a wider amplitude than that of the violin, inasmuch as the diminished number of vibrations demands a greater energy to render them heard. Thus also if we wish to make ourselves heard without great effort, we speak in a higher tone; and hence it is that when the deep voice of the seaman, strengthened by the speaking trumpet, is lost in the storm, the shrill pipe of the boatswain still pierces through the howl of winds and roar of waves. Savart has shown, by means of the toothed-wheel, that the limit of sensibility of the ear for grave tones is extended by strengthening the strokes. The complete similarity of the vibration causes the most perfect summation of impressions, because the interferences which take place when the times of oscillation are different then fall away. This uniformity renders the tone pure, and in the case of colors, renders them homogeneous. Blue stands in same relation to red that a higher tone occupies with regard to a deeper one. With blue the vibrations of the retina are more frequent than with red, as the vibrations of the tympanum are more frequent with a high tone than with a deep one. Now it is proved that with deep tones the limit of sensibility becomes contracted when the tones become weaker; and this is completely analogous to the case, that by decreasing brightness, the limit of sensibility for the red rays should become narrower. Hence with weak illumination, red, as a color, disappears; while blue, on account of the greater frequency of its vibrations, remains longer visible.

"In this way," observes the Professor, "I explain to myself the wonderful phenomena, regarding which, however, strange to say, nobody has expressed wonder, that by the weak light of the stars the blue of the firmament is rendered distinctly visible."

Herewith is connected the fact that a prismatic spectrum obtained from light which has passed through a narrow aperture, has its colors towards the red end comparatively stronger when the light is intense. This is peculiarly plain if the spectrum be viewed through a dichromatic medium, which permits the ends of the spectrum to pass and extinguishes its middle, thus enabling both ends to be immediately compared with each other. The dark space beyond the red end of the spectrum, where the calorific effect is a maximum, would probably be distinctly visible if the intensity of the sunlight were considerably increased by concentration. This would be the experiment of Savart applied to colors. Probably to the subject we are considering, belong the experiments of Sir David Brewster on the lines of Fraunhofer in this portion of the spectrum; although the facts observed appear to be referred to the destruction of spherical aberration, and not to the illuminating power of the telescope applied. In a similar manner the limits of action on an iodized silver plate at the violet end of the spectrum, become expanded with increasing brightness.

If a person pass suddenly from a brightly illuminated room into a very dark one, and then approach the place through which the light enters until blue becomes distinct, it will be found that red is at first much more vivid. The eye must remain for some time in the darkened room, before the retina becomes as sensitive as in deep twilight. When this is attained, the person may recede to a distance from the place where the light enters, where the blue is still distinctly visible, and find that the red has vanished completely. Another remarkable fact observed by M. Dove was, that among the numbers to whom he showed, in bright daylight, the stereoscopic relief with blue and red edges, one declared that he saw only the drawing with blue lines, as through the red glass he could see nothing whatever. The eyes of this individual in bright daylight, were in the same condition as a pair of normal eyes by twilight.—*Lond., Ed., & Dub. Mag., June* 1852.

THE BINOCULAR MICROSCOPE.

At the session of the Physico-Medical Society of New Orleans, April, 1853, Prof. Riddell, the original inventor of the binocular microscope, exhibited and explained a simplification of that important instrument, by which, at an expense not necessarily exceeding thirty or forty dollars, it is practicable, in existing compound microscopes of the ordinary forms, to replace the brass tube carrying the ocular and objective, by an efficient arrangement for binocular vision. To accomplish an equal division of the pencil of light immediately behind the objective, and so effect its distribution to each ocular, only two glass prisms need be used. They must be of such form, that the faces, at which the light is immergent and emergent, shall form equal angles with the face on which the internal reflection occurs. The chromatic dispersion is a minimum, and really nothing, when these angles are each near eighty-seven degrees. This form is theoretically preferable. In the instrument constructed, and shown by Prof. Riddell, the French rectangular prisms, such as sold by most opticians, were used, in which the equal angles alluded to, are forty-five degrees. The long sides of these, which are the reflecting surfaces, face each other, and, while the edges next the objective are in contact, the upper edges are adjustable, so as to vary at pleasure the inclination of the prisms to each other. In its transit through these prisms, the light is reflected internally, and undergoes two refractions which are almost mutually compensatory. The result is satisfactory. To produce orthoscopic binocular vision, simple, not erecting eye pieces, are required.

TRACINGS ON GLASS FOR MICROSCOPIC TEST OBJECTS.

The tracings executed by M. Nobert, of Prussia, for microscopic test objects, are of the most curious character. The plan adopted by him is to trace on glass ten separate bands at equal distance from each other, each band being composed of parallel lines of some fraction of a Prussian inch apart: in some they are 1-1000th, and in others only 1-4000th of a Prussian inch separated.

To see these lines at all it is necessary to use a microscope with a magnifying power of 100 diameters; the bands containing the fewest number of lines will then be visible. To distinguish the finer lines it will be necessary to use a magnifying power of 2000, and then the lines which are only 1-47000th of an inch apart will be seen as perfectly traced as the coarser lines. Of all the tests yet found for object-glasses of high power these would seem to be most valuable. These tracings have tended to confirm the undulatory theory of light, the rent colors of the spectrum being exhibited in the ruled spaces ›rding to the separations of the lines; and in those cases where the distances between the lines are smaller than the lengths of the violet light waves, no color is perceived: and it is stated that if inequalities amounting to ·00002 line occur in some of the systems, stripes of another color would appear in them.

IMPROVEMENT IN THE MANUFACTURE OF LENSES.

The following notice of an improvement in the manufacture of lenses, is given in Newton's (London) Patent Journal:

The dioptric lens, heretofore in use, for sea-lights, or other lights requiring great intensity, being constructed of single zones or rings made up of segments according to the diameter of the required lens, has induced a belief that glass could not be prepared without incurring the expense of grinding and polishing the curved surface, and that economy dictated a method of manufacture embracing a center and zones or segments. The inventor was induced to examine the method of the construction of the built-up lens, to try and reduce the expense without diminishing the strength of the light, commencing with the suggestions of Buffon, that a spherical body, from its thickness, absorbs light according to its density, and that a sectional figure of any required shape and thickness could be cast of glass and ground in concentric cones, to produce a lens, as partially accomplished by Abbe Rochon, who prepared the way for the manufacture of the dioptric lens in separate pieces by the ingenious Fresnel, termed "the annular band lens," which is now used in our best light-houses. These lenses are very expensive, for each separate piece must not only have its surfaces formed with great accuracy, but all the separate pieces must be arranged to each other, so that when put together they shall form a perfect whole. This invention is to produce a dioptric lens which shall present all the practical advantages of Fresnel's annular band lens, at so cheap a rate as to admit of its being applied to all purposes requiring intensity of light. The inventor makes dioptric lenses in one or several pieces, moulded and pressed into the form required for the surfaces; and when made in several pieces, the required fit of the several parts is produced by giving the reversed required form to metal moulds in which the molten glass is to be run and pressed. To promote focal intensity and prevent the absorption of light, each lens is manufactured as thin as the size and number of concavities and convexities will permit.

CELLS FOR MICROSCOPIC OBJECTS.

The following communication by Mr. L. S. Beale, is taken from the Microscopic Journal, October, 1852.

Some time ago a very simple method of perforating thin glass occurred to me, which has been found to answer exceedingly well, and it has this great advantage, that the microscopist can make cells for himself of almost any dimensions required.

The principle of the process depends upon the fact, that a crack will not extend across any part of a piece of thin glass which is fixed by marine glue to any firm surface to which it is capable of adhering. The edges of the thin glass may be broken in all directions, but the crack will extend only up to the marine glue and no farther. If a piece of thin glass be fixed by marine glue to one of the thick sections of tube used for making cells in which injections are mounted, and allowed to cool, a hole may be made in the centre with a file, which may then be carried round the edges, and a thin glass cell exactly the size of the thick one is produced. It is removed by heating the glass, and may then be transferred to a slide and fixed at once, or the glue adhering to it can easily be removed by soaking it for a short time in potash. The surfaces may be roughened, or the cell may be ground thinner by rubbing it on a flat surface with emery powder in the usual way. All that is requisite, then, to make thin glass cells of any required form and dimensions, is to obtain a perfectly flat, thick ring, to which the glass may be cemented, and in a few minutes several thin cells of large size may be made, and at very trifling cost.

The usual plan of constructing the deep glass cells, by joining together several slips of thick plate glass, the edges of which have been ground perfectly flat, and cementing them at the angles with marine glue, is a process of considerable labor. For some time past I have been endeavoring to devise a method by which these cells could be more readily made, as their advantage over bottles for mounting many preparations is obviously great. The process about to be detailed requires some practice, but, when this is acquired, cells may be made much more rapidly than by the old method, and have the advantage of possessing fewer joins.

A slip of plate glass, of the required depth, of about the eighth of an inch in thickness, and of sufficient length to make all four sides of the cell, is taken. The length of each side is to be accurately marked upon it with a spot of ink, and in these situations the glass is to be carefully and very gradually raised to a red heat in the blow-pipe flame, and then bent so as to form a good angle; care being taken not to twist the glass in the slightest degree. The other angles are formed in the same manner, each being cooled as gradually as it was heated. The ends are to be afterwards cemented together by heating in the blow-pipe. If the last side when bent round should be found to be too long, a small portion can be cut off by aid of the diamond, and, with a little care in heating the ends and pressing the glass together when in a softened state by a small piece of wire, an excellent juncture may be made; or, if preferred, the join may be effected in the centre of one of the sides. In this way cells may be made of half an inch in depth, or rather more, and of any required size. The great difficulty in constructing cells in this way arises from the glass cracking in the process of heating or cooling, and from the tendency of the sides to twist when the glass is softened in the position of the angles. The latter difficulty is soon overcome by practice; the former would be avoided if, instead of the ordinary plate glass, flattened and well-annealed flint glass were employed; and I believe that, with this modification, the construction of cells would be much simplified, and they might be made at a cost far less than that for which built glass cells can now be obtained. When the angles are formed and the glass joined, the surfaces are ground flat in the usual way. After grinding they are fixed to a flat plate-glass slab with marine glue.

IMPROVEMENT IN REFLECTING TELESCOPES.

At a recent meeting of the Royal Astronomical Society, Mr. Grove, F. R. S. made a communication respecting some means he had lately employed with success in improving ordinary refracting telescopes. It is known, that in the object-glasses of these instruments the chromatic aberration is, as it is termed, over-corrected, while, practically, the spherical aberration is imperfectly or under-corrected. Mr. Grove had tried many expedients to remedy or abate these defects by some simple plan applicable to existing instruments. If the glasses be separated a slight distance, as recommended by Sir J. Herschel, the chromatic aberration is generally increased to such an extent as to greatly deteriorate the performance of the instrument. In some cases where the inner curves of the flint and crown glasses approximate, Mr. Grove had employed with success a highly refracting cement, made of very clear resin and castor-oil, which, acting as a third lens or convex meniscus of a medium dispersing the colored spaces differently from the other two lenses, corrected to a very great degree the chromatic without increasing the spherical aberration. This compound forms an excellent tough cement; it is nearly, and may be absolutely, colorless, and might possibly be used in small telescopes instead of a flint-glass. With telescopes in which the curves would not admit of a cement he had tried lenses of plate-glass, placed at opposite distances between the object and eye-glasses of the telescope; this plan he conceived was applicable to by far the greater number of common telescopes, and much improved their performance. It differs from the plans of Littrow, Rogers, or Barlow, in consisting of a *convex* lens, and in being applicable, at a very trifling expense, to telescopes constructed in the ordinary way. Mr. Grove had tried various curvatures and distances of this interposed lens, but as his experiments were made for amusement, and with no notion of publication, he had not noted the details. The following was the best result he had obtained: In a five foot four inch telescope, having a clear aperture of 3-6 inches, a small plane convex lens of plate-glass, of six feet focus, was placed, at a distance of one foot from the eye-glass, with the plane side towards the eye; the diameter of this lens need not be more than an inch, and it can generally be attached with ease to the inner extremity of the sliding eye-tube. This had produced so beneficial a result that a mediocre instrument had been changed into a very good one, — showing, for instance, the inner ring of Saturn, defining beautifully the division in the main ring, and dividing double stars well up to a second of space. The effect of such a lens is three-fold : — 1st, it brings back the over-correction of the object-glass; 2dly, being of a glass acting somewhat differently on the colored spaces, it causes them to overlap, and gives a greater residuum of white light; and 3dly, upon the Huyghenian eye-piece, it lessens the spherical aberration by receiving the more refrangible at a less oblique incidence than the less refrangible rays. It will be obvious, that the nearer the interposed lens is to the object-glass, the less should its curvature be, but in proportion as the object-glass is approached, the difficulty of centering and defects in curvature become more felt; if, again, the interposed lens be brought very near the eye-glass, less effect upon the aberration is produced. Practically, lenses having foci sowewhat greater than the object-glass, and placed at a distance from the eye-glass of from one-fourth to one-fifth of the focal length of the object-glass, will be found to answer; and the effect being one of degree, no mathematical accuracy in the amount of curvature is required.

CHINESE MAGIC MIRRORS.

A great deal of attention has been given in Europe to certain metalic mirrors fabricated in China — in which forms of letters, flowers, and animals are embossed on the back, which is not polished. On looking directly and as closely as possible on the polished face, no trace of these figures is seen; but if the mirror is made to reflect the rays of the sun upon a wall or screen, the ornaments on the back are plainly seen in the reflected light. Many attempts have been made to explain this phenomenon, but hitherto unsuccessfully. On the 1st of April, however, M. Biot exhibited to the Academy of Sciences in Paris, one of these mirrors, made by M. Lerebours. It appears that in 1847, MM. Arago and Biot suggested an explanation, founded on the fact, that as the embossing of the back surfaces gave different thicknesses, and therefore different resistance to the metal when the face came to be polished, the surface opposite the raised portions would be more resistant, and would be raised in a convex form, while that opposite the hollow would, under the same pressure, be slightly concave — these effects being so slight as to be invisible to an ocular examination of the surface, but becoming manifest by the deviations impressed on the reflected rays. To test this theory, M. Lerebours took an ordinary daguerreotype plate of copper plated with silver, and on the copper back he engraved a crescent, and then polished the plate. Looking directly on it, and as carefully as possible, nothing is seen; but when the sun's rays were received on the plate and thrown on a screen, the form of the crescent was clearly defined in the reflected image, darker or lighter than the rest, according to the distance of the mirror from the screen.

ON THE CHANGE OF REFRANGIBILITY OF LIGHT, AND THE EXHIBITION THEREBY OF THE CHEMICAL RAYS.

The following is an abstract of a lecture recently delivered before the Royal Institution, England, by Prof. Stokes. When a weak acid solution of quinine is prepared, by dissolving, suppose one part of the commercial disulphate in 200 parts of water acidulated with sulphuric acid, a fluid is obtained which appears colorless and transparent when viewed by transmitted light, but which exhibits nevertheless in certain aspects a peculiar sky-blue color. This color of course had frequently been noticed; but it is to Sir John Herschel that we owe the first analysis of the phenomenon. He found that the blue light emanates in all directions from a very thin stratum of fluid adjacent to the surface (whether it be the free surface or the surface of contact of the fluid with the containing glass vessel,) by which the incident rays enter the fluid. His experiments clearly show that what here takes place is not a mere *subdivision* of light into a portion which is dispersed and a portion which passes on, but an actual *analysis*. For after the rays have once passed through the stratum from which the blue dispersed light comes, they are deprived of the power of producing the same effect; that is, they do not exhibit any blue stratum when they are incident a second time on a solution of quinine. To express the modification which the transmitted light had undergone, the further nature of which did not at the time appear, Sir John Herschel made use of the term "epipolized." Sir David Brewster had several years before discovered a remarkable phenomenon in an alcoholic solution of the green coloring matter of leaves, or, as it is called by chemists, chlorophyll. This fluid, when of moderate strength and viewed across a moderate thickness, is of a fine emerald green color; but Sir David Brewster found that when a bright pencil of rays, formed by condensing the sun's light by a lens, was admitted into the fluid, the path of the rays was marked by a *bright beam* of a *blood red color*. This singular phenomenon he has designated *internal dispersion*. He supposed it to be due to suspended particles which reflected a red light, and conceived that it might be imitated by a fluid holding in suspension an excessively fine colored precipitate. Prof. Stokes stated, that, having had his attention called some time ago to Sir J. Herschel's papers, he had no sooner repeated some of the experiments than he felt an extreme interest in the phenomenon. The reality of the epipolic analysis of light was at once evident from the experiments; and he felt confident that certain theoretical views respecting the nature of light had only to be followed fearlessly into their legitimate consequences, in order to explain the real nature of epipolized light. The exhibition of a richly colored beam of light in a perfectly clear fluid, when the observation is conducted in the manner of Sir David Brewster, seemed to point to the dispersions exhibited by the solutions of quinine and chlorophyll as one and the same phenomenon. The latter fluid, as has been already stated, disperses light of a blood red color. When the transmitted light is subjected to prismatic analysis, there is found a remarkably intense band of absorption in the red, besides certain other absorption bands, of less intensity, in other parts of the spectrum. Nothing at first seemed more likely than that, in consequence of some action of the ultimate molecules of the medium, the incident rays belonging to the absorption band in the red, withdrawn, as they certainly were, from the incident beam, were given out in all directions, instead of being absorbed in the manner usual in colored media.

It might be supposed that the incident vibrations of the luminiferous ether generated synchronous vibrations in the ultimate molecules, and were thereby exhausted, and that the molecules in turn became centers of disturbance to the ether. The general analogy between the phenomena exhibited by the solutions of chlorophyll and of quinine would lead to the expectation of absorption bands in the light transmitted by the latter. If these bands were but narrow, the light belonging to them might not be missed in the transmitted beam, unless it were specially looked for; and then the beam might be thus "epipolized," without, to ordinary inspection, being changed in its properties in any other respect. But in subjecting the light to prismatic analysis, first with the naked eye, and then with a magnifying power, no absorption bands were perceived. A little further reflection showed that even the supposition of the existence of these bands would not alone account for the phenomenon. For the rays producing the dispersed light (if we confine our attention to the thin stratum in which the main part of the dispersion takes place) are exhausted by the time the incident light has traversed a stratum the fiftieth of an inch thick, or thereabouts, whereas the dispersed rays traverse the fluid with perfect freedom. This indicates *a difference of nature* between the blue-producing rays and the blue rays produced. Now, as the lecturer stated, he felt very great confidence in the principle that the nature of light is completely defined by specifying its refrangibility and its state as to polarization. The difference of nature, then, indicated by the phenomenon, must be referred to a difference in one or other of these two respects. At first he took for granted that there could be no change of refrangibility. The refrangibility of light had hitherto been regarded as an attribute absolutely invariable. To suppose that it had changed would, on the undulatory theory, be equivalent to supposing that periodic vibrations of one period could give rise to periodic vibrations of a different period, a supposition presenting no small mechanical difficulty. But the hypothesis which he was *obliged* to form on adopting the other alternative, namely, that the difference of nature had to do with the state of polarization, were so artificial as to constitute a theory which appeared utterly extravagant. He was thus led to contemplate the possibility of a change of refrangibility. No sooner had he dwelt in his mind on this supposition, than the mystery respecting the nature of epipolized light vanished; all the parts of the phenomenon fell naturally into their places. So simple did the whole explanation become, when once the fundamental hypothesis was admitted, that he could not help feeling strongly impressed that it would turn out to be true. Its truth or fallacy was a question easily to be decided by experiment; the experiments were performed and resulted in its complete establishment.

The lecturer then described what may be regarded as the fundamental experiment. A beam of sunlight was reflected horizontally through a vertical slit into a darkened room, and a pure spectrum was formed in the usual manner, namely, by transmitting the light through a prism at the distance of several feet from the slit, and then through a lens close to the prism. In the actual experiment, two or three prisms were used, to produce a greater angular separation of the colors. Instead of a screen, there was placed at the focus of the lens a vessel containing a solution of sulphate of quinine. It was found that the red, orange, &c., in fact, nearly the whole of the visible rays, passed through the fluid as if it had been mere water. But on arriving about the middle of the violet, the path of the rays within the fluid was marked by a sky-blue light, which emanated in all directions from the fluid, as if the medium had been self-luminous. This blue light continued throughout the region of the violet, and far beyond, in the region of the invisible rays. The posterior surface of the luminous portion of the fluid marked the distance to which the incident rays were able to penetrate into the medium before they were exhausted. This distance, which at first exceeded the diameter of the vessel, decreased with great rapidity, so that in the greater part of the invisible region it amounted to only a very small fraction of an inch. The fixed lines of the extreme violet, and of the more refrangible invisible rays, were exhibited by dark planes interrupting the dispersed light. When a small portion of the incident spectrum was isolated, by stopping the rest by a screen, and the corresponding beam of blue dispersed light was refracted sideways by a prism held to the eye, it was found to consist of light having various degrees of refrangibility, with color corresponding, the more refrangible rays being more abundant than the less refrangible. The nature of epipolized light is now evident; it is nothing but light from which the highly refrangible invisible rays have been withdrawn by transmitting it through a solution of quinine, and does not differ from light from which those rays have been withdrawn by any other means. The difference of nature of the illumination produced by a change of refrangibility, or "true internal dispersion," from that due to the mere scattering of light, may be shown in a very instructive form by placing paper washed with sulphate of quinine, or a screen of similar properties, so as to receive a long narrow horizontal spectrum, and refacting this upwards by a prism held to the eye. Were the luminous band formed on the paper due merely to the scattering of the incident rays, it ought of course to be thrown obliquely upwards; whereas it is actually decomposed by the prism into two bands, one ascending obliquely, and consisting of the usual colors of the spectrum in their natural order, the other running horizontally, and extending far beyond the more refrangible end of the former. Whatever be the screen, the horizontal band is always situated below the oblique, since there appears to be no exception to the law, that when the refrangibility of light is changed in this manner it is *always lowered.* The general appearance of some highly "sensitive" media in the invisible rays was then exhibited by means of the flame of sulphur burning in oxygen, a source of these rays which Dr. Faraday, had in some preliminary trials found very efficacious. The chief media used were articles made of glass colored by uranium, and solutions of quinine, of horse-chestnut bark, and of the seeds of the datura stramonium. A tall cylindrical jar filled with water showed nothing remarkable; but when a solution of horse-chestnut bark was poured in, the descending fluid was strongly luminous. The experiment was varied by means of white paper on which words had been written with a pretty strong solution of sulphate of quinine, an alcoholic solution of the seeds of the datura stramonium, and a purified aqueous solution of horse-chestnut bark. By gaslight the letters were invisible; but by the sulphur light, especially when it had been transmitted through a blue glass, which transmits a much larger proportion of the invisible than of the visible rays, the letters appeared luminous, on a comparatively dark ground. A glass vessel containing a thin sheet of a very weak solution of chromate of potash allowed the letters to be seen as well, or very nearly as well as before, when it was interposed between the eye and the paper; but when it was interposed between the flame and the paper the letters wholly disappeared, — the medium being opaque with respect to the rays which caused the letters to be luminous, but transparent with respect to the rays which they emitted. It was then remarked what facilities are thus afforded for the study of the invisible rays. When a pure spectrum is once formed, it is as easy to determine the mode of absorption of an absorbing medium with respect to the visible rays. It is sufficient to interpose the medium in the path of the incident rays, and to notice the effect. Again, the effect of various flames, and other sources of light on solutions of quinine, and on similar media, indicates the richness or poverty of those sources with respect to the highly refrangible invisible rays. Thus the flames of alcohol, of hydrogen, &c., of which the illuminating power is so feeble, were found to be very rich in invisible rays. This was still more the case with a small electric spark, while the spark from a Leyden jar was found to abound in rays of excessively high refrangibility. These highly refrangible rays were stopped by glass, but passed freely through quartz. These results, and others leading to the same conclusion, had induced the lecturer to order a complete train of quartz. A considerable portion of this was finished before the end of last August, and was applied to the examination of the solar spectrum. A spectrum was then obtained extending beyond the visible spectrum — that is, beyond the extreme violet, to a distance at least double that of the formerly known chemical spectrum. This new region was filled with fixed lines like the regions previously known. But a spectrum far surpassing this was obtained with the powerful electrical apparatus belonging to the institution. The voltaic arc from metallic points furnished a spectrum no less than *six or eight times* as long as the visible spectrum. This was in fact the spectrum which had already been exhibited in connexion with the fundamental experiment. The prisms and lens which the lecturer had been employing in forming the spectrum were actually made of quartz. The spectrum thus obtained was filled from end to end with bright bands. When a piece of glass was interposed in the path of the incident rays, the length of the spectrum was reduced to a small fraction of what it had been, all the more refracted part being cut away. A strong discharge of a Leyden jar had been found to give a spectrum at least as long as the former, but not, like it, consisting of nothing but isolated bright bands. The lecturer then explained the grounds on which he concluded that the end of the solar spectrum on the more refrangible side had actually been reached, no obstacle existing to the exhibition of rays still more refrangible, if such were present. He stated also that during the winter, even when the sun shone clearly, it was not possible to see so far as before. As spring advanced he found the light continually improving, but still he was not able to see so far as he had seen at the end of August. It was plain that the earth's atmosphere was by no means transparent with respect to the most refrangible of the rays belonging to the solar spectrum.

ON THE CHEMICAL ACTION OF SOLAR RADIATIONS.

At the last meeting of the British Association, Mr. Robert Hunt presented a report on the continuation of an examination of the chemical action of the rays of the prismatic spectrum, after it had been subjected to the absorptive influences of different colored media. The mode of examination adopted has been to obtain well-defined spectra of a beam of light passing through a fine vertical slit in a steel plate by prisms of flint and crown glass and of quartz. The spectrum, being concentrated by a lens, was received upon a white tablet and submitted to careful admeasurement; the colored screen (sometimes colored glass and sometimes colored fluid) was then interposed, and the alterations in the chromatic image were carefully noted; the chemical preparation was then placed upon the tablet, and the chemical impression obtained. The relation which this image bore to the luminous image was a true representation of the connexion between the color of a ray and its power to produce chemical change. In the report made to the Belfast meeting of the British Association, the results of experiments made upon glass tablets prepared by the so-called collodion process were alone given. In the present report, the examination has been extended to the photographic preparation known as the calotype, and to iodide and bromide of silver in their pure states and when excited by gallic acid. M. Edmond Becquerel, in a paper communicated to the Academy of Sciences, states "that when any part of the luminous spectrum is absorbed or destroyed by any substance whatever, the part of the chemical rays of the same refrangibility is equally destroyed." The author's experiments, as recorded in the former report, and those now detailed, prove that this conclusion has been formed too hastily. Although there are many absorptive media which, at the same time as they obliterate a particular colored ray, destroy the chemical action of that portion of the spectrum, yet there are a still more extensive series which prevent the passage of a ray of given refrangibility, and do not, at the same time, obstruct those rays which are chemically active of the same degree of refrangibility. This is particularly exemplified in the case of glasses colored yellow by different preparations. With some of these the blue rays are obliterated, the chemical action of this part of the spectrum not being interrupted, whereas in some other examples those rays permeate the glass, but are almost entirely deprived of chemical power. A still more curious fact is noticed in this report, for the first time, of some media which have the power, as it were, of developing chemical action in a particular part of the spectrum where the rays did not appear previously to possess this power. Several glasses exhibited this phenomenon to a certain extent, particularly such as were stained yellow by the oxide of silver; but one glass showed this in a remarkable manner. This glass was yellow when viewed by transmitted light, but it reflected pale blue light from one of its surfaces; it obliterated the more refrangible rays down to the green, and rendered the yellow far less luminous than usual. In nearly every case the yellow rays are found to be not merely inactive, chemically, but to actively prevent chemical action. After the spectrum has been submitted to the action of this glass, *all chemical power is confined to this yellow ray.* The author has hitherto supported the view that photographic phenomena and the illuminating power of the sunbeam were distinct principles, united only in their modes of motion. He was led to this from observing that where there was the most light there was the least power of producing chemical change; and that as illuminating power diminished, the chemical phenomena of the solar rays increased. The results, however, which he has obtained during the brief sunshine of the present summer, leads him to hold that opinion in suspension. In many of the spectra obtained (copies of which will be appended to the printed report) there appears to be evidence of the conversion of one form of force into another — the change, indeed, of *light* into *actinism* or chemical power; and, again, as in Mr. Stokes's experiments, the exhibition of the ordinarily invisible chemical rays in the form of *light.*

INFLUENCE OF SOLAR RADIATIONS UPON VEGETATION.

A memoir has recently been presented to the French Academy by M. Gasparin, in which he examined the utility of adopting a new instrument for the appreciation of the part due to solar radiation in exciting the phenomena of vegetation. When we compare different climates, we may observe that the productions of our locality are not in proportion to its average temperature; we see the olive barren at Agen (France), where the mercury stands in the thermometer at 14°

(centigrade), while it is fertile in Dalmatia, where the temperature averages only 13°; the limit of grape vines ends upon the banks of the Loire, while it includes, on the banks of the Rhine, regions where the average temperature never exceeds 10°. Harvest is secured in London with a temperature of 17°, while at the same time it is made at Upsal, where the average temperature is only 15°. We are thus forced to acknowledge that these phenomena depend on the presence of an important element of calorification: luminous heat, which elevates the temperature of opaque bodies above that they can receive from the diffused heat of the atmosphere.

M. de Gasparin has adopted an instrument, composed of a sphere of thin copper, ten centimetres in diameter, with an aperture on top, in which a thermometer is placed, with its bulb as near as possible in the center of the sphere. The aperture is then closed with gum lac or wax. The sphere is coated on the outside with two coatings of lamp-black, applied with some drying oil, and then definitively attached to the top of an isolated pole. Whenever the sun shines, whatever may be its altitude above the horizon, the sphere always intercepts a luminous fasces of the same dimension, and the ascension of the interior thermometer above the environing temperature, observed in the shade, gives a precise measure of the part luminous radiation bears in accomplishing the phenomena of vegetation.

ON THE COMPOSITION OF COLORS.

Hitherto the experiments upon the composition of colors, have been few and unsatisfactory. The fundamental problem is evidently to determine the colors which result from the combination of two or more simple colors, which cannot be suitably determined, except by direct experiments made with the colors of the solar spectrum as pure as possible. Newton is the only person who has tried such experiments; all others who have been occupied with the same subject, P. Castel, Mayer, Lambert, Hay, Forbes, have studied the composition of colors by mixing coloring materials, and it is by experiments of this nature, they have endeavored to show the possibility of reproducing all the colors by means of three simple colors. The evident imperfection of these researches determined M. Helmoltz to study the question anew, making use of the means the modern physicist possesses to obtain the colors of the spectrum entirely pure and homogeneous.

It is particularly the hypothesis which reduces all colors to three fundamental colors that occupied M. Helmoltz. This hypothesis has been conceived in different manner by different physicists.

1st. We may admit simply that by means of three colors we can reproduce all possible colors.

2d. We may attribute an objective existence to the three fundamental colors with Mayer and Brewster.

3d. We may say with Young, that the three colors correspond to the three principal impressions of the optic nerve, and their combination produces the other impressions.

M. Helmoltz considers only the first and third positions, reserving for a special memoir a discussion of the views of Brewster. He endeavors to determine the colors produced by a mixture of two or more colors of the spectrum, making use of the following arrangement:

The source of light was a slit made in the form of a V, cut in a black screen, and illuminated by the light of the clouds, or by a large white screen, upon which the sun's rays fell; the two branches of the slit were, inclined 45° to the vertical and were consequently, at right angles with each other; at the distance of 14 feet was placed a prism of flint glass, its refracting angle vertical, in the position of minimum deviation, the rays refracted by this prism were immediately received upon the object-glass of a small telescope which served the purpose of observation. Upon covering one of the branches of the slit with an opake screen, one could perceive by the aid of the telescope, a spectrum of the form of a parallelogram, having two sides horizontal, and two parallel to the slit through which the light passed. In this spectrum the principal rays of Fraunhofer were distinctly visible, arranged parallel to the slit, consequently, upon permitting the light from both slits to fall upon the telescope at the same time, two spectrums were formed marked by bands parallel to the two branches of the slit, and which partly covered each other; the slit was of such dimensions that one colored band of one spectrum, crossed all the colored bands of the other, which thus permitted one to examine the effect of the combination throughout; in looking through the telescope all these combinations were simultaneously visible, and to judge correctly of the resulting tints, it was necessary to examine them separately. To effect this, the telescope was directed so that the intersection of the cross hairs in the focus of the eye-piece, was upon the combination it was desired to examine, and then the eye was withdrawn 25 or 30 inches from the eye-piece in the direction of the axis of the telescope, in this position only a very small space in the centre of the field could be perceived, enabling one to judge of the color without being influenced by the neighboring colors. This position of the eye was maintained by means of a hole pierced in a large black screen. When the compound tints had been thoroughly determined the two composing tints were observed by covering successively one and the other branches of the slit. Whenever the tint approached the white, it was estimated by comparison with a large sheet of paper, perfectly white, which encircled the eye-piece of the telescope.

In short, to vary in a known ratio, the relative intensity of the two component tints it sufficed to change the prism from the vertical position and incline it as might be necessary; by this arrangement the form of each spectrum was changed, one approaching the form of a rectangle, and the other elongating more and more, the surfaces of the two spectrums, and consequently the different colored bands ceased to be equal, and since each spectrum was produced by the same quantity of white light, the intensities at the corresponding points were changed, and since it was easy to determine the ratio of the surfaces of the two spectrums to that which they presented when the prism was vertical, it is clear the intensity could be determined, being in exactly an inverse ratio. Nevertheless, this arrangement was not applicable when it was desired to diminish very greatly the intensity of the light of one spectrum, for upon inclining the prism sufficiently, the colors ceased to be pure and distinct. In this case, leaving the prism in its vertical position, one of the branches of the slit was covered with screens more or less transparent, such as paper oiled and not oiled.

The results of the experiments upon the combination of two colors may be summed up as follows:

1st. The red gives with orange an orange-red; with yellow, an orange, the two compound tints not being distinguished sensibly from the orange-red and the orange of the spectrum; with the green the red gives a yellow more pale than the yellow of the spectrum, which passes into an orange, or red, or greenish yellow or a green, according to the increase of the proportion of one or the other of the composing colors; with the bluish green there is produced a flesh-colored tint; with azure blue, a rose-red tint passing into a violet or crimson-red, according to the predominance of blue or red.

2d. The orange with yellow gives yellowish orange; with the green, a yellow very pale; with the blue, a flesh-color; and with the indigo and violet, a carmine red.

3d. The yellow gives a greenish yellow with the green, and a greenish white with azure blue; *with indigo blue the yellow gives pure white;* with the violet, the white assumes a flesh-tint, passing to whitish violet or yellowish white, according as we increase the proportion of violet or yellow.

4th. The green gives with blue a bluish green; with indigo a lighter blue, more dull and mixed with white than the blue of the spectrum; with the violet, the green gives likewise a light blue.

5th. The blue mixed with indigo gives intermediate shades, mixed with violet it gives a dark blue, but not so deep as the indigo of the spectrum.

6th. The indigo with the violet gives intermediate shades.

The most remarkable fact contained in the above observations is evidently the production of white by the combination of yellow and blue. We are so accustomed to consider green as the only color resulting from blue and yellow, that M. Helmholtz was not willing to trust to his own personal judgment, and he exhibited the phenomenon to a great number of persons. To obtain pure white it is necessary to take a yellow which has no orange or greenish tint, that is, the yellow between Fraunholer's lines D and E, about three times more distant from E than from D, the color being very near that of chromate of lead; as for the blue, we may take indifferently the whole of that part of the spectrum ordinarily termed indigo, extending from the middle of the interval between the rays F and G, as far as the ray G, the tint of this color is rather that of sombre ultramarine than of natural indigo.

Again, this observation appears to controvert the daily experience of painters who constantly produce green by a mixture of blue and yellow, but the contradiction disappears when we examine the manner in which the effects of the mixtures of colored materials are produced. The coloring materials are generally transparent or more or less translucent. If a pencil of light falls upon a fragment of one of these materials it is partially reflected by the surface without color, and another portion of the light penetrates to the interior of the body, is colored by absorption, and returns to the eye reflected by the second surface, carrying what we consider as the proper color of the substance. If we reduce the coloring matter to a powder, we increase evidently the proportion of the light which returns to the eye, after it has been colored by absorption, for the light reflected from the first stratum of powder is added to that of the second, the third, &c., and that which is most modified by absorption which comes from the deepest layer. If a mixture is made of two coloring powders, the light which the mixture conveys back to the eye, is mostly composed of rays which have traversed the grains of both kinds of the powder, and which therefore has suffered two different absorptions, and yields the tint of those rays which are absorbed in the least proportion by these two substances. When, for example, we mix a yellow powder with a blue, the yellow grains arrest the blue and violet rays, while they diminish but little the green rays; the blue grains arrest the yellow orange and red, but permit the greater portion of the green rays to pass; the tint of the mixture appears therefore green. Again, when a red powder is mixed with a blue powder, a different tint results from that which arises from the prismatic blue and red. Cinnabar and ultramarine give by mixture a violet gray in lieu of the red, which results from the combination of the two analogous prismatic tints. In fine, it results from this explanation, that the tint produced from a mixture of two powders is generally more sombre than that of the powders themselves, a fact which accords with experience.

When we combine the colors reflected by colored bodies. we obtain the same results as with prismatic colors. For example, if we cover the two sectors of a circular disc with different colors, and give it a rapid rotation, we will obtain with chrome yellow and ultramarine, an almost colorless pale gray. We know on the contrary, that the mixture of these two colors is daily employed by the painters to make green. The same results are obtained more neatly in the following manner: — If we place upon a black table two colored discs, and place vertically between the two, a glass with parallel faces, so as to view one by transmitted and the other by reflected light, by giving to the eye and to the two discs a suitable position, we may render the two images equally or unequally intense, and cause them to be superposed; in this manner the colors of the two discs may be combined at the bottom of the eye, and the result of the combination is always similar to that of the prismatic colors; thus the yellow of chrome and gamboge combined in this manner with the azure blue of cobalt, gives a perfect white: with artificial ultramarine, a reddish white; with Prussian blue, a white, slightly greenish. The vermillion gives a rose-tint with blue, a yellow with green, &c. The compound tints obtained by a combination of two prismatic colors, have for the most part their analogues in the solar spectrum, except the white tint produced by yellow and blue and the purple tints produced by red and violet, but there is almost always an appreciable difference from the analogous tints. Thus the red and yellow give an orange not to be distinguished from the orange of the spectrum, and the violet and blue reproduce almost completely, the pure indigo; but the yellowish green and bluish green of the spectrum, in combination, give a green much more white and much more dull than the green of the spectrum; the appearance of this latter color it is almost impossible to imitate by a mixture of two simple colors. The yellow is very well reproduced by means of orange and yellowish green, and the blue by bluish green and indigo, but the violet can only be very imperfectly imitated by means of a combination of indigo with a small quantity of red; the red itself cannot be reproduced in any manner, the combination of orange and violet giving a carmine tint very different from the red of the spectrum.

It results that to reproduce simply the tints of the spectrum, in a manner at all satisfactory, requires at least five simple colors, the red, the yellow, the green, the blue, and the violet. If we confine ourselves to three simple colors, but very imperfect imitations will be produced; it is necessary always to use the red, green and violet; a choice of any other elementary colors does not permit us to imitate but partially, the tints of the spectrum, and the combination of red, yellow and blue, which is indicated by most authors, is the worst of all.

M. Helmholtz likewise made certain experiments upon the results of the mixture of three simple colors. To effect this, the slit in form of a V was replaced by another having nearly the form of N inclined, and studied as in the preceding manner by the superposition of the three spectrums. He investigated, chiefly, the combination of three colors which would give the white, and found a great number. There results from these experiments an important fact, the effect of the combination of a simple color with two others, produces a different effect from the combination of the first simple color with the color of the spectrum analogous to the tint resulting from the mixture of the two colors; for example, the red and the bluish green of the spectrum give yellow; the red, and the bluish green produced by the combinations of green and indigo, give white.

The whole of the phenomena conduce evidently to the rejection of the hypothesis cited at the commencement of this memoir; since it is impossible to reproduce the different tints of the spectrum with any three others, nor does it affect less the three fundamental colors if the same are considered as three distinct physiological impressions.

At the last meeting of the British Association, at Hull, M. Helmholtz stated that he had repeated the above experiments, following another method, similar to that lately described by M. Foucault, for obtaining larger fields equally dyed with the mixture of two homogeneous colors, — and has found that there are more pairs of complementary colors in the spectrum. These colors are situated at both ends of the spectrum: — one side, from red up to a yellow shade, a little greenish, — on the other side, from violet up to a blue shade, also a little greenish. The shades, however, in the middle of the spectrum, in which the green preponderates, can not give white any other homogeneous color. Their complement is purple, and must be compounded by violet and red. The complementary colour of red is greenish blue, — of orange, sky blue, — of yellow, indigo, — of greenish yellow, violet. The author found, moreover, that the complementary colors are arranged in the spectrum in a most irregular manner. As the breadth of the differently colored bands in prismatic spectra depends not only on the wave-length, but on the substance of the prism, he refers the following results to interferential spectra, where the distance of two colors is proportional to the difference of their respective wave-lights. If you pass with an equal velocity through the different colors of such a spectrum, the shade is altered very slowly at both its extremities, in the red and violet, but in those parts where the complements of red and violet are placed, in the greenish yellow and the greenish blue, the shade alters very rapidly, so that the distance of extreme red and golden yellow is about ten times greater than the distance of their complementary colors, greenish blue and sky blue. The author observed two circumstances in these experiments which had prevented him in his former experiments from finding other complementary colors than yellow and indigo, At first, according to the peculiar distribution of complementary shades in the spectrum, the said colors were able to give a larger white spot than the others. Secondly, it appeared to be very difficult to the human eye, which is not quite achromatic, to find and to keep the right focal length for objects illuminated by two kinds of homogeneous rays of very different refrangibility. Indigo aud yellow are of less different refrangibility than any other pair of homogeneous complementary colors, and are therefore easily combined. Others, as red and greenish blue, on the contrary, are united in the same field of the retina with great difficulty. Finally, the author gave some remarks on the best method for bringing the whole variety of colors into a system. He stated that Newton's colored disc appeared to be the most simple and complete manner. Some points, however, are to be changed. First, not only the seven principal colors of Newton must be arranged on the margin of the disc, but the whole definite number of them existing in the spectrum, so that complementary colors are placed in the opposite ends of the same diameter. Secondly, the two ends of the spectrum cannot meet together, but must be separated by an interval, where the complementary color of the green shades, namely, purple, is to be intercalated. The commonly-received theory of three principal colors includes a restriction of Newton's method contradictory to the author's former experiments.

SINGULAR APPLICATION OF PHOTOGRAPHY.

A discovery has recently been made at the Bank of England, which will cause, it is understood, a great change to be speedily effected in the character and general appearance of the notes issued by that corporation. It has just been discovered that by means of photography fac-similes can be effected by a skilful operator, with the greatest facility; and that fraudulent copies of bank notes thus obtained, would pass muster even with some of the most experienced judges. We are not aware by what means the suspicions of the authorities of the Bank were originally excited on this important subject. It is stated, however, that they were first caused by one of these fraudulent notes having been exchanged for gold "over the counter," its spurious character having escaped the generally closely scrutinising eyes of the cashiers in that department.

Under the impression, from certain indications which manifested themselves on the note, that it had been fabricated by photographic agency, experiments were made by one of the most eminent and experienced photographers in the metropolis, (whose aid was called into requisition by the Bank authorities,) when it was clearly proved, by the results of those experiments, that the spurious note had been manufactured by the means suspected, viz. photography. So close was the resemblance between the spurious note (thus experimentally obtained) and the genuine one (whence the copy was taken by the photographer alluded to) that not only were the signature and the private marks (the latter known only to the Bank officials) imitated with the closest accuracy, but the very watermark itself, in all its integrity, was as clearly and closely defined as the other more prominent characteristics of the genuine document.

The process adopted to produce these effects is well known to all photographers as "the wax paper process." The photographic thin negative paper after having been prepared with wax, and then rendered sensitive by the usual method, (which need not be described here,) is then in a fit state to receive the impression from the genuine note, the printing, the signature, and the watermark, and in fact every mark, however minute, which appears on the face of the note, being clearly and distinctly traced and defined. This is termed the "negative," and from this "negative," obtained by such an extremely simple method, when adopted by a skilful manipulator, "positives" (exact fac-similes of the note itself) might be multiplied by means of sun printing to any extent.

We understand that the Directors of the Bank of England, in order most effectually to put a stop to the possibility of frauds being perpetrated to so inconvenient and alarming an extent, by photographic agency, have determined, as soon as the necessary arrangements can be effected, and with the least possible delay, to entirely alter the color of the paper on which their notes are produced, as well as change the color of the ink used in printing them, and substitute a widely different shade. From inquiries they have caused to be made, they have ascertained that if their notes be printed on a yellow tinged paper, in blue ink, it would be impossible to transfer fac-similes to photographic negative wax paper, (rendered sensitive by being saturated with a solution of the nitrate of silver and other chemicals,) from which the imitations of the genuine notes are obtained.

Another plan, to which the attention of the Bank authorities may be called, and which would be equally efficacious in putting an end to the nefarious system referred to, would be to have a few words, or ornamental devices, struck off on the back of the genuine notes. These words or devices, by the process of sun-printing, would all be transferred to the front of the imitation note, and thus the attempts of the fraudulent to plunder the unwary would be entirely foiled.—*London Times.*

CHROMATIC PHOTO-PRINTING.

At a meeting of the London Society of Arts, Feb. 1853, a paper was read by Mr. R. Smith, on "Chromatic Photo-printing, being a mode of printing textile fabrics by the chemical action of light." The author proposes to employ the chemical agency of light in dyeing or staining textile fabrics; the cloth, whether wool, silk, flax, or cotton, being first steeped in a suitable solution, then dried in the dark, and subsequently exposed to the action of light, those parts which are to form the pattern being protected by pieces of darkened paper, or some other suitable material, attached to a plate of glass. When the desired effect is produced, the time for which varies from two to twenty minutes, according to the nature of the process, the fabric has to be removed, in order to undergo a fixing operation, whilst a fresh portion of it is exposed to light. This may easily be effected by the use of very simple mechanical arrangements, so that a number of photographic printing engines may be placed side by side, and superintended by one person. From the trials which Mr. Smith has made he believes that even the diffused light of a cloudy day will have power enough for the operation, though of course a longer time will be required for its perfection than on a bright and sunny day. In order to obtain a pale blue or white pattern upon a blue ground, Mr. Smith uses solutions of citrate of tartrate of iron, and ferrocyanide of potassium; steeping the cloth subsequently in a dilute solution of sulpheric acid. Browns and buffs are obtained by using a solution of bichromate of potash; the excess of salt in the parts not acted on by light being afterwards either washed out, leaving those portions white, or decomposed by a salt of lead which forms a yellow chromate of lead. By combining these two processes with the use of madder, log-wood, and other dye stuffs, a great variety of tints may be obtained.

IMPROVEMENTS IN PHOTOGRAPHY.

Paper Photographs. — Mr. Peter Fry adopts a simple mode of manipulation, offering many advantages to the traveller. Papers are prepared with very weak solutions, so that they are covered with a pure iodide of silver, to which the slightest addition of nitrate of silver will give sensibility. Papers might be iodized in England previously to a three months' travel. A small quantity of a very strong solution of nitrate of silver, and the same of gallic acid, are the only exciting agents required. In the morning, as many pieces of paper as are thought to be necessary for the day, are rendered sensitive. A few drops of the strong solution of the silver salt are added to some pure water, and they are washed with this on one surface, and placed in their frames. The pictures are obtained, and they are developed on the traveller's return at night with very little trouble. Thus a very small addition to the ordinary luggage is required, and at any place all the operations can be very easily performed. Sir William Newton has adopted the practice of copying the *negatives* on a paper similar to that on which they were obtained. His positive paper is prepared with from seven to ten grains of nitrate of silver to one ounce of distilled water — the iodide of potassium being in equivalent proportions. It is excited by the aceto-nitrate solution, and exposed to light for from five seconds to half a minute, and developed by gallic acid. By this the process of copying is exceedingly facilitated, and in almost any state of weather it can be carried on, and even by good artificial light successfully pursued.

Blanquart Everard and Gustave Le Gray have for some time adopted a process not very dissimilar to that of Sir William Newton, in its general character. Their positive pictures are of a very uniform tint, and of a fine black or dark violet color, which adds much to their beauty. This color is produced by the following method, according to M. Le Gray. The paper for the positives is prepared with muriate of ammonia and nitrate of silver. When a blue-black is desired in the darkest parts, the whites of the picture are allowed to assume a clear violet tint before it is removed from the sunlight. For a pure black a still more decided violet color should be obtained; and for an olive black the whites should even pass into a sepia tone. The pictures are first washed in ordinary water, to remove all the free nitrate of silver, or to convert it into a chloride. It is then placed in a bath, prepared in the following manner: — Chloride of gold, 1 grain; distilled water, 1000 grains; hydrochloric acid, 25 grains. This solution clears all the white parts, and the sepia or olive tints pass to black. When the blacks are perfectly clear, and all the details of the negative developed, the picture is well and quickly washed in several waters, to remove all traces of acid. This is very important, since any adhering acid occasions the decomposition of the hyposulphite of soda, and by precipitating sulphur destroys the picture. A little ammonia, added to the water, effectually neutralizes the acid. It is then placed in the bath of hyposulphite of soda, composed of one part of that salt to six of water, and completed in the usual manner. When properly prepared, these photographs have all the air of fine mezzotinto engravings.

Mayall's Improvements in Crayon Daguerreotypes. — The London Athenæum gives a description of a beautiful recent invention of Mr. Mayall, of London, by which he is enabled to produce an effect of arrangement similar to that which the crayon painter imparts to his portraits. By its means a more truthful gradation is obtained, — and the force in the features of the face is freed from that exaggeration hitherto inseparable from the process. The result is, a far more agreeable version of the human face than has been hitherto obtained by this instrument. Some specimens which have come under our notice are much distinguished also for the beauty of their execution, — the tint being harmonious and neutral, the various textures of flesh, hair, drapery, &c., discriminated with a painter's taste, and an entire absence of a certain commonness of aspect which has tended hitherto to disparage this art. The mechanical arrangement of this invention consists, we are informed, of a slowly revolving disc, arranged on a support somewhat like a fire-screen, and having a central opening in the form of a large star. This disc is carried between the forks of a framepiece, the stem of which is adjustable as to height in the pedestal. To keep the disc in motion, an arrangement of clockwork is attached to the framing, — the actuating spring being contained in a box, driving a spur-wheel in gear with a pinion on the spindle of the fly. The screw for setting the disc up or down is at a certain point. This apparatus is interposed between the object, or sitter, and the camera; and the central portion of the star is made large enough to admit the rays from that part of the object which is to be shown in strong light, whilst the rays from those parts which are to be gradually shaded off to a dark background are partially intercepted by the points of the star. In this way the intensity of the light is gradually destroyed, and the softened-off "crayon" effect is produced. The apparatus is applicable to every description of camera, — and by placing it nearer to or further from the lens, any portions of the image may be so softened off.

The following improvement in the method of taking daguerreotypes has been invented by James Brown, of New York. The apparatus employed is used in conjunction with the camera, and consists of an ornamental diaphragm placed in front with a suitable opening to take the picture of the intended object. The front of the diaphragm may be ornamented in any way by work in relief, or by drawing, painting, or otherwise, so as to form on the daguerreotype an ornamental background. The diaphragm is made adjustable at different heights and inclinations by being fixed in a swinging frame hung on pivots in a standing frame, and having grooves to receive the sides of the diaphragm.

Portraits from Daguerreotypes. — A plan has been devised by Mr. Ransom, of New York, for painting portraits from daguerreotypes which cannot fail to produce very important results in portrait painting. It is purely mechanical, and consists in so placing the daguerreotype as to throw an exact copy of it, magnified to any required size, upon canvass placed at the distance of a few feet from it. In this way a most accurate likeness, the size of life is projected upon canvass from a daguerreotype; and may be sketched with a crayon or otherwise, to be finished and colored with oils afterwards. The utility of the invention consists in enabling the artist to get a perfect copy of the features with infinitely more accuracy and ease than in the ordinary way; while it does not interfere in the least with the subsequent finish of the portrait.

A new method of portrait painting has also been recently introduced in Paris, by Horace Vernet. He mixes his colors with olive oil, which avoids the drying of the colors, and the cleansing of the brushes. When the painting is finished, a layer of absorbing earth is applied to the back of the canvass; the oil is absorded and the painting becomes a pastel or crayon drawing. The earth is then removed, and a coat of flaxseed oil is substituted; this penetrates the colors, and the work is done.

ENGRAVING FROM DAGUERREOTYPES.

Various attempts have been made to transform, by chemical agents, the plate of the daguerreotype into an engraved plate, engraved by the image formed by light, from which the operator might strike off, by the ordinary process of impression, a certain number of proofs on paper. Dr. Donne made the first experiments in this direction; MM. Grove, Berres, Choiselat, Fizeau, followed, with different success, his lead. Attempts have also been made to transfer upon stone photographic drawings, and M. Lemercier has produced several lithographs obtained by this way. Doubtless researches would have been pushed further in this direction, had not a formidable rival entered the list: photography upon paper, which allows the operator to obtain, by means of an original plate (*cliche*,) a large number of identical proofs, consequently most persons have judged they would herein discover the practical solution of the multiplied publication of the products of photography. Hence, all efforts have tended towards completing Mr. Talbot's invention, by endowing the plates (*cliches*) with a greater durability, accelerating and regulating the transfer to paper, with, at the same time, a complete preservation of the details of the original.

It may appear rather strange, that it is Mr. Talbot himself who reverts to engraving proper, and furnishes new processes, which one day may, perhaps, limit the employment of calotype paper. Mr. Talbot discards silver and copper, as the plate on which he proposes to employ chemical reactives. It has been ascertained these two metals are too soft to resist the wear and tear which necessarily accompanies a large impression, and to preserve unaltered all the finer details of an operation whose principal merit is to reproduce all the details of a luminous image. Mr. Talbot sought to engrave upon steel, and he succeded, after patient perseverance, in discovering the following process, which enabled him to do so: — The steel plate, after having been slightly unpolished by a mixture of acetic acid and sulphuric acid, is first covered with a good coating of gelatine, holding in solution a red salt, called bichromate of potassium, whose sensibility to light has long been familiar to chemists. When this coating has been suitably laid over the surface of the metal, and dried there, by the application of a gentle heat, the plate seems of a uniform yellow color; then the operator applies to its surface either the object whose mere silhouette is sought, or a photographic drawing already obtained on paper by the usual processes. For greater simplicity, suppose that the operator wishes to obtain the impression of some vegetable organ, profoundly marked — a leaf of fern, for example. This leaf is applied to the plate, and pressed by a piece of clear glass, after which, and while so pressed, it is exposed to the sun for one or two minutes. The parts of the plate exposed to the sun will be observed to become brownish; and when the leaf which protects the parts beneath it is removed, its image will be found very clearly traced, by the preservation of the original color of that part of the plate. This image, formed by application, becomes still more apparent when the plate is plunged in water, as the colored salt is only dissolved there, where it has not been altered by light. And the water also removing a certain quantity of the gelatine, prepares at the same time the plate for the reactive which is to eat into the steel. It was no easy task to select this reactive. Should the operator pour on the plate nitric acid, commonly used by engravers, and which Dr. Donne used the first time he sought to operate by reactives on metallic plates? It commenced to act at once on the white parts of the plate, but the gas disengaged removed the gelatine coating, and the acid soon ceased to respect the contours traced by the light, and after a while began to affect the whole surface of the plate. It was consequently necessary to resort to a reactive capable of acting without disengaging gas, and whose action would not extend to those parts which had been exposed to the sun. Fortunately there is a reactive combining all these requisites; it is a solution of bi-chloride of platina. This reactive is not so expensive as its name would seem to indicate; for it is not the platina which is expended in this operation but rather the chlorine which attacks the steel, and eats into it so deeply as that the traces are able to take and retain a sufficient quantity of printing-ink. So the operator pours upon the plate, placed horizontally, a certain quantity of bi-chloride of platina; he will observe the action commence immediately, and when he thinks it has gone far enough, he pours it off the plate, and he will find that he has the same quantity of platina as before the operation commenced. He has nothing to do further than to clean the plate, by moderately rubbing it with some soft body, to be certain that it is really engraved, and then he may send it to the printer. Mr. Talbot has sent to the Academy, as yet, only proofs of tissues and objects of natural history, obtained by simple application. They show that the corrosive action which engenders the engraving follows very faithfully the contours traced by the light. Among the specimens he sent, there were some copies of light tissues; of crapes folded double, in which the wave-line of the threads that characterize crapes were reproduced with a charming delicacy. It is evident Mr. Talbot has found a burin which will remain very docile to the indications of light, whenever the latter shall have to mark only the lines of bold demarcations between black and white; but when it is necessary to reproduce gradations of shades, such as those which essentially constitute the images formed in the *dark chamber*, it may be feared the value of the reactive's attack shall not correspond to the value of the shade sought to be represented. It is especially in vigor that all these purely chemical actions produce insufficient effects. The quantity of metal dissolved is, it may be granted, proportional to the value of the shade sought to be represented; but beyond a certain limit, the desired effect does not increase; and if the reactive eats the deeper, it does not increase the artistic effect. This Mr. Talbot feels sensibly; he has neither overlooked, nor sought to disguise this truth. He has even indicated that he is thinking on some way of using an artificial grain, to increase the available extension of the scale of shades.

The communication of the results of Mr. Talbot to the public has induced the publication of a different process devised by MM. Niepce de St. Victor and Lemaitre. The method they employ is but an extension of that used by the partner of Daguerre, M. Joseph Niepce, when he endeavored to take advantage of Judea bitumen. M. Niepce engraved only on tin; MM. Niepce (nephew) and Lemaitre operate on steel. After having suitably cleaned, and half-scoured the metal, they spread on its surface with a roller covered with skin, a varnish of Judea bitumen, or asphaltum, dissolved in essence of lavender, which they then dry by a gentle heat and in obscurity. Upon the plate thus prepared, they applied the face-side of positive or negative photographic proof upon albumened glass, or upon waxed paper, and exposed them to the light, sufficiently long to produce a counter-proof; a quarter of an hour in the sun, an hour in diffused light, is enough to terminate the operation. To bring this counter-proof out they next employed a dissolvent, composed of three parts of rectified oil of naptha, and one part benzoin, whose action is arrested at the proper point by pouring water upon the plate. Then commences the operation of engraving, properly speaking. A first *eating* is effected by a mixture composed of one part nitric acid, eight parts distilled water, and two parts alcohol. This first *eating* is intended to indicate only the engraving, for it could not, even were it prolonged, produce vigorous lines. It is then necessary to dry the plate and deposit on it what engravers call a grain of resin. This is a fine resinous powder, which at first is suspended in the air by agitation and then allowed to fall upon the metal like dust upon an article of furniture. The plate being lightly heated, the resin attaches itself to it, and allows the operator to perform another, a vigorous *eating*, and be certain they shall obtain the grain necessary to retain the ink and form a fine black. The result of all these operations is a plate engraved, as it were, in the *black manner*, capable of reproducing with greater or less fidelity to the impression on the photographic proof, on glass or on paper, (taken as the point of departure) the original object. No one has, as yet, succeeded in preserving the charm of the original image, engendered in the *dark chamber*, but the details are transmitted with considerable fidelity.

Claudet Process. — The following process for engraving from daguerreotypes has been recently patented by M. Claudet.

The process is established upon the following facts, which have come to the knowledge of the inventor:

1. A mixed acid, composed of water, nitric acid, nitrate of potassa, and common salt, in certain proportions, being poured upon a daguerreotype picture, attacks the pure silver, forming a chloride of that metal, and does not affect the white parts, which are produced by the mercury; but this action does not continue long. Then by a treatment with ammonia (containing already chloride of silver in solution is preferable for this operation), the chloride of silver is dissolved and washed off, and the metal being again in its naked state, or cleansed from the chloride, it can be attacked afresh by the same acid. This acid acts better warm than cold.

2. As all metallic substances are soon covered, when exposed to the atmosphere, with greasy or resinous matters, it is necessary, in order that the action of the acid upon the pure silver should have its full effect, for the surface to be perfectly purified: this is effected by the employment of alcohol and caustic potash.

3. When a daguerreotype picture is submitted to the effect of a boiling concentrated solution of caustic potash, before being attacked by the acid, the state of the surface is so modified that the acid spares, or leaves, in the parts which it attacks, a great number of points, which form the grain of the engraving.

4. When the effect of the acid is not sufficient, or, in other words, if it has not bitten deep enough, the effect is increased by the following process: — Ink the plate as copper-plate printers do, but with a siccative ink; when the ink is sufficiently dry, polish the white parts of the plate, and gild it by the electrotype process; then wash it with warm caustic potash, and bite in with an acid, which will not attack the gold, but only the metal in those parts which, having been protected by the ink, have not received the coating of gold. By these means the engraving is completed, as by the action of the acid alone it is not generally bitten in deep enough.

5. To protect the plate from the effects of wear, produced by the operation of printing, the following process is employed. The surface of the plate is covered with a very thin coating of copper, by means of the electrotype process, before submitting it to the operation of printing; and when the pellicle or coating of copper begins to show signs of wear, it must be removed altogether, by plunging the plate in ammonia, or in a weak acid, which, by electro-chemical action, will dissolve the copper without affecting the metal under it; the plate is then covered again, by the same means, and is then ready for

producing a further number of impressions. This recoating operation may be repeated as many times as may be required. The following is the description of the whole process, which is divided into two parts, consisting of a preparatory and finishing process:—

Preparatory engraving. — For this operation, which is the most delicate, it is necessary to have, 1. A saturated solution of caustic potash. 2. Pure nitric acid at 36° of the areometer of Beaume (spec. grav. 1.33). 3. A solution of nitrate of potassa, composed of 300 parts of water and 5 parts of nitrate by weight. 4. A solution of common salt, composed of water 100 parts, and salt 10 parts, by weight. 5. A weak solution of ammoniacal chloride of silver, with an excess of ammonia. The ammoniacal chloride of silver must be diluted with 15 or 20 parts of pure water. In the description of the process this solution will be called ammoniacal chloride of silver. 6. A weak solution of ammonia, containing four or five thousandths of liquid ammonia. This solution will be called ammoniacal water. 7. A weak solution of caustic potash, containing four or five thousandths of the saturated solution, which will be called alkaline water. 8. A solution composed of water 4 parts, saturated solution of potash 2 parts, alcohol 1 part, all in volume. This solution will be called alcoholized potash. 9. Acidulated water, composed of water 100 parts, and nitric acid 2 parts in volume. Besides, it is necessary to have two capsula, or dishes, made of porcelain, large enough to contain the plate, and covered with an air tight piece of ground plate glass, and two or three more capsula which do not require to be covered; two or three glass funnels, to wash the plate; and two or three glass holders in the shape of a spoon or shovel, by which the plate is supported when put in and taken out of the solution, without touching it with the fingers.

The daguerreotype plate is submitted to the engraving process, after having been washed in the hyposulphite of soda, and afterwards in distilled water.

First process for biting in or engraving the plate. — The following solutions must be put in the capsula in sufficient quantity, so as to entirely cover the plate: — 1. Acidulated water. 2. Alkaline water. 3. Alcoholized water in a covered capsula. 4. Caustic potash, in a covered capsula. 5. Distilled water.

The plate being put upon the glass holder or spoon, is plunged into the acidulated water, and agitated during a few seconds, then put into a glass tunnel, and washed with distilled water. It is taken again with the glass spoon, and plunged in the capsula containing alcholized potash. This capsula is covered with a glass cover, and then heated by means of a spirit lamp, to about 144 deg. Fahrenheit. The plate must remain in the capsula half an hour, during which the solution is heated now and then, and agitated. During that time, the following acid solution, which will be called *normal acid*, must be prepared; it is composed as follows: — Water 600 parts, nitric acid 45 parts, solution of nitrate of potassa 12 parts, solution of common salt 45 parts. These proportions are in volume. The normal acid must be poured in a capsula, covered with its glass cover, and a sufficient quantity must be kept in the bottle.

When the plate has been immersed in the alcoholized potash during half an hour, it is taken out of the solution by means of the glass holder and immediately plunged in alkaline water, and agitated pretty strongly; from thence it is put in distilled water. (A.)

This being done, the plate is plunged into acidulated water, and moved about therein for a few seconds; it is then put in the normal acid. When the plate has been immersed a few seconds in the acid it is taken out by means of the glass holder, taking care to keep it as much as possible covered with the solution, and it is immediately placed horizontally upon a stand, and as much acid as the plate can hold is poured upon it from the bottle; it is then heated with a spirit lamp, but without attaining the boiling point. During this operation it is better to stir or move about the acid on the plate by pumping it, and ejecting it again, by means of a pipette or glass syringe; after two or three minutes the acid is thrown away, the plate is put into the glass funnel, and there washed well with water, and afterwards with distilled water. (B.)

Then without letting the plate dry, it is put upon the fingers of the hand, and with the right hand some ammoniacal chloride of silver, which is moved about the surface by balancing the hand, is poured upon it; the solution is renewed until the chloride, formed by the action of the acid, is dissolved; the plate is then washed by pouring upon it a large quantity of ammoniacal water and afterwards some distilled water. (C.)

Without allowing the plate to dry, it is then put in the caustic potash, and the capsula being placed upon the stand, the potash is heated up to the boiling point. It is then left to cool (D.); and beginning the operation described from A to D, a second biting is obtained; and repeating again the operations described in A and B, a third biting is produced. The plate is dried: in this state the black parts of the plate are filled with chloride of silver.

The plate is then polished until the white parts are pure and bright. This polishing is done with cotton and "pounce" (pumice stone); afterwards, the chloride of silver, filling the black parts, is cleansed by the means described in B and C. The plate is then dried; but before drying, it is well to rub the plate slightly with the finger, in order to take off from the black parts any remains of an insoluble body which generally remain on it. The preparatory engraving is then finished, and the plate has the appearance of a very delicate aquatint engraved plate, not very deeply bitten in.

Nevertheless, if the operation has been well managed, and has been successful, it is deep enough to allow the printing of a considerable number of copies.

Note. — Sometimes, instead of treating the plate with the boiling potash in the capsula, a similar result may be obtained by placing the plate upon the stand, covering it with the solution, and heating it by means of a spirit lamp, until, by evaporation, the potash becomes in a state of ignited fusion. By this means the grain is finer, but the white parts are more liable to be attacked.

Last operation of biting in. — This operation requires some of the re-agents, before named, and also,

1. A siccative ink, made of linseed oil, rendered very siccative by boiling it sufficiently with litharge; it may be thickened with calcined lamp-black.

2. An electrotype apparatus, and some solution fit to gild and copper the plate.

Means of operation. — The plate must be inked as copper-plate printers do, taking care to clean off the white parts more perfectly than usual; the plate is then to be placed in a room sufficiently warm, until the ink is well dried, which requires more or less time, according to the nature of the oil employed. The drying of the oil may be hastened by heating the plate upon the stand with the lamp, but the slow process is more perfect and certain.

When the ink is well dried, the white parts are cleaned again by polishing the plate with cotton and pounce, or any other polishing powder; a ball of cotton, or any other matter, covered with a thin piece of caoutchouc or skin, can be used for this purpose. When polished, the plate is ready to receive the electro-chemical coating of gold, which will protect the white parts.

Gilding. — The gilding is obtained by any of the various processes of electrotyping which are known. The only indispensable condition is, that the surface obtained by the precipitation must not be liable to be attacked by any weak acid; a solution answering this purpose is made of ten parts (by weight) of ferrocyanide of potassium, 1 part of chloride of gold, and 1000 parts of water, used with a galvanic battery. During the gilding, the plate must be turned in several positions, in order to regulate the metallic deposit. In some cases the gilding may be made more perfect, if the plate is covered with a thin coating of mercury before being put in the gilding solution.

When the plate is gilded, it must be treated with the boiling caustic potash, by the process already indicated for the preparatory engraving, in order to cleanse it from all the dried oil or ink which fills the hollows. The plate is then washed and dried, and when the oil employed has been thickened with the lamp-black, the surface of the plate is rubbed with crumbs of bread, in order to cleanse and take off the black remaining; then, the white parts being covered and protected by a varnish not apt to be cracked, and the black parts uncovered and clean, the plate can be bitten in by aquafortis, according to the ordinary process used by engravers.

This operation must be done upon the stand, and not by immersing the plate in the solution.

Before this last biting-in, if the preparatory engraving has not succeeded well, and the plate still wants a sufficient grain, it can be given by the various processes of aquatint engraving.

Before submitting the plate to the operation of printing, in order to secure an unlimited number of copies, it is necessary, as before stated, to protect it by a slight coating of copper, which is obtained by the electrotype process; otherwise the printing will soon wear the plate. This coating must be kept very thin, lest the fineness of the engraving and the polish of the white parts, should be destroyed. In this state the plate can be delivered to the printer.

After a certain number of impressions have been obtained, it will be perceived that the coating of copper is worn in some places; then this coating must be removed, and a fresh one applied in its place. For this purpose, the plate must be purified and cleansed by warm potash, and plunged in a weak acid composed as follows:— Water, 600 parts; nitric acid, 60 parts; nitrous acid of engravers, 5 parts; all in one volume. This acid will dissolve the coating of copper, and the plate being coppered again by the same means as before, may be again admitted to the operation of printing; and as nothing can prevent the success of a repetition of the same operation, any number of impressions may be obtained. The coating of the copper can also be removed by caustic ammonia.

The daguerreotype plates engraved by this process, constitutes the present invention, which consists,—

First,— In the discovery and employment of certain properties of a mixture composed of nitric acid, nitrous acid, and hydrochloric acid in determined or fixed proportions. The two last mentioned acids may be employed either in a free state, or combined with alkaline or other bases. This mixed acid has the property of biting the pure silver which forms the black parts of the daguerreotype picture, without attacking the white parts forming the amalgam of mercury. The result of the action of biting is to form on the black parts of the picture an insoluble chloride of silver; and this chloride of silver, which when formed, stops the action of the acid, is dissolved by ammonia, which allows the biting to continue.

Secondly,— In the discovery of certain properties of a warm solution of caustic potash, and in the employment of the said solution, by which the mercury forming the picture is better and deeper amalgamated with the silver under it, so that many imperceptible points of the amalgam are effected in such a manner that the acid has no action upon them.

Thirdly,— In the discovery and employment of a process which produces a grain favorable to the engraving, by which the biting on the plate is rendered deeper. This is effected by filling the parts engraved with a siccative ink, or any substance, and then gilding the plate by the electrotype process; the gold is not deposited on the parts protected by the ink. When the plate is gilded, the ink is cleansed by the caustic potash, and the plate may be submitted to the effects of an acid which does not attack the coating of gold, but bites only on the silver in the parts already engraved by the first operation.

Fourthly,— In the employment of a process by which the plate is protected from the wear of the printing operation. This is effected by covering the plate, before printing, with a slight coating of copper by the electrotype process; and when the coating begins to wear by printing, it is removed by weak acid, or by ammonia which dissolves the copper without affecting the silver under it. The plate is coppered again, after another printing, the same operation is repeated, so that a considerable number of copies may be printed without much injury to the engraving.—*Humphrey's Journal.*

REPRODUCTION OF ENGRAVINGS.

In 1847, M. Niepce published a memoir on the action of different vapors, and amongst others of that of iodine. He stated that the vapor of iodine attached itself to the black portions of an engraving to the exclusion of the whites, so that the picture could be reproduced on paper sized with starch, or on glass coated with this substance.

He now proposes to render them unalterable by the following process: If a design obtained on starched paper or glass, in the manner described by him in 1847, be plunged into a solution of nitrate of silver, it will disappear; if the paper or glass be now exposed to the light for a few seconds, the iodide of silver, into which the iodide of amidone which formed the primitive design has been converted, being much more sensitive than the nitrate of silver with which the rest of the surface is imbued, is acted upon much more rapidly; if the paper or glass be then dipped into a solution of gallic acid, the design is immediately reproduced, and it is then treated with hypo-sulphite exactly as is done with photographic pictures. By this process the design becomes as permanent as these latter, and it will probably be adopted in many cases.

M. Bayard has applied this process to the reproduction of old engravings, by first forming a negative upon albuminised glass, by means of the previously iodized engravings placed upon it.—*Comptes Rendus, March,* 1853.

COLORED DAGUERREOTYPES.

A late number of Humphrey's Journal contains an article by James Campbell, of Dayton, Ohio, giving the results of some experiments made to produce colored daguerreotypes, from which we make the following very interesting extracts:—

M. Becquerel and Niepce de St. Victor have proved that if chloride of silver containing a slight trace of copper, be exposed to the prismatic spectrum, or to the rays of different colors, while undergoing this reduction, it is susceptible of coloration after a protracted exposure. From this it would seem that this process might be much accelerated, if we were careful to aid nature in her operations, instead of trying mere haphazard experiments, not based on rational theory. I will show by a few experiments that this may be done, and to avoid being too prolix, will, at present, speak of the chloridated silver plate, unaccelerated by iodine, bromine, fluorine, chrome, or their compounds.

If the plate, covered with the enameled chloride of silver prepared by Niepce's process, be exposed to a current of hydrogen while receiving the image, the process will be much accelerated, and the image will be impressed in from half an hour to an hour; according to the amount of gas passed into the camera, the light, temperature, electric state of the atmosphere, &c., instead of requiring from three to five hours, as in the original process, and the colors of the picture will be impressed on the plate in all their original beauty. This experiment may be very easily performed, it only requiring a few grains of zinc in a small vial, containing dilute sulphuric acid. The vial and its contents may be placed in the camera, and the hydrogen being nascent, is in its most active state, and as it is perfectly transparent, it permits the light to act on the plate, while it is itself engaged in reducing the chloride, which it is only capable of doing in sunlight.

The hydrogen, probably from its affinity for oxygen, hastens the decomposition of the organic matter, and assists in reducing the chloride, thus acting as a deoxydating and dechloridating agent. There is, however, sufficient hydrogen contained in the combined organic matter, to effect the reduction of the chloride, hence it is probable that the excess merely hastens the decomposition.

Following this train of investigation, I have tried many other reducing agents both liquid and gaseous. The most important liquid agents tried have been the proto-sulphate and nitrate of iron, ferocyanide of potassium, protochloride of tin, and the fluorides of potassium and sodium. The principal gaseous agents tried are hydrogen alone, and in combination with carbon and sulphur, ammonia, sulphuric ether in vapor, chloroform vapor, sulphuret of carbon, chloride of sulphur, hydro-sulphuret of ammonia, and sulphurous acid. As very remarkable results followed from the application of the gases, I will speak of them more particularly. Sulphurous acid has a strong tendency to abstract oxygen from organic bodies, it also unites with chlorine in sunlight, and so do light and heavy carburetted hydrogen, the latter, indeed, without the influence of light. Sulphurous acid abstracts oxygen from organic bodies, with which it combines, forming sulphuric acid, and sulphuric acid renders chloride of silver unchangeable to light by destroying the organic matter with which it is combined. I hence inferred that it might be used for the double purpose of reducing and fixing the picture. That it is a powerful accelerator is certain ; the fixing requires further experiment.

Pictures may be obtained with this gas in half an hour, by passing it nascent and in sufficient quantity in the camera, and the colors are preserved. There is, however, sometimes a little sulphur deposited under the enamel, which gives the light parts of the picture a yellowish cast. This color may sometimes be removed by heating the plate. Carburetted hydrogen acts still quicker, probably from the free carbon which results from its decomposition being a powerful reducing agent, and as the carbon is not left under the enamel, it probably passes off under the form of the volatile chloride of carbon. I obtained one picture in five minutes, by passing into the camera the gases generated from distilling alcohol and sulphuric acid in a retort. The gases formed were olefiant gas and sulphurous acid, mixed with a little light carburetted hydrogen and sulphuric ether. The colors were very fairly represented, but not as good as I had previously obtained.

I considered this experiment as very encouraging, but having only lately tried it, have not repeated it by itself without the agency of electricity.

As electricity is a powerful agent in decomposing chemical compounds, it might be naturally inferred that it would aid in this process. I have often tried it, but without, until lately, any very important results. Dry chloride of silver is not decomposed by electricity, yet its decomposition by light and other agents may, by it, be much accelerated, and I did not at first use a sufficiently powerful current. I now render the plate a part of the conducting medium which terminates at the positive pole, and terminate the poles in water, to which some saline constituent has been added, and by the decomposition of the water I am enabled to judge of the power of the current. By using the gases at the same time that the plate is thus excited, I have been enabled to take pictures in from four to five minutes, which would otherwise require from three to five hours for their production. These pictures are developed under a hard, tough enamel of chloride of silver, cannot be rubbed out by the fingers, and will even bear considerable buffing, and, if the enamel is thick, are improved by the operation. I have not been able to permanently fix the picture, but it will keep a long time, if not exposed too often and too long to the light. From the above experiments it seems that a prolonged exposure is not necessary to produce coloration, hence agents of great energy may be employed in reducing the chloride.

That coloration may be produced, it is important, I think, that the picture by whatever process it is taken, be positive, and complete on its removal from the camera. For fixing, it is important that all the organic matter be destroyed, and then, I believe it will be fixed. I am at present engaged in experimenting with iodine, bromine, fluorine, sulphur, chrome, and copper, and their compounds, deposited on the silver plate by electric action, or otherwise, but have not, as yet, any results sufficiently matured to publish, though I have produced coloration. Great care is requisite in preparing the enameled plate of chloride, and some experience is required to judge at what state of its preparation it is most sensitive to light, yet any artist can, after a few experiments, prepare it.

NEW METHOD OF ILLUMINATION.

The following new method of illumination has recently been exhibited in Paris, by M. Godillot. The principle is, that of the multiplication of light by means of innumerable small mirrors arranged in a particular manner in a multitude of frames bound together; and which may take different forms, as that of a star, that of a cross of the legion of honor, &c. This framing in light wood-work, with its mirrors, is placed perpendicularly, and made to rotate. In front of its central point is placed a bright burner, the reflexion of which illuminates every mirror and multiplies the light infinitely. If between the burner and this system of mirrors a colored glass is interposed, the mirrors reflect the color. By means of certain arrangements, the interposed glasses are made to produce effects aud combinations of tints to which the rotation gives a fairy aspect. Where the light is not colored, the reflecting power is said to be so great that a man may read by it a kilometre's distance, — about two-thirds of a mile. This mode of lighting, it is added, may be turned to account for other purposes than that of mere street illumination; — for example, for shipwreck signals, the lighting of great night works, tunnels, &c.

VALUE OF THE BAROMETER IN NAVIGATING THE AMERICAN LAKES.

At the American Association, Cleveland, a paper on the above subject was read by Mr. W. C. Redfield, of New York. He commenced by alluding to the great American lakes as remarkable, not more for their extent and commercial advantages, than for the destructive storms with which they are visited; these storms being sudden and the shores generally dangerous. The direct force of an easterly wind on the Atlantic is seldom felt on the lakes. Every great storm, viewed in its geographical extent, is a great cyclone, or eddying current of wind. In these latitudes the first wind is from an eastern or a southern quarter, preceded or attended by a fall of the barometer, phenomena due to the northwesterly progress of the cyclone, and its leftwise movement around its own axis of gyration. On the ocean these storm winds can readily pass and act along the coast, but the varieties of land surface prevent direct extension to the trans-alleghanian regions, and lessens, also, the violence of the westerly winds which constitute the westerly or closing portion of the cyclone.

On the great interior plateau where the lakes are situated, these conditions are partially reversed. The first winds of the cyclone here blow from the eastern or southern board, and are impeded by the surface of the country, and on the left side, the northwesterly winds, which are retrograde to the advancing body or entire cyclone, are necessarily less violent — often quite moderate or gentle, compared with the succeeding easterly winds. When the axial center of the cyclone has passed the observer, the barometer, which has in the mean time fallen to its lowest point, commences rising, the wind becomes westerly, its force is suddenly and greatly increased, being a compound of both the progressive and the rotative velocities; these violent westerly winds are no doubt aided by the rapid and colder current of the next higher stratum, which coincides in direction; thus these later westerly winds are almost inevitable as they sweep over the lakes.

A continual but varying series of these cyclones is passing over the temperate and higher latitudes, producing variable winds. In the North American cyclones, the first or advanced portion exhibits easterly or southerly winds, the principal direction, locally considered, being dependent upon the position of the observer laterally in its path. These first winds produce a fall of the barometer; the progress and degree of the depression of the mercurial column demands careful attention, especially on the lakes, since the later or westerly gale, the rear of the cyclone, will be proportioned to this fall. When the barometer has ceased to fall, the central portion is nearest; the local change of wind will soon follow, and the barometor will commence rising; this is the most dangerous period of the storm, of which the barometer has thus given us indication. All precautionary measures should be taken, then, during the fall of the barometer. From the favorable direction of the easterly or first winds of the cyclone, navigators are tempted to sail up the lakes; they should remember that the extent and force of the later westerly winds may be estimated by the fall of the barometer, but not at all by any moderation of the first or easterly winds. The fall of the barometer on the lakes is less than on the ocean from a like storm; yet it is sometimes one inch or even more, and whenever it exceeds the ordinary mean of moderation storms, every precaution should be taken.

ON THE GRADUATION OF STANDARD THERMOMETERS.

The following account of the graduation of standard thermometers at Kew Observatory, was given to the British Association, by Mr. J. Welsh. In the year 1851, the Committee of the Kew Observatory, impressed with the importance in meteorological investigations of possessing thermometers of a better class than those hitherto procurable from opticians, took steps with the view of producing such instruments under their own superintendence, for distribution to institutions and individuals who might require accurate standards of reference. The committee were furnished with the information necessary to carry out their intentions, by M. Regnault, of Paris, who had been accustomed to construct his own thermometers by a method proposed by himself, and with an accuracy previously unknown; they were also supplied under his directions, with the requisite apparatus. It had been assumed by physicists, that at all temperatures, as high at least as that of boiling water, the apparent expansion of mercury in a glass envelope, is uniform for equal increments of heat. A mercurial thermometer might, therefore, be called a standard instrument, when the divisions of its scale corresponded everywhere to equal volumes of the contained fluid, and when the readings were known for the temperature of melting ice, and of water boiling under a certain barometric pressure. If the tube were perfectly uniform in its bore, it would only be necessary to make a scale of equal parts between the freezing and boiling points, and to extend the division above and below these points, — but as perfect tubes were in practice not procurable, it became necessary in dividing the scale, to make allowance for the variations in the tube's capacity. These variations could be obtained by carefully measuring a short column of mercury, (an inch or less in length,) as it is made to pass along the tube by successive steps, each of which is as nearly as possible its own length. In the thermometers constructed according to M. Regnault's process, the divisions do not represent degrees of the ordinary scales of temperature, but are of an *arbitrary* value, differing for each instrument, and requiring separate tables for each thermometer to convert the scale readings into degrees, — the divisions at all parts of the scale being equivalent to equal *volumes*, although their *length* may vary very considerably. The freezing points were determined in the ordinary way, by immersion in well-pounded ice, from which the water is drained off as it melts. The boiling points were determined by the apparatus devised by M. Regnault, in *steam*, whose elastic force is exactly equal to that of the atmosphere at the time, — a correction being made for the difference in the barometric pressure from the adopted standard pressure. The boiling points, besides being determined for the usual position of a thermometer — with the stem vertical,— were also observed in a similar apparatus with the stem in a horizontal position; so that if the instrument should ever be used in any other than the vertical position, the proper correction might be applied. The difference between the boiling point of a thermometer in the two positions, was found to be from 0°·2 to 0°·5 Fahr., according to the thickness of the glass and the form of the bulb. After the graduation of a thermometer had been completed, its accuracy was examined by a subsequent culibration with a longer column of mercury. If the length of the column with reference to the scale divisions was everywhere the same, the graduation was considered good; but if any alteration was found to exist, a more complete examination was made by using columns of different lengths, each of which was nearly an aliquot part of the range of the scale, — the remaining errors being deduced from these measurements by the method adopted by Mr. Sheepshanks, for the thermometers used in connection with the national standard yard. It was, however, seldom that any appreciable correction was found to exist. It had long been known that the freezing point of a thermometer is not constant, but rises by a considerable amount during the first year after its construction. There was, however, another peculiarity in the thermometers, which was less known. If a thermometer, after having been for some weeks exposed to the ordinary temperature of the air, were placed in melting ice, its freezing point would be, for example, 32°·2; if the bulb were then put for two or three minutes, into boiling water, and soon afterwards again placed in ice, the reading would no longer be 32°·2, but would have fallen to nearly 32°·0; if, in a day or two, it were again placed in ice, the freezing point would have risen a little, about 0°·1; and if again tried after two or three weeks, the freezing point would be found to have acquired exactly the original position of 32°·2. This had been found to be the case with every thermometer examined at Kew, whatever was its age; the difference in the freezing point before and after boiling being about 0°·17 Fahr., and varying inappreciably in different instruments. This peculiar displacement of the freezing point seemed to be owing to a temporary alteration in the dimensions of the bulb, caused by a considerable change of temperature; the glass, after having been expanded by heat, requiring a week or two to contract to its original size. It appeared, therefore, that the alteration in the freezing point of a thermometer depended upon two separate causes, the one being a slow contraction of the bulb, continuing for many months, but ultimately ceasing; and the other being a temporary alteration in the dimensions of the bulb, produced by a sudden and considerable elevation of temperature, which disappeared in two or three weeks. The rise in the freezing point of ordinary thermometers, was probably due to a combination of both these causes; for, if a thermometer had its freezing point set off soon after being blown and filled, there would be, first of all, the comparatively rapid contraction of the bulb, due to the great heat to which it had lately been exposed, and afterwards, the more gradual contraction which continues for several months. The author recommended opticians, instead of "pointing off" their thermometers immediately after being filled, to allow them to rest for a month or six weeks, so as to avoid, at least, the first great change which occurs; but, of course, the longer they were kept the better. Mr. Welsh mentioned another fact which he had observed in thermometers. He took about fifteen thermometers, and after carefully ascertaining their freezing points, kept them exposed to the temperature of boiling water for about sixty hours, allowing them afterwards to cool very slowly. It was then found that the freezing point had been *permanently raised* in all of them, by about 0°·3 to 0°·4 Fahr. The effect of a subsequent sudden elevation of temperature was exactly as before, to *lower* the freezing point by nearly 0°·2; the reading which was found *after* the long continued boiling being again restored in about a fortnight. He was not yet prepared to say whether any effect would be produced by the boiling in the way of bringing the freezing point of a newly-made thermometer to a permanent position, irrespective of the temporary alteration caused by a sudden elevation of temperature.

INSTRUMENT FOR MEASURING EVAPORATION.

A simple instrument to determine the evaporation from the surface of the earth during a given period, has just been invented by Mr. Newman. A shallow basin connected with a graduated tube below it, has a given quantity of water, previously measured, in this tube, forced into it by displacement by air. At the end of the desired time, the water is again let back into the graduated tube, and its loss by evaporation noted.

ELASTIC SCALES FOR THERMOMETERS.

A patent has been granted to Messrs. Mackenzie & Blair, of Glasgow, for the construction of a thermometer scale, printed with the corresponding references on vulcanized caoutchouc, and thus by its elasticity easily adapted to each mercurial tube. The references actually printed on their scale are over one hundred and fifty.

NEW THERMOSTAT FOR REGULATING TEMPERATURE AND VENTILATION.

This apparatus, invented by Mr. Ward, of England, consists of a series of flat circular hollow cases, about one foot in diameter and one inch deep, attached together in their centers. Each case contains a small quantity of sulphuric ether, which is readily affected by change of temperature. The cases, comprising about six, are suspended one under the other, and to the lowest one is attached a weight by a cord that passes over an excentric pulley. On an increase of temperature the ether expands, and the weight falls down, and it is drawn up again by the pressure of the atmosphere on the external discs of the cases when the air is cooled. By connecting the weight with the ventilators of a conservatory, or other building, the temperature can be thus regulated to any required degree by a previous adjustment of the apparatus.

ON THE DENSITY OF SATURATED VAPORS AND THEIR LIQUIDS AT THE POINT OF TRANSITION.

The following is an abstract of a paper read before the British Association on the above subject, by J. J. Waterston. The chief object of the author in these experimental researches was, to ascertain if the low density in saturated vapors holds good up to that point when, according to M. Cagniard de la Tour's interesting researches, the liquid condition seems to terminate suddenly. The observations were made on the same principle as those which were the means of detecting the general law of density, — and the details of which have been communicated to the Royal Society. The tubes used by the author were from two to three inches in length, filled with the same liquid in different proportions, and sealed at the blow pipe. The author then described the method used in graduating them, and the simple graphic principle employed in calculating the density of the vapor and of the liquid; the same strictness not being required in these researches as in those detailed in the paper above referred to, in which the strict method of computation is given. The author then described his mode of heating the tubes, which is by suspending them by a brass wire frame in a glass funnel about three feet long, one inch diameter, and one-twelfth of an inch thick, fixed vertically over an argand cocoa-nut oil lamp. The brass wire frame being slipped with the tube into the top of the funnel, kept it in the middle of the current of heated air about four or five inches below the top of the funnel. The liquid volume in No. 1 tube being noted, the tube was taken out, and a thermometer put exactly into its place. The mercury quickly rising, the temperature is noted after it had become steady. The thermometer being then removed, a second tube, No. 2, was slipped into the same place, and its transition volume noted, — then removed, and the thermometer substituted, and noted as before. This was the general course of observations; when the temperature had to be carried above 600°, a funnel only eighteen inches long was used. The state of the liquid in the tube was closely examined by means of a watchmaker's lens, and could at all times be seen distinctly by transmitted light. One set of tubes were of hard Bohemian glass, one-eighth of an inch bore, and one-fiftieth of an inch thick. These sometimes burst when the pressure was calculated to be about 400 atmospheres, if the laws of density and pressure hold good at these extreme points. The force of the explosion was quite what might be anticipated: it was as if the liquid, which never exceeded three grains in weight, had been fulminating powder. The thick glass funnel was shattered into small fragments immediately opposite the tube. Other sets of tubes were of soft glass, one-twentieth of an inch thick, and one-fifth or one-sixth of an inch bore. None of these burst; at a very high pressure, one merely gave way, breaking across into three pieces as if cut by a file. The author then gave the details of his experiments in a tabulated form, each noting the low temperature and volume, the maximum volume and temperature, and the transition volume and temperature, with notes of the successive appearances noted in the liquid at its surface and in the vapor. The surface of the liquid at one stage always assumed a flat form, showing cessation of capillarity — often assumed a conoidal form wasting at the apex; sometimes two surfaces showed themselves. The conversion currents seen clearly in the early stages, often changing into zigzag motions of spherules of vapor at the transition point. In this way the author examined sulphuric ether, alcohol, sulpheret of carbon, distilled water, chloroform, dichloride of sulphur, anhydrous oil of turpentine, acetic acid, and sulphuric acid.

EVAPORATING POWER OF VARIOUS BOILERS.

The following interesting table of the work performed by boilers of different constructions in this country and England was furnished by Dr. S. B. Dana, of the Merrimack Works, Lowell. The article was called forth by the publication of a statement in regard to Baker's Improved Furnace, in which it was stated that, for the week ending Oct. 29th, the steam boiler at the Crystal Palace in New York, heated by Baker's furnace, evaporated 11.45 pounds of water with one pound of coal. We are not informed of the temperature from which the water was evaporated. This is a material point. It is, however, evident that the temperature has been reduced to the usual common standard 212° F., for it is said in the notice above, the obtained result "comes within three pounds of the theoretical evaporation of water by the best quality of coal, in the Laboratory."

Despritz experimentally determined that one pound of pure charcoal from sugar, would evaporate 12.3 pounds of water from 32° F.; Dr. Schafhaeutl, from theoretical calculations, assumes that one pound of anthracite coal, containing 92.42 per cent. carbon, and 3.37 hydrogen will also evaporate 12.3 pounds of water from 32°. Reducing this to to 212°, we arrive at the fact that one pound of pure charcoal, or of anthracite coal as above, evaporates 14.457 pounds of water from 212°. The result with Baker's furnace as above stated is "three pounds less," or 11.45. Hence the water in this case has been reduced to 212° F.

"This," continues the notice, "is the greatest amount of water evaporated by one pound of coal, in a boiler, ever recorded." This assertion may be true of "a boiler" heated by Baker's furnace at the Crystal Palace, but it is not true when applied to boilers heated by variously formed furnaces for the last ten or fifteen years, both in England and in this country.

	Lb. of Coal.	Lbs. of Water from 212°.
It is not true of "*Cornish boilers*"; for with these, Henwood & Parkes, Civil Engineers, in England, before 1840, evaporated with	1	11.78
It is not true of a *Locomotive boiler*, on the worst plan, for with this on board Steamer Anthracite, heated by Player's furnace, in 1840, Dr. Schafhaeutl and Bevan, C.E., evaporated with	1	12.40
Parkes and Manby, with the same boiler and furnace, on board Anthracit	1	12.70
It is not true of Dr. A. A. Hayes' *Battery* of four boilers, for with these Hayes evaporated, in 1839, for days together, with	1	11.83
It is not true of the *Upright boilers* of James B. Francis, Esq., C.E.; for with this Francis evaporated, in 1841, at the Massachusetts Mills, in Lowell, in four days, with	1	12.015
It is not true of a *Battery of* 4 *boilers*, on Hayes' plan; for with these the undersigned evaporated, at the Print Works of the Merrimack Man. Co., in 1840, in 13 days, of 12¼ hours each, with	1	11.85
It is not true of *Nest-boilers;* for with this the undersigned evaporated at the M. M. Co. Printery, in 1840, in 3 days, with	1	11.59
It is not true of a *Tubular boiler;* for with this the undersigned evaporated, in 1840, at the M. M. Co.'s Printery, in 6 days, with	1	11.96
It is not true of an improved *Cornish boiler;* for with this — devised and erected in 1840 — at the M. M. Co.'s Printery, the undersigned evaporated in 5 days, or 51½ hours, 11.57 lbs. of water, from the initial temperature of 75° with 1 lb. of coal, or with	1	13.10
The maximum evaporated by Parks on board the Anthracite, was with	1	13.35
The maximum evaporated by self with Hayes' battery was with	1	13.69
The maximum evaporated by self with Improved Cornish, was with	1	13.60
The average for several days together, by self, with Improved Cornish, with	1	13·50

ON COHESION OF FLUIDS, EVAPORATION AND STEAM-BOILER EXPLOSIONS.

The following paper was read at the American Association, Cleveland, by Lieut. E. B. Hunt, U. S. A.

I now wish to present a simple exposition of the mechanical theory of cohesion in fluid masses, and from this to deduce the structure of a fluid surface, showing that its cohesive strength is much less than that of the interior layers. This result furnishes a clear and direct explanation of the great fact of evaporation, and shows why, in all cases, even in ebullition, evaporation is a strictly surface phenome. non. Hence follows an explanation of one of the chief causes of steam-boiler explosions, and the easy suggestion of a very practical remedy; also, an explanation of the heating of fluids to high temperatures, as observed by Donny, and of the entire agency of contained air in ebullition.

Several years have now elapsed since, in tracing out the results of a highly general theory of molecular mechanics, it occurred to me to call in question the commonly received views as to the amount and character of fluid cohesion. Regarding all cohesion directly a function of the distance between adjacent molecules, it was quite impossible to imagine that the exceedingly small difference of the intermolecular distances, corresponding to the fluid and solid forms respectively in any given substance, could produce that very great difference of cohesive strength, so generally conceived to exist. The slight difference of volume, for instance, between a solid and fluid pound of iron, would not lead us to anticipate any marked difference of cohesion, so long as we regard this cohesion as any tolerably simple function of the intermolecular distance.

The ordinary experiments, professing to measure fluid cohesion, are by no means cases of direct rupture, and indeed, furnish no measure whatever of actual cohesive strength. The common experiment of separating, by counterpoising weights, a disc from a fluid which wets it, furnishes no indication of the cohesion in the mass of fluid, but merely shows the force required to break the fluid surface. Donny's experiments show positively that the yielding is here entirely at the surface, progressing through the mass by the successive breaking of the successively-formed surfaces, only a mere fluid filament being at last broken by direct rupture. It is truly a case of capillary action between a horizontal fluid surface and a horizontal circular solid surface, and like all other capillary action, exists primarily at the surfaces only. Except in the frequently-observed adhesion of well-boiled mercury in barometer tubes, to heights far above the true barometric level, we have in fact no record of any experiments exhibiting the resistance offered by a fluid mass to direct rupture, which only ought to be taken as a true measure of cohesion. All the common views of a slight fluid cohesion are based on erroneous interpretation, in which the effects of the easy mobility of parts in fluids are very loosely imputed to a low value of cohesion. Once clearly understanding that surface yielding gives no measure of cohesion or direct resistance to rupture, we can readily see that the prevalent ideas on this subject are without support.

If we study the phenomena attending the condensation of gases and vapors into fluid, it is apparent that while contiguous molecules are still at distances many times as great as that characterizing the fluid state, the cohesive attraction manifests itself appreciably. Steam instantly condensing at the rate of a foot of steam to an inch of water, shows that in water the cohesive action of a molecule extends effectively through a sphere whose diameter is at least twelve times the distance between adjacent molecular centers in the fluid. Hence in water, the radius of effective cohesive action must be so great as to include several molecular layers. The moment a gas ceases to follow

Mariotte's law, cohesive action becomes appreciable, and this is proof enough that in masses many layers contribute their action in making up the total cohesion. If we conceive any fluid mass to be distributed into layers, then the correct measure of fluid cohesion will be the force requisite to produce a direct simultaneous separation of all the parts along a unit of the dividing surface between two layers. This is equal to the resultant of all the forces acting from either direction against this unit of surface, these forces being held in equilibric by the equal opposing forces. To present the grounds which seem to me to authorize the conception that repulsion in all states of aggregation is only exercised between adjacent molecules, while the attractive actions are the resultant of all the primary constitutional forces, and extend through longer spheres, would involve the exposition of a complete theory of molecular mechanics. I must therefore leave as an assumption the conception that in fluids, the only repulsion to be taken into account is the continuous layers, which prevents their yielding farther to the cohesive forces pressing them together.

I come now to an important deduction from the preceding discussion. Fluid surfaces are in a state of weak cohesion, as compared with fluid interiors; hence, a partially atmospheric condition of rarefaction exists along such bounding surfaces. If, then, we assimilate heat to a molecular repulsion, as is customary, we see at once that as the temperature is raised, the weak cohesion in the surface will be overcome, long before the mass is heated to that point which will overmaster its internal cohesion. Hence, the surface molecules will freely pass off as vapors, while a strong cohesion still exists throughout the entire mass. Evaporation thus goes on at surface at all temperatures above that which just suffices to overcome the weak surface cohesion. This constitution, or structure, necessarily characterizing the limiting layers of fluids, is the true and full explanation of evaporation in all its forms. From this we see that a fluid mass, without interior or exterior surfaces, or so enclosed as virtually to answer this description, might be heated up far above the boiling-point without boiling. We see that ebullition is but the effect of an internal evaporation, starting in minute air-bubbles, and growing with the expanding bubble. We see that water, entirely freed from air-bubbles, and with a restricted open surface, as in Donny's tube experiments, should go on heating up far above the boiling point, until at last the whole heated mass would flash into steam with an explosion. All the phenomena described by Donny, in his excellent paper in the *Annales de Chimie et de Physique*, follow as easy and obvious deductions from this constitution of the fluid surface. Indeed, we do not wonder at his being forced, from his experiments, to conclude empirically that there must be some peculiar quality in surfaces which makes evaporation take place so much more readily on them than on fluid masses. We see, too, how utterly fallacious are the experiments usually taken as measuring fluid cohesion in surface layers, which, with the free mobility of fluid parts, fully explains all the observed results. This fully explains how a too perfect boiling of the mercury in barometer tubes makes it adhere at the top with such tenacity. It explains Bertholet's experiment on the forced dilation of fluids, in which a deaerated fluid, sealed when hot, does not shrink in cooling for a long time, but at last breaks and collapses, indicating that it has borne a great tension before yielding. Prof. Henry's elegant experiments with soap-bubbles, in which, by measuring the tension of the enclosed air, he is able to deduce — first, the compressing force, and then the cohesion of the fluid film — will furnish an independent confirmation of the same general views. We may remark that the heterogeneous structure of the outer layers would destroy the mobility of their parts, and give a film-like character to the fluid surfaces, while all within the film would have free mobility. This, with the additional fact of a drawing inward of the outward layers by the unbalanced cohesive action of the layers near the surface, explains the great variety of formal phenomena exhibited by drops, bubbles, and fluid surfaces.

About four years since, I conceived the idea of directly measuring fluid cohesion, by rupturing a pure fluid column in a cylinder with a moving piston. By filling the cylinder with the fluid to be tested, and immersing the piston, by the aid of a valve closing at will, the force requisite for starting the piston will be the cohesion of the column, on allowing for atmospheric pressure. Of course the fluid must adhere to the cylinder more strongly than it coheres in itself, else the adhesion only would be measured. Nor must it contain any air-bubbles, as the presence of one such, however small, will give a start to the break, by presenting a weak surface.

I anticipate that exceeding small air-bubbles will have the effect of making the indications irregular, as the smallest bubbles will only start a break on the application of very considerable force.

I will now apply this discussion to *steam boiler explosions*. The condition requisite for ebullition in boiling water is simply that air-bubbles in the heated portions shall present on their borders the weakly coherent surfaces requisite for evaporation to be established. Perfectly deaerated water, with a limited surface, would not boil at all, but would steadily heat up until it reached that point at which it would flash explosively into steam. Now, one chief chief cause of local explosions is clearly of this description. The boat stops at a wharf; the "doctor," or pump supplying water to the engine, being worked by the engine itself, stops its water supply when the engine stops. The water in the boiler goes on boiling until all the air bubbles are boiled off from the water, and their air is mixed with the steam above. Then there ceases to be any evaporating surface, except that on the top layer, which is farthest from the heating surface, and quite inadequate to the consumption of the heat supplied. Then the mass of water begins to heat up, and it goes on storing up the unconsumed caloric, until the water is far hotter than the head of steam would indicate. The engineer then starts the engine; this starts the pump, which throws a stream of air charged with water directly into the glowing fluid. The heat instantly finds its outlet by an overwhelming evaporation on the newly supplied bubble surfaces, and a tumultuous ebullition follows. The gathered store of heat flashes off a portion of the water into steam of excessive tension ; a tension such as nothing can withstand. The terrific consequences are too often witnessed in those fatal catastrophes, which have given to our western rivers such a tragic reputation.

No one can examine a list of western steam-boat excursions without being forcibly impressed with the frequency of these accidents just as the boat is starting from the wharf after landing. It seems to me beyond doubt that many of these occur just in the manner now stated, and from the deficiency of air-bubbles in the boiler. We see in this reasoning, too, a sufficient explanation of dry steam ; or steam hotter than its tension indicates. The heating is then going on faster than the evaporation, and the steam is thus heated as if it were not in contact with the water, or were in a vessel by itself. It is not always that the remedy for a danger is as obvious and easily applied as in this case. It is only necessary to keep the pump in steady, slow operation while the engine is at rest. It should always be capable of an independent movement, and should constantly, while a boat is going, be kept at work, however slowly. By this means air for ebullition will always be supplied, and the accumulation of heat in a sluggish mass of water cannot then go on until the explosive point is reached.

The field over which I have thus rapidly traversed, is one requiring much practical study for its full development and illustration. I could not here give all which belongs to it without exceeding reasonable limits. Nearly all the views which I have presented, were the result of my own studies, so far as concerned my original acquaintance with them. But I was happy to find that Denny and Henry had, in some points, reached the same conclusions by independent routes. But I am not aware that any one has presented the same analysis of cohesion, or of the molecular constitution of material surfaces. Especially does the derivation of evaporation from molecular mechanics seem to me novel and worthy of careful consideration. Denny indicates deaeration as a cause of steam-boiler explosions ; but it is essentially as an experimental deduction, and not connected with its mechanical derivation.

In conclusion, I will present an outline of a most interesting illustration of creative design in the earth's co-ordination. The explanation of evaporation which has been given, shows that for each fluid, the formation of vapor lies within certain definite limits of temperature as a result of its primary structure. These limits differ greatly in different fluids. Now, in framing the earth for habitation, or for the proper life of animal and vegetable forms, something equivalent to rain was necessary from the constant descent of fluids to the lowest level. Without some agency to lift the great organic fluids above the ocean bed, sterility would have been the lot of all which rose above its surface, and terrestrial organisms would have been quite impossible. But fluidity does not involve evaporation except within certain definite limits, special for each liquid. Again, evaporation might go on and yet no capacity for condensation exist, except within other limits of temperature quite unattainable save through special arrangement. Rain, then, with our earth and atmosphere, involved a special constitution of the raining fluid, not only so that co-operation at ordinary temperature should go on, but so that condensation may again take place in the ordinary air. Not only must this qualitative arrangement exist, but also a quantitative one, since the quantity of rain best sufficing to the aggregate organic need, is exactly a certain definite number of inches per annum. Now water is doubtless the only known liquid which could by possibility answer these definite mechanical conditions. Hence we say that there is a peculiarly clear evidence of design: First, in making a fluid which could under our cosmical conditions undergo the raining round; and secondly, in its being on the earth in so exactly the quantity best meeting the aggregate organic needs. Ether, quicksilver, or any other known fluid, could not in any possible arrangement of quantity, supply this primary cosmical necessity. Now when we reflect how many are the instances in which the terrestrial elements — simple and in combination — exist in strict accommodation to organic needs, both qualitatively and quantitatively, the cumulative evidence of design, is as apparent as that furnished by a locomotive or a cotton-mill. Not only is organic life found in strict relation to the earth, but the earth is also primarily constituted in strict relation to organic life. Let whoever doubts this, study the extremely slender *a priori* chance that a drop of rain, of any liquid, should ever fall upon the earth; and let him but picture the total lack of all animal life which must have followed any cast of the die other than that really existing. Life, without fluid circulation, is totally inconceivable by the mind of man; and exactly to determine the appropriate kind and quality of liquid, as has been done in the real frame of nature, was a problem of pure and absolute intellection, transcending the grasp of every mind save the all-wise creating designer.

METHOD OF OBTAINING A PERFECT VACUUM.

The following communication appears in the February number of Brewster's Journal, from Dr. Thomas Andrews.

The space left vacant in the upper part of a long glass tube, which after being filled with mercury is inverted in a basin of the same metal, affords the nearest approach to a perfect vacuum which has hitherto been obtained. It is true that it contains a little mercurial vapor at the ordinary temperature of our summers, and probably also at lower temperatures; but the quantity is exceedingly small, and its influence in depressing the barometric column must be altogether inappreciable. Besides the mercurial vapor, a trace of air may generally be detected even in tubes which have been carefully filled, and in which the air interposed between the glass and mercury has been expelled by ebullition. This is best observed by inclining the tube till the mercury comes into contact with the upper end, when the air that may have been diffused through the vacuum will be seen collected in a small bubble, but greatly rarefied.

The Torricellian vacuum leaves therefore scarcely anything to be desired in point of completeness; but it is unfortunately applicable to very few physical investigations. No instrument of any kind can be introduced into it, nor even any substance which is acted on by mercury. The vacuum obtained by the exhausting pump is not liable to these objections; but even with machines of the most perfect construction, and in the best order, a very imperfect approach can be attained to a complete exhaustion. A good ordinary pump with silk valves seldom produces an exhaustion of 0.2 inch; and it is very rare indeed, if the manometer is properly constructed, to have it carried to 0.1 inch. In his "Etudes Hygrometriques," (*Ann. de Chim.* 3d Series, vol. xv. p. 190,) M. Regnault has given the following method for pushing the exhaustion further after the valves have ceased to act. In a large glass globe of from 20 to 25 litres capacity ($4\frac{1}{2}$ to $5\frac{1}{2}$ English gallons,) he places an hermetically sealed capsule of glass containing from 40 to 50 grms. of sulphuric acid. He also introduces into the globe 2 or 3 grms. of water, and exhausts till the water has entirely disappeared and the machine ceases to act. By agitating the globe, the capsule is ruptured; when the sulphuric acid coming into contact with the vapor of water, which has displaced nearly all the residual air in the receiver, condenses it and leaves a vacuum nearly perfect. This globe thus exhausted is next placed in communication with the apparatus in which a very perfect vacuum is desired, taking care to remove the air from the interior of the connecting tubes. On opening the stop-cocks, the air becomes uniformly diffused through the two spaces; and if the capacity of the globe is considerable compared with that of the other vessel, the elastic force of the air may be reduced to a small fraction of a millimetre. If, on the contrary, the capacity of the latter is considerable, this operation must be repeated several times.

This ingenious process is not adapted to give a very perfect vacuum in the second vessel, unless the operation be repeated several times, which would be exceedingly laborious. It is also liable to other difficulties in the execution, which will at once occur to any one accustomed to experiments of this kind. Besides, it does not afford the means of obtaining a vacuum, which, as far as the indications of a mercurial manometer can be observed, is perfect; as in M. Regnault's observations, the elastic force of the air was still capable of measurement, although only amounting to a small fraction of a millimetre.

By using the necessary precautions, a vacuum may be obtained by the following process, with very little trouble, in the ordinary receiver of an air-pump, so perfect that the residual air exerts no appreciable elastic force. Even after this limit has been reached, the exhaustion may be pushed still further, till it must become at last not less complete than the Torricellian vacuum; while at the same time, by suppressing the manometer, the existence of mercurial vapor may be altogether prevented. The manipulations required to arrive at this result will not interfere with the presence of the most delicate instruments in the reciever.

Into the receiver of an ordinary air-pump, which is not required to exhaust further than to 0·3 inch, or even 0·5 inch, but which must retain the exhaustion perfectly for any length of time, two open vessels are introduced, one of which may be conveniently placed above the other; the lower vessel containing concentrated sulphuric acid, the upper a thin layer of a solution of caustic potash, which has been recently concentrated by ebullition. The precise quantities of these liquids is not a matter of importance, provided they are so adjusted that the acid is capable of desiccating completely the potash solution without becoming itself notably diminished in strength, but at the same time does not expose so large a surface as to convert the potash into a dry mass in less than five or six hours at least. The pump is in the first place worked till the air in the receiver has an elastic force of 0·3 or 0·4 inch, and the stop-cock below the plate is then closed. A communication is then established between the tube for admitting air below the valves and a gas-holder containing carbonic acid, which has been carefully prepared so as to exclude the presence of atmospheric air. After all the air has been completely removed from the connecting tubes by alternately exhausting and admitting carbonic acid, the stop-cock below the plate is opened and the carbonic acid allowed to pass into the receiver. The exhaustion is again quickly performed to about half an inch or less. If a very perfect vacuum is desired, this operation may be again repeated; and if extreme accuracy is required, it may be performed a third time. It is not likely that anything could be gained by carrying the process further. On leaving the apparatus to itself, the carbonic acid which has displaced the residual air is absorbed by the alkaline solution, and the aqueous vapor is afterwards removed by the sulphuric acid. The vacuum thus obtained is so perfect, that even after two operations it exercises no appreciable tension.

To give a clear conception of the progress of the absorption, I will describe in detail one observation in which the tension was measured simultaneously by a good syphon-guage and by a manometer, formed of a barometric tube 0·5 inch in diameter, inverted in the same resovoir of mercury as a similar tube communicating with the interior of the receiver. The barometer had been carefully filled, and the depression of the mercury estimated by the method already described at less than $\frac{1}{100000}$ of an inch.

Previous to the admission of the carbonic acid, the exhaustion was carried only to 0·4 inch; it was again carried to 1 inch; and a third time to 0·5 inch, after which the apparatus was left to itself. The manometer indicated a pressure in —

15′	of	0·25	inch.
30′	"	0·17	"
80′	"	0·10	"
200′	"	0·02	"

In twelve hours the difference was just perceptible, when a perfectly level surface was brought down behind the tubes till the light was just excluded. In thirty-six hours not the slightest difference of level could be detected. The vacuum has remained without the slightest change for fourteen days.

It is evident that the only limit to the completeness of the vacuum obtained by this process, arises from the difficulty of preparing carbonic acid gas perfectly free from air. This may be very nearly overcome by adopting precautions which are well known to practical chemists. When an extreme exhaustion is required, the gas-holder should be filled with recently boiled water, and the first portions of carbonic acid that are collected in it should be allowed to escape.

The substitution of phosphoric for sulphuric acid would remove the possibility of either aqueous or acid vapors being present even in the smallest amount, but such a refinement will rarely be found necessary.

In the experiment just described, the theoretical residue of air would be $\frac{1}{135000}$ part of the entire quantity in the receiver, which would cause a depression of $\frac{1}{4500}$ of an inch. This result must have been nearly realized. If the exhaustion had been carried at each time to 0·2 inch, the residue by theory would have been only $\frac{1}{3375000}$ part. But the experimental results will not continue to keep pace with such small magnitudes.—*London, Edinburgh, and Dublin Philosophical Magazine, Feb.*, 1852.

ON THE INFLUENCE OF MATERIAL AGGREGATION UPON THE MANIFESTATION OF FORCE.

The following is an abstract of a paper read before the Royal Institution of Great Britain, Feb. 1853, by Dr. John Tyndall. There are no two words with which we are more familiar than *matter* and *force.* The system of the universe embraces two things — an object acted upon, and an agent by which it is acted upon; — the object we call matter, and the agent we call force. Matter, in certain aspects, may be regarded as the vehicle of force; thus the luminiferous ether is the vehicle or medium by which the pulsations of the sun are transmitted to our organs of vision. Or to take a plainer case, if we set a number of billiard balls in a row and impart a shock to one end of the series, in the direction of its length, we know what takes place; the last ball will fly away, the intervening balls having served for the transmission of the shock from one end of the series to the other. Or we might refer to the conduction of heat. If, for example, it be required to transmit heat from the fire to a point at some distance from the fire, this may be effected by means of a conducting body — by the poker for instance; thrusting one end of the poker into the fire it becomes heated, the heat makes its way through the mass, and finally manifests itself at the other end. Let us endeavor to get a distinct idea of what we here call heat; let us first picture it to ourselves as an agent apart from the mass of the conductor, making its way among the particles of the latter, jumping from atom to atom, and thus converting them into a kind of stepping-stones to assist its progress. It is a probable conclusion, even had we not a single experiment to support it, that the mode of transmission must, in some measure, depend upon the manner in which those litttle molecular stepping-stones are arranged. But we need not confine ourselves to the material theory of heat. Assuming the hypothesis which is now gaining ground, that heat, instead of being an agent apart from ordinary matter, consists in a motion of the material particles; the conclusion is equally probable that the transmission of the motion must be influenced by the manner in which the particles are arranged. Does experimental science furnish us with any corroboration of this inference? It does. More than twenty years ago, MM. De la Rive and De Candolle proved that heat is transmitted through wood with a velocity almost twice as great along the fibre as across it. This result has been recently expanded, and it has been proved that this substance possesses three axes of calorific conduction; the first and greatest axis being parallel to the fibre and to the ligneous layers; while the third axis, which marks the direction in which the greatest resistance is offered to the passage of the heat, is perpendicular to the fibre and parallel to the layers.

But it is the modification of the magnetic force by the peculiarities of aggregation, which forms the subject of the evening's lecture. What has been stated regarding heat applies with equal force to magnetism. The observed magnetic phenomena are of a composite character. The action of a magnetic mass is the resultant action of its molecules, and will be influenced by the manner in which they are aggregated. The fundamental phenomena of magnetism are too well known to render it necessary to dwell upon them for an instant. A small bar of iron was suspended in the magnetic field; it set its length parallel to the line joining the poles. Should we be justified from this experiment in concluding that a magnetic mass will always set its longest dimension axial? No. A second magnetic bar, equal in size to the former, was suspended between the poles; it set its length at right angles to the line joining the poles. Whence this deportment? We find the reason of it in the mechanical structure of the bar: it is composed of magnetic plates, transverse to its length; these plates set from pole to pole, and hence the length of the bar equatorial. But let us proceed from this coarse experiment to one more delicate, where nature herself has imposed the conditions of aggregation. A plate taken from a mass of shale, picked up a few weeks ago in the coal district of Blackburn, was suspended between the poles; although strongly magnetic, it set its longest dimension at right angles to the line joining the poles. This deportment was at once explained by reference to the structure of the mass; it also though apparently compact, was composed of layers transverse to its length; these layers set from pole to pole, and hence the length equatorial. Let us ascend to a case still more refined. A crystal of sulphate of nickel was suspended between the poles, and on exciting the magnet a certain determinate position was taken up by the crystal. The substance was magnetic, still its shortest dimension set from pole to pole. The crystal was removed from the magnetic field and the edge of a penknife placed along the line which set axial; a slight pressure split the crystal and disclosed two beautiful surfaces of cleavage. The crystal could in this way be cloven into an indefinite number of magnetic layers; these layers set from pole to pole, and hence the longest dimension, which was perpendicular to the layers. Comparing all these experiments — ascending from the gross place where the laminæ were plates of iron stuck together by wax, to that in which they were crystalline, the inference appears unavoidable, that the unanimity of deportment exhibited, is the product of a common cause; and that the results are due to the peculiarities of a material aggregation.

The beautiful researches of Plucker in this domain of science are well known. Plucker's first experiment was made with a plate of tourmaline. Suspended in the magnetic field with the axis of the crystal vertical, it set its length from pole to pole, like an ordinary magnetic body. Suspended with the axis horizontal, on exciting the magnet, Plucker found to his astonishment that the largest dimension set equatorial. Let us see if we cannot obtain this deportment otherwise. Suspending the piece of shale already made use of, so that its laminæ were horizontal, on exciting the magnet the longest horizontal dimension of the plate set axial; moving the point of suspension 90° so that the laminæ were vertical, on exciting the magnet the length of the plate set equatorial. In the magnetic field the deportment of the crystal was perfectly undistinguishable from that of the shale. But it may be retorted that tourmaline possesses no such laminæ as those possessed by the shale; true — nor is it necessary that it should do so. A number of plates, bars, and discs, formed artificially from magnetic dust, exhibited a deportment precisely similar to the tourmaline, — suspended from one point they set their lengths axial, suspended from another point the lengths set equatorial. Let us now turn to what may be called the complementary actions exhibited by diamagnetic bodies. A homogeneous diamagnetic bar sets its length equatorial. But bars were exhibited composed of transverse diamagnetic laminæ which set their lengths axial. This experiment is complementary to that of the shale, &c; the magnetic laminæ set axial, the diamagnetic equatorial; and by attention to this the magnetic body is made to behave like a homogeneous diamagnetic body, and the diamagnetic body like a homogeneous body. Diamagnetic bars and discs were also examined, and a deportment precisely complementary to that of the magnetic bars and discs was exhibited. A magnetic disc sets its thickness from pole to pole and consequently its horizontal diameter equatorial; a diamagnetic disc sets its thickness equatorial and its horizontal diameter from pole to pole. Two bodies of the same exterior form and of the same color, were suspended simultaneously in the fields of two electro-magnets, and both the latter were excited by the same current; the eye could detect no difference of deportment. Both bodies possessed the shape of calcareous spar, and both set the crystalographic axis equatorial. One body, however, was composed of wax, while the other was a true crystal. In the same way a crystal of carbonate of iron exhibited a deportment precisely the same as that of a model formed of magnetic dust. The explanation of these phenomena may be given in a few words. In the construction of the models, the magnetic or diamagnetic dust was formed into a kind of dough and pressed between two glass plates; the same process was applied to the wax; and it is a universal law, that in diamagnetic bodies the line along which the density of the mass has increased by compression, sets equatorial and in magnetic bodies axial. A reference to this principle will instantly render plain all the experiments we have described. In those cases where the same artificial bar set at one time axial and at another time equatorial, the deportment depended on the circumstance whether the line of compression was vertical or horizontal. When vertical its directive power was annulled, and the action was determined by the exterior form of the body; but when horizontal, its directive action came into play and determined the position of the mass. The magnetic bar, for example, suspended with its line of pressure vertical, set axial, but with its line of pressure horizontal, it set equatorial; for the pressure was exerted at right angles to its length. This action is so general that it is difficult to find a body so perfectly homogeneous as not to exhibit it in some degree. Ipecacuanha lozenges and Carlisle biscuits were suspended in the magnetic field, and exhibited a most striking directive action. The materials in both cases were diamagnetic; but owing to the pressure exerted in their formation their largest horizontal dimensions set from pole to pole, the line of compression being equatorial.

Let us endeavor to arrive at the precise logical import of these experiments. Let us suppose that before ever a crystal had been suspended in the magnetic field, we were acquainted with the fact that a slight change of density in any direction is accompanied by such modifications of the magnetic force as those above described: — that we know that flour, bran, soap, shale, magnetic dust, &c., all exhibited this directive action, — that it is, in fact, a universal law of matter; and then let us imagine some fortunate experimenter hanging a crystal between the poles and observing a deportment in every respect similar. Would not the analogy of the case at once flash upon him? Would not he regard this deportment as a beautiful, but still special example of that all-pervading law with which he was previously acquainted? Would he not congratulate himself on the possibility thus opened to him of searching out the mysteries of crystalline structure, and rendering apparent to his mental eye the manner in which the molecules are aggregated together? He would never have assumed the existence of forces altogether new to account for the observed actions; much less would he have affirmed that they were wholly independent of magnetism or diamagnetism, for he would know beforehand that the modification of these forces by the peculiarities of aggregation was the exact thing calculated to produce the phenomena. But magnocrystallic action was discovered when its universality was unknown; and hence its discoverer was led to regard it as something unique. A great temptation lay in his way; years before, a magnet, now present, had twisted a ray of light, and thus suggested a connexion between light and magnetism. What wonder, then, if this unifying instinct, this yearning to find the mystic bond which unites these forces, this prediction of the human mind that all the forces of nature are but branches of a common root, — what wonder, I say, if it jumped its bounds and cried "I have it!" too soon? For a long time the optic axis, and it alone, was chargeable with these phenomena, — phenomena which it was now hoped there would be little difficulty in referring to their proper cause, and regarding as examples of the modification of force by the peculiarities of aggregation.

The lecturer then pointed out the bearing of the described results upon the problem of the diurnal range of the magnetic needle. Professor Faraday had referred the matter to the modification of atmospheric magnetism by the sun's rays. That an effect was produced here could not for a moment be doubted, but the precise extent of this effect was still an open question. The discovery of a decimal period by Lamont threw a great difficulty in the way of any theory which would refer the diurnal range to thermic action; and the difficulty was greatly increased by the observation of Col. Sabine, who connected Lamont's discovery with that of Schwabe regarding the solar spots. But whatever the result of future inquiries as to the direct magnetism of the sun may be, no theory which proposes to exhaust the subject can afford to omit the mediate operation of the sun by his heat; not however confining it to the atmosphere, but extending it also to the earth's solid crust. Let us look once more to our experiments. The line of greatest density is that of strongest magnetic power. The body operated upon by the magnet is itself a magnet, and it is an experimental fact that it is a stronger magnet along the line of greater density than along any other line. If instead of increasing the density in one direction we increase it in all directions, we thereby augment the general magnetic power of the body. Anything, therefore, which tends to increase density increases magnetic power; and whatever diminishes density diminishes magnetic power also. Knowing this, the conclusion is inevitable, that the local action of the sun upon the earth's crust must influence, in some degree, the resultant effect. The action here meant is wholly different from that hitherto speculated on, and which had reference to the generation of thermo-electric currents which affect the needle. The simple mechanical change of density is what is meant. It is a true cause, and no complete theory can omit taking it into account.

DETERMINATION OF VELOCITIES.*

The invaluable instrument which we call a pendulum, has been applied to an infinity of objects, and always with characteristic advantages in point of precision or sensibility. It was only recently that by

*Translated from the Mechanics Magazine, from M. De Boucheporn's paper, read before the French Academy of Sciences.

a new application of it, the most lofty in its object, and the most ingenious in its nature, it was made to render visible the rotation of the globe. Perhaps it was in reflecting on this elegant experiment, that I have been led to the thought of another kind of application, which, without participating in its elevated character, recommends itself by having in view an end of real utility, that end having reference to the determination of velocities.

The question with which we are dealing is, the application of the pendulum to the measure of the real velocity of vehicles; that is, their velocity referred to the center of the earth. In everything that concerns navigation, the importance of such an object will be immediately perceived. There exist, indeed, several precise and convenient means of measuring the speed of trains on railways — for example, where the point of support between the wheel and the rail remains fixed (as distinguished from slipping), it is sufficient to be able to assign the rapidity of the rotation of the wheels. But at sea the case is very different. The sea is subject to currents, of which the extent, the direction and the velocity are but imperfectly known. The sustaining point is thus itself transported in one direction or the other, and the log, the only elementary and non-astronomical means of measuring the speed of ships, gives, under any circumstances, only the difference between it and that of the surface of the water. On the contrary, it is possible to ascertain the real speed of the vessel by the indications cf the pendulum, of which I am about to endeavor to explain the principle.

Suppose that a pendulum beating, say half-seconds, and carrying a bob weighing a few grammes (a gramme is equal to 15.44597 grains Troy) be suspended in such a manner that its plane of oscillation may be parallel to the axis of progression of the vehicle. If the pendulum be vertical, the bob and the point of suspension being subjected to the same velocity, it would remain in the same state for an indefinite period making abstraction of irregularities of motion, and derangements of various kinds. But if, by a small impulsion given by the hand in a direction contrary to that of the motion of the vehicle, the bob be made to recede a little from the verticle, the velocity of the point of suspension then produces upon it a tractive force through the instrumentality of the rod, which has become inclined to the horizon. That traction has a horizontal component, and ought, consequently, to draw forward the center of the little mass, with a force proportionate in its intensity to the speed of the vehicle. In falling back again, and after having retrogressed a little behind the verticle, as soon as the obliquity of the rod has become sufficient, the same traction will exert itself anew, and the bob will re-commence the same oscillation forwards, under the influence of the two forces of traction and gravity.

Without knowing precisely the law of these two combined actions, we may nevertheless conjecture that the pendulum, under these circumstances, would take a deviation forwards, great or small in proportion to the velocity of traction, and remaining sensibly constant if the same speed were maintained. An experimental graduation might then teach how, for a pendulum of given length and weight, to measure the speed of a vehicle on which it was carried, by observing its deviation in front of the vertical.

Such is the principle which I have desired to subject to experiment, in order to test the possibility and the sensibility of a measure so contrived. This may be done by an experiment easily reproduced, and which although deprived of elegance is none the less decisive. If we get into a railway-carriage and resting our arm against a vertical support, hold a pendulum suspended in connection with the graduated arc of a circle, in conformity with the conditions indicated above, and if, with a proper amount of attention, we preserve this instrument as much as possible from the effect of lateral shocks and vertical movements, we may observe the following result. We shall hardly have given the bob a slight retrograde impulse, than under the influence of traction we shall see it almost immediately spring forward through an angle which, for an ordinary speed of 28 miles an hour will soon increase to about 33 degrees. In falling back on the contrary the backward deviation is hardly 5 or 6 degrees, and the same motion continuing so long as the velocity lasts, there is thus a very considerable and permanent inequality between the two branches of the oscillation. This is in some degree the characteristic part of the phenomenon. If, in this state of things, the velocity of traction should diminish, the direct deviation diminishes nearly as rapidly; and I have never failed, in experimenting in this manner, to become aware of my approach to a station, without taking my eyes off the pendulum. The inequality between two branches of the oscillation is also sensible for inferior velocities, and for less than 28 miles an hour, and we still see the pendulum advance 10 degrees before the vertical. The rate of ships being ordinarily comprised between 6 and 18 miles per hour, the variations of amplitude corresponding to such velocities, have a very appreciable sensibility. It is clear that there must be certain dimensions which will belong to the maximum of effect; but as to that, experiment does not always bear out suppositions of a complicated and difficult nature, and it is experiment that will have to pronounce.

If we wish to arrive at true precision in the kind of measure of which I have been speaking, the great and real difficulty lies evidently in the construction of apparatus capable of protecting the point of suspension of the pendulum, whether from jerkings and shocks on a railroad, or, above all, from the pitching and rolling of a ship. It is upon this point that my researches are being directed. Already I have made some attempts, and it was to try to combine these several dispositions that I seek to improve our prospects, as regards time, by this communication. Perhaps it will never be possible to obtain an apparatus of continuous action, nor an apparatus capable of working independently of the manual address of the operator. But many very useful instruments are precisely in the same condition with regard to continuity.

ON THE CONSTRUCTION AND ARRANGEMENT OF TIME BALLS AT THE EDINBURGH OBSERVATORY.

The earliest signal-balls which were made, though provided with ropes passing over pulleys by which they were enabled in their descent to raise a series of weights in order to check in a gradual manner the velocity of their fall, were yet invariably found, after a short time, to pull or smash themselves to pieces. Steel springs were next tried to break the force of the concussion, but were pretty sure to be themselves snapped with a heavy ball, while a light one would not descend quick enough on a windy day. Recourse was finally had to compressed air, a spring of perfect temper, never injured by time and capable of any degree of delicacy at first, and any amount of violent resistance at last. To carry out this principle, a staff was attached to the ball below, terminating in a piston, which in the course of its descent entered an accurately turned cylinder, and compressing the air therein, was gradually brought to rest. Where the cylinder quite closed at the bottom, the spring of the included air might be greater than required, and also have a tendancy to throw the ball up the mast again, which would be somewhat troublesome to observers. But by simply opening a graduated aperture below, so as to admit of the air partially escaping as it is compressed, the strength of the spring is diminished, and by the time that the piston has descended to the lowest point, there is so little air remaining in the cylinder, and it is escaping so fast, that there is no power left to make the ball rebound. Thus the time-ball is made to descend without injuring the building or spoiling itself; and the trigger apparatus, by which the detent that holds the ball when hauled to the top of the mast is unlocked, being very nicely adjusted, and observers being duly cautioned to look to the instant of separation of the ball from the cross-staff — the descent, that is, the first part of it — is as instantaneous as needs be. In the next place, the trigger being pulled, not by the finger of a person at the ball, but by an electro-magnet which is instantaneously set in action by the contact made at the end of a wire led into the walls of the observatory, and brought immediately before the transit clock itself; the instant for the signal outside can be conveyed to the undeviating mechanism there, with all the refinement of a chamber experiment, and to the utmost extent of the observer's knowledge of the real time by the stars, as obtained the previous night, and continued on by the clock.

For raising the ball, a plan has been proposed by which a weight having been wound up at any previous hour of the day or night, then on electrical contact being made at the observatory by the astronomer at a precise moment, that weight is unlocked, immediately descends and hauls up the ball. Next at five or any other number of minutes a second contact being made on another wire, lets the ball down.

MOORE'S SPHERICAL, OR GREAT CIRCLE INDICATOR.

This instrument, which is another, and a great step towards simplifying that most troublesome, but most important problem of great circle routes, consists of four graduated circles of eleven inches diameter; two of which, arranged in opposite planes, represent a meridian and the equator, and over these, two others, by a most ingenious arrangement, are made to revolve in every direction, so that by two attached compasses, or graduated circles, every element of spherical trigonometry can be readily ascertained by inspection, to a great degree of accuracy: a process also adapted to those problems necessary in nautical astronomy.

DRAINAGE BY MEANS OF A SYPHON.

Calhorn Loch, in Scotland, was drained more than 100 years ago by a drain or cut, in some places 36 feet deep. That operation still left about eight acres of water, above sixteen feet deep in the center, and fully twenty acres of marshy ground, which could not be drained without more fall than the whole cut could afford. This marsh has long been considered an eye-sore, but the expense of deepening the outlet, in some places through quicksand, seemed so difficult and expensive, that although often talked of, the operation was never undertaken. A plan has, however, been recently adopted, which it is believed is new in the annals of draining, at least on so great a scale as in the present case, viz. by means of a large syphon. This syphon is exactly half a mile long and seven inches in diameter. It has now drawn off 9 feet in depth of the water in the loch, which it is expected will give fall to enable the proprietor to drain properly the marsh already referred to, and reduce the loch to an ornamental pond. The highest part of the syphon is 21 feet above the present surface of the lock, and the longest limb is 10 feet under the level of the water, giving 10 feet fall. The main part of the syphon consists of cast-iron pipes 5-8ths of an inch thick, with spigot and faucet joints very carefully joined and made air tight with lead. The contract price of the iron-pipe laid and complete, was 7s. 6d. per yard.

SPEED OF CLIPPER SHIPS.

The recent arrival at New York of the clipper ship "Sovereign of the Seas" in 82 days from the Sandwich Islands, and of the "Comet" from San Francisco in 83 days, has called forth a report from Lieut. Maury to the Secretary of the Navy on ships and ocean routes, from which we make the following extracts. Speaking of the former vessel, Lieut. Maury says: Returning from the Sandwich Islands to New York in the remarkably short run of eighty-two days, she passed through a part of the "Great South Sea," which has been seldom traversed by traders—at least I have the records of none such. Little or nothing, except what conjecture suggested, was known as to the winds in this part of the ocean. The results of my investigations elsewhere, with regard to winds and the circulation of the atmosphere had enabled me to announce as a theoretical deduction, that the winds in the "variables" of the South Pacific would probably be found to prevail from the westward with a tradewind like regularity.

Between the parallels of 45 and 55 degrees south from the meridian of the Cape of Good Hope eastward, around to that of Cape Horn, there is no land or other disturbing agent to intercept the wind in its regular circuits; here the winds would be found blowing from the west with greater force than from the east in the tradewind region, and giving rise to that long rolling swell peculiar to those regions of the Pacific, they would enable ships steering east to make the most remarkable runs that have ever been accomplished under canvass. The Sovereign of the Seas has afforded the most beautiful illustration as to the correctness of these theoretical deductions. Leaving Oahu for New York, via Cape Horn, 13th February last, she stood to the southward through the belts, both of the northeast and the southeast trades, making a good course on the average through them, a little to the west of south. She finally got clear of them March 6th, after crossing the parallel of 45 degrees south, upon the meridian of 164 degrees west. The 8th and 9th she was in the horse latitude weather of the Southern hemisphere. So far, her run had been good, but there was nothing remarkable in it. Having crossed the parallel of 48 degrees south, she found herself on the 10th, fairly within the tradelike west winds of the Southern ocean; and here commenced a succession of the most extraordinary days' runs that have ever been linked together across the ocean. From March 9th to March 31st, from the parallel of 48 degrees south in the Pacific, to 35 degrees south in the Atlantic, during an interval of twenty-two days, that ship made 29 degrees of latitude, and 126 of longitude. Her shortest day's run during the interval, determined by calculation, (not by log) being 150 knots. The wind, all this time, is not recorded once with easting in it; it was steady and fresh from the westward.

In these twenty-two days, that ship made five thousand three hundred and ninety-one nautical miles. But that you may the more conveniently contrast her performance with that of railroad cars and river steamers, I will quote her in statute miles.

Here, then, is a ship under canvass, and with the winds alone as a propelling power, and with a crew, too, so short, the captain informs me, that she was but half manned, accomplishing, in twenty-two days, the enormous run of six thousand two hundred and forty-five miles, (one-fourth the distance round the earth,) and making the daily average of two hundred and eighty-three statute miles and nine-tenths (283.9). During eleven of these days consecutively, her daily average was three hundred and fifty-four statute miles; and during four days, also, consecutively, she averaged as high as three hundred and ninety-eight and three quarter statute miles. From noon of one to the noon of the next day, the greatest distance made was three hun dred and sixty-two knots, or four hundred and nineteen miles, and the greatest rate reported by the captain, is eighteen knots, or twenty-one statute miles the hour. This is pretty fair railroad speed.

The greatest distance ever before performed from noon to noon on the ocean, was 374 knots, (433¼ statute miles,) by the clipper ship Flying Cloud, in her celebrated passage of eighty-nine days and twenty-one hours, to San Francisco, in 1851, and which yet stands unequalled. I say from noon to noon, because from noon to noon was not, with either of these ships the exact measure of twenty-four hours. The Flying Cloud was going to the northward and westward, and on the day of her great run she made four degrees forty-six of longitude—which in time, is nineteen minutes four seconds—that is her noon to noon for that day was twenty-four hours nineteen minutes four seconds. On the other hand, the Sovereign of the Seas was steering to the eastward, and on the day of her great run, she made eight degrees forty-four of longitude—which in time, is thirty-four minutes fifty-six seconds—that is, her noon to noon for that day, was only twenty-three hours twenty-five minutes four seconds long. Thus the Flying Cloud's run in twenty-four hours nineteen minutes four seconds, was 433¼ statute miles, and the other, 419 statute miles in twenty-three hours twenty-five minutes four seconds. Reducing these runs each to the performance *pro rata*, according to the log, for twenty-four hours, we have for the former ship 427.5, against 437.6 by the latter—that is, the best twenty-four consecutive hours run by the Sovereign of the Seas, exceeds the best consecutive twenty-four hours of the Flying Cloud, only by the one-tenth part of one mile.

The log of the Sovereign of the Seas stops May 3d, latitude 33 deg. 16 min. N., 432 nautical miles in a straight line from Sandy Hook. Taking it therefore for the seventy-nine days for which she gives it, and stating the distance by straight line from her place at noon of one day to the noon of the next, it appears that her daily average was 222.7 statute miles, making the whole distance sailed during the interval to be 17,597 statute miles, which gives for canvass the remarkable achievement of accomplishing a distance more than two-thirds of that which it requires to encircle the earth at the average rate of nine miles and upwards the hour for 1,896 consecutive hours.

CHEMICAL SCIENCE.

ON GERHARDT'S DISCOVERY OF ANHYDROUS ORGANIC ACIDS.

The following paper was recently read before the Royal Institution, England, by Prof. Williamson. The discovery by M. Gerhardt, of a number of anhydrous organic acids has thrown so much light on one of the most important questions of chemical philosophy, that it constitutes one of the most remarkable illustrations of the manner in which the rich materials of organic chemistry may be brought to bear on the explanation of the phenomena of chemical action, and the laws of chemical combination. It is not unworthy of remark, that the bodies prepared by Gerhardt, had for some years past been supposed to exist ready formed in combination with water and other bases, and that the chief objection to that supposition was founded on the circumstance of their never having been separated from such combination, and presented in an isolated form. In fact, Gerhardt has supplied the very link in the chain, which was expected to constitute evidence for a familiar theory of the constitution of salts. But the process by which the result was attained, is even more important than the result itself, and has led to our drawing from that result a conclusion different from that which was generally expected. Chemistry aims at discovering the nature of that action by which substances of opposite properties undergo those remarkable changes which we call chemical combination; and it naturally follows from this view of its objects, that chemical science is more advanced by the discovery of a new *process*, than by the discovery of a new *substance;* and its theories are more immediately affected by the nature of a process of change, than by any physical fact, such as the existence of a peculiar body or class of bodies. Thus it is that the method of isolating the anhydrous organic acids, has afforded evidence of a new view of the constitution of acids and salts. A few words may serve to give an idea of the previous state of the question. Compounds of oxygen-acids were supposed to consist of the anhydrous acid united with an oxide. Thus hydrated sulphuric acid was represented as containing the anhydrous group $S\,O_3$ plus an atom of water H_2O; and in the saturation of this hydrated acid by a base such as potash, it was conceived that this oxide replaced the water. The existence of anhydrous sulphuric acid in an isolated state, and the fact that it so readily combines with water, was urged as an argument in favor of this theory; and the same holds good with phosphoric, carbonic, sulphurous, lactic, nitrous, and even (according to the recent discovery of Dessaignes) nitric acid. However simple this view might appear, and however satisfactory it might be in explaining those cases of combination for which it was specially intended, chemists soon became acquainted with bodies perfectly analogous in their general properties to the oxygen-acids, and producing by their action upon bases similar effects, but which, from the fact of their containing no oxygen, could not possibly be conceived as made up of water and an anhydrous acid. For instance, hydrochloric acid was proved, both analytically and synthetically, to be composed of nothing but chlorine and hydrogen; and when it combines with potash, the hydrogen is found to leave the chlorine, whilst potassium takes its place. Being desirous of simplifying as far as possible their views of these phenomena, and of extending the same explanation to all like cases, certain chemists were led to imagine a new mode of representing the constitution and reactions of oxygen acids, which had the advantage of connecting the two classes of analogous reactions by the same theory. This consisted in conceiving, that in the formation of a hydrated acid a compound radical is produced in combination with hydrogen; so that hydrated sulphuric acid is the hydrogen-compound of $S\,O_4$, in the same way as hydrochloric acid is the hydrogen-compound of chlorine. There were many arguments in favor of this view, amongst which the most prominent was derived from the fact, that when a salt of the one class, as chloride of potassium, decomposes a salt of the other, as sulphate of silver, the result is exactly in conformity with what must occur on the supposition of the compound radical; and in like manner, the electrolytic decomposition of a sulphate moves the group $S\,O_4$ to the positive pole, where it either combines with a metal or undergoes decomposition. One of the strongest arguments against the view that the oxygen acids contain water, is afforded by the results of recent researches (especially of MM. Laurent and Gerhardt) on the atomic weight of acids. Those chemists have rendered more definite and exact than they had been before, our ideas on the distinctions between monobasic, bibasic, and tribasic acids, and have clearly established that the correct expression of the atom of nitric acid must be such as contains half as much hydrogen as is contained in one atom of water (inasmuch as water is bibasic, and nitric acid monobasic). Of course, this proportion may be as well established by doubling the atomic weight of water as by halving that of hydrated nitric acid; but either way it is clear that hydrated nitric acid cannot *contain* water. Such was the position of the question, when an English chemist proved that the formation of ether from alchohol (which was considered chemically as the hydrate of ether,) does not consist in a separation of two already formed compounds, but in a substitution of hydrogen by the organic radical ethyl. A similar fact M. Gerhardt has proved respecting a great number of organic acids, by preparing bodies which stand to them in the same relation as ether does to alcohol. The researches of M. Cahours had led to the discovery of a series of bodies necessary for Gerhardt's process. These were obtained by the action of pentachloride of phosphorus on various organic acids, and consisted of chlorine combined with the oxygenized radical of the acid. Thus from benzoic acid was prepared the chloride of benzoil, $C_7\,H_5\,O\,Cl$, and the corresponding bodies, from cuminic, cinnamic, and various other acids. Gerhardt has since made, by the same process the body $C_2\,H_3\,O\,Cl$, which is the chloride of the radical of acetic acid, called *othyl*. Now, on bringing any one of these chlorides in contact with the potassium salt of the corresponding acid, the chemical force of combination between chlorine and potassium induced the decomposition. These results can be most simply stated in the form adopted by M. Gerhardt, the discoverer, which consists in comparing the composition of these bodies with that of water, from which they are formed, by the substitution of one or both atoms of hydrogen by organic radicals. Thus water being represented by the formula $\begin{matrix}H\\H\end{matrix}\,O$, acetic acid is formed from it by the action of chloride of othyl $C_2\,H_3\,O\,Cl$, which forms $\begin{matrix}C_2\,H_3\,O\\H\end{matrix}\,O$ * H Cl *i. e.* hydrated acetic acid and hydrochloric acid. If a second atom of chloride of othyl is made to act upon this acetic acid, or better, upon the acetate of potash, $\begin{matrix}C_2\,H_3\,O\\K\end{matrix}\,O$, we get, besides chloride of potassium, a compound $\begin{matrix}C_2\,H_3\,O\\C_2\,H_3\,O\end{matrix}\,O$, which, when compared to the original type, may be considered as water having both its atoms of hydrogen replaced by the radical othyl, $C_2\,H_3\,O$. This compound is the anhydrous acetic acid which might be called the acetate acid of othyl, inasmuch as that radical has, in the formation of the compound, taken the place of the basic potassium in the acetate of potash. In like manner, the anhydrous benzoic acid $\begin{matrix}C_7\,H_5\,O\\C_7\,H_5\,O\end{matrix}\,O$ was made by the action of the chloride of benzoil $C_3\,H_5\,O\,Cl$ on the benzoate of potash. It is a crystalline body, perfectly neutral to test paper, scarcely soluble in water, readily soluble in alcohol and ether. On continued boiling with water, it is converted into hydrated benzoic acid, one atom of the anhydride with one atom of water forming two atoms of the hydrated acid by an interchange of hydrogen and benzoil. Besides several of these anhydrous acids, Gerhardt has prepared some intermediate acids, analogous to the intermediate ethers, by combining two different radicals in the same group. Thus chloride of benzoil with cuminate of potash $\begin{matrix}C_{10}\,H_{11}\,O\\K\end{matrix}\,O$ formed cuminate of benzoil or benzocuminic acid $\begin{matrix}C_{10}\,H_{11}\,O\\C_7\,H_5\,O\end{matrix}\,O$; and in like manner several other intermediate acids were prepared. In conclusion, to this very brief exposition of this important series of discoveries, the lecturer alluded to a feature of the development of the human mind in scientific research, which is strikingly illustrated by the substance and form of these results, and of which instances are probably to be found in the history of many others. The explanation of the above reactions consists in a combination of two modes of reasoning, which were developed by different schools, and for many years were used independently of one another. Gerhardt, to whose researches and writings, some important steps in the doctrine of types are owing, formerly believed the truths which he saw from that point of view, to be incompatible with the idea of radicals, but he now joins those chemists who find in each of these notions a necessary and most natural complement to the other. May we not hope that such may be the result in other cases of difference of opinion on scientific questions, which the progress of knowledge will show to have been owing to the incompleteness and one-sidedness of each view, rather than to anything absolutely erroneous in either?

ON THE INFLUENCE OF THE ELECTRIC SPARK IN CONVERTING PURE DRY OXYGEN INTO OZONE.

At a recent meeting of the Royal Society, Prof. Faraday gave a communication respecting the late researches of Fremy and Becquerel on the conversion of oxygen into ozone. The electric discharge from different sources produces this effect, but the high intensity spark of the electric machine is that best fitted for the purpose. When the spark contains the same electricity, its effect is proportionate to its length; for at two places of discharge in the same circuit, but with intervals of 1 and 2, the effect in producing ozone is as 1 and 2 also. A spark can act by *induction;* for, when it passes on the *outside* a glass tube containing within dry oxygen, and hermetically sealed, the oxygen is partly converted into ozone. Using tubes of oxygen which either stood over a solution of iodide of potassium or, being hermetically sealed, contained the metal silver, the oxygen converted into ozone was absorbed; and the conversion of the *whole* of a given quantity of oxygen into ozone could be thus established. The effect for each spark is but small; 500,000 discharges were required to convert the oxygen in a tube about 7 inches long and 0.2 in diameter into ozone. For the details of this research, see the "*Annales de Chimie,*" 1852, xxxv. 62. Mr. Faraday then referred briefly to the recent views of Schonbein respecting the probable existence of part of the oxygen in oxy-compounds in the ozone state. Thus of the peroxide of iron, the third oxygen is considered by him as existing in the state of ozone; and of the oxygen in pernitrous acid, half, or the two latter proportions added when the red gas if formed from oxygen and nitrous gas, are supposed to be in the same state. Hence the peculiar chemical action of these bodies; which seems not to be accounted for by the idea of a bare adhesion of the last oxygen, inasmuch as a red heat cannot separate the third oxygen from the peroxide of iron; and hence also, according to M. Schonbein, certain effects of change of color by heat, and certain other actions connected with magnetism, &c.

ON THE MECHANICAL PROPERTIES OF METALS.

At the British Association, a report was presented by Mr. Fairbairn on the mechanical properties of metals, as derived from repeated meltings, exhibiting the maximum point of strength and the causes of deterioration. The experiments on which this report was founded were undertaken at the request of the Association. Mr. Fairbairn said that it was generally supposed that the strength of iron was deteriorated after three or four meltings, but the results of his experiments proved that opinion to be erroneous. The metal experimented on was Eglinton hot-blast iron, and the quantity was one ton. In melting the iron the proportions of coke and flux were accurately measured, and proper precautions were taken to prevent any difference in strength from variations in cooling and casting. The metal was run into bars one inch square, — lengths of seven feet were supported on two points, and weight was applied in the center till the bars broke. It was found that the strength of the iron bars increased up to the twelfth melting, after which it diminished, and at each successive melting deteriorated rapidly. The breaking weight at the commencement was 403 lbs., and the deflexion of the bar before breaking was $1\frac{1}{2}$ inch; at the twelfth melting the breaking weight was 725 lbs., and the deflexion $1\frac{2}{3}$ inch; at the thirteenth melting the bar broke with a weight of 671 lbs.; at the fifteenth, with 391 lbs.; at the sixteenth, with 363 lbs.; at the seventeenth with 330 lbs. At that point the experiments were discontinued, as the quantity of iron had been so far diminished by waste and by reserving specimen bars, that no further trials would have been satisfactory. Mr. Fairbairn exhibited specimens of the bars at the various meltings. The fracture of the iron in the later experiment presented a marked change. In the fifteenth melting there was a bright rim like silver surrounding the interior, which was of the usual crystaline structure. This bright silvery fracture extended in the sixteenth and seventeenth specimens till it pervaded the mass, which then resembled cast steel. Mr. Fairbairn said he intended to have the different specimens analyzed, to ascertain if the iron had undergone change in its chemical constituents as well as in the arrangement of its molecules.

STRUCTURE OF IRON.

The physical properties of iron differ considerably according to circumstances. Some species present also very striking differences in their chemical composition. It is well known that no species of iron is really pure. The most prominent of the substances commonly found combined with iron is carbon, which is always present in a greater or less quantity, and is nearly always accompanied by silica; which may possibly fulfil partially the same functions as carbon. Fuchs directed his investigations more particularly to carbon; this substance is found in greatest quantity in pig-iron (particularly the sort called *a* *facettes,)* *fer miroirtant*, and in the smallest quantity in bar iron, steel may be placed between these; in none, however, is a constant proportion between the iron and carbon maintained, and it is impossible, therefore, to give an exact classification of the different sorts of iron according to the quantity of carbon contained in them, which appeared to prove that the combination of iron and carbon cannot be really a chemical combination. We may not, however, infer from this that the different conditions of this metal depend only on the larger or smaller proportions of carbon contained therein, and this has been entirely confirmed by a number of very interesting analysis made by M. Fuchs of the different sorts of iron. Persons desirous of becoming acquainted with the nature of various descriptions of iron, which differ so much in other respects, have, by merely directing their attention to the quantity of carbon contained in iron in its different states, generally overlooked another essential property or consideration, viz., the *crystallization*. M. Fuchs is of opinion that iron is a *dimorphous substance*, presenting itself under two distinct general forms or systems of crystallization, viz., the *tesseral* and the *rhombohedral* (or its modification, the *hexagonal;*) and consequently there may be said to be two classification species of iron, which may be distinguished as tesseral and rhombohedral iron, and which are sometimes combined in different proportions. M. Fuch's experiments have proved decisively that the malleable or bar-iron belongs to the tesseral crystallization form, and it may be conjectured that all the malleable metals may be classed under that system of crystallization. The crystallization system of pig-iron is not so exactly determined, but it is very likely that it belongs to the rhombohedral system, because facette iron particularly is one of the perfectly brittle metals which generally belong to the rhombohedral form. The difference between bar and facette iron is based not only on the difference of the system of crystallization, but also in the great difference between their physical and chemical properties; such as the tendency of the molecules of metal to burst, and become displaced; hardness, liability to oxidization, solubility, fusibility,* &c. M. Fuchs is of opinion that steel is an alloy of tessaral and rombohedral iron; and he thinks that hardening and tempering consists only in the transformation of all the molecules, or a portion of them from one system of crystallization to the other; the rhombohedral iron being predominant in hardened steel, and the tesseral in non-hardened steel. — *Poggendorf's Annalen.*

COKE FOR THE MANUFACTURE OF IRON.

M. Calvert, in the Comptes Rendus, XXXV., communicates the following respecting the manufacture of iron by means of coke.

It is well known to scientific and to practical men, that the presence

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* Wohler has already directed his attention to the fact that every dimorphus substance has two different degrees of fusibility.

of sulphur in iron diminishes its value, principally by rendering it brittle at a red heat. The sulphur which the iron contains is rarely derived from the ore, but principally from the fuel employed. Searching for a method which would enable me to decompose the mineral sulphides, as also those of the fuel, after many trials I discovered that chloride of sodium (common salt) applied in a certain way, and in suitable proportions, would accomplish the end I proposed, and this in consequence of the following chemical reaction.

By the influence of heat, the bisulphide of iron is decomposed into the protosulphide of iron, which again, in contact with the chloride of sodium, forms chloride of iron and sulphide of sodium; the former at a high temperature, in the presence of watery vapor is decomposed into protoxide of iron and chlorohydric acid, while the latter passes off in the slag or scoria of the furnace, and consequently the sulphur is not fixed by the iron. This process, which I have tried on a large scale at three manufactories, has afforded very satisfactory results. I would remark that the iron which I have the honor to submit, was obtained at the same kind of furnace, and under similar circumstances, as the ordinary iron, except the application of my process; the crystalline structure of the iron, which diminishes its tenacity, it will be remarked, has disappeared, and it has become fibrous and very tenacious. In the case of the malleable iron, I have not been able to determine exactly the ratio of the tenacity which the purified iron presents, compared with that prepared in the usual manner; but I have determined the comparative resistence to fracture of two bars of cast iron; the bars were 1 inch diameter and 5 feet long, placed upon two supports distant 4 feet 6 inches. A gradual pressure was applied to the centre of the bars until fracture occurred. Pounds required to fracture the unprepared cast iron: 487, 456,487, 470; pounds required to fracture the purified cast iron: 556, 525, 544, 562, 569, 544.

The same specimens of iron were analyzed, and the unpurified was found to contain $\frac{6}{1000}$ of sulphur, while the purified did not contain over $\frac{1}{1000}$.

I have applied the process to the combustion of coke on a large railway in England; and it has proved that during the combustion, the sulphur was not at all set free, confirming what I have above advanced, that it remains in the cinders, so that it does not attack the copper coverings of the fire-boxes or the brass tubes, resulting in a great economy. At some future time I shall take the liberty to submit to the Academy the difference in wear of a locomotive in which my coke is burnt, and one used with the ordinary fuel.

I have obtained at Manchester, by the employment of prepared coke, very satisfactory results by refining the cast iron in the *cubilots;* iron of the same quality melted in the same cubilot, with coke of the same kind, was during the operation purified, and acquired great tenacity, as shown by the numbers below.

Bars of Cast Iron, 1 inch diameter 4 feet 6 inches long	(ordinary coke)	514 lbs.
" " " " "	(prepared coke)	528 lbs.

By the aid of this coke the English blast furnaces produce 120,000, to 200,000 kilogrammes of iron each week, when by the employment of charcoal the quantity produced would only be 20,000 to 30,000 kilogrammes.

IMPROVEMENTS IN THE MANUFACTURE OF IRON AND STEEL.

A Parisian, says the *London Mechanic*, has patented a method of manufacturing malleable iron and steel from decarbonated cast iron, without casting, by heating it in contact with a metallic oxide, or a carbonate containing a sufficient proportion of oxide, and then rolling or hammering it without previous puddling. The cast iron to be converted should be cast in bars or plates, in such a way that the bubbles or impurities may form the end of the bar or plate, and be cut off with the rough end, instead of being distributed over the entire surface; and the bars or plates should also be of such size that, when extended by rolling, they will give the required form of bar or plate to be produced. The substances used for effecting the conversion of the cast iron are protoxide of zinc and calamine; but the oxides of iron, red oxide of manganese, deutoxide of copper, protoxide of tin, or oxides of lead may also be employed. The protoxide of zinc calamine, and the oxides of iron, when not too large a proportion of silica therein, are the most suitable. The quantities of oxide employed will vary with the degree of decarbonization to be effected. The cast-iron bars or plates to be converted, having been placed along with a proper quantity of the particular oxide employed in a cementing a case, are raised to a cherry-red heat in a suitable furnace, and kept at this heat till the process is completed. The rate at which the process proceeds is one third of a line from each surface in 25 hours. For making steel, a less quantity of oxide is used, or the process continued for a less time. The metal is then extended by rolling, and the rough ends cut off. It is then fit for market.

BURNT LIME AS A FLUX.

The study of the gases formed in blast-furnaces, with which the authors have been engaged for some years, has shown that the use of carbonate of lime as a flux is attended with great loss, and likewise that this loss may be obviated by using burnt lime instead. The gases were taken from a blast-furnace, 54 feet high, at Ougree, at thirty-two places, 1 foot apart, and the per-centage of carbonic acid determined.

It is evident from the examinations, that the carbonic acid is formed on the first introduction of atmospheric air, and within a remarkably short distance is reduced to carbonic oxide, for the gas 8′ above the tuyere does not contain a trace of carbonic acid; however, the zone from which carbonic acid is entirely absent is of very limited extent; from 9′ to 10′ above the tuyere the gas again contains carbonic acid, and in no inconsiderable quantity.

The per-centage of carbonic acid in the gas increases at a height of 10′ or 11′ above the nose pipe, above which point a second reaction takes place between the carbon of the fuel and the carbonic acid, the per-centage of the latter decreasing up to a height of 15′ above the tuyere, where it is 0. From this point it again increases in quantity, and rapidly, for at a height of 30′ it amounts to 3.5 per cent. The authors ascribe this considerable increase of carbonic acid solely to the decomposition of the limestone used as a flux.

Thus after the increase of the per-centage of carbonic acid to 3.5 in consequence of the decomposition of carbonate of lime, it again diminished in proportion to the increased height, until at a point from 37′ to 39′ above the tuyere it amounted to only 1.69 or 1.91 per cent., which may be regarded as about the quantity present in the gas before the decomposition of the carbonate of lime. Above this point the quantity of carbonic acid increases again up to the furnace-mouth, and indeed with tolerable rapidity and regularity, in consequence of the reduction of peroxide of iron to protoxide by the action of carbonic oxide.

The authors are of opinion that the carbonic acid, which is disengaged from the limestone at a height of 27′ above the tuyere and again disappears almost entirely at a height of 39′, reacts within this space upon the ignited coke, taking up part of its carbon; and an examination of the analysis confirms this view.

Although other observers who have studied the composition of the gases from the blast furnaces have not collected them at so many different heights, still their analytical results clearly indicate that in the furnaces from which they took the gas, the carbonic acid derived from the limestone was at least partially reduced to carbonic oxide, as at Ougree. If carbonic acid is converted into carbonic oxide by passing over ignited carbon, the action is essentially two-fold, a combination of carbon and oxygen, and a decomposition of carbonic acid into carbonic oxide and oxygen; the former is accompanied by development of heat, the latter by absorption of heat. The practical question to be decided in the present instance is, which of these two calorific changes preponderates?

Theoretically, from the experiments of Dulong, there should be a considerable loss of heat.

These considerations led the authors to employ burnt lime in working blast furnaces, and thus to obviate the loss of heat. The experiment was commenced at Ougree in July, 1849. During the first few days the results were unsatisfactory, the management of the furnace was difficult, and the slags black and pasty. Subsequently, when taking into account the impurities of ordinary limestone, 63 parts of burnt lime were substituted for 100 parts of limestone; the working of the furnace, until it was let out at the beginning of 1851, was continually regular and good; during these eighteen months the most satisfactory results were obtained. The saving of coke and increase of production were, as the experimenters anticipated, very evident; moreover, the raw iron was of better quality, and all the interior parts of the furnace, especially the tymp stone, remained in a much better state of preservation than when limestone was used. The following table gives the quantities of coke consumed, in the production of 100 kilogrms. raw iron, in the above-mentioned furnace, during the four months before and the four months after the alteration of the charging:—

WITH LIMESTONE.		WITH BURNT LIME.	
1849—March . . .	150·0 kilogr.	1849—July	142 kilogr.
April	154·5 "	August	138 "
May	156·5 "	September . .	133 "
June	151·5 "	October . . .	139 "
Average quan.	153·2 "	Average quan.	137·75 "

Average quantity consumed with limestone, . .	153·20	or 100 p. cent. coke.
Average quantity consumed with burnt lime, .	137·75	or 90 p. cent. coke.
Difference, ...	15·45	or 10 per cent.

REGENERATION OF BURNT STEEL.

M. Marbury, of Prussia, has proposed to regenerate burnt steel by heating it to a red heat, and putting it, when in that state, into boiling water. Repeated experiments at the Royal Mint at Berlin, have proved perfectly successful.

TO REMOVE TIN FROM COPPER VESSELS.

There are many instances in which it is desirable to remove tin from copper vessels, which is accomplished in the most perfect manner by immersing the vessels in a solution of blue vitriol. The tin disappears entirely and the copper gets as bright as when new. Old tinned copper brings a low price on account of the tin which mixes with the copper when melted; by this simple method such copper can be made more valuable.

ON THE PURIFICATION OF GRAPHITE.

A German chemist has recently ascertained that impure and cheap graphite may be rendered pure, and fit for the manufacture of lead-pencils, by pulverizing and digesting for 36 hours in strong sulphuric acid. The best English graphite is now worth $1 30 per lb.; the price of ordinary graphite fit for refinery is merely nominal.

FIRE-PROOF BRONZE COLOR FOR COPPER AND BRASS.

One-sixteenth of an ounce of crystalized verdigris, and the same quantity of finely pounded muriate of ammonia, are to be dissolved in 5-6ths of a pint of rain water, the solution left standing covered for 3 to 4 hours, and then 1½ pint more water poured into it. The copper vessel, which must be perfectly clean, is now to be held over a charcoal fire until it is equally heated throughout and becomes uniformly tarnished. The copper is now to be rubbed over with the mixture and then carefully dried.

After five or six repetitions of this treatment, the copper receives a brass color; after from six to ten repetitions, it acquires a fine yellow. If the copper is now to be changed from yellow to brown, it must no more be wetted whilst hot; if, however, it be desired to have it very pale brown, the process must be repeated twenty or twenty-five times. When the desired color is attained, the copper is to be laid in clean water, taking care to clean it or dry it rapidly after taking it out. This must be done carefully. The copper is then held over a weak charcoal fire, when the bronze becomes permanent and fire-proof.

To give a fire-proof, brown, bronze color to brass, the following is the process:—

$\frac{3}{32}$ of an ounce of crystallized verdigris and the same quantity of sal-ammoniac are mixed with 5-6ths of a pint of rain-water, and left to stand form 2 to 3 hours. The brass is then to be rubbed over with it from 2 to 3 minutes, when it becomes green. $1\frac{1}{4}$ pint of rain water is now to be added to the solution. The metal is now held over a charcoal fire, which must not be too strong, until it acquires a copper color. It is then again wetted, and left to dry by evaporation. When it has been treated in this manner four or five times, it becomes olive-colored. The heat may now be somewhat increased, but it is necessary to be very careful that the metal does not become too hot. When it has been treated nine or ten times in this manner, it becomes brown. As long as any greenish places are to be seen, however, this treatment must be continued, in many cases 20 to 25 times before the required color is obtained.

If, however, the metal be strong, the materials are to be dissolved in hot rain-water, and the metal rubbed with it immediately until it acquires a fine dark green color; it is then to be held over a strong charcoal fire, by which means it acquires a fine brown color after 10 to 12 repetitions of the treatment. It is necessary to be careful that the metal is equally heated throughout. If spots appear, they must be bitten out during the work and polished with brick-dust.—*Gewerbe-blatt aus Wurtem.*, 1852, No. 1.

ELECTRO-DEPOSITION OF ALLOYS.

A patent has been recently issued to Messrs. Morris and Johnson, of Birmingham, England, for a method of depositing alloys by electro-chemical agency. The invention consists in the employment of solutions composed of cyanide of potassium and carbonate of ammonia, to which are added cyanides, carbonates, and other compounds of metals, in proportions according to the amount of deposit required to be made.

In order that the invention may be fully understood and carried into effect, the patentees proceed to describe the means pursued by them, as follows:—These improvements consist in the employment of solutions composed of carbonate of ammonia or the sesqui-carbonate of ammonia of chemists, and cyanide of potassium, to which are added carbonates, cyanides, or other compounds of metals, in various proportions. For the well known alloy, brass, carbonate of ammonia, and cyanide of potassium are used in the following proportions:—viz. to each or every gallon of water are added 1 lb. of carbonate of ammonia, 1 lb. cyanide of potassium, 2 ozs. of cyanide of copper, and 1 oz. of cyanide of zinc; these proportions may be varied to a considerable extent. Or the patentees take the before-named solution of carbonate of ammonia and cyanide of potassium, in the proportion of 1 lb. of each to one gallon of water; and they take a large sheet of brass of the desired quality, and make it the anode or positive electrode, in the aforesaid solution, of a powerful galvanic battery or magneto-electric machine, and a small piece of metal, and make it the cathode or negative electrode, from which hydrogen must be freely evolved. This operation is continued till the solution has taken up a sufficient quantity of the brass to produce a regular deposit. The solution may be used cold; but it is desirable, in many cases, to heat it (according to the nature of the article or articles to be deposited upon) up to 212° Fah.; for wrought or fancy work, about 150° Fah. The galvanic battery, or magneto-electric machine, must be capable of evolving hydrogen freely from the cathode or negative electrode, or article attached thereto. It is preferred to have a large anode or positive electrode, as this favors the evolution of hydrogen. The article or articles, treated as before described, will immediately become coated with brass: by continuing the process any desired thickness may be obtained. Should the copper have a tendency to come down in a greater proportion than is desired, which may be known by the deposit assuming too red an appearance, it is corrected by the addition of carbonate of ammonia, or by a reduction of temperature, when the solution is heated. Should the zinc have a tendency to come down in too great a proportion, which may be seen by the deposit being too pale in its appearance, this is corrected by the addition of cyanide of potassium, or by an increase of temperature.

The alloy, German silver, is deposited by means of a solution, consisting of carbonate of ammonia and cyanide of potassium (in the proportions previously given for the brass,) and cyanides or other compounds of nickel, copper, and zinc, in the requisite proportions to constitute German silver; it is, however, preferred to make the solution by means of the galvanic battery or magneto-electric machine, as above described for brass. Should the copper of the German silver come down in too great a proportion, this is corrected by adding carbonate of ammonia, which brings down the zinc more freely; and should it be necessary to bring down the copper in greater quantity, cyanide of potassium is added — such treatment being similar to that of the brass before described.

The solutions for the alloys of gold, silver, and other alloys of metals, are made in the same manner as above stated, by employing anodes of the alloy or alloys to be deposited; or by adding to the solutions the carbonates, cyanides, or other compounds, in the proportions forming the various alloys — always using, in depositing, an anode of the required alloy. These solutions are subject to the same treatment and control as those of the brass.

COATING IRON WITH ZINC AND OTHER METALS.

Messrs. Gressel and Redwood, of London, recently patented the following method 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 and 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 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° Fah.; the iron is then immersed, and the mercury rubbed on its surface 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 the 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.

DESILVERING OF LEAD.

A patent has recently been taken out by Mr. Parks, of England, for a process by which he separates silver from argentiferous lead ores entirely by one operation. To do this, the alloy of silver and lead is melted in the usual way in a large iron pot. To this a small quantity, a few pounds of zinc per ton, is added, the whole mixed up and allowed to remain a short time. By this means the silver is brought to the surface in the form of alloy with zinc, and this mixture is subsequently skimmed off and treated for the silver it contains. In order to do this the zinc is first partially separated by oxydation and the residual alloys afterwards treated in the cupel.

Dr. Karsten, a German chemist, several years ago made some experiments with lead and zinc, and found that when a mixture of these metals was allowed to cool very gradually, lead with a minute trace of zinc was found at the bottom of the crucible, and zinc with a small amount of silver at the top. If the lead contained silver, it was almost entirely transferred to the zinc. Hearing that in Carmarthen silver is withdrawn from lead by means of zinc, he resumed his examination of the subject.

He found that silver may be entirely separated from lead by zinc, and that the following method gives the best results: — A tube of cast-iron 1½ inch in diameter is fitted to the crucible, so that the desilverized lead may be let off from the bottom. One end of this tube, dipping nearly to the bottom of the crucible, is furnished with a slide moving in grooves at the edge of the crucible, so that it can be shut when required by means of a rod. In this way the stream of melted lead may be regulated, and the fall of level gradual and uniform. In the crucible were put 25 cwt. of lead, containing seven-eighth of an ounce of silver to the cwt., and 4 cwt. of zinc. The whole was then fused, and stirred together for one hour at a bright red heat. This large amount of zinc was used because it was intended to attempt a process of concentration in which the same quantity of zinc should serve to desilverize subsequent charges of lead. After the stirring apparatus was withdrawn, and the melted mass kept for four hours at a red heat, the lead, perfectly freed from silver, was drawn off until only about 6 cwt. of metal remained in the crucible. To this residue a second 25 cwt. of zinc were likewise added, for reasons given below. A fourth, fifth, and sixth charge of lead were introduced and treated in like manner, 2 cwt. of zinc having again been added to the fourth charge. The lead drawn off, in each case, was entirely freed from silver. But when lead was introduced without an addition of zinc, the lead, when drawn off, still retained silver to the extent of three-eighths of an ounce to the cwt. The desilverizing of 150 cwt. of lead in this manner requires 8 cwt. or 5½ per cent of zinc, a quantity differing widely from that indicated by former experiments — namely 1½ per cent.

An addition of 1½ per cent. of zinc is quite sufficient for the perfect desilverization of lead when only one charge is worked. Thus 25 cwt. of lead may very well be freed from silver 42 lbs. of zinc, but the difficulty of separating the small quantity of argentiferous metal from the desilverized zinc is so great that this plan is not practicable. On the other hand, there is a certain limit to the size of the crucible, which cannot be exceeded, and recourse must, therefore be had to a process of concentration. The silver is separated from the lead very imperfectly, if twice or thrice as much zinc as is required for one charge of lead is added at once, with the view of making it serve for several charges. It is likewise imperfect when, on introducing into the crucible the several charges of lead, the 1½ per cent. needed for desilvering the lead is added with each charge. If, therefore, with reference to the above example, the first melting is made with 25 cwt. of lead, and 42 lbs. of zinc, the second, third, fourth, &c., charges (added to the residue in the crucible) must also consist of 25 cwt. of lead and 42 lbs. of zinc. The cause of the unavoidable result of the process attempted by the author lies in the necessity for stirring the melted metals. The oxidation of the lead and zinc at the surface of the mass is very disadvantageous.

The argentiferous zinc obtained by this process always retains a portion of lead sufficient for the refining of the silver after the zinc has been separated from the mixture ; and the alloy of silver and lead remains in the distillation muffle. If the percentage of lead is not sufficient for this purpose, more must be added, in order that in the distillation vessels the silver may be accumulated in the lead, which is afterwards cupelled. The distillation does not present any difficulties when suitable muffles are employed. The author had muffles constructed, which, except a slit $\frac{3}{4}$ of an inch in diameter, were quite closed for a height of 4 inches from the bottom. The slit could be closed and re-opened in the usual manner, when the distillation being completed it was necessary to draw on the remaining argentiferous lead. Such a muffle was charged for each distillation with 1 cwt. of the alloy of zinc, lead, and silver. The product of four distillations of a mixture which, according to the most careful essays, contained $47\frac{1}{4}$ ozs. of silver, was 242 lbs. of lead and 44 9-44 of silver. The loss of silver amounted, therefore, to 3 1-22 oz. ; this is owing chiefly to the scattering of small globules in the muffle, and it partly remains in the scum, from which it may be again recovered by subsequent distillations, washings, &c.

ON THE ACTION OF SUGAR UPON IRON.

At the British Association, Mr. Gladstone drew attention to the fact that the owners of iron-built vessels object to sugar cargoes, on account of the rusting of the metal by the saccharine juices that exude from the casks; and this had led to a chemical examination of the reaction then instituted. It was found that when pieces of iron were placed in bottles containing a solution of cane sugar, the metal at the edge of the liquid soon became deeply corroded, but that which was permanently immersed in the fluid remained bright for a considerable time. The solution soon gave indications of the presence of protoxide of iron, which absorbing oxygen from the atmosphere was speedily thrown down as the red sesqui-oxide, leaving the sugar free to dissolve a fresh quantity of iron, the precipitated oxide in the mean time forming a deposit. After eighteen months, the liquid was of a deep red-brown color ; it became pale blue with ferrocyanide of potassium, black with sulphuret of ammonium ; alkalies produced no precipitate ; nitric acid peroxidized it. A portion dried and analyzed gave 20.78 parts of metallic oxide to 100 of combined sugar, which is almost exactly in the proportion expressed by the formula $C_{12}\ H_{11}\ O_{11}$, FeO. The author, however, considered that this might differ from the true composition by one equivalent of water. No such iron compound could be formed by direct combination. In vain was it attempted to dissolve any freshly-precipitated and well-washed oxide of iron in a solution of sugar; and almost equally unsuccessful was the attempt to do so when the oxide was liberated by means of potash in the presence of sugar itself. It was found that under all circumstances of dilution or quality of the sugar solution, iron was attacked; the presence of zinc in contact with the iron did not prevent its being acted upon; nor was there any marked difference when the salts of sea-water, or the nitrates sulphates, or chlorides of the alkalies were added to the solution. No other ordinary metal was found to be so easily acted upon as iron. Copper was very little affected by the sugar. Lead was slowly attacked, indications of the presence of its oxide in solution being obtained after three day's exposure. Tin appeared to give the binoxide. Zinc was little affected when alone; it seemed to be dissolved more quickly when in contact with iron. It is doubtful whether mercury was touched by the sugar solution; silver certainly was not. The author regretted that his experiments did not suggest any method by which the corrosion of iron ships by sugar cargoes might be prevented. They showed rather the strong disposition to combine that there is between the two substances; and how a small quantity of sugar may eat continuously into a large sheet of iron. The attention of chemists was especially drawn to the fact that the iron enters into combination with the organic matter not when it has already been oxidized, but only when in a metallic condition, rendering the action, as would be imagined, more complicated.

HIGH TEMPERATURE PROCURED FROM CARBON.

The following communication has been made to the French Academy by M. Deville. It is well known that near the tuyeres of blast furnaces, a very elevated temperature is developed, which M. Eblemen considers to be equal to the melting point of platinum. Some experiments made in the course of an investigation altogether different, have led me to believe that the heat developed during the combustion of carbon, is capable of producing effects much more energetic and comparable with those obtained by means of a mixture of hydrogen and oxygen. Thus, by a suitable arrangement of the furnace, and with the proper kind of carbon, it is possible to melt and even to volatalize platinum and to melt pure silica. These results, and the simplicity of the means by which they may be obtained, have convinced me that they will become useful to the chemist and manufacturer. I have therefore decided upon submitting to the Academy, the details of the operation, which, I trust, will not be found unworthy of attention. The apparatus which I employ, is a simple furnace, 30 centimetres high, and 18 centimetres diameter, supported on a plate of cast iron pierced with holes, arranged in a circle 5 centimetres from the centre. This is placed in connection with the bellows of a portable forge. The best kind of crucibles melt down at the temperature in question, to a perfectly liquid glass, and for a substitute I was obliged to have recourse to pieces of well burnt lime, which may easily be brought into the shape of thick crucibles. Their covers are likewise made of lime. M. Berthier observed that hydraulic limes were readily fused at a high temperature, and I have found that very pure lime very frequently agglutinated. It is, therefore, indispensable to employ a somewhat porous lime. With regard to the combustible, it must be very porous and in a state of very fine division; and I should add, that I succeeded only when I made use of the residue of the imperfect combustion of coal, the clinkers mixed with cinders which fall from the grate of the heating apparatus and still at the *Ecole Normale*, passed through a wire seive. With coal of the best quality, in very small particles, the effects are much more feeble, and do not differ from those which have already been obtained.—*Comptes Rendus, Nov.* 1852.

ARTIFICIAL FORMATION OF THE DIAMOND.

Considerable interest has recently been excited in the scientific circles of Paris, by the announcement of M. Despretz to the Academy, of the artificial formation of diamond powder. Some time since M. Despretz collected a large number of powerful galvanic batteries, and concentrated all their fires upon poles of carbon enclosed in glass. Carbon, which hitherto had been deemed absolutely fixed, exposed to an extreme temperature, gave out vapors which immediately were precipitated upon the sides of the vase; but here, again, the direct intervention of heat furnished only an amorphous powder, a sort of lampblack, without the least crystalline appearance. This experiment was regarded as having furnished new arguments against the supposition that the diamond was of igneous origin.

Despretz, however, continued his researches, believing in the practicability of effecting his object. After having ascertained that the precipitation of the vapors of carbon disengaged at a high temperature, gave only a black powder like lamp-black, he endeavored to operate without heat, and to compensate the weakness of the action he intended to excite by the intervention of time. To effect this, he made use of an apparatus invented by M. Ruhmkorff, which, placed in connection with a simple voltaic couple, gives a series of discharges caused by the development of the current of induction. As long as this battery retains enough power, the instrument illuminates the interior of a globe from which the air has been exhausted, with an arc of electric light, which is periodically reproduced every few seconds. This arc developes very little heat, and yet in the course of time it carries from one pole to the other very small quantities of matter. M. Despretz thought that if he placed at the positive pole a mass of pure carbon, and disposed platina wires at the negative pole, that the transfer and the accumulation of the carbon would take place under circumstances favorable to crystallization. He made the experiment as follows: — Placing at one, the inferior pole of a voltaic battery a cylinder of pure charcoal (its purity being secured by preparing it from crystallized white sugar candy,) and at the superior pole a bundle of fine platinum wires so arranged that the charcoal was in the red portion of the electric arc, and the platinum in the violet, — he fonnd the carbon volatilized, and collected on the platinum wires in a changed state. In this experiment this current continued for about a month in great activity, during which time a slight deposit of darkish substance has been made, and which M. Despretz compares to diamond dust.

This deposite, M. Despretz says, seen through a magnifying glass, presents nothing very distinctly; when examined with a microscope, magnifying some thirty times, it offers several interesting points. M. Despretz is persuaded that he has distinguished octahedron crystals, both on the platina wires (and especially at the extremities) and upon the deposite itself; and M. Delafosse, a practised and an eminent crystallographer, is also satisfied that he has seen black and white octahedrons on the platina wires. He removed the wires and placed in their stead a piece of polished platina, a centimeter and a half in diameter; although this experiment was made uninterruptedly for six weeks, no crystals were deposited on the surface. The half of its surface was covered with almost circular curves of a larger radius than the plate; each of these curves was painted with the colors of thin lamella, and here and there were small spots of grayish white, which seemed to be the result of the momentary adherence of isolated deposites. In another experiment, M. Despretz fixed a cylinder of pure carbon to the positive pole of a weak Daniel's battery, and to the other pole a platina wire, after which he plunged both of the poles in weakly acidulated water; the experiment lasted two months; the negative pole was found to be covered with a black coating, which was examined with the microscope, without however discovering any thing. To appreciate the mechanical properties of these two powders, M Despretz sent them to M. Gaudin, an eminent lapidary, to try on precious stones. He ascertained that the deposites on the platina wires, mixed with a little oil, polished several rubies in a very short time; the black powder deposited on the wire in the water, required a longer time to give the same polish. M. Gaudin believes the deposite to be the same matter as diamond dust: nothing but diamond dust can polish rubies.

A similar result has been obtained by decomposing a mixture of chloride of carbon and alcohol by weak galvanic currents.

In his communication to the Academy, M. Despretz concludes as follows: "Have I obtained crystals of carbon which I can separate and weigh, in which I can determine the index of refraction and the angle of polarization without doubt? No; I have simply produced by the electric arc, and by weak volatile currents, carbon crystallized in *black octahedrons*, in *colorless and translucent octahedrons in plates*, also *colorless and translucent*, which possess the hardness of the powder of the diamond, and which disappear in combustion without any sensible residue."

It is understood that M. Despretz is persuaded that he will ere long present the Academy of Sciences with a large crystal of carbon (a diamond) and solve the difficult question which has so long mocked all *savants*.

IMITATION PEARLS AND DIAMONDS.

The science of imitation of the works of nature has never been carried to greater perfection than by the French; and in none of its branches does it excite more astonishment and admiration than in the art of imitating precious stones.

One of the most curious sights in Paris, or, indeed, in the whole world, is afforded by a visit to the vast atelier of M. Bourguignon, situated at the Barriere du Trone, where the whole process of transforming a few grains of dirty, heavy-looking sand into a diamond of the purest water, is daily going on, with the avowed purpose of deceiving everybody but the buyer. The sand employed, and upon which everything depends, is found in the forests of Fontainebleau, and enjoys so great a reputation in the trade, that large quantities are exported. The coloring-matter for imitating emeralds, rubies, and sapphires, is entirely mineral, and has been brought to high perfection by M. Bourguignon. He maintains in constant employment about a hundred workmen, besides a number of women and young girls, whose business it is to polish the colored stones, and line the false pearls with fish-scales and wax. The scales of the roach and dace are chiefly employed for this purpose, and form a considerable source of profit to the fishermen of the Seine, in the environs of Corbeil, who bring them to Paris in large quantities during the season. They must be stripped from the fish while living, or the glistening hue which we admire so much in the real pearl cannot be imitated. The Paris pearls have been of late years perfected to so great a degree, that the Roman pearl, which delighted our grandmothers by its supposed skillful imitation of nature, has been entirely beaten out of the field. It is, however, to the "cultivation" of the diamond that M. Bourguignon has devoted the whole of his ingenuity; and were he to detail the mysteries of his craft, some of the most singular histories of "family diamonds" and "heir-looms" would be brought to light. The single fact of the sudden falling off in the pattern orders, that is, execution of orders according to pattern, on the decrease of the *fureur* of lansquenet, gives rise to many a sad conjecture, and M. Bourguignon could tell us the tale, no doubt, of the gradual conversion of the contents of many a fair lady's *ecrin*, which coming to her on her marriage from Fossard's splendid show-room, have been replaced, in secret, by Bourguignon, and worn in the very face of him who gave them, without exciting the smallest suspicion. Often, on the other hand, has the artist's skill been called into requisition to deceive the trusting wife, who had confided her diamonds to the safe keeping of her husband or his confidential man of business. Some curious coincidences, worthy of dramatic record, have occurred in that same retired, *distingue* looking shop of Bourguignon's on the Boulevard. A few months ago, one of our fair compatriots entered it, looking rather flushed and excited, and drawing from her muff a number of morocco cases of many shapes and sizes, opened them one after another, and spread them out on the counter. "I wish to learn the price of a *parure* to be made in exact imitation of this," said she, "that is to say, if you *can* imitate the workmanship with sufficient precision for the distinction never to be observed." Bourguignon examined the articles attentively, named his price, and gave the most unequivocal promise that the *parure* should be an exact counterpart of the one before him. The lady insisted again. She was urgent overmuch, as is the case with the fair sex in general. Was he sure the imitation would be perfect? Had he observed the beauty and purity of these stones? Could he imitate the peculiar manner in which they were cut? &c. "Soyez tranquille, madame," replied Bourguignon; "the same workman shall have the job, and you may rely upon having an exact counterpart of his former work." The lady opened her eyes in astonishment and trepidation, and M. Bourguignon, with unconscious serenity, added, by way of reassuring her, "I will attend to the order myself, as I did when I received the commands of Milor ——, who ordered this very *parure*, I think, last February;" and, with the greatest unconcern, he proceeded to search his ledger, to ascertain which of the workmen executed it, and what the date of its delivery. Meanwhile the lady had sunk down in a complete fainting fit. Milor ——, whom Bourguignon had named, was her own treacherous lord and master, who had forestalled her, by exchanging Rundell and Bridge's goodly work against Bourguignon's deceptive counterfeit; no doubt to liquidate his obligations on the turf. "But the worst of all," adds the worthy artist, who recounts the scene with infinite humor, "was the utter fury into which Miledi fell, when she recovered from her swoon, reproaching *me* for having aided her husband in deceiving her; for she herself had never discovered the difference between the false and the real, although the diamonds made by Rundell and Bridge had been in her possession ever since her marriage, and had been worn by her upon every state occasion.

Not only, however, is domestic deception carried on by means of M. Bourguignon's artistic skill, but he has often been called upon to lend his aid to diplomatic craft likewise. Numberless are the snuff-boxes, "adorned with valuable diamonds," which issue from his atelier in secret, as the reward of public service, or skilful negotiation; innumerable the portraits, "set in brilliants," which have been mounted there, to gladden the hearts of charge-d'affaires, attaches and vice-consuls. The great Mehemet Ali, like all great men who, when they commit little actions, always do so on a great scale, may be said to be the first who ever introduced the bright delusions of M. Bourguignon to the unconscious acquaintance of the children of that prophet, "who suffered no deceivers to live."

The wily old Mussulman, who knew the world too well not to be conscious of the value of an appearance of profusion on certain occasions, had announced that every pacha who came to the seat of government, to swear allegiance to his power, would return to his province laden with presents of jewels for his wives. It may readily be imagined that, under such conditions, the duty became a pleasure, and that there needed no second bidding. Meanwhile, Mehemet, with characteristic caution, had despatched an order to his envoy then sojourning in Paris, to send him forthwith as many of the diabolical deceptions of the lying Franks, in the way of mock diamonds, as he could collect. Bourguignon undertook to furnish the order, which was executed in due course, and duly appropriated, no doubt, causing many a Mashallah! of delight to fall from the lips of the Harem beauties of Egypt, and many an Allah Hu! of loyality from those of their husbands, at sight of so much generosity. It is thus that civilization will in time stride round the earth and enable us to deceive one another according to our peculiar means and resources, a result certainly never anticipated by any of the great civilizers of the world.

One of the most ingenious inventions of M. Bourguignon, and the one upon which he prides himself the most, is that of the crysophate, which for a long time created a kind of *fureur* amongst the fashionables of Paris, and was described amongst the discoveries of the period as a *pierre precieuse*, newly discovered and of a *valeur inestimable*. The invention is, however, strictly due to the Duchess de Berri, whose excellent taste and refined coquetry conduced in so great a degree to the advancement of every art of the toilet during her time.

Upon the creation of the grand *fetes* given to the Duc d'Angouleme, on his return from Spain, her Royal Highness, who at that time was the glass of fashion, was anxious to discover some *parure* which would in daylight help her complexion to a little harmony. The task was difficult; diamonds were too brilliant for her deadened glance, pearls blackened her skin, turquoise made it look yellow, emeralds were dark and heavy. "If I could only find some precious stone of a *bright* green!" exclaimed she in very weariness, when she had tried the whole of Talochon's display. Old Talochon laughed, as well he might — the thing did not exist. Madame would not believe it. In vain he protested. If it did not exist it must be discovered, for bright green she must have! Ironically, the name of Bourguignon was mentioned as the most fitting man for such discoveries, but, contrary to expectation, the duchess took the thing *aux serieux*. She sent immediately for Bourguignon, and the result of their conference was the discovery of a "bright green stone, called crysophate, of a value inestimable," which adorned the over-bright tresses of the fair duchess on the occasion of the military reception at St. Cloud, and which the journals of the day described as having been found in the mines of Chili, and as being destined to be registered amongst the greatest discoveries of modern times.

A visit to Bourguignon's shop will inspire the mind with wonder to behold the perfection with which art can be made to imitate the most exquisite productions of nature. The lustre of the diamond; the richness, the double reflection of the ruby; even the caprice and deviation in the form and color of the pearl, escape not the cunning eye of the artist. Some of the *parures* are valued as high as five or six thousand francs. The workmanship, however, is as tasteful and costly as any produced by the first jewellers in the world. The setting is always of real gold, and the fashion of the newest kind. A tiara from the shop of Bourguignon, of the price of six hundred francs, will rival in effect and delicacy of finish its neighbor which may have cost as many hundred pounds; none can tell the difference but those who have been allowed to handle it, and breathe upon it, and touch it with the tongue, and apply an acid to it, in order to see whether or no it becomes tarnished on the instant!

Really, if all this trouble becomes necessary to detect deception, why, ignorance is bliss, and the distinction must be literally one without any difference whatever.—*London Court Journal.*

ON A CHEMICAL CAUSE OF CHANGE IN THE COMPOSITION OF ROCKS.

The following is an abstract of a paper read before the British Association, by Prof. Johnston. The first example of a chemically altered rock adduced by the Professor, was the rotten-stone of Derbyshire, — a light and porous substance used chiefly for polishing metals, and stated in Phillips' "Mineralogy" to be composed of silica, alumina, and carbon. It is obtained from a ridge covered with "drift" 10 or 20 feet thick, consisting of brown clay, with manes of black marble, chert, and rotten stone. The rotten-stone is so soft whilst in the soil that the spade goes through it readily, but it hardens on exposure; the holes from which it is dug are sometimes only 2 feet deep, at others from 6 to 8 feet. On examining a series of specimens, Prof. Johnston found that whilst some were homogeneous, others had a nucleus of black marble; he then treated specimens of the black marble with weak acid, and found that on the removal of the carbonate of lime, there remained from 15 to 20 per cent. of a silicious substance perfectly like the natural rotten-stone. He concluded that there existed in the soil some acid which penetrated it and dissolved out the calcareous matter of the rocks below. The agent in this case might be the carbonic acid of the air, brought down by rain; but there were instances not capable of explanation by this agency alone, and attributable to other acids, which are produced under certain conditions and exercise a much wider influence. The bottoms of peat bogs present very strong evidence of the action of acids, the stone and clay are bleached and corroded, only silicious and colorless materials being left. The source of the acid is here the same as in the former instance; the vegetable matter growing on the surface produces in its decay acid substances which exert a chemical action on the subsoil, and escape by subterranean outlets, carrying away the materials dissolved in their progress. Another instance was afforded by the mineral pigotite, formed in the caves of Cornwall by water dripping from the roof: this water contains a peculiar organic acid, derived from the soil of the moors, which dissolves the alumina of the granite and combines with it. The organic acids are very numerous and different in composition, but agree in producing chemical action upon rocks. They are produced over the entire surface of the earth, especially over uncultivated tracts, and are the means provided by nature to dissolve the mineral food of plants; they are also amongst the chief causes of the exhaustion of soils. The author then alluded to Prof. Way's examination of some of the green-sand strata of Surrey, known as *firestone*, — a light and porous rock, containing silica in a soluble state. It was well known that common sandstone, quartz, or rock crystal were not acted upon by potash or soda at ordinary temperatures; but of the firestone 30 per cent., and sometimes 50 or 70 per cent., may be dissolved. In all such cases the silica must have been originally in a state of chemical combination with lime, alumina, or something else, which has been subsequently removed. The silica in the *rotten-stone* was soluble, but he had never met with instances of black marble in a bedded state converted into rotten-stone. He believed, however, that a similar cause, operating over a wide area, and during a long period, had produced the altered condition of the firestone. — Prof. Johnston then alluded to the nodules of phosphate of lime in the green-sand and crag, and suggested that the phosphorus had been derived from animal remains in higher strata, dissolved out by acids, and redeposited at a lower level. The last example was the *fire-clay* of the coal measures, a stratum almost universally found beneath beds of coal. It differs from the other clays both in color and composition, being whiter, and containing less of those substances which acid bodies could dissolve, viz., the earthy bases, which would render the clay fusible in fire; the condition of the fire-clay might be accounted for by the action of acids developed during the production of the vegetable matter now forming coal.

MANUFACTURE OF STARCH.

Some improvements in the manufacture of starch have recently been patented by Mr. Tucker, of Belfast, Ireland, which relate essentially to the application of certain salts, both alone, and in combination with some mineral acids, for the more effective separation of the pure starch from the glutinous and other foreign matters, with which the starch itself is originally combined; as well as to the neutralizing the injurious effects of the vegetable acids generated in the process of starch making, and the increase of the produce of good starch from a given quantity of wheat. By the same means, Mr. Tucker is also enabled to render any pure water suitable for starch making, although in its natural state such water may be ill adapted for this purpose.

After the wheaten meal, or reduced grain, has been submitted to the usual process of fermentation, and has been washed, to separate the bran from the rest of the elements of the treated substance, the starchy liquor is run into a receiver or vat, where it is allowed to remain for about the space of thirty-six hours for precipitation. The supernatant liquor is then run off or removed, and the precipitate is broken up. Then a solution of sulphate of soda, or Glauber's salts, in boiling water, is prepared, in the proportion of about twelve pounds weight of the salt to one ton of the wheat under treatment, and after cooling down, the solution is poured on the precipitated starch, and the vat being filled up with water, the entire contents are thoroughly mingled and incorporated by stirring. The mass is then allowed to stand for twenty-four or thirty hours perfectly quiescent. In the subsequent process, technically known as the "fine shift," when the water and slimes are removed, the operator employs another solution of the same salt, but in smaller proportion — about three pounds weight being applied to the produce of one ton of wheat. At this stage is also used, in combination with the sulphate of soda, a portion of sulphuric acid, in the proportion of about one quart of the acid to the produce of four tons of wheat. The acid, in a diluted state, is poured gradually into the vat, and the latter is nearly filled up with fresh water, the whole contents being thoroughly mixed by agitation. When the starch has been precipitated, it is finished and prepared for sale and use in the usual way.

Although Mr. Tucker prefers to use the materials and the proportions which we have described, he states that he has found sulphate of magnesia, muriate of soda, and other salts and acids, available for a similar purpose. This general process renders all pure water suitable for manufacturing starch, however soft and unsuitable it may be originally. The pure starch is also better separated from the glutinous constituent of the grain, whilst the manufactured starch is superior in purity, sweetness, strength, fineness of texture, and whiteness, as compared with all starch made in the usual way, and the yield is greatly increased. — *Practical Mechanics' Journal, July.*

WATER-PROOF COMPOSITION FOR FRICTION MATCHES.

M. Krutzer, of Vienna, gives the following new composition for preparing water-proof friction matches: — Six grains of colophonium are boiled in four grains of spirits of turpentine, and allowed to cool. In a retort are separately heated to about 122° F., eight ounces of water, twelve grains of red-lead, zinc-white, or some other like color, and one grain of phosphorus; the whole is well stirred, and when removed from the fire the stirring is continued until it is cool; the water is then separated, and the residuum is mixed with the resinous mass. This mixture is sufficient for 500 matches.

NEW MIXTURE USED IN WASHING CLOTHES.

In Berlin, Prussia, the washerwomen use a mixture of 2 oz. of turpentine and $\frac{1}{4}$ oz. of spirits of sal-ammoniac, well mixed together. This mixture is put into a bucket of warm water, in which $\frac{1}{2}$ lb. of soap has been dissolved. Into this mixture the clothes are immersed during the night, and the next day washed. The most dirty cloth is perfectly freed from all dirt, and after two rinsings in fresh water the cloth has not the least smell of turpentine. The cloth does not require so much rubbing, and fine linen is much longer preserved by it.

NEW PLASTIC MATERIAL.

Five parts of sifted whiting are mixed with a solution of one part of glue. When the whiting is worked up into a paste with the glue, a proportionate quantity of Venetian turpentine is added to it, by which the brittleness of the paste is destroyed. In order to prevent its clinging to the hands whilst the Venetian turpentine is being worked into the paste, a small quantity of linseed oil is added from time to time. The mass may also be colored by kneading in any color that may be desired. It may be pressed into shapes, and used for the productian of *bas-reliefs* and other figures, such as animals, &c. It may also be worked by hand into models, during which operation the hands must be rubbed with linseed oil; the mass must also be kept warm during the process. When it cools and dries, which takes place in a few hours, it becomes as hard as stone, and may then be employed for the multiplication of these forms. — *Gewerbebl. aus Wurtemb.*, 1852.

INK FOR STEEL PENS.

Professor Runge has long sought to obtain an ink which would not yield sediment, which should adhere to paper, resist the application of acids, and have no action on steel pens. He has at length obtained a liquid of this kind, containing only Campeachy wood, chromate of potassa, and water. As it contains neither vinegar, gum, sulphates of iron and copper, nor galls, its cost is very moderate. The proportions are 500 litres decoction of Campeachy wood to 500 grammes chromate of potassa. The Campeachy wood is boiled in a sufficient quantity of water to form 80 litres (4½ litres=1 English gallon) of decoction from 10 kilogrammes of wood (about 20 lbs). After the liquid is cool, the chromate is added and the whole well stirred. The ink is then ready and may be used at once. Any addition of gum would be injurious. It may appear strange that so little chrome should convert so large a quantity of decoction into ink. But the proportion must not be exceeded, as a larger amount would destroy the coloring matter. If, on the other hand, the proportions here given are observed, a blackish-blue is formed from the yellow pigment of the wood. This is not a suspended precipitate, like the gallate of iron in common ink, but a true solution, from which no sediment can be deposited. A paper written with this ink may be immersed in water for twenty-four hours without injury. Dilute acids do not destroy it or change its tint. The pens used with this ink should be perfectly free from grease, and may for this purpose be cleaned by immersing them in ley of wood ashes.

MILK FOR MANUFACTURING.

Milk now possesses other offices besides the production of butter and cheese, and the flavoring of tea. It has made its way into the textile factories, and has become a valuable adjunct in the hands of the calico printer and the woolen manufacturer. In the class of pigment-printing work, which is indeed a species of painting, the colors are laid on the face of the goods in an insoluble condition, so as to present a full, brilliant face. As a vehicle for effecting this process of decoration, the insoluble albumen obtained from eggs was always used, until Mr. Pattison, of Glasgow, found a more economical substitute in milk. For this purpose, buttermilk is now bought up, in large quantities, from the farmers, and the required insoluble matter is obtained from it at a price far below that of the egg albumen. This matter the patentee has called "lactarine." A second application of the same article, milk, has just been developed, by causes arising out of the recent high price of olive oil. The woolen manufacturers are now using the high-priced article, mixed with milk. This mixture is said to answer much better than oil alone, the animal fat contained in the globules of the milk apparently furnishing an element of more powerful effect upon the woolen fibers, than the pure vegetable oil alone. —*Lond. Mechanics' Jour.*

ADULTERATION OF SULPHATE OF QUININE.

At present, a great quantity of quinine containing quinidine is met with in commerce. The sulphate of quinidine is much heavier and less flaky than sulphate of quinine. The sulphate of quinidine is far more soluble in water and absolute alcohol than the other salt; when exposed to the air, it loses its water of crystallization, without acquiring an effloresced appearance, remaining crystalline. As a distinction between quinine, cinchonine, and quinidine, the author states that a mixture of 60 drops of ether and 20 drops of solution of ammonia dissolves at least 10 grs. of pure sulphate of quinine, but only 1 gr. of sulphate of quinidine. If, therefore, sulphate of quinine, containing cinchonine and quinidine, be thus tested, the two latter will remain if there be more than 1 gr. of sulphate of quinidine in 10 grs. of the salt. Even this small quantity may be ascertained if the ether be previously saturated with quinidine. Quinidine is distinguished by crystallizing from the ethereal solution after a certain time; it may be distinguished from cinchonine by its being dissolved on the addition of a larger quantity of ether, the cinchonine remaining undissolved.—*Buchner's Repert.*, i. p. 143.

ADULTERATION OF LARD.

A communication has been received by the London Pharmaceutical Society, on the above subject, from Mr. Whipple, in which he states that for some time past he has had reason to suspect the purity of commercial lard, and had recently made a few experiments, which led to the detection of large quantities of some farinaceous substance in it. In a quantity weighing $105\frac{1}{2}$ lb. he found as much as $22\frac{1}{4}$ lb. of this foreign matter; and in another lot, weighing $43\frac{3}{4}$ lb., he found $12\frac{3}{4}$ of a similar substance. Mr. Whipple points out the pernicious effects which this adulteration would be likely to produce in the employment of such lards for some pharmaceutical purposes, and the danger which might ensue from its application to machinery. In another communication from Mr. Calvert, of Manchester, that gentleman confirms Mr. Whipple's statement, and informs us, in addition, that the American lard analyzed by him contained from 10 to 12 per cent. of water, 2 to 3 per cent. of alum, and about 1 per cent. of quicklime. The quantity of alum, it is supposed, is added by the manufacturer for the purpose of communicating to the lard the property of facilitating the rising, and increasing the whiteness of the confectioner's paste, in which it is largely employed.

METHOD OF RESTORING OIL PAINTINGS.

One of the chief drawbacks to the employment of white-lead in artistic painting, consists in the facility with which it becomes blackened by the sulphuretted hydrogen, and hydrosulphuret of ammonia, both so prevalent in the atmosphere of towns. A very elegant way of instantaneously by restoring those discolored parts to their original whiteness was suggested by M. Thenard, the discoverer of peroxide of hydrogen, otherwise called *oxygenated water*. It is a prominent quality of this liquid to impart oxygen — and hence if applied to a coating of black sulphuret of lead, the latter immediately acquires oxygen, and is changed into the white sulphate, thus restoring the original tint. Unfortunately, however, this peroxide of hydrogen is so difficult of manufacture, and so expensive, that its use for the purpose in question is almost impossible. A much easier plan, but founded on the same principle, has been suggested by M. Schonbein, of Bale, who in the course of his studies on ozone, discovered that oil of turpentine if exposed in an open glass vessel to the atmosphere in the sun's rays, and agitated from time to time during the space of two or three months, acquired such oxydising properties, that it was capable of acting on sulphuret of lead just like the oxygenated water of Thenard, that is to say, capable of changing it almost instantaneously into the white sulphate. Professor Schonbein has himself suggested the value of this oxygenized oil of turpentine to artists and picture-dealers. Many other liquids, besides oil of turpentine, can be oxygenated in a similar manner, and would probably be as advantageous.

LIQUID INDIA RUBBER.

A new method of preparing the gum of the india-rubber tree, has recently been brought out. The milk as drawn from the tree, is bottled in large glass bottles, or demijohns. A preparation of some chemical nature, (understood to be a salt of ammonia,) is mixed with the milk, and the bottles are securely sealed. In this way the gum is exported. It curdles twenty-four hours after exposure to the air, and forms a pure, white, solid, and remarkably strong rubber.

PRELLER'S PATENT LEATHER PROCESS.

The following is a description of the improvement in tanning and preparing leather, which has been highly praised in England during the past year.

The first stage of the process is analagous to that which the hides or skins undergo in the tan yard. When the horns have been removed, the hides are slightly washed, and then unhaired in the usual manner. Next they undergo a partial drying, and receive a uniform coating of a peculiar paste, the composition and mode of preparation of which is fully detailed in Mr. Preller's specification, and explained generally in No. 1519 of the *Mechanics' Magazine.* This paste is worthy of notice, as constituting the main feature of the invention; but it will be sufficient for our purpose at present merely to state its general nature, as being a compound of various vegetable, animal and saline substances. The choice of the vegetable substances employed is determined by the condition that they shall contain a large proportion of starch and little gluten — such, for instance, as barley flour, rice flour, or starch itself. The animal substances are of an oily or fatty nature, the patentee preferring ox-brains, butter, milk, animal oil, and grease. Salt and saltpetre are used merely as preservatives for the brains and the butter. As barley flour contains an abundance of starch — 720 parts in 1,000, according to the analysis of Einhof — this material has been economically selected to form the basis of the impregnating paste, and the other materials added, serve to give properties to it for which the gelatinous nature of the skin exhibits a remarkable affinity, the exact chemical nature of which it is not easy to ascertain.

The paste having been prepared according to the directions contained in the specification, which involve the most simple appliances, and but a small amount of labor, the hides are laid upon large tables, where they are smeared with it on the flesh side, and in that state they are put into the interior of large drums, mounted upon horizontal axles, to which a rotary motion is imparted. They are each about 9 or 10 feet in diameter, and 5 feet long, and are furnished with a square hole at each end through which the hides can be passed. Around their inner peripheries a number of stout pegs are disposed radially, the intention of which is to agitate the hides forcibly, so as to effect an equal distribution of the moisture they still retain, and the complete and uniform absorption of the paste throughout their fibrous system. The drums are driven by a derived motion from the shafting of a steam engine, can be readily thrown into or out of gear, and their speed is susceptible of ready adjustment, according to the state of forwardness of the process. To promote a drying action, which is frequently desirable, the waste steam from the engine is conducted into a large chest, from which a main passes along the floor near the cylinders, and a communication is effected between this and the interior of the drums by the use of connecting pipes and hollow axles which can be closed or adjusted by a stop-cock. Having been kneaded forcibly together in this manner for some hours — more or less, according to the nature and thickness of the hides — the drums are thrown out of gear, and the hides drawn out. It is now ascertained that the work of absorption and of partial drying has gone on vigorously, and with uniformity, and that the hides not having yet attained the point of saturation, are ready for another supply of the paste. Previous to this, however, they are hung up in an airy part of the room, so as to insure a more perfect uniformity of condition. They are then smeared over with the paste again, returned to the drums, and the same process repeated a second time, and afterwards, in general, a third time, when a cut into the substance of the material displays a perfect uniformity of color and of substance, proving that the conversion of the gelatinous mass has been equal and complete. They are now ready, after a little more drying, for the operations of the currier, who finds that his work is considerably lessened in amount by the effects of the above process.

This being the general nature of Mr. Preller's process, we have a few facts to state which will show the principal characteristics of the resulting leather, and the advantages which it possesses over ordinary leather for a variety of purposes. One of the most remarkable qualities of Preller's "H. B. Crown" leather is, that it is smaller in weight and in thickness than leather produced by tanning. At present there is a great prejudice in favor of stout and heavy leather for purposes where great strength is desirable; but this is fairly attributable, in part, to the action of moisture during the tan process, and in part to the interest which the tanners have in producing weight. Some of their processes, indeed, have been directed with this object in view, while achieving which, the quality of the leather has, to a great extent, been injured. The comparison of the two systems on the question of weight has been represented to be as follows: 100 lbs. weight of "green" hide will yield by oak tanning 50 lbs. of leather, and only 34 lbs. by Preller's process. With weight as a standard of excellence, therefore, the comparison would be extremely unfavorable to the new process, and we must therefore see how they answer respectively the great purposes which arise in the manufacture. In Preller's process the hide is left to the natural operation of the converting substance applied, without the intervention of any mechanical means to hasten it, which could only lead to an injurious result. It appears that the fibrous structure of the hide, and the whole of it — which is extremely important — is preserved in a condensed state, thus accounting for its great strength, and its greater reduction of bulk. If a piece of oak-tanned leather be rent asunder forcibly, the internal structure disclosed appears to be rather of a felty character than otherwise; but upon subjecting any piece of "H. B. Crown" leather to the same test, all the fibers will be perceived to be in close juxta-position, and with no sensible deviation from their original parallelism. The comparison, in point of strength, gives great superiority to the new process. It has been found that oak-tanned leather, of $\frac{3}{8}$ of an inch in thickness, is incapable of resisting the strain which Preller's leather of $\frac{1}{4}$ of an inch in thickness will resist in constant working. A strip of it a yard long, about half an inch in width, and $\frac{1}{8}$ of an inch thick, gave way with a breaking weight of 6 cwts. 20 lbs., while oxhide, well tanned on the oak-bark system, and of the same dimensions, could only resist a strain of 5 cwts.

As this leather combines strength with thinness, and also with lightness, it is eminently adapted for driving bands. Its superior thinness and flexibility, enables it to be passed round pulleys of only a few inches in diameter; in which service it will continue effective for a considerable time. When thick leather is employed for a similar purpose, the fibers of its running surface are compressed, and those of its outer surface extended, within the limits of the extreme points of contact; and the rapid change of state from the normal to the extended, soon exhibits itself in cracks and fissures, which are a source of loss of power, and vitiate the tension originally intended. The thinness of Preller's bands obviates this state of things; as the whole of the leather more nearly corresponds in its condition to that of the neutral line. The bands which consist of only one thickness of leather, are formed by simply cementing the ends of successive lengths, which have previously been thinned away to an edge by the knife. In this chamfering process the fibers crop out in abundance, and when the two surfaces are brought into close contact, with a layer of cement between them, the fibers on opposite sides embrace each other firmly, and give enormous strength to the band. Compound bands, for heavy work, are made by using two, three, and sometimes four thicknesses of ox-hide, which are united by countersunk stitches. In either case the motion is perfectly smooth — not the slightest jerking action being propagated throughout the mechanism — a result of the greatest value.

A very considerable saving of time in the process of making, is another important feature incidental to this invention. Calf-skin can be prepared in this manner in about twice eight hours, the time consumed in agitating it twice in the drums. A short interval is allowed to elapse between the two operations, but the action of the converting substance is not then continued. The thickest ox-hide requires only two days and a half to be fully converted by the application of this process. Under the most favorable circumstances, it now requires four or five weeks subjection to the tanning liquor. Under the old process of tanning, in which the hides were placed in the pit, with layers of tan to separate them, and afterwards filled with water, a very considerable period has been known to elapse during the process; sometimes amounting to four years. This old-fashioned method has not been yet completely abandoned for more scientific ones, and contrasted with it the great change which this invention has effected is the more remarkable.

When ordinary leather is boiled in water, it gradually hardens and becomes rigid; and if the operation be continued for half an hour, it will be found to have assumed a kind of woody texture, and to have become brittle. Some descriptions of leather, on the other hand, become converted into a mass somewhat resembling glue. When Preller's leather is tried in the same way, it gradually approaches to the condition of horn, but it requires several hours before that state is attained.

We have little more to add to our account of this singular process and its results. Its thinness, pliability and strength, render it immediately available for a number of new purposes. Thus by simple twisting, it forms an admirable material for "lacings," the strips with which the stitches of the compound driving-band are made. By cementing two or three strips together into a triple thickness, and then paring the edges down to a circular form, an excellent lathe-band is produced which is free from the tendency to become dry and stringy which is now observed in catgut bands. The "but," or lower part of the horse-hide, which on account of its greater thickness, has usually been cut out and applied to separate purposes, is in this process found to be produced in so supple a state, that with a little paring down it may take part equally with the rest of the skin in any purpose to which it is applied. Thus a very large horse-skin is produced, which is extremely valuable for many useful purposes, especially for the coverings of carriages. There are several other purposes to which this leather has been applied: but we have said enough to indicate its general nature and incidents, and the circumstances in which its use would be attended with practical advantage. These are becoming rapidly known and appreciated, and it is not too much to say that Mr. Preller has introduced into this department of industry, a change which will prove as beneficial to the community, as, in a practical point of view, it has already shown itself advantageous, by improving the character of a most useful mechanical appliance. — *London Mech. Jour.*

ON THE EMPLOYMENT OF PICRIC ACID FOR DISTINGUISHING VEGETABLE AND ANIMAL FIBERS IN STUFFS.

Dr. Pohl employs a solution of picric acid in water or alcohol for the distinction of vegetable from animal fiber. The original watery solution is diluted with 6 parts, the alcohol with 15-20 parts of water; a small piece of the stuff to be examined is then dipped in the solution. In from 6 to 10 minutes at ordinary temperatures, or in 2 or 3 minutes when the fluid is heated to 104° F. the stuff or yarn is taken out and washed with water. Stuffs made entirely of cotton or linen appear perfectly white after washing; but those consisting of wool, or silk, or other animal fibers, acquire a yellow-color, it being understood that undyed stuffs are to be used in the experiment. In mixed stuffs the animal fibers appear colored, whilst the vegetable fibers remain white. The test is so exact, that even in those stuffs or yarns in which the individual threads consist of both substances., the proportion of animal or vegetable fiber can be exactly ascertained by means of a lens. By the employment of an ordinary thread counter, the number of vegetable or animal fibers in these mixed fabrics can be ascertained with sufficient exactness.

This test may also be employed with most dyed stuffs; at least it may be applied to orange red, fawn color, rusty yellow, violet, every kind of blue, and some browns. Thus, as the mordants usually employed, as eumina, and salt of tin, and lead and iron compounds, don't produce any essential change in the yellow color of picric acid, but only deepen it more or less, stuffs dyed with the above named colors, undergo no remarkable change by being dipped in the test-solution if they consist of vegetable fiber; but a change always takes place if animal fiber is present, and this will always indicate with perfect certainty whether a stuff consist of animal or vegetable fiber, or of a mixture of both. Thus wool dyed red becomes changed by picric acid into orange-red, or orange according to the shade of the original color, whilst rusty yellow becomes bright yellow, blue colors green, and green, greenish-yellow.—*Chemical Gazette.*

DETECTION OF COTTON IN UNBLEACHED LINEN.

A piece of the stuff to be examined is well washed with boiling water, and dried; then laid in a mixture of 2 parts of dried nitrate of potash and 3 parts of ordinary sulphuric acid, and left in intimate contact with it for 8–10 minutes, according to the strength of the fabric. After a complete washing and drying, the piece of stuff which has been changed by the nitric acid is decocted with ether, to which some alcohol is added; the more consistent the collodion thus obtained, the more cotton was there in the linen. If it is wished to determine the quantity of cotton, it is only necessary to weigh the linen after it has been boiled with water and dried, then to proceed as above, separate the collodion obtained from the residue (which is unchanged linen,) wash this well with some ether and alcohol, dry and weigh it; the loss of weight gives the quantity of cotton with tolerable accuracy.—*Archiv. der Pharm. Zimmermann.*

ARTIFICIAL MALACHITE.

Rose, of Berlin, has mentioned the following process as being capable of simulating in appearance, whilst it is identical in composition with, natural green malachite. Precipitate a solution of sulphate of copper in the cold by carbonate of soda, or of potash, allow the precipitate which is voluminous at first to cohere, finally dry it, and wash it. By polishing, the characteristic appearance of malachite may be brought out.

NEW ANÆSTHETIC.

At a recent meeting of the London Medical Society, Mr. Richardson read a paper on the anæsthetic properties of the common Puff Ball (Lycoperdon Proteus). His attention was directed to the subject by the fact, that in some parts of the country bees are stupefied by this agent before extracting the contents of the hive. He was thus induced to try some experiments on cats and dogs in which he succeeded in producing anæsthetic effects, perfectly similar to those obtained by the agency of chloroform and ether. In one case a painful operation was performed by Dr. Willis, of Barnes, with perfect success. The mode of administering this agent is to allow the animal to inhale the fumes of the dried fungus whilst in a state of ignition. Mr. Richardson inhaled the fumes himself, and found them productive of similar effects with those of chloroform. It is curious that this fungus which emits these narcotic fumes, may be eaten with impunity, and that it is amongst those which Dr. Badham has recommended in his recent work to be eaten as the esculent fungus of Britain. No chemical principle has yet been detected to account for these very curious effects.

ETHER AND CHLOROFORM.

The following conclusions respecting the nature and action of ether and chloroform have been laid before the French Academy, by M. Jobert de Lamballe.

Anesthesetics, by suspending the functions of the nervous system, suspend at the same time those of the organs which are under its dependence; consequently their action affects the heart, as well as the muscles which officiate as servants of the voluntary motions. The action of the heart diminishes progressively at first, then it diminishes with an alarming rapidity, sometimes falling to 112, to 72, to 60, &c., beatings. The effects of chloroform are not as remarkable, not so prompt with all persons as with the young, and certain adults; the absorption of chloroform by the respiratory organs takes place with a wonderful rapidity, from whence results the prompt loss of sensibility and motion. In some persons there are large mediate communications between the bronchi and the pulmonary organs, which favor anesthesia instantly. Indeed, injected *post mortem* preparations show that the communications established between the bronchia and the pulmonary organs are more remarkable in some persons than others; do not these anatomical exceptions indicate that chloroform should be administered with the greatest caution? Prudence consequently commands that chloroforming should instantly cease so soon as the beatings of the heart suddenly lose their power and their number. The physician should constantly observe the patient, taking care to avoid placing confidence in irregular motions and loquacity, as indications of the degree of the chloroform's action; for it does sometimes, not to say frequently, happen that insensibility is produced even while the patient is moving his limbs and uttering incoherent words. The pulsations of the heart must always be the guide to the suspension and the prosecution of the chloroforming, for, to repeat what has been said, it is the best method of appreciating the degree to which the nervous system is saturated, and of judging the extent of the chloroform's influence. The general rule may be thus stated: the anesthesetics must be suspended when the pulse has fallen so low as 55 or 56 per minute, unless the operator would see the patient suddenly sink, and succumb by paralysis of the heart. Persons whose heart habitually beats slowly must be still more carefully observed during the chloroforming, for the pulsations of the pulse tend to cease instantly with some persons and place their life in imminent danger.

Although chloroform has definitively obtained the preference over ether, the parallel traced by M. Jobert de Lamballe between these two agents is interesting and may be profitable. Ether has a strong, penetrating odor, which renders it repugnant to some persons; it always commences by irritating the respiratory organs; it frequently provokes coughing, and sometimes suffocation. Chloroform does not disturb nor irritate the organs it passes through; on the contrary, patients take pleasure in inhaling it. Chloroform produces only a feeble organic excitement; ether would seem to cause a violent one, as the inspirations of the latter give rise to a good deal of agitation in the heart and in the other muscles. Ether develops its anesthesetic effects slowly, and they remain for some time after the experiment or the operation is ended, in the form of intoxication, headache, feeble pulse, and cold limbs. Chloroform, on the contrary, ceases, in general, its action, when the patient stops inhaling it, and it is only in especial cases it is seen to prolong its effects for some time after the patient ceases to inhale it, cases which never occur except where the operator has pushed the saturation of the system to an extreme degree. Ether alters the color and the consistency of the blood, while chloroform does not change either its nature or its color. Chloroform never retards the healing of wounds, ether frequently militates against their healing. M. Jobert de Lamballe has never observed chloroform diminish in any way the productions engendered by, and necessary to, the healing process, or alter their consistency; ether, on the contrary, seems to produce marked effects, making the plastic lymph less consistent and less vital. Both chloroform and ether excite at first the vascular apparatus, precipitating the motions of the heart, as if the latter was disturbed by the introduction of some foreign body. Ether produces these effects in a much greater degree than chloroform, and continues them almost indefinitely, i. e., during nearly the whole time of the experiment, or the operation. Ether acting upon the organs it touches, under the form of vapor, has a tendency to inflame them — chloroform produces nothing of the sort. Chloroform and ether, in their second action, stupefy the nervous system, and consequently suspend the functions of the muscles of locomotion and of organic life. Chloroform paralyses them hopelessly, as in a second the heart may cease to beat. Chloroform produces its effects instantly: in thirty seconds, in a minute and a half, in two, three, or four minutes, at most. Ether, on the contrary, determines insensibility only in 13, 15, 18 or 20 minutes, and sometimes requires even more time. Chloroform calms the organs — ether troubles them in a violent manner, even during sleep, which is accompanied with agreeable or painful dreams.

Ether excites, especially women, in a manner which forbids it being administered publicly — while chloroform makes all persons gay, a gaiety which may be indulged in before witnesses of both sexes. The sequent accidents produced by ether are phenomena of inflammation; those following chloroforming are symptoms of feebleness and of organic weakness. Ether produces death, during the experiment, very rarely, and with great difficulty, while chloroform may determine life instantly, when the patient is not watched, or the chloroform awkwardly administered, or when the bronchia have a large communication with the sanguineous pulmonary organs, and when the chloroform is absorbed in the form of abundant vapors. In no case should chloroform be resorted to, when a grave disturbance of the functions exists, dependent upon a profound lesion of the central organs of circulation or nervous swellings. It may easily be understood that a new disturbance of the functions being added to that existing, should produce a rapid, and so to say, instantaneous death. Chloroform consequently should never be used when the nervous system has been enfeebled by a violent shock — a gun-shot wound, or when the patient is exhausted by a long and abundant suppuration, by losses of blood, or a chlorotic state carried to an advanced degree. When chloroform has suspended the vital forces and death is apparent, the surgeon must not abandon the patient until he has endeavored *for a long time* to recall him to life. The skin should be partially excited by cold water, frictions with alcoalats, alkali, etc., etc., the organs should be reanimated by currents of air directed upon the face and the limbs, while the breast is agitated by slight communicated motions; care must be taken to place the patient in the position most favorable to the re-establishment of the circulation, by putting him horizontally upon his back, or obliquely upon his side. Excitants introduced in his mouth; mint water; antispasmodics placed upon the rectal surface, favor the resuscitation of the motions of the heart, reduced to oscillation or complete resolution; cauterizations in the mouth or in the pharynx with ammonia, may contribute to restore the dying man; there are also examples of electricity being successfully applied to vivify an organization about stagnating forever.

In studying the effects of ether and chloroform, M. Lamballe has made a long and varied series of experiments on dogs, cats and rabbits. He would plunge the animal's head into a bladder containing only chloroform vapors; or into a bladder where the chloroform vapor was mixed with a given quantity of atmospheric air; or the chloroform was administered by a concave sponge, which was gradually carried to the animal's nose, and which was kept before the nostrils, so that a free current of air and of chloroform were simultaneously introduced. In the first case the action of the chloroform was instantaneous and *foudroyante;* the heart and the respiration were immediately arrested. In the second case the same phenomena were observed, but not with the same rapidity. In the third case the progress of the phenomena was slow compared to the former. In the first series of experiments, where the quantity of chloroform absorbed was considerable, all the phenomena are, so to say, confounded together, the intoxication is so rapid: the resolution, the absence of respiration, and the cessation of the contractions of the heart, take place, so to say, at the same moment; while these same phenomena were distinctly and easily analyzed, in the experiments where the hematosis and the anesthesia occurred at the same time. When the chloroform was administered with mixture, the experiment succeeded, (though not without difficulty) notwithstanding its instantaneous effects, in recalling to life a few animals, whose hearts still contracted, although their beatings could no longer be felt. When a certain quantity of air was mixed with the chloroform, the respiration and the beatings of the heart persisted longer, and less difficulty was experienced in obtaining the same results.

M. Jobert de Lamballe says that he is firmly convinced that so soon as the heart has ceased to perform its functions, it is idle to endeavor to recall a life which has fled away forever; but he is as firmly convinced that if the heart has any, the least contractions, they may be recalled to their normal number by the application of electricity. Two methods have been employed to direct electricity upon the vital organs, or upon the agents which transmit to them motion and sensibility. Either it has been excited on the surface of the body by exciting sponges, or it has been directed through the organs by the aid of the electro-puncture. Its action upon the sensitive and moving part of the body has been constant, and when vitality was not altogether extinct it has invariably awakened the nervous system, reanimated the functions, and revived the muscular contractions. Is sensation lost by the oppression of the nervous system, is motion benumbed? Electricity soon restores them to their normal states. If the stupor of the nervous system has gone so far as to produce a grave trouble in the senses, and in the respiration, and in the circulation, or in any of them; electricity will altogether remove the perturbation. So long as the air circulates in the breast, even imperceptibly; so long as the heart contracts, even if it be so slight as to be inappreciable; so long as the blood flows thither, and is expelled thence, even irregularly; electricity still has sufficient power to bring the animal completely back to life. It is almost certain that water, air, and other, the common excitants, would have been vainly employed while the animal was in this *syncopal* state. But when the contractions of the heart are merely a muscular irritability; when the circulation has ceased; when the muscles of the glottis have ceased their action; electricity produces only irregular contractions, like those the battery excites in the muscles after they have been separated from the body. Life is extinct, and electricity cannot bring back what is not there. One of the most striking results of electricity is its influence over the stupefying action of chloroform. The whole animal machine, when submitted to the action of the electric battery, is rapidly awakened. As the shocks are increased, the muscles increase their contractions; the exterior and the interior muscles are equally influenced by the regenerating fluid, so that sensibility and motion are both excited, "which, according to my sense, is the great object to which the operator should aim." Electricity also manifests its power in the partial paralysis resulting from the administration of chloroform. All the phenomena of paraphlegia instantly disappear, under the influence of one electric shock. M. Lamballe cannot decide whether the effect of electricity is to maintain the vitality of the animal, and allow the chloroform to exhaust its toxical influence, or, by directly neutralizing the chloroform; but it appears to him that its effects are to increase the nervous influence, and consequently to maintain the muscular action and the vitality, until the complete disappearance of the chloroform, either by evaporation by the mucous surfaces, (and especially the lungs) or escaping by the secretions.

In the application of electricity by contact, M. Jobert de Lamballe chose, particularly for the application of the two poles, the point where the mucous surfaces were united to the teguments — the two opposite extremities of the body. He made the experiment with M. Boulogne's apparatus, by carrying the exciters upon the buccal and rectal extremities of the mucous surfaces. At the moment of contact, muscular contractions took place on all the points of the body, which seemed to gather itself up (*se pelotonner*) when the current became very strong. He says he has also used the electro-puncture, one of whose remarkable properties is that its effects are not prolonged beyond the experiment, and cease, so to say, at the will of the operator; under its energetic and violent influence motion and sensibility soon reappear. The rapid contractions it causes accelerate the respiration and the beatings of the heart, and at the same time excite sharp and plaintive cries from the animal on whom the experiment is made. The operation was made in two different manners: either by plunging two metallic needles, one in the neck and the other in the inferior extremity of the trunk, so as to comprehend all the length of the spinal marrow between the poles; or, by plunging one of the needles in the nape of the neck, and the other in the muscles of the breast. To repeat in a word M. Lamballe's opinion: electricity, notwithstanding its energy, cannot revive the contractions of the heart when they have altogether ceased to exist; but when the circulation is not yet completely stopped, where there exists some vitality in the animal, electricity applied upon the buccal and rectal mucous surfaces suffices to revive the organs, and recall the functions of the organism.

GUILLOUET'S PROCESS FOR IMPARTING LIVELINESS TO INDIGO BLUE.

This discovery consists in exposing the stuffs colored with indigo to the pressure of steam at an elevated temperature.

The blue coloring matter of the indigo is insoluble, and in order to fix it upon the stuffs, it is necessary to deoxidize it with green vitriol and lime. By dipping the stuffs into a solution of deoxidized indigo a darker or lighter color is obtained according to the length of the immersion.

Indigo is also of a volatile nature, and this is in fact one of its characteristic properties. It occurred to me therefore to turn this property to account by exposing the stuffs colored with indigo to the action of a high temperature, under constant pressure in air-tight metallic vessels, strong enough to resist an internal pressure sufficient to act upon the molecules of the indigo to incorporate them with the fibers of the stuff, and thus produce a change in the physical condition of the indigo.

The form of the vessels employed is immaterial, but they must be furnished with a safety-valve and also with a cock, through which the atmospheric air may escape on the introduction of the steam.

The stuffs died with indigo are laid one upon another in the vessel in question upon a wooden pan, and enclosed in a cloth, which serves to prevent their coming in contact with the sides of the vessel, and also to absorb the moisture which is produced at the first introduction of steam. The steam is then allowed to flow in at a pressure of from two to six atmospheres. After the lapse of about twenty minutes, or half an hour, the cover of the apparatus is removed, and the stuffs taken out and left to cool, when they may be folded and packed.

This operation communicates a violet tinge to the color of the indigo, without in the least injuring the other true colors fixed on the stuff, which, on the contrary, become fuller and brighter. The web loses considerably in length in the operation, but the loss of breadth is scarcely perceptible; at the same time a thicker and finer texture and more body and softness are obtained. — *Schweig. Gewerbeblatt*, xi.

GREEN DYE FROM CHINA.

In the *Comptes Rendus*, xxxv. p. 558, we find an account by M. J. Persoz, of a green coloring matter from China, of great stability, from which it appears that the Chinese possess a coloring matter having the appearance of indigo, which communicates a beautiful and permanent sea green color to mordants of alumina and iron, and which is not a preparation of indigo, or any derivative of this dyeing principle. As furnished to M. Persoz by Mr. Forbes, the American consul at Canton, it was in thin plates of a blue color, resembling Javanese indigo, but of a finer grain, differing also from indigo in its composition and chemical properties. On infusing a very small quantity of it in water, this fluid soon acquired a deep blue color with a greenish tinge: upon boiling and immersing a piece of calico on which mordants of iron and alumina had been printed, it was dyed a sea-green color of greater or less intensity according to the strength of the mordant — the portions not coated remaining white.

ON THE VALUATION OF INDIGO.

The method I have now to propose, is based upon the circumstance that indigo-blue in presence of hydrochloric acid, is decolorised by bichromate of potash. This salt has long been used for discharging indigo-blue and other colors in the printing of textile fabrics, as well as for bleaching oils, fats, and several other substances. In employing it for estimating the comparative value of commercial indigo, the necessary manipulations are extremely simple.

Ten grains of the sample, in very fine powder, are carefully triturated with two drachms by measure of fuming sulphuric acid, and the mixture being excluded from the air is allowed to digest with occasional stirring for twelve or fourteen hours. A small flat-bottomed flask with a tightly fitting cock, is a very convenient vessel for this operation. Some pieces of broken glass should, however, be thrown in to facilitate the contact of the indigo and acid during the agitation, and thus to prevent the aggregation of the former into small clots, which the acid by itself cannot penetrate. If a small capsule or test-glass be used, it should be covered, during the digestion, with an air-tight glass jar. It will also be found advantageous to place the mixture in a warm situation, say between 70° and 80° F., that the action of the acid may be fully developed; a higher temperature than this must be avoided, as sulphurous acid is liable to be produced, and the trial in consequence completely vitiated. Great care must be taken to insure the perfect solution of the indigo-blue in the acid. This result being accomplished, the solution is poured slowly, with constant stirring, into a pint of water contained in a basin, and $\frac{3}{4}$ of a volume ounce of strong hydrochloric acid immediately added, the flask or capsule being rinsed clean with water.

An alkalimeter of 100 equal measures, is now made up in the usual way with $7\frac{1}{2}$ grains of dry and pure bichromate of potash, and the solution added in small successive portions to the diluted sulphate of indigo in the basin, until a drop of the mixture, on being let fall on a white slab or slip of bibulous paper, presents a distinct light brown or ochre shade, unmixed with any blue or green. The process is then finished; the number of measures of bichromate used is read off, and this number shows the comparative value of the indigo subjected to the trial.

In applying the test-drop to the bibulous paper, the best results are obtained by bringing the end of a glass rod into contact with the indigo-solution, and then gently pressing it against the surface of the paper. The stain thus produced will be circular and conveniently localized to a small space. By using bibulous paper it will also be found much easier to recognize the last traces of the blue color than when a slab is employed, and the results, when dry, may be preserved unchanged for reference or comparison.

It is advisable to keep the indigo-solution gently heated while the chrome-liquor is being added; and it is essentially necessary that the mixture should be well stirred after each addition. Several measures of the chrome-solution may at first be poured in without risk of error, but towards the conclusion, the liquor must be added very slowly and with great care, as one or two drops will then be found to produce a very decided effect. The characteristic changes of color which the mixture undergoes during the addition of the chrome-solution, will distinctly indicate the approach of the process towards conclusion. The blue color of the solution gradually diminishes in intensity, becoming perceptibly lighter and lighter, and after a time it acquires a greenish shade, which soon changes to greenish-brown, and almost immediately to light ochre-brown.

I have tried this process very carefully upon pure indigo, prepared according to Fritzche's method. The mean of three experiments, which gave results almost identically the same, showed that 10 grains of pure indigo require very nearly $7\frac{1}{2}$ grains of bichromate of potash; and I have accordingly taken this quantity of the salt for solution in the alkalimeter.

The method here proposed is open, I am well aware, to some of the many objections that have been advanced against the well-known chlorine process. It is quite obvious, for instance, that unless particular care is taken in dissolving the indigo in the sulphuric acid, not only is a part of it liable to escape solution and proper estimation, but in the case of inferior indigo, sulphurous acid may be produced, which would of course involve a larger consumption of the bichromate of potash than the indigo-blue itself would require. It may also be objected that bichromate of potash, in the presence of hydrochloric acid will act upon the other constituents of ordinary indigo; but so far as I have been able to judge from a very extensive course of experiments upon a great variety of specimens, the amount of these influences is extremely slight, and altogether inappreciable when the process is executed with proper care. The same opinion has been expressed by Berzelius and Schlumberger regarding the chlorine process; and it is further supported by the fact, that indigos containing a large proportion of brown and other coloring matters, consume a very small quantity only of the bichromate. While, therefore, this process has no pretensions to supply scientific men with the means of determining the actual amount of pure indigo-blue in samples of commercial indigo, it is in my opinion admirably adapted for ascertaining their relative values, being in many respects superior to those which have hitherto been proposed. The bichromate of potash possesses in an eminent degree all the qualities requisite for a trustworthy agent of valuation, being easy of purification, unchangeable by keeping, and of uniform composition.

ESTIMATION OF MINUTE QUANTITIES OF IRON.

The author having been much occupied with the anlysis of water containing minute quantities of iron, and finding the ordinary mode of estimation by precipitation and weighing very troublesome and inaccurate, when applied to such quantities, was led to avail himself of the following centigrade method, founded on the reaction of persalts of iron with sulphocyanide of potassium. A standard solution of per-chloride of iron containing a little less than $\frac{1}{100}$ of a grain of metallic iron per cent. was prepared by dissolving 1 grain of iron in hydrochloric acid with the addition of a little nitric acid, evaporating nearly to dryness, and diluting to 10,000 grains measures with distilled water at 60°; and from this, other standard solutions of different strengths were formed. A convenient quantity of the water, generally half a gallon, was evaporated to dryness, and the saline mass so obtained was afterwards dissolved in hydrochloric acid. The iron contained in the solution having been converted into perchloride by boiling with a few drops of nitric acid, the silica and other insoluble substances were separated by filtration, and the peroxide of iron precipitated by ammonia. This latter precipitate was collected on a filter, and well washed with water. It was then re-dissolved in the smallest possible quantity of hydrochloric acid, and the liquid having been introduced into a phial or tube of known capacity was diluted with distilled water, until it reached a particular mark upon the side, corresponding to 1000 water-grain measures; care being taken of course to add previously a few drops of a solution of sulphocyanide of potassium. The depth of tint was then compared with that of the standard solutions before mentioned, contained in tubes or phials of similar diameter, in which certain known quantities of iron, ranging from the $\frac{1}{1000}$ to the $\frac{1}{4}$ of a grain, were contained in the same bulk of water. In order to render the comparison of tints more perfect, the tubes were placed against a sheet of white writing paper, and held between the eye and the diffused light. Operating in this way, the author was enabled to estimate the $\frac{1}{1000}$ of a grain of iron per gallon with the greatest readiness. It was sometimes found preferable to employ but one standard solution. The proportion of iron, in the liquid tested, was then determined by measuring the volume of water that was required to lighten the tint so as to render it identical with that of the normal solution, or *vice versa.* — *Quarterly Jour. Chem. Soc.*

SEPARATION OF MANGANESE.

Dr. Schell, of St. Louis, recommends the following method for the separation of manganese: — If a current of chlorine is passed through a diluted solution of acetate of manganese, or better, through a mixture of chlorid of manganese and acetate of soda, the acetate of manganese is decomposed after a very short time and all the manganese precipitated as peroxyde, while the acetates of iron and of nickel are not affected under similar circumstances. Therefore, if a solution of chlorides of manganese, nickel and iron contains free hydrochloric acid, a sufficient quantity of acetate of soda is added to convert all the chlorides into acetates and bind the free hydrochloric acid. The free acetic acid thus liberated does not prevent the formation of peroxyde of manganese. By this method, cobalt cannot be separated from manganese, because it is also *partly* precipitated.

ON A NEW TEST FOR UREA.

As is well known, a dilute aqueous solution of corrosive sublimate may be mixed with an excess of a solution of bicarbonate of potash without the immediate production of a precipitate; if a solution of urea be added to this mixture, the white precipitate of urea and protoxide of mercury is immediately formed. This compound is so little soluble in water, that by this process $\frac{1}{5000}$ urea can be detected with certainty in a liquid. The whole of the urea can be precipitated from urine by this means, and its application to the quantitative determination of urea in animal fluids is evident.— *Liebig.*

NEW ORGANIC BODY, PHYCITE.

The Academy of Sciences has received a memoir from M. Lamy, upon a new substance he has succeeded in extracting from a sea-weed, the *protococcus vulgaris*, or as it is commonly called in France, the *phycie*, a plant of very simple organization. Although this new substance, *phycite*, (as he calls it) is very sweet, M. Lamy objects to its being called *a sugar*. There are in chemistry several sorts of sugars, whose least important characteristic is their sweet savor. There are, too, several sugared substances which are not real sugars. The cause of this apparent contradiction, is in the necessity chemists lie under of classing bodies rather according to their composition and the reactions they furnish, than by the manner in which they affect our senses. The first sugar studied was the common sugar, sold by every grocer. This distinctly possesses but the sweet taste and the chemical and physical qualities found in all bodies constituted after the same model. It contains equivalent quantities of oxygen and hydrogen. It ferments in contact with beer-yeast, and is transformed into alcohol and carbonic acid. Lastly, it acts in a well known and very remarkable way upon polarized light. Other substances were subsequently examined, and found to contain more or less sweet savor. Some of these fermented, others did not; some active, others inactive on polarized light. It became necessary to class them according to the relative importance of these different characters, and at the risk of violating grammar, chemists determined to class these bodies as if they had never tasted them, and merely according to their physical and chemical affections. By the side of cane sugar, grape sugar was next placed (though the sweet flavor is much weaker than in the former,) then sugar of milk, still less sugared, and lastly a certain unchrystallized sugar, which like molasses, remains always more or less liquid. As to the sugar of manna, the sugar of liquorice, the sugar of gelatine and *glycerine*, which do not ferment, and are without action on light, they have been struck off the list of sugars, notwithstanding their greater or less sweet flavor. It is upon these grounds M. Lamy declares *phycite* no sugar. Phycite is especially remarkable for its tendency to chrystallize, (which is always an index of a clearly defined composition,) the chrystals it furnishes seem to belong to the system of right rectangular prisms. It is distinguished from other sugars by the influence heat exerts on it; while real sugars are black and caramelized by the action of fire, phycite, (although remarkably sweet,) is volatilized, and leaves in the capsule, where the experiment is made, nothing but some traces of carbon. It contracts no definite combinations with the bases nor with sea-salt; it remains unaltered when placed in contact with potassium. It reduces (with the greatest difficulty) copper solutions; it is, however, easily operated on by azotic acid, with which it gives the same products as veritable sugars. It is not in the least influenced by beer-yeast; it exerts no influence on polarised light. In a word, phycite belongs to that class of singular bodies, which, while presenting the sweet flavor, lack altogether the characters essential to sugars, in the scientific acceptation of that word.

ON THE DETERMINATION OF AMMONIA CONTAINED IN WATERS.

Since the discovery by Braudes and Liebig, of the occurrence of ammonia in rain water, no complete investigations of the quantity of ammonia in natural waters has yet been made. Bousingault has now begun to determine the ammonia in such waters by means of a distillatory apparatus. He regards it as certain, that water charged with a small quantity of ammonia, will have given off the whole of this with the watery vapor when two-fifths of the water have distilled over.

We may, consequently, by submitting large quantities of water, as 10 litres or more, to a preliminary distillation, obtain a concentrated fluid, so as to treat this in the still set apart for the determination of the ammonia. Where the water is not too poor in ammonia, it may be placed in the apparatus itself.

The apparatus consists of a retort capable of containing $\frac{2}{3}$ litres. A litre of the water to be examined is put into this, if necessary previously concentrated. The cooling of the distillate is effected by means of a glass worm tube. One-fifth is distilled off, and the quantity of ammonia contained in it ascertained, according to Peligot's method of determination of nitrogen by means of a solution of sulphuric acid of known strength. A second fifth is then distilled. In this there is generally no more ammonia, and the quantity found in the first portion is usually correct.

The normal solution of sulphuric acid for the determination of the ammonia is so composed that 5 cub. centims. of this fluid shall be saturated by 0·0106 of ammonia. As the alkaline fluid which serves for the testing of the solution is so far diluted that 33 cub. centims. of it saturate the 5 cub. centims. of dilute acid, 1 cub. centim. of the alkaline fluid represents 0·00033 of ammonia; and as the burette is divided into tenths of a cubic centimetre one division represents 0·000032 of ammonia.

As regards the accuracy of the determination, it is necessary in this process to take care that the normal acid is first added to the fluid to be tested for ammonia, and that the alkaline fluid intended for the saturation of the acid is then poured in. Any inaccuracy must therefore arise from an error of two divisions of the burette. The determination of the ammonia can therefore only be brought within 0·06 milligrm.; but as the operation can always be performed twice, even if the errors of the two experiments do not compensate one another, the error of the method cannot exceed a tenth of a miligramme.

The author then instituted experiments to test this method. From these it appeared that distilled water to which a known quantity of ammonia had been added, furnished more ammonia than had been mixed with it; so that, apparently, all distilled water contains ammonia. The water employed in the following experiments was distilled first with sulphate of alumina, and afterwards over potash, to remove any ammonia and carbonic acid that might be contained in it. In the following table the first column gives the number of the experiment, the second the quantity of ammonia added to the water, the third the quantity obtained from the distillate, and the fourth the difference between the two preceding:—

I.	II.	III.	IV.
1.	0.01233	0·01224	—0·00009
2.	0·00036	0·00037	+0·00001
3.	0·01056	0·01040	—0·00016
4.	0·01130	0·01131	+0·00001
5.	0·00836	0·00840	+40000.0
6.	0·04944	0·04950	+0·00006
7.	0·00413	0·00410	—0·00003

The quantity of ammonia found in a cubic meter of water taken from various wells and rivers of France, varies from 0·03 of a gramme to 0·73 of a gramme. In one instance, the quantity found in a river-water, adjacent to several manufacturing establishments, was 2.61 grammes, other waters examined yielded no traces of ammonia. In a litre of sea-water from near Dieppe, M. Boussingault found 0.00020 grammes of ammonia. If we consider that two-thirds of the surface of the globe are covered with water, the sea always contains a considerable quantity of ammonia, which may return again into the atmosphere. In places where great numbers of persons live, the quantity of ammonia in the soil increases. In the rain-water collected in Paris, Baral found on an average 3.35 milligrammes of ammonia to one litre of water. The greatest quantity he met with was 5.45 milligrammes. Boussingault's determinations thus far agree well with Burral's. Thus in the first week in April he found 4.34 milligrammes in litre of rain water at Paris. This was twenty-seven times as much as existed at the same time in the Seine water.

OIL OF HOPS.

Wagner has recently published some researches on this body. It does not contain sulphur and belongs to the hydrocarbons of the group 6^{10} H^{8}. This oil is but slightly soluble in water. It has no narcotic action. When pure it is of a light brown color, has a powerful but not intoxicating odor, a warm and bitter taste, resembling thyme. It scarcely reddens litmus paper. It appears to be isomeric with the oil of bergamot and the aldehyle of camphodic acid. By treating the oxygenated part of hop-oil with nitric acid, the author was unable to obtain anything more than a brittle yellow resin. A series of experiments have also been made in regard to the physiological action of hop oil. It does not appear to produce any narcotic effect, and corresponds with other volatile oils. A rabbit bore a dose of 20 drops without loss of appetite or any other sign of discomfort.

Rochleder's investigations have shown that the so-called active principles are common to all the members of a natural family. Both hops and hemp belong to the Urticaceæ; both plants have a great analogy in a physiological point of view. Now since the narcotic effect of beer results from a yet unknown constituent of the hop, probably an organic base, and as hemp, according to the above principle, would contain the same constituent, it would perhaps be theoretically correct to grow hemp instead of hops for the purpose of communicating to beer its bitter taste and narcotic properties. The bitter of hemp closely resembles that of the hop. In an agricultural point of view this would be very advantageous, for besides the fact that the growth of hemp is less dependent than the hop upon meteorological conditions, the former can, after the extraction of the soluble constituents, be employed in making yarn.

ANALYSIS OF OILS BY SULPHURIC ACID.

The fishy oils mixed with sulphuric acid set free from heat; this action serves to distinguish them, and to separate decidedly, the drying oils from the others.

In a common tumbler place 50 grammes of olive oil, place a thermometer in the liquid to ascertain the temperature, pour upon it 10 cubic centimetres of concentrated sulphuric acid (66° Baume); mix the liquids by agitating with the thermometer, and observe the rise of temperature. If the temperature of the oil and acid at the commencement is 25° C., the thermometer will indicate presently 67° C., being an increase of 42° C. The mixture does not require more than two minutes to arrive at the maximum temperature.

In another glass place 50 grammes of poppy oil, and treat it in like manner with the acid; if the temperature at the commencement is 26° C., the thermometer will rise to 100°.5C. showing an increase of 74°.5 C.

It is essential to remark in this case, 1st, a considerable disengagement of sulphurous acid, which is not produced by the olive oil; and, 2d, a bubbling or boiling up of the liquid; in consequence of these two circumstances, the number 74°.5 is somewhat uncertain.

The difference between 42° and 74°.5 is so great, that it gives us the means of analysis.

The experiment repeated many times under the same conditions, with the same olive oil, always gives the same development of heat, 42°. The experiment made with olive oil from different provinces, shows that the action of the sulphuric acid is constant when the oil is pure, always producing the same degree of heat.

The action of the acid is not less constant upon the poppy oil. Experience proves that the development of heat with this oil is really 86°.4, instead of 71° to 74° indicated by direct experiment.

This method of analysis may be applied to the olive oils of commerce ; and if these oils are falsified with poppy or other oil, the analysis can be made if we are assured of their qualitative composition. But in this case, how shall we ascertain the mixture of the two acids ? To answer this question, I have determined the elevation of temperature produced by most of the pure oils.

It results from my researches that the oil of ben* and of suet give almost exactly the same elevation of temperature as the olive oil. The other oils differ so considerably from olive oil in this respect, we may easily distinguish it — in fine, the siccatives or dying oils give a much greater heat than the non-siccatives.

The oil of ben and suet oil are not mixed with olive oil, consequently if we find that the olive oil gives more than 42° of heat, with a mixture of 10 cubic centimetres of sulphuric acid (the normal temperature being 25°) this oil cannot be pure. — *M. Maumene Compt. Rend.* xxxv.

QUANTITATIVE DETERMINATION OF IODINE.

Benzine possesses the property of dissolving iodine wherever it meets with it in a free state. The color presented by this solution is bright red, which becomes deeper in proportion to the amount of iodine contained in it. When exposed to the air, the iodine is volatilized, and the solution becomes discolored. If a few drops of nitrous acid be put into a liquid containing an alkaline iodine, and after the mixture is effected 2 or 3 grms. of benzine be added to it, and the whole strongly agitated, the benzine soon rises to the surface of the liquid, exhibiting a magnificent color, arising from the iodine which it brings with it. This reaction renders it possible to determine with the greatest ease the presence of 1 milligrm. of iodine in 4 litres of water. Neither ether nor the oils of lavender, citron or turpentine, furnish under similar circumstances such decisive results. Chloroform employed either in M. Rabourdin's method, or in that of M. Grange, certainly in many cases readily shows the presence of iodine ; but its sensibility and the color which it acquires are far from being conclusive as to the characters offered by benzine. In carefully conducted experiments, I have been able in this way to determine the presence of iodine wherever traces of it were indicated by starch paste, and the employment of benzine has always appeared to me to furnish most satisfactory results.

I will add to these observations, that if by means of benzine we

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*The oil of ben is largely used as a vehicle for perfumery in Paris, being entirely inodorous and tasteless, it is little known in this country, and must not be confounded with the benne oil of the pharmacopeias It is obtained from the fruit of the *Moringa aptera* (*M. oleifera*), principally from Arabia.

can separate extremely small quantities of iodine from water, it is also very easy to determine these quantities by nitrate of silver or metallic mercury. Thus, after washing the iodized benzine repeatedly in distilled water, I take it up in a pipette, and introduce it into a corked tube, in which I agitate it in contact with a few drops of solution of nitrate of silver or with a known quantity of mercury, until the liquid is completely decolorized. In the first case, the yellow precipitate of iodide of silver is washed with alcohol of 0·86 spec. grav., thrown on a filter, and treated like chloride of silver which it is intended to weigh.

In the second, the mercury is shaken with the iodized solution, and the augmentation of its weight determined. These results may be checked by dissolving the protiodide of mercury formed in an excess of iodide of potassium. Bromine and bromides to which dilute nitric, nitrous or muriatic acids have been added, do not communicate any color to benzine; the same is the case with chlorine and chlorides. The bromine and chlorine remain dissolved in the water which serves to wash the benzine; they may be separated in the form of a white precipitate by nitrate of silver. Benzine, taking up iodine without possessing the property of dissolving either bromine or chlorine, enables us therefore to separate iodine perfectly from these two bodies, and to prove in a precise manner the presence of chlorides or bromides in commercial iodide of potassium. — *Comptes Rendus*, *Nov.*, 1852.

NEW TEST FOR NITRIC ACID.

The want of a simple and satisfactory test for minute qauntities of nitric acid and its salts has long been felt by those engaged in chemical research; for though a number of methods, more or less delicate, have from time to time been proposed, most of them are objectionable, being inconclusive if taken alone, inapplicable in many cases, or requiring the aid of expensive alkaloids not easily procured. The test I propose, appears to me to be free from those objections, and accomplishes its object with considerable facility; it depends on the formation of that interesting class of salts lately discovered by Dr. Playfair, the *Nitroprussides*, and the beautiful and characteristic effect produced on them by an alkaline sulphuret. I have found that the nitroprussides may be formed (under certain circumstances) when only very minute quantities of nitric acid or its salts are present. The method I adopt is as follows: To the solid or liquid supposed to contain nitric acid, in its free or combined state, add a few drops of a strong aqueous solution of ferrocyanide of potassium (yellow prussiate of potash,) then some pure muriatic acid, mixing the ingredients well together both before and after the addition of the acid, and gradually raise the temperature of the mixture to about 160° Fahr., or in some cases it may be necessary to raise it a little higher; let it cool, and then neutralize with carbonate of soda or potash, a slight excess of either being of no consequence. Filter if there is much precipitate, and finally add to the fluid a drop or two of a solution of either sulphuret of ammonium, sodium or potassium, when, if nitric acid were present, a fine purple or violet color will be produced, which, however, is not permanent, but soon disappears. In using this test, certain precautions are necessary, viz, 1st, much dilution of the materials must be avoided, as the acid is required to be tolerably strong to produce the necessary reaction. The muriatic acid I have used is of specific gravity 1·15 ; if a much weaker acid be employed the results will not be satisfactory. 2nd. If the nitric acid or nitrate be in very minute quantity, the mixture of it with the ferrocyanide and acid (already referred to) should be allowed to cool to the ordinary temperature before the alkaline carbonate is added; much excess of this last substance should be avoided, as at a temperature of about 100° it begins to decompose the nitroprusside, on the formation of which the test depends.

In proof of the delicacy of this test, I may remark that I have detected by its means the nitric acid in the one-twohundredth part of a grain of nitre ; and with one-hundredth part of a grain the effect is very striking. Its efficacy, too, seems scarcely impaired by the presence of a number of substances, whether of mineral, vegetable, or animal origin, as by it I readily detected the presence of nitric acid in mortars taken from old buildings ; also where that acid or its salts were added in small quantity to soils, sulphuric and muriatic acid, tea, porter, milk, &c.

I may further add, that there is generally a striking difference between the cases where no nitric acid is present, and where it occurs, when the substance is heated with muriatic acid and the ferrocyanide. When nitric acid is not present, the mixture quickly becomes of a blue color ; but where that acid exists, it first becomes of a yellowish green, then of an olive or dark brown ; but these indications alone are not sufficient to prove the presence or absence of nitric acid, until afterwards confirmed by the action of an alkaline sulphuret. In heating the mixture, the temperature stated should be maintained for a few moments till it ceases to acquire a darker shade, thereby indicating that all the nitroprusside is formed.

Sulphuric acid may be substituted for muriatic in using this test; but I prefer the latter, as being more easily procured pure, and as strong sulphuric acid aided by heat will decompose the nitroprussides.

This test may also admit of application to nitrous acid and the nitrites ; but as those compounds are comparatively unimportant I will not now enter on this subject. — *Philosoph. Mag.*

FORMATION OF PROTOXIDE OF NITROGEN BY THE ACTION OF NITRIC ACID ON SAL-AMMONIAC.

The following method of deriving almost pure protoxide of nitrogen (laughing gas) by the action of nitric acid on sal-ammoniac, is communicated to Silliman's Journal by Dr. J. Lawrence Smith.

The experiments made with the nitric acid heated with sal-ammoniac, to test the character of the decomposition, have resulted in the discovery of a new method for procuring protoxide of nitrogen with the aid of a very low temperature. Among the experiments, the following were quantitative. Two grammes of sal-ammoniac were placed in a glass flask, and half an ounce of nitric acid poured upon it, the flask was connected with a small wash bottle containing a little water, and from this latter a tube passed into a pneumatic trough filled with hot water, heat was applied to the flask, and before the temperature reached 140° Fah., a gas began to be given off, and at 160° it came off rapidly and continued to do so after the lamp was withdrawn. A small amount of red fumes appeared in the flask, that were condensed in the wash bottle, the gas that passed over was collected in a receiver, and measured 1008 cubic centimeters; the gas smelt of chlorine, the flame of a candle burnt with an increased brilliancy when introduced in it, the candle was re-ignited when extinguished, if a burning coal remained on the end of the wick — no red fumes were formed when it came in contact with the air, and the gas was absorbable by cold water. The properties were those of protoxide of nitrogen. In another experiment the gases were collected at different stages of the process, in vials over hot distilled water, and a solution of caustic potash introduced and shaken up for some time; this latter was subsequently analyzed for the chlorine it absorbed, and in three different portions, collected at the beginning, middle, and end of the process, the proportions of the chlorine to the whole bulk of the gas were 1-57, 1-29, and 1-16. The amount of protoxide of nitrogen due to the ammonia in two grammes of sal-ammoniac and its equivalent of nitric acid, is 887 cubic centimeters. The gas freed from chlorine, on being shaken up with cold water for some time, was found to be almost entirely absorbed by the water. What remained was a mixture of nitrogen and a little air; some nitrous or hyponitrous acid forms during the whole process, if concentrated nitric be used; if, however, it be diluted, little or none is formed, and the gas is readily given off at about 212°.

In all my experiments, the protoxide of nitrogen constituted from seven-eighths to twenty-four-twenty-fifths of the gaseous products, and when washed from its chlorine by a little lime-water or soda, possessed all the properties of pure protoxide of nitrogen, and I would recommend it as a convenient way of forming this gas, especially when not required for respiration.

The character of the decomposition which takes place, is somewhat curious and unexpected. At first, I supposed that the decomposition resulted in the formation of equal volumes of N, O, Cl, and N, but it appears that such is not the case, and that all but a very small portion of the ammonia, with its equivalent of nitric acid is converted into N, O; the liberated hydrochloric acid mixing with the excess of nitric acid does undergo the decomposition first supposed, and in this way only can the small amounts of chlorine and nitrogen be accounted for. At the time this method was first tried, I also tried the decomposing effects of nitrate of ammonia on sal-ammoniac, that has been shown by Maumone to result in the formation of chlorine and nitrogen; but the difficulty of controlling the decomposition once commenced, the puffing up of the mixture, and the necessity of having the salts dry to begin with, render this method (which was proposed by the author for forming chlorine) useless in processes for removing the sal-ammoniac in analysis.

NEW METHOD OF ANALYSIS FOR ORGANIC POISONS.

Flaudin has recently published his observations on organic poisons, together with a new method of analysis for the detection of the same. The author commences by laying down the principles on which he supposes the action of poisons may be explained:—1. Poisons are unassimilable substances. 2. They pass into the organism by absorption. 3. Their action is that of presence.

If these principles be correct, it follows that all poisonous substances, whatever they may be, must be found in the organs with which they have been brought into contact, or to which they have been transported by absorption. In the case of the inorganic poisons, experience has shown that there is no exception to the rule. It still remains to be shown that the same rule applies to the organic poisons.

Christison states, with regard to opium, that as a general rule, the medical jurist can scarcely obtain satisfactory proof of the existence of this substance by the best methods of analysis at present known. Now the best methods of analysis known at present for ascertaining the presence of opium, and of the organic proximate principles in general, consist in treating the suspected substances either with acetic acid or alcohol, filtering the liquid, and evaporating it to the consistence of an extract. This extract is then re-dissolved in water, either pure or acidified, and decolorized by animal charcoal, or the animal matters are precipitated as far as possible by various re-agents, such as subacetate of lead, sulphuretted hydrogen, nitrate of silver, &c. Lastly, the extractive matter thus obtained is tested by different re-agents, such as nitric acid and perchloride of iron, when it is desired to ascertain the presence of morphine, the active principle of opium. In this way, however, no satisfactory result can be obtained. The poison is not isolated; it is not directly acted upon by the re-agents; its characteristic properties consequently cannot be ascertained.

The author considers that animal substances may be divided as follows:—1. Proteine or albuminous substances. 2. Coloring matter. 3. Fatty substances.

The proteine substances are readily coagulable, and in this state they become insoluble in water, alcohol, acids, &c.

The colored or coloring matters are easily changed by various acids, and alkaline agents, anhydrous lime and baryta for instance, without mentioning heat.

The fatty substances are separated with ease from all the other matters by alcohol and ether.

Now, if an inorganic substance be mixed with organic substances there is nothing more easy than to discover it. The organic substance is burnt, the inorganic principle is brought to the state of a soluble compound within the cinder, and then extracted with water. The process of carbonization or incinderation by means of sulphuric acid for the discovery of the mineral poisons, is founded on these very simple data.

But if the substance which it is necessary to separate from animal matters be combustible, or capable of essential modification by heat, the course is not so clear. The following is the process proposed:—

To 100 parts of the substance to be examined, 12 parts of anhydrous lime or baryta are to be added, and the whole pounded together in a mortar. The mixture is then to be heated to 212° Fah., then pulverized, either with a pestle, or with a special apparatus appropriated to this operation, which is very essential; the powder is to be treated with boiling anhydrous alcohol three times, filtering the liquid after cooling. This liquid as it leaves the filter is scarcely colored; it only contains the proximate principle or principles sought for with the fatty or resinous matters.

The alcohol is now slowly evaporated, and the dry residue treated with ether to remove the fatty matters. If the principle be insoluble in ether (morphine, strychnine, brucine,) it will be separated in the fluid, and may be obtained by filtration or simple decantation. If it be soluble in ether, the alcoholic residue or the etherial fluid must be treated with a special solvent of the organic bases, such as the acetic acid, precipitating the base afterwards by ammonia.

To 100 grms. of animal matter the author added a single grain or 0·05 grm. of morphine, strychnine, and brucine; and by operating in the manner just described, succeeded in obtaining, in a state of absolute purity, a ponderable quantity of each of those principles. Instead of strychnine, morphine, and brucine, the author applied crude opium, laudanum, decoction of nux vomica, and of false angostura bark; and in these cases also he was able to isolate the poisonous principles. He also, in order to assure himself that his process was applicable to medico-legal purposes, poisoned animals with the smallest effective doses of the above-mentioned substances, when he was able to detect the poisons in the matters contained in the stomach and intestines, and sometimes even in organs to which they had been carried by absorption.

In one experiment, he mixed 2 grs. (or 10 centigrms.) of morphine with 100 grms. of flesh, leaving the substances to undergo putrefaction for two months. At the end of this period he discovered several centigrammes of morphine in the mass. — *Comptes Rendus.*

INFLUENCE OF POISONS UPON ANIMAL HEAT AS A CAUSE OF DEATH.

Dr. Sequard, of Paris. has published some peculiar views respecting his experiments with poisons, reducing animal heat. He says he has seen death take place in a rabbit after a diminution of its heat of only 22° of Fah., and he never observed any animal live after he had diminished its temperature more than 44° Fah. Accordingly as the heat is rapidly diminished, so is death produced in less time. When by a wound or poison the temperature of a man is reduced many degrees, his life is in danger from that very cause. It is thus in cholera, palsy, &c.

In cases of poisoning it has been found that the temperature of the person always decreased, and Chossut, who injected opium into the veins of a dog, found the temperature diminish from 105° to 62° Fah. M. Sequard believes that many poisons may kill simply by their action in reducing animal heat. He has found that some poisons which kill animals when there is no obstacle to prevent the diminution of the body's temperature, will not destroy life when the temperature is sustained by artificial means to its normal degree. — Equal doses of poisons were given to two animals as much like one another as possible. One was left in a room at a temperature of 46° Fah., the other was kept in a place where the temperature was 75° Fah. The first was dead after a certain number of hours, the other that was kept warm was generally cured very soon. In cases of poisoning by opium, belladona, tobacco, camphor, alcohol, oxalic acid, and many other poisons, physicians should labor to prevent a diminution of heat by keeping the patient as near as possible, by artificial means, up to the standard of 100° Fah.

NEW THEORIES IN AGRICULTURAL SCIENCE.

M. Baudrimont, professor of chemistry at the Faculty of Sciences at Bordeaux, has just published a work "On the Existence of Interstitial Currents in Arable Soil, and the influence which they exert on Agriculture," in which, after a long study of the subject, he states that there is a natural process at work by which liquid currents rise to the surface from a certain depth in the ground, and thus bring up materials that help either to maintain its fertility or to modify its character. Many phenomena of agriculture and of vegetation have at different times been observed, which, hitherto inexplicable, are readily explained on this theory. Such, for example, the improvements which take place in fallows; and there is reason to believe that these currents materially influence the rotation of crops.

In Germany, Schleiden is attracting much attention by his masterly views on the phenomena of vegetation; and it will surprise many to hear that he admits of no relation between the fertility of a soil and the quantity of fertilizing matters expended upon it. "The goodness of the soil," he says, "depends upon its inorganic constituents, so far at least as they are soluble in water, or through continued action of carbonic acid; and the more abundant and various these solutions, the more fruitful is the ground." Arguing from this view, it is not richness of soil or humus that produces the multiplied varieties of Alpine plants in Germany, or the absence of it that produces but few. "Soluble mineral constituents" are shewn to be the characteristic of our cultivated field; and "an agricultural plant" is defined as one "distinguished from wild individuals of the same species by peculiar qualities which constitute its fitness for culture, and which depend upon a modification of chemical action." The amazing yield of Indian corn in Mexico — from 200 to 600 fold — is something which, with all our skill, we cannot accomplish, and is a fact in favor of the argument, "that in no case do the organic substances contained in the ground perform any direct part of the nutrition of plants." The annual destruction of organic matter all over the earth is estimated at 145 billions of pounds, equal to $2\frac{1}{4}$ billions of cubic feet; and if all vegetation depends on organic matter for nutrition, to satisfy this consumption "there must have been, five thousand years back, ten feet deep of pure organic substance on its surface." Another illustration is furnished by taking the number of cattle and other animals in France in a given year (1844), and observing the amount of food they consume. The process of nutrition would require 76,789,000,000 pounds of organic matter — six times more than the whole number contribute of organic matter towards reproduction, and in 100 years "the whole organic material of the country would be consumed."

Again; look at a farm. How much more is carried off from it than is given back again: generally the amount of its yield is three times greater than that of the organic matter it receives; while of the manure applied, the greater part is not taken up, but imperceptibly decomposed. Carbon is the most important of the constituents of plants: an acre of sugar plantation produces 7500 pounds of canes, of which 1200 pounds are carbon, and yet sugar plantations are rarely manured, and then only with the ashes of the burnt canes. With bananas the result is still more striking: the yield is 98,000 pounds of fruit in a year from a single acre, and of this 17,000 pounds — more than a fifth — is carbon; and the same acre will give the same return year after year for twenty or thirty years; and the ground at the end of that time will be richer than at the commencement, from nothing more than the decay of the large leaves of the plant. Here in Europe, too, the difference in weight and in carbon between the seed and the produce has often been noted — in wheat, 89 per cent.; in red clover, 158 per cent.; and in peas, 361 per cent. These facts afford evidence of a supply of carbon derived from other sources than those commonly supposed to exist; and while we know that seeds will germinate and become vigorous plants in pure quartzose sand, or in cotton wool, or on a board, we seem to have proof that the chief source of supply is the atmosphere. This is an interesting point, which further research will verify: Schleiden shews the process to be eminently simple. He says in his work, of which a translation has been published by the Horticultural Society: "According to Link, Schwartz, and others, an acre of water meadow contains 4400 pounds of hay, which, when dry, contains 45·8 per cent. of carbon. The hay then yields 2000 pounds of carbon, to which 1000 pounds may be added for the portion of the year in which the grass is not cut, and the roots. To produce these 3000 pounds of carbon, 10,980 pounds of carbon acid is requisite, which may be raised to 12,000 pounds, to compensate for the nightly expiration. Now, Schubler has shewn that an acre of so wretched a grass as *Poa annua* exhales in 120 days (too low a computation) of active vegetation, 6,000,000 pounds of water. To supply the exigencies of the plants, therefore, it is only necessary for the meadow to imbibe $3\frac{1}{2}$ grains of carbonic acid with every pound of water.

Mr. Lawes has found, also, that in a plant of any one of our ordinary crops, more than 200 grains of water must pass through it for a single grain of solid substance to accumulate within it. He states the evaporation from an acre of wheat during the period of its growth to be 114,860 gallons, or 73,510,000 gallons per square mile. With clover, it is rather more; with peas and barley, less. When we apply these calculations to a county or a kingdom, we are lost in the magnitude of the processes by which nature works; but we see the more clearly that, on such a scale, the quantity of material supplied by the air, though minute to the individual, becomes vast in the aggregate. We see, moreover, the necessity for understanding the relations between evaporation and rate of growth, and the laws and effects of absorption in soils. A thousand pounds of dry calcareous sand will gain two pounds in weight in twelve hours when the air is moist, while pure agricultural clay will gain thirty-seven pounds.

The source of nitrogen comes next to be considered; and this also is seen to be independent of manures. Hereupon, it is observed that "our domestic plants do not require a greater supply than in a state of nature. A water-meadow which has never received any dung, yields yearly from 40 to 50 pounds of nitrogen, while the best ploughed land yields only about 31 pounds. The plants for which most dung is used, as potatoes and turnips, are in fact proportionally the poorest in nitrogen." That there is a supply independent of the soil, is further seen in the millions of hides furnished every year by the cattle of the Pampas without any diminution of produce; and in the great quantities of nitrogenous matters, hay, butter and cheese, carried off from pasture-land; far more than is returned by the animals fed thereon. Experiments with various kinds of plants on various soils have satisfactorily demonstrated that increase of nitrogen in the land and in the crop does take place quite irrespective of supplies of manure.

With respect to ammonia, "it appears that one-thirteenth of a grain in every pound of water is sufficient for the exigencies of vegetation, and there is perhaps no spring-water in the universe which contains so little." Then as to sulphur and phosphorus, which are also among the constituents of plants, the quantity needed in proportion to the time of vegetation is so small, that one-540,000th of a grain of sulphuretted hydrogen per cubic foot diffused through the atmosphere to a height of 3000 feet is all that is required.

The consideration that cereals would soon disappear from the north of Europe, if not cultivated, and perhaps from nearly the whole of this quarter of the globe, adds weight to the arguments in favor of enlightened attention to the inorganic-constituents of plants. The point is to bring the soil into harmony with the conditions by which growth may best be promoted. Much depends on the nature of the soil; the darkest colored lands are generally the highest in temperature; hence the advantage of vegetable mould; while deep, light sands, and clay, which turns almost to stone in dry weather, weary and vex the cultivator by their unprofitableness. It is to be remembered, however, that soils which have the highest temperature of their own, may not be those most susceptible of receiving heat — that is, from the sun, because some lands are warmed by the springs that irrigate them. Here we have an explanation of the phenomena of certain soils which are warm in winter and cool in summer. The application of humus evolves heat by the process of combustion; and sand, lime, clay, and humus, are the combinations needed, the clay being in a proportion of from 40 to 50 per cent.; if less than 10 per cent., the land will be too light and poor.

Although Schleiden's views apply chiefly to the practice of German agriculturists, they will be found to bear on the whole science of cultivation. In summing up he insists strongly on the necessity for selecting good seed; that from a barren soil, he observes, is likely to be more true to its kind than from well-manured land. Also, that the time of sowing should be adapted to the requirements of the plant; rye and barley, for instance, should be sown in drier weather than oats. And it will surprise many to read, that he advocates a less frequent use of the plough. He holds ploughing to be "a necessary evil, one to be employed only so far as necessity requires;" because, by the two frequent loosening of the soil, the decomposition of humus is so rapid as to overbalance the benefit supposed to arise from exposure to the atmosphere. He shews, too, that covered fallows are in most cases preferable to naked fallows, as the latter tend to waste the valuable qualities of the soil; while, in a field sown with clover, the quantity of humus and carbonic acid is increased by the leaves preventing evaporation. Naked fallowing is to be adopted only when the soil cannot be loosened in any other way; but there is to be no stand-still; "the notion of rest, so prevalent among cultivators, is clearly wrong except it be rest from the destructive influence of the plough;" and always must it be borne in mind, "that manures do not act immediately on vegetation by means of their organic contents, but by reason of the inorganic substances which they involve."

Such is a brief outline of some of the views of one who holds a high position among men of science; and though in some particulars they may seem to be at variance with practice in this country, there is much in them worthy the attention of intelligent cultivators. It is remarkable how different branches of science help in advancing the question, and facts arise in support of the philosopher's theories. By a recent inquiry into the amount and nature of the rain-fall at the observatory, Paris, it has been proved, that from the 1st of July, 1851, to the end of 1852, the quantity of azote combined therewith was — omitting fractions — 22 kilogrammes per acre, being 12 kilogrammes in the form of azotic acid, and 10 kilogrammes of ammonia. The quantity of uncombined ammonia in the same time was 13 kilogrammes per acre; and of uncombined azotic acid, 46 kilogrammes. In the months when azotic acid was most abundant, there was least ammonia; the former always increases with stormy weather. Besides these elements, the quantity of chlorine present was equivalent to 18 kilogrammes of marine salt, leaving out the insoluble matters held in suspension.

In all this, we seem to get a glimpse of the law of supply and demand in the great vegetative operations of nature; and we see that those who advocate a more sparing employment of manures are not without good reason for their arguments. In the middle of Russia, corn is grown year after year on the same land, with no other fertilizer than the burnt straw; and in parts of Spain, wheat and barley succeed each other without any manure at all. And without going so far for facts, we have them close at hand in one of our midland counties. A few years ago, the Rev. S. Smith, of Lois Weedon, in the neighborhood of Banbury, instituted a course of experiments on this very point, and with results which are singularly interesting. He took a field of four acres, having a gravelly soil, with clay, marl, and gravel as the subsoil. It had been hard worked for a hundred years; but except a thorough ploughing, no other means were taken to improve it: not a particle of manure was supplied. Wheat was then sown in single grains, three inches apart, and in rows a foot apart, a space of three feet being left quite bare between each three rows, and this was continued in alternate stripes all across the field. The sowing took place at the beginning of autumn; and in November, when the planted rows began to shew, all the intervening three-feet spaces were trenched by the spade, and six inches of the subsoil made to change places with the surface. "In the spring," says the reverend agriculturist, "I well hoed and hand-weeded the rows of wheat, and stirred the intervals with a one-horse scarifier three or four times, up to the very period of flowering in June." The crop looked thin and miserable until after April, when it began "to mat and tiller;" it did not turn yellow in May, and the stalk grew so stout and strong as to bear up well against the storms. When harvested, the result was highly gratifying, for the yield amounted to from thirty-six to forty bushels per acre, or rather per half acre, seeing that as the alternate stripes were left bare, only one half of the field was really planted. The quantity of seed used per half acre was a little more than a peck.

Adjoining the field in which these experiments were carried on was another which had four ploughings, ten tons of manure, six or seven times as much seed, and yet it gave a quarter less to the acre. This might be looked on as an accident, were it not that Mr. Smith has repeated his experiment year after year, and always with greater success. He believes that if all the conditions be literally fulfilled, the same favorable result may invariably be obtained. No manure whatever is to be used; and in the second year, the stripe is to be sown which was left bare in the first; and so on, changing from one to the other, year after year.

Here arises the question as to cost, and in contrasting the expense of ploughing with that of spade-labor, he finds that he takes up only so much of the subsoil as the atmosphere will readily decompose in the year — four, five, or six inches, descending gradually to two spits. He employs six men at 2s. a day, and they dig an acre in five days, making an outlay of 60s. for the whole; but as only one half is to be dug for the year's crop, the time and cost are reduced by one-half, and thus brought down to the cheapest rate of ploughing. The cost per acre, in the instance above mentioned, was £3 14s., the return from the four quarters and two bushels of wheat, and the straw, £11 14s., leaving a profit of £8. It should be understood that the cost includes rates, taxes, interest, scarifying, reaping — in short, all the operations from digging to harvest.

The parish in which Mr. Smith resides contains 200 wheat-growing acres; he calculates that fifty laborers would have dug these in two months and eight days, so that, beginning the last week in September, all would be finished by the first week in December, leaving five months for the occurrence of casualities and their reparation before the crop has grown. His system, after the first ploughing, it will be seen, is based entirely on *spade-husbandry;* he is of opinion, that it is applicable to thousands of acres "of hitherto impracticable and unremunerating clay."

Schleiden and Smith agree in their faith in nature's unassisted fertilising powers, if not in their mode of clearing the way for the exercise of those powers. The system of the latter combines fallow without loss, for the yield is double; nature is left to drop the ammonia, and the time is given for its combination with mineral matters in the soil. The atmosphere contains all the organic elements of wheat, and if the ground be kept stirred, uncrusted, and loosened to a suitable depth, they will find their way in; and nitrogen even, as late experiments demonstrate, will be absorbed. As for inorganic constituents, Mr. Smith believes that they always exist in sufficient abundance, if sought for by frequent digging.

USE OF NITRATE OF SODA AS A FERTILIZER.

The Royal (English) Agricultural Society having offered a prize for a manure equal to guano at a cost of 5*l.* a ton, Mr. Pusey has shown that the conditions are satisfied by nitrate of soda, and at a charge less than that specified. He says, in illustration, that forty-six acres of land, if cropped with barley, and dressed with seventeen hundred weights of nitrate, would yield an increase of eighty sacks beyond the quantity usually obtained. A cargo of this fertilizer was brought to England in 1820, but for want of a purchaser, was thrown overboard; a second importation took place in 1830; and from that date up to 1850, the quantity brought from Peru, where the supply is inexhaustible, was 239,860 tons; value, 5.000,000*l.* With the price reduced to 8*l.* a ton, Mr. Pusey observes, "our farmers might obtain from their own farms the whole foreign supply of wheat, without labor, and with but a few months' outlay of capital. I do not mean to say, that no failures will yet occur before we obtain a complete mastery over this powerful substance; but I am confident that, as California has been explored in our day, so vast a reservoir of nitrogen — the main desideratum for the worn-out fields of Europe — cannot long be left within a few miles of the sea, passed almost in sight by our steamers, yet still nearly inaccessible, at the foot of the Andes."

WATT'S IMPROVED METHOD FOR THE PREPARATION OF FLAX FIBER.

The following is a description of a plan recently brought out in Ireland, by Mr. Watt, for the preparation of flax fiber, and which is known as "Watt's System." This system in all its details was examined in October, 1852, by a committee of the Royal Flax Society of Belfast, Ireland, who reported favorably concerning its merits by their Chairman, Richard Niven, Esq., of Belfast.

Mr. Watt's system may be briefly described as follows:— The flax straw is delivered at the works by the grower in a dry state, with the seed on. The seed is separated by metal rollers, and afterwards cleansed by fanners. The straw is then placed in close chambers, with the exception of two doors, which serve the purpose of putting in and discharging the straw; the top which is of cast-iron, serves the double purpose of a top and a condenser. The straw is then laid on a perforated false bottom of iron, and the doors being closed and made tight by means of screws and clamps, steam is driven in by a pipe round the chambers and between the bottoms; this penetrating the mass, first removes certain volatile oils contained in the plant, and then becomes condensed on the bottom of the iron tank, descending in a continuous shower of condensed water, saturating the straw, and forming, in fact, a decoction of the extractive matters which attach the fibrous and non-fibrous portions of the plant. This liquid is drawn off from time to time, and it is proposed to use the more concentrated portions for feeding pigs and other animals. The process may be shortened by using a pump, or such other arrangements as will repeatedly wash the mass with the water, which has been allowed to accumulate in the bottom of the tank.

In about eight to twelve hours, ranging with the nature of the straw operated on, the mass is removed from the chambers, and having been freed from its extractive matters without decomposition, it is then passed through rollers, for the purpose of removing the epidermis or outer skin of the plant, of discharging the greater part of the water contained in the saturated straw, and while in the wet and swollen state, splitting it longitudinally. The straw being thus freed from all products of decomposition, is then easily dried, and in a few hours is ready for scutching, or breaking.

In the experimental trial, personally superintended, throughout all its details by the committee of the Belfast Society, a quantity of flax straw, of the ordinary quality, was taken from the bulk of the stock at the works, weighing 13¾ cwt. with the seed on. After the removal of the seed, which on being cleansed thoroughly from the chaff, measured $3\frac{3}{4}$ imperial bushels, the straw was reduced in weight to 10 cwt. 1 qr. 21 lbs. It was then placed in the vat, where it was subjected to the steaming process for about eleven hours. After steeping, wet-rolling and drying, it weighed 7 cwt. 11 lbs.; and on being scutched, the yield was 187 lbs. of flax; and of scutching-tow, 12 lbs. $6\frac{1}{2}$ oz. fine, and 35 lbs. 3 oz. coarse. The yield of fiber in the state of good flax, was, therefore, at the rate of $13\frac{1}{2}$ lbs. from the hundred weight of straw, with seed on; 18 lbs. from the hundred weight of straw without the seed: $26\frac{1}{2}$ lbs from the hundred of steeped and dry straw.

The time, according to the report of the committee, occupied in actual labor in the processes, from the seeding of the flax to the commencement of the breaking, was $13\frac{1}{4}$ hours, to which if 11 hours be added for the time the flax was in the vat, 24 hours would be the time required up to this point. The breaking by four hands, occupied six hours sixteen minutes. But in this statement the time required for drying is not included, as, owing to some derangement in the apparatus, no certain estimate could be made of the actual time required in this part of the process. It would appear, however, that about 36 hours would include the time necessary in a well arranged establishment, to convert flax straw into fiber for the spinner.

The cost of all these operations, in the experiment in question, leaving out the drying for reasons noted, appears to be under £10 per ton of clean fiber, for labor exclusive of general expenses.

A portion of the fiber was sent to two spinning-mills to be hackled and to have a value set upon it. The valuation of the samples varied from £56 to £70 per ton, according to the quality of the stocks of fiber sent; the yields on the hackle was also considered satisfactory.

The report of the committee in regard to the experimental trial of Watt's process, concluded as follows: — "On the result of this experiment, which was necessarily of a limited nature, the committee think it best to offer no general remarks. They are sufficiently favorable to speak for themselves. It remains to be ascertained whether the qualities of flax fiber, proposed by this method, are such as to suit the spinner and manufacturer. They have been informed by a spinner who has been trying some flax prepared by Mr. Watt's system, that the yarn made from it appears equal in all respects to what is ordinarily spun from good Irish flax, of the finer sorts. They believe that before long, information will be given by several individuals, who are about to carry out more extended trials in the spinning and manufacturing departments. The committee conceive that the most prominent and novel feature of this plan consists in the substitution of maceration, or softening for fermentation. In this steeping of flax, both by cold and hot water, the fiber is freed from the substance termed gum, by the decomposition of the latter; while in Watt's system the maceration of the stem loosens the cuticle and gum, which are further separated mechanically in the crushing operation, and after the drying of the straw readily part with the wood, under the action of the scutch mill. Before concluding this statement, the committee wish to call attention to a very curious feature in Mr. Watt's invention. The water from the vats, in place of being offensive and noxious, as is the case with ordinary steep water, contains a certain amount of nutritive matter. This arises from its being an infusion of flax stems, in place of holding in suspension, or solution, the product of the decompositon of the gum, and other substances contained in the stems. The inventor is now employing this water, along with the chaff of the seed-bolls, for feeding pigs. It is of much interest, therefore, to note, in how far this may be found practically to answer, as between the seed, the chaff, and the water, by far the greatest portion of what the flax plant abstracts from the soil would thus be returned in the shape of manure. However this may turn out, the avoidance of all nuisance in smell, and of the poisonous liquid which causes some damage among fish when let off into rivers, is a matter of some consequence.

ON COMMON SALT AS A POISON TO PLANTS.

The following memoranda has been communicated to the Royal Botanical Society, England, by W. B. Randall.

In the month of September last, three or four small plants in pots were shown to the writer, nearly or quite dead; and he was, at the same time, informed that their destruction was a complete mystery to the party to whom they belonged, and that Dr. Lindley had expressed his opinion, from the examination of a portion of one sent to him, that they were poisoned. Having searched in vain for any strong poison in the soil, and in the plants themselves, he inquired more minutely into the circumstances of the case, and found that these were only specimens of many hundreds of plants both in the open air and in greenhouses (but all in pots) which exhibited, in a greater or less degree, the same characteristics. The roots were completely rotten, so as to be easily crumbled between the fingers; the stems, even in young plants, assumed the appearance of old wood; the leaves became brown, first at the point, then round the edge, and afterwards all over; while the whole plant drooped and died. At least 2,000 cuttings in various stages of progress, and 1,000 strong, healthy plants had been reduced to this condition; including different varieties of the fir, cedar, geranium, fuchsia, rose, jasmine, and heath. The sight of this wholesale destruction, coupled with the fact that the whole were daily watered from one particular source, suggested the conclusion that the cause of the evil must reside in the water thus used; and this was accordingly examined. It yielded the following constituents, making in each imperial pint of 20 fluid ounces, nearly 9½ grains of solid matter, entirely saline, without any organic admixture:

Carbonate of lime,	0·600
Sulphate of lime,	0·462
Chloride of calcium,	0·200
Chloride of magnesium,	1·252
Chloride of sodium,	6·906
	9·420

The mould around the plants and an infusion of the dead stems and leaves also afforded abundant evidence of the presence of much chloride of sodium. Further inquiry showed that the well from which the water was procured had an accidental communication, by means of a drain, with the sea; and had thus become mixed with the salt water from that source, and had been used in that state for some weeks, probably from two to three months. From about that time the plants had been observed to droop; but it was not until nearly the whole of a valuable stock had been destroyed, that any extraordinary cause of the evil was suspected. To place it beyond doubt that the water was really the cause of the mischief, twelve healthy fuchsias were procured from a distance and divided into two parts; half being watered morning and evening with the water in question, and the others with rain water. In a week, the six plants watered from the well water turned brown, and ultimately died, while all the rest remained perfectly flourishing. Assuming, from these facts, that the common salt in this water was the chief cause of the results described, it is proved that water containing about seven grains of salt in each pint is, in its continued use, an effectual poison to the weaker forms of vegetation; or that when a soil is continually watered with a weak solution of salt it gradually accumulates in it until the soil becomes sufficiently contaminated to be unfit to support vegetable life. In either case an interesting subject of inquiry is suggested — What is the weakest solution of salt which can produce in any measure this poisonous effect? — or, in other words, at what degree of dilution does the danger cease?

MEANS OF DETECTING DYES.

It is not unfrequently desirable to know with regard to a dyed stuff, in what manner it has been dyed, and what dying material has been employed. This cannot always be decided by the appearance: for example, in the case of a dark blue, the question arises whether the ground is pure indigo or pure logwood, or a mixture of both, or whether prussian potash-blue is not present, &c. For this purpose recourse must be had to chemical reagents.

In order to ascertain what mordants have been used, the most accurate method is to incinerate a sufficiently large piece of the stuff, and examine the ash.

Blue Colors. — These may consist of indigo, logwood, prussian blue or ultramarine.

Indigo blue is fixed on cloth in various ways: 1st, in the blue vat; 2nd, as so-called China or English blue, blue patterns upon a white ground, fixed, according to the principle of the blue vat, with lime and sulphate of iron; 3rd, as pencil-blue, the indigo being deoxidized by means of oxide of tin and potash; and 4th, as soluble indigo.

The first three blues are not acted upon by diluted acids or alkalies. By chlorine and nitric acid, on the contrary, they are destroyed. When the stuffs decolorized by chlorine are washed and dipped in a solution of logwood, the first two remain colorless because they contain no mordant, while the stuff dyed with pencil-blue becomes red on account of the tin which it contains.

The blue of soluble indigo, and that obtained with cyanide of potassium, agree in being destroyed by alkalies; at the same time, however, the blue of indigo leaves a white ground, while that of the cyanide leaves a rusty yellow ground on account of the iron mordant employed. In order to remove all doubt, a few drops of acidulated solution of cyanide of potassium should be added, which, if iron is present, reproduces the blue color. This confirmatory test should always be used in the case of green colors.

Prussian blue may be recognized by its being decolorized by alkalies, but not by chloride of lime, while the latter re-agent destroys indigo blue. The appearance alone is sufficient to indicate whether the blue is ordinary prussian or *bleu de France*, prepared with stannate of potash.

Logwood-blue may be recognised from the fact that it is destroyed by weak acids, and becomes red; in most cases this is a sufficient ground for inferring the presence of logwood, &c. When the color to be examined is a mixed one, for example, logwood blue, with prussian blue or indigo, the color of the logwood is first destroyed by diluted acid, the stuff washed, and treated with chlorine to ascertain whether the ground-color is indigo or prussian blue.

Ultramarine may usually be recognised by its peculiar tint; after incinerating the stuff, it remains unaltered in the ash. Hydrochloric acid decomposes it, disengaging at the same time an unpleasant odor of sulphuretted hydrogen. When the ultramarine is imprinted with varnish, the stuff must be moistened with ether before the hydrochloric acid will act.

Red Colors. — With the exception of safflower, the red coloring matter requires a preparation of alumina or tin.

Safflower may be easily recognised by its color being discharged by caustic, potash, or soda. Madder colors, when treated with hydrochloric acid, acquire a yellow or orange tint without any shade of puce; upon then being treated with milk of lime, the color becomes violet at those places where the hydrochloric acid has acted. The violet is permanent, and by boiling with soap, passes into rose color.

The madder-red colors are less susceptible of alteration by acids the more they have been brightened by soap and the higher the temperature at which this took place. The great durability of the Turkish-red is owing to this fact.

The red and rose colors from madder are separable into several kinds — Turkish-red and rose, ordinary madder-red and rose, the true topical red, and the colors from garancine and garanceux.

Turkish red may be known by its brightness and indestructibility by acids. Ordinary madder-red, when brightened, scarcely differs in any particular from a true topical color. The only difference is in the mode of preparation. As the topical color is prepared before printing with tin, and after printing the stuff is steamed, the white is somewhat yellowish, and becomes colored in a decoction of logwood. The red and rose from garancine and garanceux differ from the above colors in not bearing brightening with soap, acids, and alkalies. When treated with hydrochloric acid, they pass into orange, and do not then give a violet, but a dull blue color, with milk of lime.

The tone of color is sufficient to distinguish between colors produced from garancine or garanceux, the latter possessing an orange shade. When the red is accompanied by violet, the distinction is still more easy, because garancine yields a violet, which is nearly as beautiful as that from madder, while the madder of garanceux is more reddish-gray.

The red colors from Brazil-wood and cochineal, when treated with hydrochloric acid and tin salt, become gooseberry-red; and then milk of lime produces a violet of little permanence, which disappears entirely on subsequent boiling with soap, while the madder colors acquire their greatest brilliancy by this treatment.

The red from cochineal differs from that of Brazil-wood in tone, and in its behavior with concentrated sulphuric acid; the former becomes bright cherry-red, the latter orange.

Yellow Colors.—The yellow of quercitron is discharged by chlorine and sulphurous acid, but it is not sensibly changed to orange by either caustic potash or tin salt.

The yellow of buckthorn-berries is likewise destroyed by chlorine; caustic potash renders it bright yellow. Heated with tin salt, it passes into orange; with sulphuric acid, it acquires a stone color.

The orange and nankeen colors from fustic and fustet are changed to red by sulphuric acid; treated with potash, they acquire a color resembling that of catechu; they are discharged by nitric acid.

The yellow green from sumach acquires greater brightness with tin salt; with nitric acid, it becomes red; sulphuric acid does not produce much alteration; sulphate of iron changes it to gray.

The yellow from arnotto is but little affected by chlorine; concentrated sulphuric acid changes it to bluish green; with nitric acid it assumes a dark color, and then disappears entirely.

Chrome-yellow is unaltered by heating with weak hydrochloric acid, but destroyed by the concentrated acid. It is destroyed by caustic alkalies; boiling potash converts into orange. Chrome orange becomes greenish-yellow when treated with weak acids.

Black Colors.—Logwood-black contains iron as a mordant, sometimes iron and alumina. In the latter case it has a shade of blue. Such a color is discharged by chloride, a yellow resulting from the iron ground remaining. Treated with hydrochloric acid and tin salt, it becomes red, with the former more cherry-red, with the latter violet-red.

The blacks from astringent substances are easily recognizable by the shade of olive which they present. When treated with hydrochloric acid, they acquire a dull orange color; tin salt dissolves the iron, and changes the color to a dirty olive.

Chrome-black may be known by its behavior with chloride of lime, which destroys the other kinds of black, while it changes chrome-black to a chesnut-brown.

The examination of mixed colors is somewhat more complicated; but as they are for the most part constituted of the substances already mentioned, it will not be difficult, by means of the above reactions, to ascertain in what manner and with what materials such colors have been produced.—*Beiblatt zur Deutzche Musterzeitung.*

GEOLOGY.

THE AGE OF OUR PLANET.

Monsieur Boue, of Vienna, (Austria,) communicated to the Geological Society of France, some memoranda of a book just published by M. Unger, "The History of the Vegetable World."

In it there are some considerations respecting the age or antiquity of the earth, drawn from its rate of cooling.

It is supposed that the plants of the coal period required a temperature of 22° Reaumer. The mean is at this time 8°, or 14° less.

By experiments on the rate of cooling of lavas and melted basalt, it is calculated that 9,000,000 of years are required for the earth to lose 14° Reaumer.

M. Hibert puts the period at 5,000,000. But supposing the whole to have been in a molten state, the time that must have elapsed in passing from a liquid to a solid state, is fixed at 350,000,000 years.

CENTRAL HEAT OF THE EARTH.

Prof. William Hopkins, President of the British Association, in his annual address, notices the above subject as follows. One favorite subject of speculation in the physical branch of geology has been, at all times since the origin of the science, the state of the interior of our planet, and the source of the high temperatnre observed at all considerable depths beneath its surface. The terrestrial temperature at a certain depth in each locality (about 80 feet in our own region) remains constant during the whole year, being sensibly unaffected by the changing temperature of the seasons. The same, of course, holds true at greater depths; but the lower we descend the greater is this invariable temperature, the increase being proportional to the depth, and at the rate of 1° Fahr. for about every 60 or 70 feet. Assuming this rate of increase to continue to the depth of 50 miles, we should arrive at a temperature about twice as great as that necessary to fuse iron, and sufficient, it is supposed, to reduce nearly the whole mass of the earth's solid crust to a state of fusion. Hence the opinion adopted by many geologists is, that our globe does really consist of a solid shell, not exceeding 40 or 50 miles in thickness, and an interior fluid nucleus, maintained in a state of fusion by the existing remains of the heat to which the whole terrestrial mass was originally subjected. It might, at first sight, appear that this enormous mass of molten matter, inclosed in so thin a shell, could scarcely be consistent with the general external condition and temperature of our globe; but it is quite certain that the real external temperature and this supposed internal temperature of the earth are not inconsistent with each other, and that no valid argument of this kind can be urged against the above hypothesis.

The above estimate, however, of the thickness of the earth's solid crust, entirely neglects the possible effects of the enormous pressure to which the terrestrial mass at any considerable depth is subjected. Now, this pressure may produce effects of two kinds bearing directly on the question before us. In the above calculation, terrestrial matter placed at the depth of 40 or 50 miles, with a pressure of more than 200,000 pounds on the square inch, is assumed to be fusible at the same temperature as if it were subjected merely to the ordinary atmospheric pressure; whereas the temperature of fusion may possibly be very much increased by such immense pressure as that which I have mentioned. In such case, the terrestrial matter may be retained in a solid state at much greater depths than it otherwise would be:—*i. e.* the solid crust may be much thicker than the above estimate of 40 or 50 miles. Again, in this estimate, it is assumed that heat will pass as easily through the most superficial portion of the earth's mass as through the compressed portions at considerable depths. Now, in this assumption there is, I think, a great *a priori* improbability, and especially with reference to those superficial rocks in which observations on the increase of terrestrial temperature in descending have generally been made; for these rocks are, for the most part, sedimentary strata, which in general, independently of the effect of pressure, are doubtless worse conductors than the older, more compact, and more crystalline rocks. But if the heat passes through the lower portions of this terrestrial mass with more rapidity than through its uppermost portion — *i. e.* if the *conductive power* be greater at greater depths—the temperature at considerable depths must increase *more slowly* as we descend than it is observed to increase at the smaller depths to which we can penetrate,— and consequently it would be necessary, in such case, to descend to a greater depth before we should reach the temperature necessary to produce fusion. On this account also, as well as from the increased temperature of fusion, the thickness of the earth's crust may be much greater than the previous estimate would make it.

It has been for the purpose of ascertaining the effects of great pressure that Mr. Fairbairn, Mr. Joule, and myself, have undertaken the experiments in which we have been for some time engaged at Manchester. The first object in these experiments is, the determination of the effect of pressure on the temperature of fusion of as many substances as we may be enabled to experiment upon. We expected to meet with many difficulties in the use of the enormous pressures which we contemplated, and these expectations have certainly been fully verified; but we were also satisfied that those difficulties might be overcome by perseverance and patience, and in this also we have not been disappointed,—for I may now venture to assert that our ultimate success, with respect to a number of substances, is beyond doubt. Without the engineering resources, however, at Mr. Fairbairn's command, success would have been hopeless.

At present our experiments have been restricted to a few substances, and those of easy fusibility; but I believe our apparatus to be now so complete for a considerable range of temperature, that we shall have no difficulty in obtaining further results. Those already obtained indicate *an increase in the temperature of fusion proportional to the pressure to which the fused mass is subjected.* In employing a pressure of about 13,000 lbs. to the square inch on bleached wax, the increase in the temperature of fusion was not less than 30° Fahr.,—about one-fifth of the whole temperature at which it melts under the pressure of the atmosphere. We have not yet ascertained the degree in which the conductive power of any substance may be increased when solidified under great pressure. This point we hope to investigate with due care; and also to determine the effects on substances thus solidified, with respect to their density, strength, crystalline forms, and general molecular structure. We thus hope to obtain results of general interest and value, as well as those which may bear more directly on the questions which first suggested the experiments.

ON THE TERTIARY FORMATIONS OF ST. DOMINGO.

The following is an abstract of a paper recently read before the London Geological Society, by Col. Heneken and Mr. Lonsdale. In the north-east part of the island of St. Domingo, the river Yaqui flows in a west north-west direction, through a plain four or five miles wide, flanked on its northern boundary by the cordillera of Monte Christi, and on its southern by the Cibao mountains. The Monte Christi range rises to the height of 3500 feet, and consists principally of compact limestone, covered with shales and sandstone, and believed to be of secondary age. The northern flank of the Cibao mountains on the south also consists of beds, presumed to be of secondary age; but their more central ridge, which rises to the height of 6000 feet, consists of granite, porphyry, chlorite slate, and other crystalline rocks. Between these two mountain chains, and following the course of the river Yaqui, the tertiary beds occur, forming a line of low hills, which extend from Santiago to Manchineel Bay, a distance of nearly 70 miles. The lowest beds consist of green shales, in many places full of fossils. Ten species of corals, one hundred and sixty-three of mollusca, and the teeth of four species of fish have been procured from these beds. The corals are all believed to be extinct species; some of them belong to genera only known in the fossil state; and one of them cannot be referred to any known genus. Of the mollusca, sixteen species are believed to be identical with recent species, most of them now living in the adjacent seas. Three of them — a Malea, a Triton, and a Venus — cannot be distinguished from shells living in the Pacific. Only two shells have been identified with American fossils; one, the *Turbinellus infundibulum*, occurs in the upper Eocene of South Carolina; and the other, *Chama arcinella*, in the Miocene formation of the United States. The fish all belong to species found fossil in Malta, and in the older tertiaries of America. These green shales, which are about six hundred feet in thickness, are covered by a few feet of coarse conglomerate, which is overlaid by a tufaceous limestone, about three hundred feet thick, and containing many fossils. The most abundant of these are corals, of which there are five species, belonging to three genera, all of which have living representatives in the West Indian seas. Not one, however, can be identified with any living species. The mollusca of the tufaceous limestone are eight in number, four of which also occur in the green shales above mentioned. One only, *Pleurotoma Virgo*, is believed to be still living. The groups of fossils which appear to have the closest resemblance to that of the green shales are, in North America, the Upper Eocene beds of Vicksburg, described by Mr. Conrad; and, in Europe, the Maltese tertiaries.

ON THE DEPOSITION OF THE CHALK.

At a meeting of the Boston Natural History Society, January, Prof. Rogers read the following memorandum on the probable depth of the ocean of the European chalk deposits:

Various geologists, and among them Professor Edward Forbes, in his excellent and learned Palæontology on the British Isles, in Johnston's Physical Atlas, have suggested that the ocean of the chalk deposit of Europe was a deep one; and in evidence of this, Prof. Forbes cites the striking relationship existing to deep sea forms of the English chalk corals and brachiopods; adding, that the peculiar Echinoderms (Holaster, Galerites, Anarchytes, Cidaris, Brissus and Goniaster) favor this notion, as also the presence of numerous foraminiferæ.

I beg leave to present a difficulty in the way of this conclusion. Several of these genera of Echinoderms, as Anarchytes, Cidaris, &c., occur in the green sand deposit of New Jersey — referable by any fossil test to the age of the green sand and chalk of Europe; and this American stratum was unquestionably the sediment of quite shallow littoral waters. That they must have had a trivial depth is proved by the circumstance that they repose in almost horizontal stratification, at a level of not more than from 100 to 200 feet lower than the general surface of the hills and upland region to the N. W. of the margin of the zone they occupy at their outcrop. It is obvious that a depression of the cretaceous region, such as would cover the present deposits with a deep sea, would have likewise overspread the low gneissic hills to the N. W. of the Delaware, which present no traces of having ever been submerged during the cretaceous in any secondary period."

Mr. Ayres remarked that of those genera of Echinoderms which Mr. Forbes regarded as deep sea genera, two or three are found in North America, in water not 200 feet deep. Terebratula, which has been generally regarded as only an inhabitant of very deep water, and whose structure has been described as admirably adapted to the depth at which it has been found, and which Prof. Owen has demonstrated cannot exist at a depth of less than two or three hundred fathoms, exists at Eastport, Me., in water so shallow that it can be taken by hand. In the same locality and position, Radiata are found which have heretofore been thought to be only inhabitants of deep water. Some of Mr. Forbes's genera are also found in less than ten fathoms of water.

THE RED RIVER.

This is the name of one of the largest of the great streams of the west, which, taking its rise in the northeastern part of Texas, and flowing a distance of about one thousand miles, in a southeasterly direction through Texas, the Indian Territory, Arkansas and Louisiana, finally empties its waters into the Mississippi river in Louisiana, opposite the southwestern corner of the State of Mississippi. The soil of the inhabited portions of the valley of this river is probably not surpassed in the world for fertility, and rewards the labors of the planter with abundant crops. The navigation of the stream has been seriously impeded by the obstruction called the great raft — which is located about 90 miles above Nachitoches — where the river, in crossing an immense swampy alluvial, divides into a great many small channels, and has in the course of a long series of ages become choked with logs, brush-wood, &c., to such a degree that in some places vegetation is growing above the water, and it is difficult to find a channel. Boats only can pass above the raft. At a recent special meeting of the American Statistical and Geographical Society of New York, Capt. R. B. Marcy, of the U. S. Army, read an interesting paper relative to his recent exploration in the upper Red River country.

After briefly describing the previous attempts which had been made both by government and by private individuals to explore the head waters of the Red river, but which had invariably resulted unsuccessfully so far as the main object of the expeditions was concerned, the paper proceeds to state that on the 2d day of May, 1852, agreeably to an order from the War department, Capt. Marcy left Fort Belknap, on the Brazos river, accompanied by a suitable escort of soldiers and Indians, for the purpose of exploring Red river, from the confluence of Cashe creek to its sources. Cashe creek was the highest point that had been examined; it is a stream of considerable magnitude, and unites with the Red river one hundred and twenty miles above the Wachita, or one hundred miles above the highest settlement on the river. About fifty miles from the confluence of these streams, the explorers found that Red river divided into two nearly equal branches. Following the northern branch for forty miles they arrived at another fork, the branches of which were of nearly equal magnitude. Capt. Marcy chose for their route the northernmost of these, and after following it up a distance of three hundred and seventy miles, arrived at its sources, in lat 35° 14′ north, and lon. 101° 51′ west. While at its head waters, he made an excursion across the country to the Canadian river, which he had visited in 1849, and found it about twenty-five miles distant, in a position exactly corresponding to that assigned it by their astronomical observations.

After completing the examination of the north branch of Red river, Capt Marcy directed his course southward, across an elevated prairie country, and after thirty miles travel reached the middle fork, which having explored, he resumed his southerly course, and marching fifty miles, arrived at the southern and principal branch of the river. The Camanches. call this stream Ke-che-ati-que-ho-no, or Prairie Dog Town river. In one place, near the bank of this stream, the travellers passed for twenty-five miles through a continuous community of these animals. "Supposing its extent to have been the same in other directions," says Capt. Marcy, "the town would occupy an area of 625 square miles, or 396,000 acres; with the burrows at the usual distances of about twenty yards apart, and each containing a family of five or six dogs, the aggregate population would, I fancy, exceed that of any city in the world."

The southern branch of the stream proved to be one thousand yards wide at the point of intersection, and flowing over a sandy bed through so rough a country that the gallant captain was obliged to leave his wagon train, and proceed with a small escort of mounted men directly along the bed of the stream; and after three days hard riding he arrived at the fountain head—in lat. 34° 12′, lon. 102° 35′. Three miles from its source, the bed, which had previously, with one exception, been of sand from its confluence with the Mississippi, changed to rock, and the water, which had been nauseating and bitter, became cool, clear, and free from salts. This was an unlooked for luxury, and after indulging freely in the delicious element, they ascended along the narrow dell through which the stream flowed for a distance of two miles, when they were obliged to leave their horses and clamber over the remaining mile of distance on foot. Capt. Marcy says:

"The gigantic walls of sandstone, rising to the enormous height of eight hundred feet, on each side, gradually closed in until they were only a few yards apart, and at last united above us, leaving a long, narrow corridor beneath, at the base of which the head spring of the principal branch of Red river takes its rise. This spring bursts from its cavernous reservoir, and leaping down over the huge masses of rock below, commences its long journey to unite with other tributaries in the noblest river in the universe. * * * *

"The stupendous escarpments of the solid rock, rising to such a height as to exclude the rays of the sun for a great portion of the day, were worn away by the lapse of time and the action of water and the weather into the most fantastic forms, which it required but little effort of the imagination to convert into works of art; all united in forming one of the most sublime and picturesque scenes that can be imagined, and we all, with one accord, stopped and gazed with wonder and admiration upon a panorama which was now for the first time exhibited to the eyes of civilized man."

Capt. Marcy remarked that one of the most striking features of this region was a small strip of woodland, from 5 to 30 miles in width, called the Cross Timbers, extending from the Arkansas river in a southwesterly direction to the Brazos — some 500 miles. On the eastern side of this belt is a well watered champaigne country abounding with timber, teeming with vegetation, here and there interspersed with verdant glades and small prairies, and affording inexhaustible grazing and the most beautiful natural meadows that can be imagined. To the westward commence those barren and desolate wastes, where but few and unimportant streams greet the eyes of the few travellers who visit that region, and but little wood is found, except on the borders of the water courses. The explorers particularly remarked this change in the valley of the river which they were ascending. As they passed to the westward of the Cross Timbers, the country suddenly changed its character. The bluffs approached nearer the river and the bottoms did not support that dense and heavy vegetation which characterized the lower part of the stream. The undergrowth of cane-brakes and vines disappeared, the land gradually rose into broad and elevated swells, with spacious intervening valleys, and the soil became more sterile until they reached the 101st degree of west longitude; and from this point onward, with but few exceptions, they found no more arable land.

The Red river flows for a hundred miles over a gypsum formation, which is considered by Dr. Hitchcock to be the most extensive in the known world; and it is to this fact that Capt. Marcy ascribes the peculiarly bitter and disagreeable taste which characterizes its waters. He says that the Arkansas, Canadian, Brazos, Colorado and Pecos rivers all pass over this formation, and a similar taste is imparted to each. All these rivers, too, have their sources in the borders of the same elevated table lands, and where they make their exit from this plateau, their waters are confined within vast sluices, or canons, the sides of which rise abruptly to an enormous height. Capt. Marcy observes: —

"This defile on Red river is 70 miles in length, the escarpments from 500 to 800 ft. high on each side, and in many places they approach so near the water's edge that there is not room for a man to pass; and occasionally it is necessary to travel for miles in the bed of the river, before a spot is found where a horse can clamber up the precipitous sides of the chasm. I could not determine in my own mind whether this remarkable defile had been formed after a long lapse of time by the action of the current, or had been produced by some great convulsion of nature."

The barren plain in which these rivers take their rise is about 3650 feet above the level of the sea. It extends in a southerly direction from the Canadian river about 400 miles, and in some places is nearly 200 miles in width. It is an ocean of trackless, desert prairie, where no animal resides, and through which few living creatures wander. Even the Indians venture to cross it only at two places, where they find a few small ponds which suffice to sustain life. Many years since the Mexicans marked out a route across the plain with stakes, and hence the name by which it is known through Mexico of *El Llano Estacado*, or The Staked Plain.

The geological features of the valley of the upper Red river are generally characterized by rocks of the secondary formation. The Wachita mountains, however, are composed of granite, with veins of quartz running through them as in the gold regions of California. The party discovered copper ores of a rich quality in many portions of the valley, and found, also, a few small particles of gold in the detritus from the mountains.

THE ARTESIAN WELL, CHARLESTON, S. C.

The following account of the celebrated artesian well of Charleston, S. C., was given to the American Association by Rev. Mr. Lynch, of that city :—

This well, commenced in 1848, under the authority of the city council, is the fifth effort in Charleston to procure good water by means of an artesian well. In 1824, one was undertaken under the same authority, and sunk to the depth of 335 feet, when the iron rods twisted off in the well and could not be extracted. In 1826, a second effort was made by private enterprise, and soon abandoned for want of means. In 1846, Captain Bowman undertook one at fort Sumter, in the harbor, under the authority of the general government. The appropriation giving out, this work was suspended after attaining the depth of 360 feet. In 1847, another one was commenced in the city, and was sunk 280 feet. The following year the city council engaged the services of Mr. Welton, who had bored many wells in Alabama, and other States, with great success. He preferred to commence anew. From that time the work has been perseveringly followed up, with only such delays as were necessary for obtaining tubes; and the well has obtained a depth of 1,145 feet. Few wells have presented so many difficulties, or called for greater skill in the engineer. The superficial soil of Charleston is a loose alluvial sand, about twenty feet thick, the lower half of which is saturated with water. Beneath this lies a stiff, compact clay (postpleiocene), gradually passing into a sand likewise water-bearing, and about forty feet thick. At sixty feet below the surface, the firm eocene marl is encountered, the various strata of which are, in the aggregate, six hundred and fifty feet thick. Beneath these, and differing but little from them in mineralogical character, lie the cretaceous strata of as yet unknown thickness.

Mr. Walton has had to chisel his way through not less than fifty-four rocks, varying from ten to two feet in thickness, and amounting in the aggregate to about 250 feet. Cast iron tubes, of six inches internal diameter, were at first sunk eighty feet to exclude the superficial and the postpleiocene sands. But as these succeeded in gradually working their way downwards, passing under the mouth of the tube and into the well the tubes were sunk deeper at various times until finally they rested firmly on a thick rock 230 feet deep. Below this point the alternations continued and generally underneath a large and hard rock, a bed of loose sand was found, which poured into the well. Such a bed the engineer at first strove to exhaust — that is, to draw out with the bucket all the sand that would run in and impede the work. By this operation, repeated at various points, the well finally consisted of a series of chambers, some perhaps of several feet in diameter, one below the other, and all connected together by the narrow neck-like passage of the well, three and a half inches diameter, through the intermediate rocks. At 700 feet the sands ran in so steadily and in such quantities, that no progress could be made. The engineer generally found the well 50 or 100 feet, sometimes 140 feet less deep in the morning than he had left it the preceding evening.

After toiling in vain for a long time to exhaust the streams, it was determined to shut them out by a system of tubing. To do this the passages through all the rocks had to be opened from three and a half to fully five inches diameter. This was done. At the depth of four hundred and seventy feet there was a rock on which the tools had generally impinged, and which caught the tubes. Withdrawing these that passage was worked over again. It appeared that a nodule in the rock projected into the passage, and had always driven the tools into an oblique direction. It was at length broken off. Below this rock was a large chamber, and the tools now entering it, without losing their perpendicularity, struck the bottom a little on one side of the bore previously made, which they never could be afterwards induced to enter. From this point down the whole work had to be done over again. This was finally effected, and sheet iron tubes were sent down to shut out the sands. The well was then continued down to 1.020 feet; but again the sands came in, and filled the well for over a hundred feet. The tubing, several hundred feet of which had been sent down, was found too light and unmanageable. The engineer resolved to withdraw it, and insert instead wrought iron tubes, $4\frac{7}{8}$ external and 4 inches internal diameter, screwed together so as to form one continuous tube from the bottom of the well to the surface of the earth. This was the largest size which the somewhat warped cast iron tubing at top would allow to pass through. Twenty-four feet of the light tubing obstinately refused to be extracted, and remained fixed in the well, more than 700 feet below the surface. Nothing daunted, the engineer thrust a portion of it aside into the chambers, and cut his way through the rest; and has finally succeeded in sinking the wrought iron tubes to the depth of 1,102 feet, and has bored 43 feet lower still. In sinking these tubes, which generally followed a few feet behind the auger or chisel, little difficulty was met, save from the rocks. When one of these was encountered, the tube was arrested, if possible, a foot or eighteen inches above its surface, and a tool invented by Mr. Welton was sent down, which could be opened when on the bottom, so as to cut a hole five inches diameter, and which could be closed at pleasure so as to be withdrawn again through the narrower passage of tube. At times the tubes would rest immediately on the rock, or would be caught by some protuberance while passing through it. In this case, the tool just referred to was not sufficient, for it could open out only at a certain distance below the mouth of the tube, which it would therefore leave standing on a ledge. Here, the engineer, having first drilled a $3\frac{1}{2}$ inch hole entirely through the rock, and into the softer stratum below it, sent down another tool, closed during its descent, and made to open out below the rock, and to cut a passage through it of the requsite size, from the bottom upwards to the mouth of the tube. This done, the tool could be closed and withdrawn. None of those tools caused any embarrassment, or failed to effect their purpose, although worked with a handle more than a thousand feet long. Notwithstanding the use of the most perfect tubes that could be procured, the sands still continued to give annoyance. As the rods were withdrawn, they would rush in from below with the water, to fill the vacant space, sometimes filling the well to the depth of 60 feet almost instantaneously. This was remedied by building a reservoir at a sufficient height, from which, as the rods were withdrawn, the water was let into the well, so as to produce a downward current through the pipes. Such a current was likewise made use of, at times, to loosen and start the sands packed about the mouth of the tube, and allow it to proceed. The lateral pressure on the tubes has rapidly increased as they descended, requiring a powerful leverage and heavy blows of a rammer to force them down. When started, however, they frequently descend very easily until arrested by a rock. The present system can scarcely be sunk any lower, for, although the bottom is free, so great is the lateral pressure that the tubes cannot be started by a power under which the joints show signs of giving way. Other tubing of such a size as to be let down inside of the present system, will be speedily procured, when, it is hoped, the work will again be prosecuted with vigor.

A brief notice of the principal tools may not be out of place. The rods used are of pine, about $3\frac{1}{4}$ inches diameter and 30 feet long, tapering at their extremities, where they are armed with iron heads bearing screws. The tool to be used is screwed to a rod, and both are let down into the well until only one end of the rod bearing a male screw, projects above the mouth of the well, where it is firmly held by an iron catch or yoke, beneath a suitable iron band on the screw. A second rod is then screwed to the first one, and is similarly let down and caught. A third is screwed to the second; and so on until the bottom is reached. The upper rod is held suspended either wholly or in part, as the engineer desires, by a movable pulley, and bears a cross bar or handle, by means of which the workmen may turn the rods and tool as they please. The chief tool is the auger, used for boring clays, marl, or any consistent layer not of stony hardness. It is exceedingly simple and ingenious. A steel blade an inch wide and half an inch thick, slightly tapering towards one extremity, is twisted like an auger, and terminates in two cutting edges, like those of a drill for boring iron. About six inches above the point two bitts like those of a plane are securely fastened, one on each side of the central bitt, and are inclined at an angle of 45 degrees, so as to fit exactly its auger-like twist of the blade; the upper extremities of those bitts are extended backwards horizontally, so as to give some support to the load when packed above the auger. The upper portion of the central blade terminates in a strong tube, with a screw. The auger thus made is screwed to a metal tube eighteen or twenty feet long, and this again is screwed to the lowest or first rod. The earth cut by the side bitts in shavings, ascend their inclination, and is gradually packed around the stem. In a tenacious soil, such a load soon becomes an air and water-tight piston in the well, which cannot be extracted from a great depth without great risk of breaking tools and machinery. In Mr. Welton's auger, this difficulty is admirably obviated. The stem, or metal tube, above the auger, has three or four suitable orifices near the top. As the load is raised the water above enters into these, passes down through the stem and upper portion of the auger, and issues through two apertures beneath the side bitts, into the cavity under the load. By a dexterous manipulation of this instrument, in a suitable soil, ten feet may be bored, and the entire load brought up at a single insertion of the auger. Where rocks are encountered, the chisel must be used. This is made in the usual form, and is rendered weighty by the use of one or two iron rods to which it is screwed. A slip-link two feet long, unites this tool to the wooden rods, which are so suspended that when the chisel is on the bottom the slip-link has five or six inches play. The upper rod is raised say two feet and a half, by which the slip-link is tightened and the chisel is raised two feet. The whole is let fall; the chisel strikes the rock, the rods continue their descent for six inches more, and thus escape the shock of the concussion, which would otherwise quickly shatter their joints. The detritus of rocks chipped by the chisel, or the mud or sand that collects in the bottom of the well is extracted by a copper tube or bucket, 20 feet long, of nearly the same diameter as the well, and having a valved bottom. This is likewise the most efficient tool for penetrating loose sands, provided the tubing of the well is made to keep pace with it.

The Charleston Basin is formed by a depression in the cretaceous strata, as they descend the Atlantic slope, and pass under the waters of the Atlantic. Its narrow diameter or minor axis, from near Georgetown to Beaufort, is a little over 100 miles along the coast, northeast and southwest, while the semi-major axis, from Charleston to Lexington, is about 120 miles. To the northeast the cretaceous strata crop out; to the southwest, the lower eocene beds, immediately over the cretaceous strata, are seen on the surface, while to the northwest, the sands and tertiary clays lie on the granite. It was originally hoped that the lowest tertiary stratum under Charleston, would be a water-bearing sand, the continuation of that which on the northwest edge, immediately over lies the granite, and is traversed by the chief river of the state. This hope has not been realized. The lowest tertiary stratum proved to be under Charleston an argillaceous marl, in which little or no water was found. We are now boring to reach those cretaceous sands, which are exposed on the northeast edge of the basin, and which, in Alabama, yield a plentiful supply of water to several hundred wells. So far several streams of water have been met, the lowest of which rose in the tubes ten feet over the surface.

The following interesting table of the temperature of the well, at various depths, has been prepared by Prof. Hume, of the State Military Academy.

	Degrees Fahr.
At the surface, the temperature of the water is	68
50 feet, the temperature is	68*
100 " "	68
200 " "	70
300 " "	71½
400 " "	72
500 " "	73½
600 " "	74½
700 " "	76½†
800 " "	80
900 " "	82½
1,000 " "	84
1,065 " "	86
1,106° " "	88

* At 58, eocene commences. † At 708, cretaceous commences.

From this table it will be seen that the increase of temperature by no means tallies with the increase of depth. The greatest increase of temperature seems to occur about those places at which streams of water were encountered, and the variations may be due to the fact that the well passed through some as they descended from a higher and less heated, and through others as they descended from a lower and hotter level, and while the waters of both classes were still to some extent influenced by their previous temperature. The average rate of increase of temperature, 1 degree F. for every fifty-two and a half feet, agrees with the results heretofore obtained in other wells.

ARTESIAN WELL AT ST. LOUIS.

An artesian well of great depth is being bored at present at St. Louis, for a sugar refinery in that city. It was begun in 1849, and has been worked 1,590 feet. The object is to obtain a supply of other than limestone water which is the only sort that can be found by the ordinary channels in that vicinity. At the present depth of 1,590 feet a pretty copious stream of sulphur water flows from the well, having precisely the taste of the Blue Lick water in Kentucky, although perhaps it is not quite so thoroughly impregnated with sulphur. It is, however, concluded from recent indications, that a supply of pure sweet water will be now obtained. The following is a list of the different strata passed through in the course of operations.

1st. Through limestone, 28 feet; 2nd, shale, 2; 3rd, limestone, 231; 4th, chert, 15; 5th, limestone, 75; 6th, shale, 20; 7th, limestone, 75; 8th, shale, 1½; 9th, limestone, 38½; 10th, sandy shale, 7½; 11th, limestone, 128½; 12th, red marl, 15; 13th, shale, 30; 14th, red marl, 50; 15th, shale, 30; 16th, limestone, 119; 17th, shale, 66; 18th, bituminous marl, 15; 19th, shale, 80; 20th, limestone, 134; 21st, chert, 62; 22nd, limestone, 134; 23rd, shale, 70; 24th, limestone, 20; 25th, shale, 56; 26th, limestone, 34; 27th, white soft sandstone, 15 feet.

The well was first commenced as a cistern. From the surface of the ground, where it is fourteen feet in diameter, it has a conical form, lessening at the depth of thirty feet to a diameter of six feet. Thence the diameter is again lessened to sixteen inches, until the depth of 78 feet from the surface is attained. From that point it is diminished to nine inches, and this diameter is preserved to the depth of 457 feet. Passing this line the diameter to the present bottom of the well, is three and a half inches.

The lowest summer stand of the Mississippi river is passed in the first stratum of the shale, at the depth of twenty-nine or thirty feet from the surface. The water in the well, however, is always higher than the water line of the river, and is not affected by the variations of the latter. The first appearance of gas was found at a depth of 566 feet, in a strata of shale one and a half feet thick, which was strongly imbued with carbonated hydrogen. When about 250 feet below the surface of the earth at the beginning of a layer of limestone, the water in the well became salty.

The level of the sea — reckoned to be five hundred and thirty-two feet below the city of St. Louis — was passed in the same layer; two hundred feet lower still, in a bed of shale, the water contained one-and-a-half per cent. of salt. At a depth of 950 feet, a bed of bituminous marl 15 feet in diameter was struck. The marl nearly resembled coal, and on being subjected to a great heat, without actually burning, lost much of its weight. In the stratum of shale which followed, the salt in the water increased to two-and-a-half per cent. The hard streak passed, a bed of chert, was struck at a depth of 1,179 feet from the surface, and going down 62 feet. In this layer the salt in the water increased to full three per cent. The boring at present is, as appears by the statement above, in a bed of white soft sand rock, the most promising that has yet been struck for a supply of water such as is wanted.

Observations have been made with a Celsius thermometer of the temperature of the well. At the mouth of the orifice, the thermometer marks 50 degrees; at the depth of 45 feet, the heat is regular, neither increasing nor diminishing with the variations above, and at the distance of 351 feet, the heat has increased to 60 degrees.

ON THE EFFECT OF THE RECLAMATION OF THE ANNUALLY INUNDATED LANDS OF THE MISSISSIPPI VALLEY UPON THE GENERAL HEALTH OF THE COUNTRY AND THE NAVIGATION OF THAT RIVER.

The following report was presented at the Cleveland meeting of the American Association, by Andrew Brown, Esq., of Natchez, Miss.

At a meeting of this Association, held at Philadelphia, 1848, your Committee on the Mississippi river, reporting their investigations of the waters and sediment of that great stream, were by resolution directed to continue their observations, with the view of ascertaining the probable effect which the reclamation of the annually inundated land would have upon the improvement of its navigation, and the general health of the country.

They therefore submit the following as a combination of their observations, in accordance with the terms of the resolution, viz: That the reclamation of the bottom or swamp lands, which has been in more or less successful progress for a great number of years, and of late very generally and rapidly prosecuted by means of a system of artificial embankments, by which it is intended ultimately to restrict the whole waters of the river to their legitimate channels, which object has been in a very considerable degree already effected, an improvement of the general health of the country is found to have been more than in the simple ratio of the reclaimed lands, and so decided is the character of this salutary change, that it is alike evident to the individual occupants of such lands, and to the residents of cities and towns in their vicinity.

From long continued observation, supported by concurrent testimony, your committee entertain not the least doubt but that the occupants of these low, wet lands may secure a perfect immunity from their miasmatic effect, by clearing them of the forests, and bringing them into cultivation, when their exposure to the action of the sun and the free circulation of the atmosphere will render them healthful to the inhabitants, and contribute largely to the general salubrity of the country. Much speculation has been entertained with respect to the effect of restricting within its proper channel the vast body of water that periodically overspreads so many hundred square miles of bottom land. Fears have been entertained that no practical embankments could possibly confine the accumulating waters as they received their tributary contributions on their way to the ocean; and other rivers have been cited as a proof that, if embankments were thrown up to restrict the waters of the river to their proper channel, they will, in the same ratio, elevate their own bed; and hence that any general system of leveeing the waters of the river within the limits of its channel would be impracticable, and if practicable, inexpedient, as tending to inundate the good lands already reclaimed by the present inconsiderable embankments that protect them.

Now, however formidable the force of these arguments may seem at first sight, they will be found to have little practical application in fact, and what experience there is, seems at least to confirm their insufficient foundation.

When it is contemplated that the whole extent of country from which these surplus waters flow, is rapidly undergoing great physical changes, by its settlement and cultivation, it may certainly be inferred that such must in some measure have its effect upon the relative quantity and condition of such waters as are discharging from the lands, and should that be found equivalent to the progressive confinement of the river within its banks, there will certainly be less to fear from any undue accumulation caused by such confinement.

In the former report, based on the best procurable data, on this subject, your committee deduced the annual quantity of water discharged by the Mississippi river to be only 8-91 parts of the rain-water falling in the whole valley; consequently, a disposition of 8-91 parts must be made by its evaporation. That report suggested the progressive increase of the evaporating process as consequent from the rapid denudation of the primeval forests, and consequent exposure of the lands to the action of the sun and winds, which are so obviously well calculated to cause a very considerable increase of evaporation of the falling waters by dissipating the aqueous matter in the atmosphere of the valley. Any such progressive increase in the evaporating process must necessarily, to some certain extent, leave the river less and less water to discharge.

These inferences may not seem to be well supported by facts, during the several years that have intervened between the time of submitting the last and the preseut report; for the annual swelling of the waters in several of these years would seem to imply but little diminution in the quantity of water transported to the ocean, and but little reliance on the facts and inferences as detailed in that report.

But our subsequent observations have been directed to the facts and phases of another very important element in the same connection, which, in that report was in a great measure overlooked; or, at least, received less attention than its importance demanded, as having, and still continuing to have, no inconsiderable effect in both the physical and commercial relations, as affecting navigation, and, therefore, now requiring special notice.

This feature, in this connection, consists in the very considerable change now in progress with respect to the sedimentary matter with which the waters of the rivers are charged on their descent to the ocean. When the valley of the Mississippi was an uncultivated waste, and its lands clothed in their primeval forests — with the waters of the river annually overflowing all its low lands — these waters could not have had the same proportional quantity of sedimentary matter in suspension during floods they now have; because this dense and unbroken vegetation must have been a great protection against the corroding effects of falling and running waters, so that much less must have been washed into the river than at the present time; and even the most of that must in time of high-water, have been deposited on the banks and in the woods, into which the waters were constantly running on their way to the ocean. Thus, the waters of the river, in periods of inundation, from its source to its mouth, would let fall its sand and sedimentary matter all along in the bottoms and on the banks, and would necessarily have that much less to urge into the ocean; so that the bar at the river's mouth, during high water, would not be subject to interpose such obstructions as at the present impede navigation.

But, during the last few years, this system of things has been undergoing rapid changes, inasmuch as the face of the country is becoming entirely cleared and cultivated, so that the heavy rains and running waters now act with full force thereon, and displace vast quantities of the soil, and other more solid matter, and run the same into the river, which being now more and more restricted to its channel by the leveeing process, has less opportunity of depositing any of this solid matter either upon the banks or in the woods; and the consequence is, it is forced to transport all this detrital matter to the ocean, or permit its channel to be filled up; of which there is no fear so long as its descending velocity is of sufficient force to agitate and urge forward all such matter obstructing its passage, having no more specific gravity than that with which the water of this river is charged. The effect, however, of this great and increasing quantity of matter so much more ponderable than the water by which it is transported, having to be carried along the channel of the river, must be, and is to cause extensive accumulative deposits wherever the force of the water is insufficient for its agitation and transportation. These deposits, in such localities, constitute, by the formation of immense sand bars, such obstruction to the free flow of the water as may make the river swell to a height equal to that of former years, while it is really discharging a much less quantity of water.

These obstructing deposits are likewise well calculated to make the main thread of the channel more sinuous; not only obstructing the water, but by causing them to travel a greater distance, likewise increasing their accumulations. These impediments to the passage of the waters being of a very fluctuating character, are sometimes found to disturb the relative heights of the high water at the several points on the river from year to year; so that plantations secure from the high waters of one year, may not be safe against the same general level of the water the following year.

But, with all this increasing quantity of sand and other solid matters, against which the waters of the river have to contend, while they are being more and more restricted to their channels and retarded in their velocity — they are not perceptibly elevated in their high-water stages, nor does the high water continue for any longer period than in former years. Now this is certainly to be attributed to some change in the general quantity requiring to be discharged annually by the river; and we know of no adequate cause of such diminution, save the increased evaporation, consequent from the exposure of the lands by clearing and cultivation.

This increasing quantity of sedimentary matter subject to deposit, makes river navigation somewhat more uncertain, from the more extensive formation and fluctuating transfers of bars and middle grounds caused by the settling of this solid matter on its descent to the ocean, and on which no safe calculations can be made from one year to another. Those channels which are shortest and safest for steamers during the several stages of water one year, may not be equally so the next. But over some part of the river bed, the waters will always have power to wash out for themselves a channel through which to descend to the ocean; and in so doing will insure a depth sufficient, even during the greatest depression of the waters, for the passage of steamers. When the river bed is wide, and the waters thereby much spread and shallowing, there is often but barely sufficient water in which to make the passage; but as these spread waters subside, they concentrate in the most depressed portions of their bed, thereby acquiring sufficient force from the accumulation to wash for themselves a passage through which steamers can always make their way.

The lower the river periodically falls, the deeper does it reduce this low water bed, thereby making more room in the channel for the passage of the rising waters in the ensuing spring; which, again, when at their highest stages, more or less fill up these low water passages with sand, and other solid matter, as before; thus alternately obstructing and removing obstructions, by urging this impeding matter onward to where the force of the current is insufficient at the time for its further transportation. Such is the general rule of this river, so far as it affects navigation, from its juncture with the Ohio to the bar at its mouth.

Although the increasing quantity of solid matter to be transported to the ocean opposes no serious obstacle to river navigation, it necessarily increases the difficulty at its mouth, for at high water stages, when the force of the waters is urging so much of their solid matter along, there must be an extensive deposit in the most depressed portion of the bar-channel; because the still waters of the Gulf impede the force of the current by which the detrital matter is agitated and carried forward, thus shallowing the channel through which ships are conducted, and rendering difficult the egress to and from the ocean. This will at times amount to a serious obstacle to the free commercial intercourse between the Gulf and the city of New Orleans, against which there is no certain remedy; for so long as the waters of the river are charged with the transport of so much solid matter, so surely will they let such an amount of it fall on the bar, as will at times seriously block up the free passage for large ships.

This evil is progressively increasing with the changes taking place above, against which the almost continual agitation of the water and mud by the steamers and ships in making the passage of the channel on the bar, is not at all counteractive of the disposition to deposit. But the evident effects in this particular, are sufficient to indicate the agitating processes the most effectual, and we may say the only practical remedy for relieving the bar channel from this obstruction. By agitating the current the solid matter would be kept in suspension till it passed forward into deep water. Therefore, if the usual operations on the bar are at any time insufficient for the removal of any excess of deposit, practical means of such a character, constructed for the purpose, may be beneficially applied at no considerable expense.

The following table of statistics respecting the Mississippi were appended to the report of Mr. Brown, presented in 1848, and used for reference in the present report.

1. Quantity of water discharged by the Mississippi river, annually, 14,883,360,636,880 cubic feet.

2. Quantity of sediment discharged by the Mississippi river, annually, 28,188,083,892 cubic feet.

3. Area of the Delta of the Mississippi, according to Mr. Lyell, 13,000 square miles.

4. Depth of the Delta, according to Professor Riddell, 1,056 feet.

5. The Delta, therefore, according to 3 and 4, as above, contains 400,378,429,440,000 cubic feet, or 2,720 cubic miles.

6. According to 2, it would require for the formation of one cubic mile of Delta, five years and eighty-one days.

7. For the formation of one square mile, of the depth of 1,056 feet, one year sixteen and one-fifth days.

8. For the formation of the Delta, according to 2, 3, 4, time required 14,208 4-5 years.

9. The valley of the Mississippi, from Cape Girardeau to the Delta, is estimated to contain 16,000 square miles, of 150 feet depth; it therefore contains 66,908,160,000,000 cubic feet, or 454½ cubic miles.

MUD LUMPS IN THE MISSISSIPPI.

Among the many mysterious operations of nature, one of the most singular, and at the same time apparently inexplicable, is the formation of what are termed "mud lumps," in the delta of the Mississippi river. At frequent intervals, small islands composed of clay and mud suddenly make their appearance on either side of the channel, above the surface of the water, jetting mud and water from an orifice in the centre, something like a small mud volcano. The action continues until an island is formed, sometimes to the height of twelve or fifteen feet above the level of the water, when its operations cease, as apparently without cause as had been their beginning. And not always is this mysterious formation confined to the still waters on either side of the channel. Often when a ship grounds upon the bar, an island suddenly appears under her lee, changing the channel and puzzling the pilots to their utter disgust.

Many theories have been suggested as to the probable or possible cause of this phenomenon, and much ingenious speculation thereon has been brought forward, but without leading to any convincing or satisfactory explanation. Professor Forshey, and Lyell, the geologist, suggested a subterranean connection with the springs of more northern latitudes; but one of the difficulties with this theory is to account for the non-appearance of the "mud lumps" any where else than in the delta of this river. Mr. Sidel endeavored to find a cause for these formations in the evolution of gases formed by the decomposition of vegetable matter buried under the alluvial deposits of the river; while the pilots of the Balize have, with a semi-seriousness, ascribed them to witchcraft or magic. None of these theories give a reasonable cause, nor suggest any possible removal of the difficulty, which has so long been a serious detriment to the deepening of the bar at the mouth of the Mississippi.

We believe the cause of these formations has now been explained, and the credit of the discovery belongs to Major Beauregard, of the U. S. Engineers. Under an appropriation by Congress, a board was formed last autumn, to examine the bar of the Mississippi, and to report a plan for deepening the channel. Upon the recommendation of this board, a contract was entered into for the purpose of opening the channel, and we have great satisfaction in announcing that the operations in consequence have been eminently successful. A channel eighteen feet deep at low water, and three hundred feet wide, has been formed and buoyed out, and ships drawing even twenty feet of water can now be taken out at high tide.

During the examination of the bar by the board of engineers, preliminary to their report, extensive borings were made throughout its extent, and it was found to consist generally of alternate layers of mud, or river deposit, clay and sand. While on a recent visit to the bar, this fact suggested to Major Beauregard an explanation of the cause of the "mud lumps," of which we shall endeavor to give our readers an idea as well as can be done without a diagram. It is an admitted fact, that these lumps always appear on or about the bar of the passes, but generally a little outside of them, and to the right or left of the channel; that they are of mud or clay, very little mixed with sand, the latter being in such fine particles that it can hardly be discovered except by trying it with the teeth; that they rise to the height of sometimes twelve or fifteen feet above the level of the sea; that a little brackish water, mixed at times with mud, issues from their summits, the temperature of which is lower than that of the waters of the Gulf.

The form of the bar presents an inclined plane, on the inside, to the current of the river as the water gradually shoals to its summit, and again on the outside, the water gradually deepening, the bar presents a similar inclined plane to the waters of the Gulf. Now if we suppose a tube to pass from the inside of the bar where the current is more or less strong, towards the outside of it, where there is hardly any current, it is evident that the force of the current will fill this tube with that floating mud lying at the bottom of the river, and cause it to issue at its other extremity to a higher or lower level, or not at all, according to the strength of the current acting at the time. Its temperature will necessarily be lower than that of the waters of the Gulf, for the river water, especially at the bottom, is always much colder, and is also generally brackish. The sandy particles contained in that floating mud being the heaviest, will remain only in the lower portion of the tube, allowing only the better dissolved mud to pass through it. If the outlet of this tube be in the channel over the bar, the flow of the current will carry off the mud which passes out of it, unless it be in the still water under the lee of a ship aground.

The alternate layers of soft mud, clay and sand, which were found by the borings to run through the bar, present in greater or less perfection these tubes, and the force of the current impinging upon their inlets in the inclined plane which the bar presents on its inside, forces the dissolved mud through their outlets on the outside of the bar, and wherever these occur in the still water on either side of the channel, an island or "mud lump" is formed around the orifice, varying in height acccording to the force of pressure of the current, or the height of the water in the river over that of the gulf.

The cause, therefore, of the "mud lumps" is evident, and they occur wherever a fissure is made in the upper strata of clay on the outside of the bar, and at such points as the still water will allow the mud forced out thereof to remain deposited. We hope that as the cause of this phenomenon is now ascertained, some method of applying it to the preservation of the channel will be found, by leading it to form banks on either side or otherwise, and we congratulate Major Beauregard upon his happy explanation of a phenomenon which has been so greatly detrimental to the commercial interests of the Mississippi river. — *N. O. Picayune.*

NOTICE OF THE DISCOVERY OF A DEEP SEA BANK, IN THE EXAMINATION OF THE GULF STREAM.

The following communication was presented at the last meeting of the American Association, by Prof. A. D. Bache. The Gulf Stream has been explored in connection with the Coast Survey by running sections perpendicularly across it, at different points in its course, and exploring the temperature, and as far as practicable, other phenomena of the stream at stations on those sections; and from the surface to depths of six, and in some cases of 1200 fathoms. The stations being selected at greater or less distances, according to the less or more rapid changes occurring in that portion of the stream which they were intended to explore. In the explanation made in June last, the hydrographic party of Lieut. Commander Craven was instructed to explore the stream on four sections, beginning with one from Cape Canaveral, Florida, perpendicular to the direction of the stream; next taking up one across it, from St. Augustine; next from St Simons, Georgia; and last from Charleston, S. C.

That of Lieut. Com. Maffit was to run over the same section from Charleston, and then take up others in succession, further north. The section from Charleston was explored by Lieut. Com. Maffit's party between the 2d and the 11th of June, and soundings were kept entirely across the stream at depths of less than 600 fathoms, the bottom being brought up. The longitude named was 77 deg. 12 min.

On the 11th of June, Lieut. Commander Craven, having crossed the Gulf Stream without finding bottom at 1000 fathoms, came upon a deep sand bank at a depth of 469 fathoms, in lat. 28 deg. 24 min. N.; long. 79 deg. 05 min. W. This bank was again struck on the section north of this one at similar depths, bottom being brought up, and traced thus to a position comparing with the Charleston section, where it had been struck by the other party, and bottom brought up from the depth of 300 fathoms, in lat. 31 deg. 37 min., and long. 78 deg. 33 min., on the 7th of June.

This bank is supposed to be an extension of the Bahama Banks, and will be carefully explored. Its discovery is claimed for the officers whose names are at the head of this article, and for the vessels with which they are connected.

The following interesting remarks in regard to the nature of the bottom brought up, are made by assistant L. F. Pourtales, who has examined the specimens deposited in the Coast Survey Office, and has compared them with those of the coast of Cape Henlopen, formerly examined by him. Mr. Pourtales says:

"I have in hand now the specimens of bottom from the Gulf Stream, obtained by Lieut. Craven, and can say that they are among the most interesting I have ever seen. You recollect that I said in my Report that with the increase in depth (in the greater depths) the number of individuals appeared to increase. The greatest depth from which I had seen specimens was between 200 and 300 fathoms. There the sand contained perhaps 50 per ct. of foraminiferæ (in bulk.) The specimens now before me go to 1050 fathoms, and there is no longer sand containing foraminiferæ, but foraminiferæ containing little or no sand. The grains of sand have to be searched for carefully under the microscope to be noticed at all. The species are the same as found in the deep sea sounding in section 2, but the specimens look fresher and appear somewhat larger. The *Globigerina* rosea of *D'Orbigny* which forms the majority, has frequently that delicate pink color to which it owes its name, but which I cannot recollect to have noticed in northern specimens. There are also some species of coral and dead shells from the depth of 1050 fathoms. The corals do not look much worn, but still appear to have been dead. There are some delicate shells of molluscus from depths beyond 500 fathoms, where they were certainly living."

ON DEEP SEA SOUNDINGS AND ERRORS THEREIN, FROM STRATA OF CURRENTS, WITH SUGGESTIONS FOR THEIR INVESTIGATIONS.

The following is an abstract of a paper on the above subject read before the British Association, by Dr. Scoresby.

He set out by observing that the subject of deep sea soundings was one which lately had become of great interest, inasmuch as recent soundings had tended to show that there were profundities in the sea, much greater than any elevations on the surface of the earth, for a line had been veered to the extent of seven miles. He believed the first soundings beyond a mile were mad: by himself, when quite a youth, in the Arctic regions. Since then, in 1849, Her Majesty's ship Pandora had obtained soundings in the North Atlantic, at 2,060 fathoms. Capt. Basnet, in 1848, in the North Atlantic, got soundings at 3,250 fathoms. In 1849, Lieut. Walsh, of the United States Navy got soundings at 5,700 in the North Atlantic. But a much greater depth had been obtained by Capt. Denham, in the South Atlantic. In 1852, he got soundings at 7,706 fathoms. After the line had been let out to that depth it came to a pause. It was then raised a little, and then let out again, when it came to a stop at precisely the same point. The line used was a silk one, one-tenth of an inch in diameter, weighing about one pound to every hundred yards, the plummet weighing about nine pounds, and being about eleven inches long. These were perhaps very favorable circumstances; but there were considerations connected with all deep sea experimeuts which rendered these results extremely doubtful, and not only doubtful, but in some cases actually erroneous. This arose from the action of what he had, in a previous paper, spoken of as the strata currents of the ocean, — that was, currents flowing beneath each other, in different ways, as he had shown in the case of the Gulf stream and the Polar current. It would be evident that, in the case of a sounding, where as with Capt. Denham, a light lead required nine hours, twenty-four minutes, and forty-five seconds, to run out, the action of these currents would affect the length of line run out, and the sounding could not be relied upon. If the sea were a stationary body, or if its currents were uniform movements of the entire mass of waters from the surface to the bottom, then the lead might be fairly expected to take a direct and perpendicular course downwards. But if, in the place of sounding, strata currents, so prevalent in the sea, should be running in different directions, or what would have the same effect, if one stratum of water, say a superficial stratum, should be in motion, and the main body below at rest, no correct results could be derived. Dr. Scoresby proceeded to show, illustrating his argument with diagrams, that under such circumstances the line would be carried away by the under current so as to make a bend, which, at great depths, might go to the extent of miles. He had repeatedly noticed this effect when in the Arctic seas, in his youth, hunting the whale, and by noticing it had been able to strike many second harpoons, where the other whale fishers had been at fault. He had noticed that after a fish was struck, say at the edge of the ice, it had dived in an oblique direction under it, carrying out line for a quarter of an hour or twenty minutes, when there would be a tension of from half-a-ton to a ton on the line, and then pause for a short time. Then the fish would "take line" again, as if under the ice, and perhaps come up a-stern of the fast boat. There could be no doubt that the second pulling out was owing almost entirely to the resistance of the water. But if the boat was in clear water, and run until the pause; then her head would perhaps incline to the right or left. The boats then went a-head of her; but he, instead of doing so, had always gone to perhaps treble the angle of inclination, and had, for the most part, been rewarded by his close proximity to the fish when it rose. Well, then, all circumstances showed that the currents of the sea had very considerable influence on the line when let out, and he came, then to the consideration of a plan for the determination of the surface and relative strata currents. No doubt broad determinations as to great and decided currents and proximate results by means of multiplied observations on currents of moderate velocities were derivable from the ordinary process; but for really satisfactory results, far more accurate and conclusive processes need to be instituted.

Two leading processes appeared to him as being applicable to these determinations: — First, the planting in particular positions of inquiry in the ocean, from an attendant vessel, buoys with flags, kept in their places by a resisting apparatus below the surface, which might be denominated a current measurer, and determining, after a night's action, for instance, the changes of their position from celestial observations. Then, secondly, placing a small boat upon the water during a calm, with the current apparatus for the determination of the relative set of strata currents. The current measurer attached to, and suspended by, a small wire run off a reel fixed in the bow of a boat, might be let down to various depths in succession, with a register thermometer attached at each new depth, when the motion of the boat and its direction, as shown by the position of a surface float or buoy, would after but short intervals of time, indicate proximately the relative motion of the surface water at the several depths of the resisting apparatus below.

At the conclusion of the above paper by Dr. Scoresby, Dr. Buist exhibited and explained the construction of a new current measurer. This instrument resembled a common weathercock turned upside down, and which on being lowered by a wire to any depth, took the direction of the current. It was furnished with a compass, the needle of whic was clamped at the proper time by a second wire, when a bladed wheel like tnat of a patent log, or of a ventilator, was allowed to revolve for a minute, and worked like a gasmeter by an endless screw into a toothed wheel, and when the whole was drawn up, it indicated the direction and velocity of the current at any given depth.

DEEP SEA SOUNDINGS.

The following is an account of a remarkable deep sea sounding made on the 30th of October, by H. M. Ship Herald, in the course of a passage from Rio de Janeiro to the Cape of Good Hope, 36° 49′ South Latitude, and 37° 6′ West Longitude. The sounding-line was $\frac{1}{10}$ of an inch in diameter, laid into one length, and weighing, when dry, one pound for every hundred fathoms. Captain Denham received from Commodore McKeever, of the United States Navy, commanding the Congress frigate, a present of 15,000 fathoms of this line, 10,000 fathoms on one reel, and 5000 on another; and considers it to have been admirably adapted for the purpose for which it was made and to which it was applied. The plummet weighed 9 lbs., and was 11.5 inches in length, and 1.7 inch in diameter. When 7706 fathoms had run off the reel the sea-bottom was reached. Captain Denham states that Lieut. Hutcheson and himself, in separate boats, with their own hands, drew the plummet up 50 fathoms several times, and after it had renewed its descent, it stopped, on each occasion, abruptly at the original mark to a fathom, and would not take another turn off the reel. The velocity with which the line run out was as follows: —

	H.	M.	S.
The first 1000 fathoms in	0	27	15
1000 to 2000 "	0	39	40
2000 " 3000 "	0	48	10
3000 " 4000 "	1	13	39
4000 " 5000 "	1	27	06
5000 " 6000 "	1	45	25
6000 " 7000 "	1	49	15
7000 " 7706 "	1	14	15
	9	24	45

The whole, time therefore, taken by the plummet in descending through 7706 fathoms, or nearly 7.7 geographical miles of 60 to the degree, was $9^h\ 24^m\ 45^s$. The highest summits of the Himalaya, Dhawalagiri and Kinchinginga, are little more than 28,000 feet, or 4.7 geographical miles above the sea. The sea-bottom has therefore depths greatly exceeding the elevation of the highest pinnacle above its surface.

The strength of the line tried before the sounding was found to be equal to bear 72 pounds in air. The 7706 fathoms which ran out weighed, when dry, 77 pounds, exclusive of the plummet, 9 pounds. Great care was taken in the endeavor to bring the plummet again to the surface to show the nature of the bottom, but, whilst carefully reeling in, the line broke at 140 fathoms below the water-line, carrying away a Six's thermometer which had been bent on at 3000 fathoms.

During the past summer, the United States brig Dolphin has been engaged in Atlantic explorations under the direction of Lt. Maury. Sailing from the Chesapeake Bay his first task was, to strike a line from that bay to Rockule, on the west coast of Scotland, and take soundings at intervals of a hundred miles along it. From Rockule a second line was run to the Azores; a little to the north of which a ridge, 6,000 feet in height from the ocean bed, was discovered,— the soil on this elevation being a fine yellow, chalky substance, mixed with fine sand. From the Azores the explorer made a westerly cut, — everywhere finding bottom, and everywhere noting the set of tides and currents, and the temperature of the water. The Dolphin next steered for the Three Chimnies, where she found bottom at a depth of 1,900 fathoms. The greatest depth of water was found in lat. 41° to 43°, long. 51° to 56°, — where the line fell out 3,130 fathoms. The Dolphin is to continue her observations on the eastern side of the Azores. She is admirably fitted for her work, and possesses the finest sounding apparatus hitherto constructed. Hitherto a continuous series of soundings in deep water has been rendered difficult by the fact of each sounding costing the ship a fresh line; however strongly the line was made, when once out it has never been recovered. A method has, however, been invented by which the weight on touching the bottom is detached, so that the line may be drawn back with ease. This is effected in the following manner. A hole is drilled through a 64 lb. or heavier shot, sufficiently large to admit a rod of about three-quarters of an inch in diameter. This rod is about 12 or 14 inches in length, and with the exception of about 1½ inch at the bottom, perfectly solid. At the top of the rod are two arms extending one from each side. These arms being upon easily acting hinges, are capable of being raised or lowered with very little power. A small branch extends from the outside of each of them, which is for the purpose of holding by means of rings a piece of wire by which the ball is swung to the rod. A piece of rope is then attached by each end to the arms, to which again is joined the sounding line. The ball is then lowered into the water, and upon reaching the bottom the strain upon the line ceases, and the arms fall down, allowing the ball to detach itself entirely from the rod, which is then easily drawn in, — the drilled portion of which is discovered to be filled with a specimen of that which it has come in contact with at the bottom.

ORIGIN OF THE BITUMEN OF STRATIFIED ROCKS.

The following is an abtract of a communication by Mr. Charles Whittlesey, of Cleveland, Ohio, published in the Annals of Science.

In the above caption I purposely abstain from using the word *mineral* bitumen, as distinguished from that of plants, because most geologists deny that there exists on the earth bituminous matter not derived through either vegetable or animal life. In a tabular statement, I have collected from all sources of information within my reach, the various instances where bitumen flows from the rocks, or is embedded in their composition in notable quantities. The exact geological position of petroleum springs has not always been well determined by travellers. It is not easy, therefore, to construct a table, such as I have undertaken, in which we can place full confidence.

The table embraces 68 cases, extending from the oldest sedimentary rocks up through the column to the drift, and located in all portions of the earth.

The super-cretaceous rocks of South America, the cretaceous of Syria, the oolite of France, and the lias of Europe furnish, out of sixty-eight	15	instances.
The coal series and carboniferous rocks	8	"
The Devonian rocks	13	"
The Silurian	12	"
The Metamorphic and Magnesian	6	"

I have classified the cases in the best manner the present state of information in my possession admits; but do not offer it as in every respect correct. For convenience I have terminated the *Devonian* system in Ohio and New York, at the base of the Black or Hamilton Shales, and commenced the Silurian at the surface of the cliff or Heldenberg limestones. In the present state of the discussion, it is not easy to fix the true limit of those geological divisions; and of course if we use the terms Devonian and Silurian, an arbitrary line of separation must be adopted for present purposes. I have placed several instances of bituminous springs in the alluvium, drift, and tertiary deposites; but very much doubt whether in every case they do not proceed from subjacent rocks.

If we throw out of view 6 cases above classed as tertiary, quartenary, or alluvium, and which might properly be placed with the unknown or miscellaneous, and also 8 cases of really unknown, there remain but 54 instances, whose geological relations are determined.

Of these 54, 31 are below the carboniferous and coal-producing rocks; and 23 are in or above the coal series. Of the number of 23, 15 are due to the rocks from the lias upward, 8 only belonging to the coal-bearing strata.

In the present state of knowledge, therefore, the rocks below the coal, produce about four times as much liquid and coagulated bitumen as the carboniferous strata, and one quarter more than all the rocks above the Devonian. The mica slate, serpentine and magnesian beds, explored by Mr. Taylor, in Cuba, are doubtless the equivalent of the Azoic system of Lake Superior, and older than the Potsdam sandstone. Mr. Taylor regards all the bitumen of the West India Islands, including the Pitch Lake of Trinidad, as belonging to the same age.

In the mine of Consualidad, near Havana, he found asphaltum in a vein or fissure of the metamorphic rock, which at the bottom of the shaft attained the thickness of 9 feet. On the Tapaste, and on the Matanzas road, he saw it in the same rocks in still greater masses, whose dimensions had been penetrated more than 100 feet without finding the sides. In those islands asphaltum rises to the surface from beneath the sea, after volcanic action has been experienced. The great lake of Trinidad, 3 miles in circumference, he considers as supplied from the rocks of the same age, as those he inspected around Havana. The specimens observed by Mr. Logan on the east coast of Lake Superior were in rocks doubtless not newer than the Potsdam. Those streams of naphtha seen by Humboldt issuing from mica slate, in the Gulf of Cariaco, in Venezuela, were without doubt flowing from the most ancient rocks, and the same may be said of the gneiss, containing iron, in Scandinavia, in which liquid bitumen is found. Everything points to an early, a very ancient existence of bitumen, both solid and liquid in the rocky strata of our planet.

Was it not *as ancient* as any of the compound substances comprising these strata?

The systems composed of magnesian slates, magnetic iron ore, mica slate, and magnesian limestone, which are so well developed on Lake Superior, in Missouri, and in Sweden, are older than most of the granites. Rocks that are apparently of the same age, or at least more ancient than any traces of animal or vegetable life in Cuba, in Scandinavia, and in Canada contain bitumen.

This assertion has not, it is true, a perfectly incontestable basis whereon to rest, but a reasonable good foundation, approaching to a mathematical demonstration. Aside from the facts here presented, the assertion is not theoretically a strange or startling one.

The components, or simple substances of which bitumen is constituted, existed from the earliest creation. Oxygen must have been in existence as early as the metals; otherwise they would be found pure, and in the form of alloys, and not of oxides. We must suppose that there was iron ore, lime, silica, magnesia, and other oxides, alkalies and earths as soon as there was calcium or silicium.

Oxygen gas, which constitutes about *one-fourth* of the mass of the globe, must have been primeval. Are not chlorine, sulphur, nitrogen, hydrogen and carbon equally ancient? Is there any rock so old that it does not contain sulphur?

The dolomites of the metamorphic rocks contain carbon; and the carbonates generally carry about *one-eighth* of their mass of this singular substance, which is sometimes an imperceptible vapor, and again the hardest kind of matter known. These dolomites are sometimes found older than the Potsdam sandstone. Nitrogen may not have been found in rocks below the mountain limestone, where it exists in the form of nitrate of potassa. But nitrogen must have been in being before organic life; for it is one of their component parts, and there could not have been an atmosphere fit for respiration without it.

Hydrogen is not found in combination with the rocky strata of the early geological eras; but hydrogen must have been present, with oxygen, before water could have been formed, and consequently before the deposition of any sedimentary rock. If the ancient seas which deposited the silurian system, were, as their fossils prove them to have been, salt, then their water contained chlorides and chlorine in the same manner as our seas do at the present day.

All the gaseous substances exist now in a free state in the oldest sedimentary strata, and flow out in combination with salts in thousands of mineral springs. The thermal springs that proceed from great depths in the lowest and oldest rocks, bring up carburetted hydrogen and other gases, and chlorides, carbonates, etc., in solution. Almost all the salt wells and the petroleum springs in the above catologue evolve gases, some of them pure nitrogen, and salts of various kinds. All these kindred substances are found wherever man has penetrated the earth or divined its composition, in the oldest as well as the most recent formations, and they include all the constituents of bitumen.

Chemists regard the various forms of native bitumen, whether under the name of naphtha, petroleum, seneca oil, mineral tar, or asphaltum, as essentially the same compound, mixed with different proportions of earthy matter, or exposed more or less to the atmosphere, which coagulates and hardens it. It is an *atomic combination* of carbon and hydrogen — 6 atoms of each. In the atmosphere it absorbs oxygen and nitrogen. From the same rocks and the same depths there issues, in company with naphtha, petroleum, etc., an inflammable or light carburetted hydrogen gas, composed of *one atom* of carbon to *two* of hydrogen.

Having convincing proofs that the elementary substances composing bitumen were in existence and universally diffused in nature before the production of organic life, with the same chemical affinities they now possess and obey, is it philosophical to suppose that they did not, when in contact, obey those affinities until after animals and vegetables were created? Is it not equivalent to the assertion that carbon and hydrogen did not unite in the proportion of six atoms of each, nor of one atom of carbon to two of hydrogen, till after they had been elaborated in the vessels of a plant, or the stomach of an animal? Is it not more philosophical to reverse the process, and to say that animal and vegetable life derives its material substance by a power of accretion from what existed before, in a mineral state; and from gases *coeval* with the primitive minerals?

ARCTIC PHENOMENA.

The following interesting items of scientific intelligence we glean from the recently published despatches of Com. Mc Clure, the Arctic navigator. When abreast of the Horton river, between Cape Bathurst and Cape Parry, large volumes of smoke were observed, and the look-out watch reported that he saw several persons moving about dressed in white shirts, and saw white tents in a hollow of the cliff. An examination of the locality confirmed the existence of the smoke, — which proceeded from fifteen small mounds, of volcanic appearance, occupying a space of about fifty yards. The entire ground was strongly impregnated with sulphur; and the land in the neighborhood was intersected by ravines and deep watercourses, varying in elevation from 300 to 500 feet. Marks of reindeer were seen in the vicinity, — and the temperature at the time (September the 6th) was warm. Several whales and seals played around the ship. The mystery of the white shirts and tents was thus satisfactorily explained: — and it is highly interesting in a geographical point of view to find these volcanic appearances at so high a latitude. The active volcano discovered by Sir James Ross in a high latitude in the Antarctic regions will be in the remembrance of our readers.

Another discovery of great interest was made on the north of Banks Land, by shooting parties who had proceeded a short way into the interior in search of game. This consisted of "a range of hills, composed of one entire mass of wood in every stage from petrification to a log fit for fire-wood. Many large trees were among it; but in endeavoring to exhume them, they were found too much decayed to stand removal. In the vicinity the heads of musk-oxen and the well-picked carcases of deer were frequently met with; and there was every appearance of the country being frequented by large herds of animals. Since the publication of Capt. M'Clure's despatches, an official return, of which the following is a copy, has issued from the Admiralty, showing the game killed by Capt. M'Clure's party between Oct. 1st, 1850, and April 8th, 1853. It is right, however, to state, that the principal part was killed during the spring of this year. —

	Number Killed.	Average Weight of each.	Total Weight.
Musk Oxen	7	278 lbs.	1,945 lbs.
Deer	110	70	7,716
Hares	169	6	1,014
Grouse	486	not weighed	
Ducks	178	"	
Geese	29	"	
Wolves	2	"	
Bears	4	"	
Total	1,005		

— It is supposed that this number would have been greatly augmented had the shooting parties gone into the interior of the country.

Another interesting table has been published, showing the monthly mean height of the barometer and temperature of the air on board the Investigator, from August, 1850, to March, 1853 : — from which the following yearly abstract is drawn. —

Barometer.	1850.	1851.	1852.	1853.
Maximum	30·650	30·750	31·000	30·726
Minimum	29·160	29·030	28·970	29·180
Mean	29·828	29·934	29·906	29.960
Air.				
Maximum . . .	+5	+52	+52	+17
Minimum . . .	—40	—51	—52	—65
Mean	4·66	+1·58	+0·05	—35 92

STRENGTH AND DENSITY OF BUILDING STONE.

By a series of experiments recently tried in Washington, under the direction of the Ordnance Board, the specific gravity of various sandstones presented, averaged 1,929 — the best Quincy granite, or to speak properly, Sienite, 2,648, and the Malone sandstone, 2,591.

The report of the examining officers further states —

1st — That the sandstone of the capitol broke under a pressure, per square inch, of 5,245 lbs.

2d — Several of the marbles tested broke under pressures varying from 7,000 to 10,000 lbs.

3d — The compact red sandstone, of which the Smithsonian Institute is built, broke under 9,518 lbs.

4th — The granite, or blue micaceous rocks employed for the new foundations, broke (as the average of 7 samples) under 15,603 lbs.

6th — The Malone sandstone, 24,105 lbs.

7th — The most compact Sienite from Quincy, 29,220 lbs.

It should be mentioned that the various sandstones were tested in the weakest position — with the lines of stratification perpendicular to the horizon, as such is the way that they are usually employed in building. The marbles and granites were tested in an exactly opposite position.

RESEARCHES ON CRYSTALLIZATION.

M. Lavalle has recently presented to the French Academy a memoir narrating some remarkable phenomena discovered, and patiently observed by him. All bodies, whose composition is clearly defined, have a tendency to crystallize ; in other words, when they take the solid state slowly, their last particles, in grouping themselves, each after the other, are so disposed as to form a mass, which the mind successively decomposes into plane layers, into rectilinear files, and into elementary particles. As these are disposed parallel to each other, and at equal distances, to be arranged in files, so the layers are formed by the assembly of parallel and equi-distant files, so also parallelism and equality of distance preside at the aggregation of layers which compose the solid mass. It results from this that the crystal is identical to itself throughout, and that any given particle affects in space, and in relation to the neighboring particles, the same direction and the same relations as every other particle in every part of the mass. This regularity of interior structure is generally exhibited on the exterior by characteristic forms, which the practised eye can always detect. Varied as they may be, these forms may be reduced to a small number of species, which are called the crystalline system, and in which are naturally classed all real and possible crystals. Competent judges think nothing is more likely to reveal the existence of the elementary particle than the phenomenon of crystallization; for if the particle does not exist in the same form as that of the smallest sensible crystal, the last particles whose integrity seems necessary to the maintenance of the properties of the body, must have particular and fixed directions. Be this as it may, we shall (perhaps) never see the particle itself; but this in no way lessens the interest of the phenomena connected with the mysterious operation of their free aggregation. It is to this point M. Lavalle's experiments were made. Among a good many curious experiments, M. Lavalle took an alum crystal, a perfect octaed; he destroyed one of the six summits, and so made a square face, parallel to one of the faces of the corresponding cube; then placing it upon this face he abandoned it in the bottom of a vase, containing a saturated solution; the crystal increased as usual, with perhaps what may be called the exception that a face exactly like the square face on which it stood, was spontaneously produced on the opposite summit. Thus was confirmed, by a striking example, that great law of symmetry which, in natural crystals, always opposes symmetrical faces. Another of his experiments was cutting away the augular edges of a crystal and the faces, so as to destroy completely all traces of its original form. But it must not be supposed that this will destroy its original nature; its structure will still remain. The experimenter has but to re-plunge it into the dissolution where it was formed, to see it complete itself and cover again its angles and faces. It may happen, however, that this sort of restoration proceeds too rapidly, and that numerous small crystals shoot on the surface of the altered crystal. This gives a new piece of information; for all these small crystals have a common direction, which coincides with that of the mass from which they spring — thus demonstrating the constancy of structure and the identity of the particles of which it is composed. We need not be astonished, then, that if a fragment of a crystal in process of formation be broken off, this loss will be promptly repaired. Nay, it is further seen that if a crystal is broken into fragments, each fragment soon reproduces in the saturated water an entire crystal, imitating in this respect that marvel of organization which, of one polypus, divided into several parts, makes in a few days so many entire polypi. Curious phenomena are produced when a crystal is transferred from one solution to another.

ON SOME PHENOMENA OF CRYSTALLIZATION.

Sir David Brewster, at the last meeting of the British Association, after stating that crystals of titanium within quartz had been long known and attended to, drew attention to the fact that regular crystals of tourmaline, titanium and quartz had been discovered by him within mica, amethyst and topaz. That in some instances these crystals had been found grouped in very regular figures, and that the groups of crystals were sometimes distributed over what were obviously surfaces of inner crystalline forms of exactly the same shape as the entire crystal, from which the author drew inferences as to the original growing of the crystal.

CURIOUS EXAMPLE OF CRYSTALLIZATION.

At the British Association, some curious crystals were exhibited by Mr. J. Pearsoll, which were obtained while searching the coast of Africa, between Saldanha Bay and the island of Ichaboe, for guano deposits. The crystals are of carbonate of lime, inclosing sand; 15 to 20 per cent. of sand is obtained from some specimens. The crystals are very hard, and have sharp cutting edges, so as to make it a painful task to walk upon them. The beach was covered with crystals to the extent of miles; and was from one-half to one mile in breadth. Some of the specimens are from four to five inches in length, and with surfaces showing a thickness of half an inch, and from two to three inches across the plane. The report given was that some of the crystals protruded up from the sands so far as to wound the ankles and legs without great care in walking over them. Some crystals seem to be opaque, with the sand inclosed except at the edges. Carbonate of lime and magnesia, with small quantities of saline matter, common salt principally, can be obtained by breaking them up in distilled water. They are entirely soluble in diluted nitric acid. Mineralogists and chemists are perfectly well aware of the stony substance called Fontainebleau sandstone, in which the sandstone is found having forms of crystals of carbonate of lime. The crystals exhibited show the grains of sand of the beach inclosed, without altering the general form, and also that the crystal has, at its base, adapted itself to the sand and other crystals.

ARTIFICIAL FORMATION OF MINERALS BY IGNEOUS ACTION.

Prof. Hausmann, of Gottingen, has recently published a memoir on the formation of minerals in and about furnaces by furnace action. He enumerates the following varieties observed by him: Silver, lead, copper, iron, bismuth, lead-glance, blende, oxide of zinc, red-copper ore, iron-glance, magnetic iron ore, crysolite, pyroxene containing alumina, Humboldtite, orthoclase, lead-vitriol, and arseniate of nickel. Brown, yellow, green, and black blende were observed formed in the furnaces of the Lauten valley, Hartz, in regular octahedrons and dodecahedrons; also in lamellar and radiated concretions. Lead-glance, he informs us, is often formed by sublimations in the chimneys of furnaces, and the crystals are cubical with the usual cleavage; and crystals of magnetic iron sometimes incrust cavities in the stone or brick-work of the furnaces.

EXPERIMENTS UPON THE FORMATION OF MINERALS IN THE HUMID WAY IN METALLIFEROUS REPOSITORIES.

The following communication has been read before the French Academy, by M. de Sanarmont.

Geology has means of investigation which are peculiar to itself, and now comprehend a certain number of special truths definitely acquired to science. It is thus that geoleogy has been able, without foreign aid, to characterize the manner of the formation of the sedimentary rocks, and to arrange them in series; it is thus that it has succeeded in distinguishing in crystalline rocks, and in metalliferous repositories different classes of which it can assign the probable origin; and in so far as it has not drawn conclusions too far removed from its fundamental principles, its anticipations have been almost always confirmed by experiment. It is to mineralogical chemistry that geology owes the useful experimental control of its rational conceptions. Crystalline minerals have, in fact, a complete chemical origin; and a more thorough study and knowledge of them must be advanced by chemical experiment.

Chemistry, then, can do much for geology by lending its means for experiment; but upon the condition of itself remaining purely geological, and of borrowing in its turn particular means of study, and the general data which the science *a priori* has collected upon all the conditional peculiarities of structure, relative position, association, or mutual exclusion, to which certain mineral species must needs be subject. In a word, it is necessary that all the circumstances where the natural operation has left characteristic traces, discovered by the geologist, should reappear in the artificial operation of the chemist.

The experiments, then, of mineralogical synthesis should embrace the different groups of mineral species which are united in nature, and should support themselves upon certain probable geological inductions concerning the formation of the beds which they inclose. Certain isolated species have already been obtained, and principally those which approximate to the usual products according to the dry method. I have attempted to do more, and to discover some indices of the general causes which have originated the different classes of metalliferous beds. I commence this problem by the study of the concretionary veins which approach most nearly to the existing formations, and the principles I have just explained have been the starting point of the researches I am about to submit to the Academy.

The concretionary repositories seemed to be formed by solution;

the mineral species we there find would then be the products of the humid method, derived from liquid deposits, and to a certain extent may be compared to geysers and thermal springs. Moreover, the principles most generally prevalent, even at the present day, in these springs, are the carbonic and hydrosulphuric acids, the alkaline salts, and amongst others the carbonates and the sulphates; these then are the reagents I propose first to employ. But amongst the different influences which may modify in the subterranean canals, the usual chemical reactions, we must undoubtedly reckon first pressure, and a temperature increasing indefinitely with the depth; and I have endeavored to realize this double experimental condition. It is very evident that this creates numerous difficulties; and we must not be surprised if the crystalline state of the products thus formed is sometimes imperfect, and always microscopic. Besides, it is not the size of the crystals which results from such problems, it is the mere fact of their creation; and in order to obtain more, all that is required, is time, space, and rest — powerful means which belong to nature alone.

The method I have pursued essentially consists in producing all the chemical reactions *in a liquid condition*, and in glass tubes, hermetically sealed, heated from 100° to 350° C. I have almost solely employed solutions of carbonic and hydrosulphuric gases, of bicarbonates and alkaline sulphurs, alone or mixed in variable proportions; I have, then, I repeat, as a starting point, the composition of mineral waters. and their most energetic principles. By these means of procedure I have artificially formed a great number of natural compounds. Each family of minerals generally group themselves around a common generating agent; so that we might then classify them thus in relation to the presumed composition of the thermal depositions which have served to produce them. I do not wish to make this approximation too absolutely; as it appears to me to go beyond the immediate interpretation of the facts; and I shall limit myself here to the mention of the compounds which I have obtained, and the different classes of minerals to which they belong.

Native Metals. — Copper and silver, mixed but not combined, as observed in certain mineral repositories in North America. Native arsenic.

Oxides. — Red iron ore $Fe^2 O^3$. Quartz $Si O^3$, in regular six sided prisms, acuminated with six planes, with striæ, and sometimes with unequally-developed acuminating planes, so frequent in natural crystals. Red copper ore, or red oxide of copper, in red shining translucent octahedrons.

Carbonates. — Carbònates of magnesia, of iron, of manganese, of cobalt, of nickel, of zinc, of copper or malachite.

Sulphates. — Sulphate of baryta, in the primitive form.

Sulphurates. — Realgar, in transparent crystals, with the colors, lustre and form, as in mineral veins. Sulphuret of antimony, in acicular, shining, metallic-looking crystals. Sulphuret of bismuth with similar characters as the preceding. Sulphurets of iron, of manganese, of cobalt, of nickel, of zinc, of copper. These last mentioned are massive, as is the case with those prepared in our laboratories; but it appears that the hydro-sulphuric acid, under certain conditions of temperature and pressure, is a solvent of sulphurets, and a general agent of crystallization. The properties of this acid explain the accumulation of metallic sulphurets in the deep parts of mineral repositories, and of metallic carbonates near their crop, or outgoings. Arsinio sulphurets and antimonio sulphurets were also formed.

Conclusions. — I had proposed to establish, upon experimental proofs, the controverted, and, as I think, very probable opinion, which attributes the filling up of the concretionary veins to incrusting thermal depositions, and to show that the formation of a great number of minerals which we there meet, whether they be crystallized or amorphous, do not always pre-suppose conditions or agents far removed from the actual existing causes. We thus, in fact, perceive that the two principal elements of the most widely-extended thermal springs, the sulphurets and the alkaline bi-carbonates, have sufficed to produce twenty-nine distinct mineral species, almost all crystallized, belonging to all the great families of the chemical compounds peculiar to concretionary beds, each of which has some representatives in my experiments. Means of synthesis equally simple, applicable however to compounds as variable, give certainly a great probability to the speculative ideas which have directed me in these researches. It will moreover be necessary to diversify them to a much greater extent, and when we shall in the same manner have studied the different chemical agents, and the influences of every kind which can modify their effects, we shall undoubtedly succeed in defining the probable condition of the formation peculiar to each class of metalliferous beds; and in tracing their origin step by step, in the same order of systematic experiments, we may finally arrive at the crystallized rocks which associate themselves to these beds by methods and phenomena of continuity which it is impossible to mistake.

ON THE PRODUCTION OF GOLD IN THE BRITISH ISLANDS.

In a communication on the above subject presented to the British Association, by Mr. J. Calvert, it was stated that gold was found in forty counties in these islands, and over an area of 50,000 square miles. He thus classified the gold regions: — The West of England, North Welsh, Mid-England, Northumbrian, Lowland, Highland, Ulster, and Leinster. In Cornwall, the tin-streams, which were of the same composition as gold diggings, had long been known to contain nuggets and coarse dust, or hops of gold, but had only been slightly worked by Sir Christopher Hawkins, at Ladoch. The largest Cornish nugget was not worth more than about ten guineas. The Cornish districts were very rich in gold. The Dartmoor district contained gold in its northern and southern streams. A miner, named Wellington, got about 40*l.* worth of gold, at Sheepston, and Mr. Calvert had obtained gold from the granite by this process. In the West Somerset were four companies for working gold ores. From 55 tons of Poltimore ores, 102 ounces of gold were lately reduced, being at the rate of 16 dwts. per ton, or twice the rate of the St. John del Rey ores. The South of Scotland district had only been worked for its river deposits in Clydesdale and Nithsdale, but in his (the lecturer's) opinion it extended throughout the lowlands. Gold was found in above forty brooks or gullies, and all of the miners have gold for sale, obtained in their holiday excursions. Mr. Calvert mentioned that in the manuscripts of Queen Elizabeth's time the diggers relied on keele, a reddish earth, as an indication of gold, and the miners do now. He has seen it also in Westmoreland, and had recognized it also in Australia and elsewhere. At one place the miners, two years ago, got gold, which at Glasgow they sold for 42*l*. The Highland gold regions were unexamined. Gold localities had been reported in Aberdeenshire and Sutherlandshire. The Wicklow diggings were only shortly referred to. It appeared, by returns obtained from the Dublin goldsmiths, that the present supply of the peasantry was about 2,000*l*. a year. In Ulster the peasantry work the aura or gold mountains in Antrimshire; and the Mayola streams in Londonderry yielded gold. The yearly produce of gold in these islands was now abont 5,000*l*. a year, which might be largely increased. The number of gold bearing streams known was one hundred. Gold had been found in nearly all the clay-slate districts. Many of these were worked in the Middle Ages, and probably also by the Romans. Gold, in ores, was found associated with silver, lead, copper, iron, and zinc; with quartz, granite, slate, oxide of iron, sulphate of iron. These ores have only been worked of late in Devonshire and Merionethshire. The washing of gold-stuff in our home districts was very rude, and not equal to that in Australia, nor had there been for a long time any deep workings. Many rich gold ores were thrown away, and much metal was produced from which the gold was not refined. The only two gold-fields which had yet been worked had yielded considerable amounts. The Lanarkshire district from a quarter of a million to half a million, the Wicklow above 100,000*l*. The largest known nuggets were 3lb. from Lanarkshire, and others of $2\frac{1}{2}$ lb. from there and Wicklow. Mr. Calvert concluded by stating that he considered the clay-slate formations of Canada would soon be discovered to be a vast gold-field.

ON THE COMPARATIVE RICHNESS OF AURIFEROUS QUARTZ AT DIFFERENT DEPTHS OF THE SAME VEIN.

At the British Association, Dr. J. H. Blake stated that no shaft had yet been made in California deep enough to test the correctness of the opinion that auriferous lodes diminish in value as they descend, but he described a circumstance which seemed to confirm that view. A horizontal mass of auriferous quartz was discovered in Grass Valley, which measured 60 yards by 45, and was from 6 to 18 inches thick; in the centre it was depressed 10 yards below the surface, its edges cropping out all round. Every part of this mass had been removed, and was found to contain 1 oz. or $1\frac{1}{4}$ oz. of gold to the ton; one part was extremely rich, affording 60 oz. to the ton. No continuation of this quartz vein could be found in the valley or surrounding hills, but at some distance above a similar vein occurred in which the proportion of gold was much smaller. In another locality a more than average amount of gold had been obtained from a lode which appeared to have been the upper part of a vein. The writer had never heard of "nuggets" being found in mining operations.

Mr. Strickland stated, that it was a popular opinion with the Siberian miners that auriferous veins were richest near the surface; but this was not the case with other metals, nor had any reason been assigned for the belief. The materials in mineral veins had been deposited by chemical action from water flowing through them, and probably rising up from great internal depths. He suggested, that the diminution of temperature or of pressure near the surface might have caused a greater deposition of gold in the upper part of the veins.

Prof. Harkness remarked, that lead veins in Scotland were as rich low down as in the upper part.

GOLD DISCOVERIES.

Gold has been found in considerable quantities in Arkansas, on the banks of the Ouachita river. Gold in small quantities has been found in the valleys, on the hill-tops, and indeed almost everywhere where search has been made. Scarcely a rock can be found that does not contain some sign of gold.

Gold in Maine. — During the past year, gold has been obtained in the towns of Madrid and Salem, Maine, on a small stream, known as the Sandy river. The amount which a man is able to obtain in a day, averages from one to three dollars in value. The gold is found in fine black sand, in pieces ranging from the size of a wheat kernel to the smallest perceptible particles; though pieces are said to have been found as large as a kernel of corn.

Gold in Vermont. — Rev. Zadock Thompson gives the following account of the gold deposits in the town of Bridgewater, Vermont. He says: "The gold is found in the range of talcose slate and steatite, which is known to extend through the entire length of the State, from north to south. This range passes through Bridgewater near the middle, and the gold locality is but a short distance from the center of the township, towards the southwest. The gold is disseminated very sparingly in veins or seams of quartz, and is associated with the sulphurets of lead, iron and copper. The strata of slate, between which the quartz is interspersed, dip some 55 degrees towards the east, and the seams of quartz vary much in thickness, and are somewhat irregular. Gold has yet been found in only a few of these seams, and most of which has been obtained was from a single seam, in which several hands are now at work. This is from ten to twenty inches wide, and some portions of it are filled very abundantly with galena, or sulphuret of lead. At a blast made in this seam while I was present, more than one hundred pounds of pure galena were thrown out with the quartz, together with some sulphuret of iron, and a very few small particles of gold: but whether gold or lead will here be found in sufficient quantities to pay for working, is yet problematical."

Gold in Australia.—The actual production of the precious metal of this new and wonderful gold field has thus far proved fully up to the wildest calculations entered into in 1852. The ascertained yield of the Melbourne mines to the 31st July, amounted to 53 tons weight, or in exact Federal value, to $25,312,800! And at the Sydney mines to $12,500,000.. A further sum of $5,000,000 is set down to Adelaide, South Australia, though thence taken, for the most part, by miners from the Melbourne district. The aggregate, therefore, stands thus:—

At Melbourne	53 tons	....	$25,312,800
At Sydney	26 "	....	12,500,000
At Adelaide	11 "	....	5,000,000
Grand total	90 "	....	$42,812,800

As considerable interest is felt at the present time concerning the diffusion of gold over the earth's surface, it may be interesting to our readers to be informed of the results of an investigation of that subject, which is now being carried on at the Government School of Mines. So far as that investigation has extended, Prof. Piercy states, that a sensible and visible amount of gold has been extracted from every variety of British and foreign lead, as well as every specimen of litharge, minium, white-lead, and acetate of lead, which have been examined. It has also been extracted in very sensible proportion from commercial bismuth. Between thirty and forty determinations have already been made.

EARTHQUAKE INDICATOR.

M. Ratio-Menton, a gentleman connected with the French diplomatic corps in the Argentine Republic, has recently communicated to the Paris Academy of Sciences, by a letter addressed to the French Minister of Foreign Affairs, a sure means of learning the approach of an earthquake. According to this gentleman, the earthquake indicator is nothing more than a magnet, to which is suspended, by magnetic attraction, a little fragment of iron. Shortly before the occurrence of an earthquake, the magnet temporarily loses its power, and hence the iron falls. According to M. Ratio-Menton, the accuracy of this indicative sign has been thouroughly tested by a highly educated Argentine officer, Colonel Epinosa, during a residence of many years at Arequipa, a region where earthquakes are very frequent. Independently of the authority of the communication, arising from the respectability of the communicator, and from its being published in the transactions of the French Academy of Sciences, the result is nothing more than might have been suspected from theoretical considerations of the alliance between electricity and magnetism. A disturbance of electric power has long been known to be associated with earthquakes.

EARTHQUAKES IN 1853.

The following memoranda of earthquakes have been made since November 2d, 1852.

Nov, 2. Shock of earthquake at Richmond, Petersburg, and Scottsville, Va., at 6 35, P. M.

6. Shock of earthquake at Santiago de Cuba, in the night.

8. Two shocks of earthquake at Reggio, Sicily, in the morning.

9. Shock of earthquake at Liverpool, England, and suburbs, including Manchester 31 miles distant—its greatest force was along the river and particularly at Bootle—at 4,30, A. M.; also over a large portion of Ireland.

10. Earthquake shocks and seaquakes at Amboyna, E. I.

16. Shock of earthquake at Banda Neiro, and other islands of the E. I., at 7 40, A. M.; and at 8, A. M., a seaquake.

17. Shock of earthquake at Lima, S. A.

19. Shock of earthquake at Valparaiso, S. A.

23. Shock of earthquake in California, accompanied with thunder and lightning and the bursting of a lake, a little before midnight.

24. Shock of earthquake at Lake Merced, Cal., and the waters partially discharged through a fracture supposed to be caused by the earthquake.

25. Severe shock of earthquake at Port au Prince in the night.

26. Shocks of earthquake at St. Jago de Cuba, at 3 25, A. M., at 4, and 7, A. M., at 2 25, P. M., followed by cholera, small pox and fever. Shock at Jamaica; severe shock at Port au Prince. Earth and seaquakes at Ceram and Amboyna about 8 30, A. M.: about Ternate and Caebrian at 8, A. M.

27. Smart shock of earthquake at Salem, Mass., about 11, P. M.; at Exeter, N. H., shaking houses and chimneys; an explosion and roar heard at Newburyport, Mass., and along the valley of the Merrimac, at 11 45, P. M.; at Beverly, Woburn, Groton, and Wenham, Mass., and Danvers, Amesbury, Topsfield, Hamilton, Ipswich and Portsmouth: at Lima, S. A.; also at sea, at 7, A. M.

29. Earthquake at San Diego, Cal.; Fort Yuma, Cal., at 12 20, followed by more than a dozen shocks in the course of a day or two at Campo Yuba, on the Gila, Cal., at 12, P. M., and during the rest of the day and evening more than a dozen slight shocks were felt. Also on the Colorado River, Mexico; a vessel on the sea at one time being high and dry; the earth thrown up and banks thrown down.

Dec. 4. Earthquake at Acapulco, S. A., the first shock about 10 20, P. M.

5. Shock of earthquake every hour or so at Acapulco, S. A.—Shock about 11, P. M., at Campo Yuma, on the Gila, Cal.

Dec. 6, 7, 8, 9. Shocks of earthquake every hour or so, at Acapulco, S. A.

10. Two slight shocks of earthquake at Kingston, Jamaica, in A. M.

15. Shock of an earthquake at Carlton, Orleans Co., N. Y., at 4, P. M.

16. Shock of earthquake at Shanghae, China, in the evening, equally violent as the shock of August, 1846.

18. Shock of an earthquake at Acapulco.

20. Shock of an earthquake at Batavia and Buitzenzong, Krawang, Magelang, Bantam, Banyamaas, Tagal and Pekalong, and in the Lampong District.

21. Heavy shock of earthquake at Batavia, Java, E. I. Shock at sea, lat. 48° S., lon. 105° 15′ E., lasted for two minutes.

26. Shock of earthquake at Los Angelos, Cal.

28. Two slight shocks of earthquake at Holguin, Cuba.

Jan. 5, 1853. Violent earthquake at Fox and Bayonne, in the Pyrenees; a few hours after, a snow storm covered the whole country with snow.

7. Three shocks of earthquake at Conception, Chili, accompanied by loud noises and suffocating heat.

8. Shock of earthquake at Milledgeville, Ga. at 8 40, P. M.

11. Slight shocks of earthquake at Santiago, Cuba.

12. Two shocks of earthquake at Fayal, Azores, in the night—one quite heavy.

15. Two violent shocks of earthquake in the Parishes of Ardora and Vadersvil, Sweden, accompanied by violent thunder shocks.—They were also felt at Jeutisoe and Delebo, Sweden.

21. Slight shocks of earthquake at St. Kitts, W. I.

25. Slight shock of earthquake at St. Jago de Cuba.

26. Slight shocks of earthquake at St. Jago de Cuba.

29. Shock of earthquake at Santa Barbara.

30. Shock of earthquake at Woodstock, Va.

Feb. 1. Slight shock of earthquake at St. Jago de Cuba.

9. Two shocks of earthquake at the city of Guatemala.

10. Severe shock of earthquake at Belize, Honduras.

March 12. Shock of earthquake at Watertown, Jefferson County, N. Y., and vicinity, at 2 10, A. M.; at Lowville, Lewis County, attended by a loud explosion; at Copenhagen and Martinsburg, Lewis County, N. Y., at 2 30, A. M.

13. Shock of earthquake at St. Catharine's and Niagara at 5, A. M.; four shocks at Grimsby, Jordon, Thorold, the Falls, Queenston; also Fort Mississangua, all Canada; at Lewiston, Niagara Co., about 5, A. M.

16. Shock of earthquake on Salt Plains, at Iquique, Peru, S. A.

27. Slight shock of earthquake at Brecon, Wales, at 11½, P. M.

Feb. 3. Shocks in Sweden and various parts of Norway.

10. At Belisle, and throughout the month shocks were frequent in Central America.

March 12. Watertown, N. Y.

29. At sea, noticed by U. S. ship Portsmouth, lat. 8° 10′, lon. 84° 4′.

April 9. At Naples and vicinity.

14, 15, 17, 23. At Shanghae, China, the last an earthquake of great violence.

May 2. At sea, lat. 14° 12′ S., lon. 75° E.; shock very heavy, and lasting from 30 to 40 seconds.

2. In Western Pennsylvania and New York.
3. Great earthquake of Shiraz, Persia.
5. Western Pennsylvania.
27, 28. At the Canary Islands.
June 2. At Acapulco.
17. Portland, Maine.
20. do. do.
Aug. During the month earthquakes were frequent in Guatemala.
17. At New Bedford, Mass.
18. Throughout Greece.
23. At Athens and Thebes, Greece.
Sept. 11. At Port au Prince ; at New Orleans and the Gulf Coast.
30. Throughout Greece and European Turkey.
Oct. 2. At Kingston, Jamaica.
4. At sea 200 miles west of the island of Java.
7. At Athens, Greece.
23. In Oregon and the Northwest Coast of America.

Throughout the month of October, earthquakes were frequent in the Crimea, accompanied with frequent volcanic eruptions.

Nov. 8. At St. Jago de Cuba.
18, 21. At San Francisco and San Jose.

A terrible earthquake destroyed the city of Shiraz, Persia, on the 3d of May, 15,000 perishing in the ruins. This earthquake dried up the river Zsianderood, upon which the town of Ispahan depended for its supply of water. This calamity was followed by a flight of locusts, which, in a few hours, destroyed vegetation ; and following these, was an inundation which did great damage ;—and with all this, the cholera morbus set in at Teheran, carrying off 150 persons daily. On the 2d of May, shocks of earthquake were felt at Washington City, on the Potomac ; Lynchburg, Va., on the James River ; Wheeling, Va., on the Ohio River, and at Zanesville, Ohio, on the banks of the Muskingum River. The difference in longitude is about equal to the difference in clock-time between Shiraz and Washington. The earthquake was, therefore, simultaneous in both hemispheres. On the 4th of May, a severe earthquake was experienced in the island of Antigua ; and on the 5th, a shock was felt at Newcastle, Pa.

Since November 21st, 1852, up to August 1853, there were thirty-two shocks of an earthquake within the limits of California. The effects of these continued shocks have been confined principally to the southern section of the State, and have, therefore, excited but little attention, although entitled to much more than has been elicited. The effects on the desert have been considerable ; so much so that the waters of the New River, the Big Lagoon, and other waters, which made their appearance on the surface in 1848 and1849, have now disappeared, and in their places volumes of sulphurous and effervescent sulphur have appeared.

FREQUENCY OF EARTHQUAKES.

A correspondent of the New York Courier, who keeps hourly thermometrical observations, says, that earthquakes produce changes in the atmosphere that rests upon the earth, and exert an influence upon it to a greater and wider extent than persons who are not in the habit of observing the phenomena in connexion with atmospheric changes have generally supposed.

"Within the field of our research, during a period of fifteen months, commencing with January, 1852, and ending with March, 1853, (four hundred and fifty-five consecutive days,) we have recorded earthquakes that have been active on one hundred and seventeen of these days, on each of which the place and places where the earthquakes were felt are particularly stated, and the day of the month also. In addition to these thus particularly specified, we have recorded many earthquakes during the same fifteen months; the places where they were felt are stated, but the day of the month could not be ascertained from the published accounts; and others also, in considerable numbers, where neither the day of the month nor the month of the year is mentioned, but which were within the said fifteen months.

"The field of our research embraces but a small portion of the globe. Large districts of our earth are uninhabited, and of the inhabited districts there are many where there are no intelligent minds to observe and make record of the phenomena, and others where there are no newspapers to convey intelligence.

"The conclusion we have arrived at from these observations, made without any interruption for a series of years, is that all the great and sudden changes of the temperature of the atmosphere are produced by the earth, and these changes affect those who breathe it both physically and mentally, to a greater or lesser extent."

ON THE DISCOVERY OF FOSSIL REPTILIAN REMAINS, AND A LAND-SHELL IN THE INTERIOR OF AN ERECT FOSSIL TREE IN THE COAL MEASURES OF NOVA SCOTIA.

The following is an abstract of a lecture by Sir Charles Lyell on the above subject, before the Royal Institution of Great Britain.

The entire thickness of the carboniferous strata, exhibited in one uninterrupted section on the shores of the Bay of Fundy, in Nova Scotia, at a place called the South Joggins and its neighborhood, was ascertained by Mr. Logan to be 14,570 feet. The middle part of this vast series of strata, having a thickness of 1400 feet, abounds in fossil forests of erect trees, together with root-beds and thin seams of coal. These coal-bearing strata were examined in detail by Mr. J. W. Dawson of Pictou, and Sir C. Lyell, in September last (1852) and among other results of their investigations, they obtained satisfactory proof that several sigillariæ, standing in an upright position, or at right angles to the planes of stratification, were provided with stigmariæ as roots. Such a relation between sigillariæ and stigmariæ had, it is true, been already established by Mr. Binney of Manchester, and had been suspected some years before on botanical grounds by M. Adolphe Brongniart; but as the fact was still doubted by some geologists both in Europe and America, it was thought desirable to dig out of the cliffs, and expose to view, several large trunks with their roots attached. These were observed to bifurcate several times, and to send out rootlets in all directions into the clays or ancient soils in which they had grown. Such soils or underclays with stigmariæ afford more conclusive evidence of ancient terrestrial surfaces than even erect trees, as the latter might be conceived to have been drifted and fixed like snags in a river's bed. In the strata 14,000 feet thick, above mentioned, root-bearing soils were observed at sixty-eight different levels; and, like the seams of coal which usually cover them, they are at present the most destructible masses in the whole cliff, the sandstones and laminated shales being harder and more capable of resisting the action of the waves and the weather. Originally the reverse was doubtless true; for in the existing delta of the Mississippi, the clays in which innumerable roots of swamp trees, such as the deciduous cypress, ramify in all directions, are seen to withstand far more effectually the excavating power of the river or of the sea at the base of the delta, than do beds of loose sand or layers of mud not supporting trees. This fact may explain why seams of coal have so often escaped denudation, and have remained continuous over wide areas, since the roots, now turned to coal, which once traversed them would enable them to resist a current of water, whilst other members of the coal formation, when in their original and unconsolidated state consisting of sand and mud, would be readily removed. The upright trees usually inclose in their interior pillars of sandstone or shale, or both these substances alternating, and these do not correspond in the thickness of their layers, or in their organic remains, with the external strata, or those enveloping the trunks. It is clear, therefore, that the trees were reduced while yet standing to hollow cylinders of mere bark, (now changed to coal) into which the leaves of ferns and other plants, with fragments of stems and roots, were drifted, together with mud and sand, during river inundations. The stony contents of one of these trees, nine feet high and twenty-two inches in diameter, on being examined by Messrs. Dawson and Lyell, yielded, besides numerous fossil plants, some bones and teeth which they believed were referable to a reptile; but not being competent to decide that osteological question, they submitted the specimens to Dr. Wyman, of Harvard University. That eminent anatomist declared them to be allied in structure to certain *perennibranchiate batrachians* of the genera *Menobranchus* and *Menopoma*, species of which now inhabit the lakes and rivers of North America. This determination was afterwards confirmed by Professor Owen, of London, who pointed out the resemblance of some of the associated flat and sculptured bones, with the cranial plates, seen in the skull of the *Archegosaurus* and *Labyrinthodon*. In the same dark-colored rock, Dr. Wyman detected a series of nine vertebræ, which from their form and transverse processes he regards as dorsal, and believes them to have belonged to an adult individual of a much smaller species, about six inches long, whereas the jaws and bones before mentioned are those of a creature probably two and a half feet in length. The microscopic structure of these small vertebræ was found by Professor Quekett to exhibit the same marked reptilian characters as that of the larger bones. The fossil remains in question were scattered about the interior of the trunk near its base among fragments of wood, now converted into charcoal, which may have fallen in while the tree was rotting away, having been afterwards cemented together by mud and sand stained black by carbonaceous matter. Whether the reptile crept into the hollow tree while its top was still open to the air, or whether it was washed in with mud during a flood, or in whatever other manner it entered, must be matter of conjecture. Foot-prints of two reptiles of different sizes have been observed by Dr. Harding and Dr. Gesner, on ripple-marked flags of the lower coal measures in Nova Scotia, evidently made by quadrupeds walking on the beach, or out of the water, just as the recent *Menopoma* is sometimes observed to do. Other reptilian foot-prints of much larger size had been previously noticed (as early as 1844) in the coal of Pennsylvania, by Dr. King; and in Europe three or four instances of skeletons of the same class of animals have been obtained, but the present is the first example of any of their bones having been met with in America in rocks of higher antiquity than the Trias. It is hoped, however, that other instances will soon come to light, when the contents of upright trees, so abundant in Nova Scotia, have been systematically explored; for in such situations the probability of discovering ancient air-breathing creatures seems greater than in ordinary subaqueous deposits. Nevertheless we must not indulge too sanguine expectations on this head, when we recollect that no fossil vertebrata of a higher grade than fishes, nor any land-shells, have as yet been met with in the Oolitic coal-field of the James River, near Richmond, Virginia; a coal-field which has been worked extensively for three quarters of a century. The coal alluded to is bituminous, and as a fuel resembles the best of the ancient coal of Nova Scotia and Great Britain. The associated strata of sandstone and shale contain prostrate zamites and ferns, and erect calamites and equiseta, which last evidently remain in the position where they grew in mud and sand. Whether the age of these beds be Oolitic, as Messrs. W. Rogers and Lyell have concluded, or Upper Triassic, as some other geologists suspect, they still belong clearly to an epoch when saurians and other reptiles flourished abundantly in Europe; and they therefore prove that the preservation of ancient terrestrial surfaces, even in secondary rocks, does not imply, as we might have anticipated, conditions the most favorable to our finding therein creatures of a higher organization than fishes. In breaking up the rock in which the reptilian bones were entombed, a small fossil body resembling a land-shell of the genus *Pupa* was detected. As such it was recognised by Dr. Gould, of Boston, and afterwards by M. Deshayes, of Paris; both of whom carefully examined its form and striation. When parts of the surface were subsequently magnified 250 diameters, by Professor Quekett, of the College of Surgeons, they were seen to exhibit ridges and grooves undistinguishable from those belonging to the striation of living species of land-shells. The internal tissue also of the shell displayed, under the microscope, the same prismatic and tubular arrangements which characterize the shells of living mollusca. Sections also of the same showed what may be part of the columella and spiral whorls, somewhat broken and distorted by pressure and crystallization. The genus cannot be made out, as the mouth is wanting. If referable to a pupa, or any allied genus, it is the first example of a pulminiferous mollusk hitherto detected in a primary, or palæzoic rock.

BOTANY.

STATISTICS OF THE AMERICAN COTTON CROP FOR 1852–53.

The total growth of the cotton crop of 1852–53, is estimated at 3,262,882 bales, against 3,015,029 of the previous year. Of this there is assigned to the several districts, after making proper deductions for receipts from and shipments to the neighbouring districts, the following :

Districts.	1852-3.	1851-2.
New Orleans,	1,580,875	1,373,464
Alabama,	545,029	549,449
Texas,	87,790	64,052
Florida,	179,476	188,499
Georgia,	349,490	325,714
South Carolina,	463,023	476,614
North Carolina,	23,496	16,242
Virginia,	25,783	20,820
Overland to Eastern Cities,	9,740	175
Total crop in United States,	3,262,882	3,015,029

Increase over 1851-'52,	247,853
Increase over 1850-'51,	907,625

The comparative product of the United States, by decades, since 1824, is as follows :—

1824	569,249 bales	1844	2,394,503 bales
1834	1,254,328 "	1852	3,262,882 "

The annual quantity of cotton consumed and in the hands of manufacturers, *north* of Virginia, for the past 26 years, is as follows :—

	Bales.		Bales.
1852–53	671,099	1838–39	276,018
1851–52	603,029	1837–38	246,063
1850–51	404,108	1836–37	222,540
1849–50	487,769	1835–36	236,733
1848–49	518,039	1834–35	216,888
1847–48	531,772	1833–34	196,413
1846–47	427,967	1832–33	194,412
1845–46	422,597	1831–32	173,800
1844–45	389,006	1830–31	182,142
1843–44	346,744	1829–30	126,512
1842–43	325,129	1828–29	118,853
1841–42	267,850	1827–28	120,593
1840–41	297,288	1826–27	149,516
1839–40	295,193		

The comparative quantity manufactured in 1852–3, and in 1851–2, *south* of Virginia, is as follows :—

	1853.		1852.	
North Carolina, . .	20,000	....	15,000	bales, of 400 lbs.
South Carolina, . .	10,000	....	10,000	" " "
Georgia, ...	20,000	....	22,000	" " "
Alabama, . . .	5,000	....	5,000	" " 500 lbs.
Tennessee, . . .	5,000	....	7,000	" " "
On the Ohio, &c., . .	30,000	....	16,000	" " "
Total to Sept. 1,	90,000	....	75,000	bales.

	Bales.		Bales.
Total to Sept. 1, '51, .	60,000	Total to Sept. 1, '49, .	110,000
Total to Sept. 1, '50, .	107,500	Total to Sept. 1, '48, .	75,000

To which, if we add the stocks in the interior towns, &c., the quantity burnt in the interior, and that lost on its way to market, to the crop as given above, received at the shipping ports, the aggregate will show very nearly the amount raised in the United States the past season — say, in round numbers, 3,360,000 bales, against 3,100,000 for the year 1851–52, and 2,450,000 for the year before.

The amount of cotton exported to foreign ports, during the years 1852 and '53, ending Sept, 1st, was as follows : 1852, 2,443,103 bales; 1853, 2,526,545 bales; increase, 83,442. The amount of cotton burnt by fires in the Atlantic towns and cities for 1852, was 6,025 bales; for 1853, 20,861 bales.

CURIOUS FRESH WATER PLANT.

A recent number of the Edinburgh Journal contains a description of a new and singular fresh water plant, which has recently appeared in the inland waters of Great Britain, filling her canals, lakes, and streams, and threatening, unless a remedy be speedily discovered, to interfere seriously with, perhaps to destroy, all or most of her facilities for inland navigation and drainage. This terrible foe is a species of aquatic weed, the first specimen of which was discovered in the year 1842, in the lake of Dunse Castle, Berwickshire, Scotland. The appearance of the little vegetable stranger excited considerable interest among botanists, and the discovery was duly noted in various scientific publications; specimens were sent to a few individuals, and then—it was forgotten. But the plant was of too aspiring a character to live and blush unseen in British waters. In 1847, it was found growing in great abundance, and closely matted together, in the reservoir adjoining the Foxton Locks, on the canal in Leicestershire. This discovery induced a re-examination of the original plant, when it was found that the long neglected water-weed had travelled out of the lake, and was making its way down the Whiteadder to join the Tweed. In the same season it was found in great profusion in a tributary of the Trent, in Nottinghamshire, and it was also discovered to exist in " dense masses, and great abundance" in the Watford Locks, Northamptonshire. In 1849, it appeared in Derbyshire and Staffordshire, "forming very large submerged masses of a striking appearance," in the Trent and adjoining canals. In 1850, it was found near Rugby, in Warwickshire; and in 1851, it was discovered in the rivers Ouse and Cam, near Cambridge.

The botanical interest which was at first excited by the discovery of large quantities of this new plant in various districts, at nearly the same time, soon gave place to a feeling of serious alarm prompted by the injurious effects of its unparalleled increase. A year after it was first noticed in the Cam, the stream near the colleges was so blocked that extra horses were required to draw barges through the vegetable mass. A year after its appearance at Ely, the railway dock became so choked with the weed that boats could not enter until several tons of it had been removed. In many places fishermen were obliged to discontinue setting long lines, or using nets, because the weed either carried them away or stripped them of the fish. It is evident that this plant, styled by Mr. Babington, of Cambridge. the *anacharis alsinastrum*, cannot a great while have been a native of Great Britain. If so, its remarkable prolific powers would long since have brought it into notice. And it is a noteworthy fact that the anacharis is *diœcious* — that is, the male and female flowers grow on separate individuals — and all the plants known to exist in England are females. This fact affords an almost positive proof that only one stem or seed of a female plant was the progenitor of all the anacharis in Great Britain; and this seed was possibly introduced from Canada in the crevice of some one of the many logs which are annually conveyed across the ocean to England, and of which so many have been used in the great railroad works at or about Rugby. It is thought that in the clear, swift-flowing rivers of America, the weed would not form the immense masses which characterise its growth in the sluggish and — as they contain a greater amount of inorganic animal and vegetable matter — more nourishing waters of the English rivers and canals. But our readers will inquire how — as only the female anacharis has been discovered in England, and it is therefore unable to propagate seed in that country — how it contrives to extend itself so rapidly and widely, and wherein are its prolific powers vested. These questions are easily answered; its leaves, which grow in threes, around a slender stem, are studded with minute teeth, which cause them to cling to every object with which they come in contact, and the stems are so very brittle that whenever the plant is disturbed pieces are broken off; and as every fragment of the stem is capable of becoming an independent plant, producing roots and leaves, and extending itself indefinitely in every direction, it is evident that the anacharis must be in an almost continual state of reproduction. All the localities in which this singular plant seemed to appear almost simultaneously, are reducible to two — Dunse Lake in Berwickshire, and the Foxton Locks in Liecestershire. It probably originated in the Foxton Locks, and was afterwards introduced into the former place. The Foxton Locks are in direct communication with nearly all the English localities of the plant, and a single sprig of the anacharis would in a very short time inoculate any connected water system from one end to the other. The plant was introduced by scientific men into the Cam, and other places, originally for experimental purposes, and is of such a nature that, clinging to the bottoms of vessels or boats, it might easily inoculate other streams and waters.

In the case of the Cam, in the short space of four years, it multiplied so, from a single stem, as to impede both navigation and drainage. It has become a great and growing evil; and the attention of scientific men — of practical men — is loudly demanded to the subject of its extinction.

DYE-LICHENS.

In a paper lately read by Dr. Lindsay, before the Botanical Society of Edinburgh, on "the natural history of the lichens," there are several remarks on the commercial value of this widely-distributed class of plants well deserving publicity; it being highly probably that, were masters and supercargoes of ships aware of the value of these plants, which cover many a rocky coast and barren island, they might, with a slight expenditure of time and labor, bring home with them such a quantity of these insignificant-looking plants as would realise considerable sums, to the direct advantage of themselves and the ship-owners; and consequently to the advantage of the State. It is with the view of inciting those to whom the opportunity may offer of gathering a valuable article of commerce, the value of which they would little suspect from its external aspect, and of inducing the owners of vessels to direct the attention of their officers to this subject, that I subjoin some simple methods of detecting the varieties of lichens valuble as dye-stuffs, together with a slight outline of this paper, so far as it bears on the commercial aspect of the subject. Dr. Lindsay properly points out that it is not the lichens which themselves exhibit the most beautiful red and purple colors which yield the finest and most valuable dyes, but that the opposite rather obtains; since it is those which are devoid of any bright tint, the grey and ash-colored varieties, which yield the greatest amount and most valuable descriptions of dyes. In these varieties, of which orchil or orcella-weed of commerce, the *Rocella tinctoria* of botanists, and the *Lecanora tartarea* or cudbear are examples, the dyeing principles exist in the plant in a colorless state; nor do these mosses yield their beautiful tints until crushed and exposed to the combined influence of the atmosphere, water, and ammonia. To prove the frequency with which these lichens are met with, and the wide extent of latitude in which they grow, the author of this memoir points to an examination made by him of the raw vegetable products in the exhibition of 1851, amongst which he found specimens of good dye-lichens from almost every part of the world, including our own young colonies; and he cites a note, affixed to a specimen of orcella-weed from Socotra, "Abundant, but unknown as an article of use or commerce—also abundant on the hills around Aden, and might be made an article of trade." To show their value, he states their price to be 190*l*. to 380*l*. per ton, and that in times of scarcity the orcellas have sometimes fetched 1000*l*. per ton; whilst he remarks on the above-quoted note that he believes a similar statement might be made with respect to many islands in the Atlantic and Pacific, which probably abound in this vegetation, furnishing, like Ichaboe and other sources of guano, a hitherto unsuspected field of profitable trade. The great similarity of species in external form and appearance is a favorable element of successful research, since, whether natives of the Andes, of North America, New Holland, Africa, Madagascar, or the Himalayas, these tribes are similar if not identical with the European species. Of tests, to distinguish between the dyeing and the valueless lichens, Hellot's is the easiest and most certain, if not in every respect the best. Having previously dried and pulverized the lichen under examination, steep it in a weak solution of ammonia for several hours in a warm place, a temperature of 130° Fahr. being that recommended, stirring occasionally to expose fresh surfaces to the air, when, if the plant be a dyeing lichen, the solution will gradually acquire a purple red color, from the intensity and beauty of which, a comparative judgment of the commercial value of the orchil may be estimated. Stale urine may be substituted for the weak ammoniacal solution, should the latter be wanting. By the mutual action of the atmospheric oxygen and the ammonia, assisted by the heat and the moisture on the dyeing principles of these lichens, existing in the plant in a colorless state, new compounds are formed, in which the colorless dyeing principle is transformed into the beautiful purple-reds characteristic of the dye-lichens.

VEGETABLE IVORY.

Berthoed Seeman in his account of the voyage of the Herald, R. N., Capt. Kellett, recently published, has the following notice of the vegetable ivory nut of South America.

In Darien, on the banks of the river Cupica, vast groves of vegetable ivory, a species of the genus *Phytelephas*, probably distinct from that found on the Magdalena, were met with. The Darien kind is always collected in separate groves, growing gregariously and unmingled with other trees, or even herbs, the ground beneath these palms (or rather screw-palms) being as bare as if it had been swept. The flowers of both male and female trees are exceedingly odorous, emitting a scent like that of almond-essence, and attracting swarms of bees. The fruits are aggregated in heads, each plant bearing from six to eight of these masses of drupes at one time. On an average each head contains eighty seeds, and when ripe weighs about twenty-five pounds. No use is made of them, however, although they might be turned to excellent account, and we call the attention of speculators to this discovery as one of considerable commercial interest; the more so, since at present much attention is being directed towards the products and resources of Darien.

CAOUTCHOUC AND ITS SUPPLY.

The sources from whence the supply of caoutchouc to the United States has been derived, have until within a very recent period, been exclusively the northern and eastern districts of South America. Latterly, however, owing to the inadequacy of the supply from that quarter to meet the growing demand, a quantity has during the last two years been brought from Java, Penang, Singapore and Assam. Yet with all these additions to our sources of obtaining this useful article, it is apprehended that the market will shortly fail to offer enough to meet the growing demand at remunerative prices, as this gum, formerly so despised as not to be worth importation, has increased in value, within a few years, from 15 to 60 cents per pound—a price almost too high to render its manufacture remunerative, though it is difficult to obtain it, even at this enormous rate. This deficiency arises not from natural but solely from artificial causes, the interior of the countries to which this tree is indigenous, being for the most part inaccessible to our traders; were it otherwise, South America alone could assuredly supply all the wants of this Continent and Europe.

Though we are indebted to the East Indies and Carthagena, in New Grenada, for a portion of the india rubber gum we employ in manufacture, yet Para, in Brazil, is the place from which we derive our principal supply, and the following table, derived from the most reliable sources, will show the steady increase of the last six years. Our merchants imported from Para:

In 1848	666,000	In 1851	1,836,000
In 1849	805,000	In 1852	1,439,000
In 1850	1,310,000	In 1853	2,000,000

The latter being the estimated returns by the close of the present year. A decrease will be observed in the year 1852, but this was occasioned entirely by the deficiency of the supply from that quarter, large importations from England having brought the general entries slightly above those of any former year. Small shipments have latterly been made from East Indian ports, to the extent of about 100,000 lbs., during each of the last two years, but owing to the inferiority of the article to that of Para, it is but little in demand. Carthagena sent to the United States in 1852, 150,000 lbs., and this year it is supposed that not less than double that quantity will be derived from the same source.

THE COONTEE, OR FLORIDA ARROW ROOT.

A correspondent of the New York Tribune gives the following description of the Coontee, or Florida Arrow Root.

It is allied to the Sago palm, and a plant some three feet high, apparently thriving best in barren lands. The root contains 12 per cent. of pure starch, and has been used by the Indians, as an article of food, from time immemorial. This plant seems to have been created to grow in a certain portion of South Florida. The everglades are an immense basin, one hundred and fifty miles long, by about ninety miles wide, and bounded on the south and east by a ridge or rim of tertiary lime-stone; on the west, this basin stretches along the Gulf coast, from near Cape Sable to Carloosa Hatchee river; and on the north, the Lake Okeechobee is the limit, although in high water, the Kissimee valley is a continuation of the glades. The strip of land outside the glades, and bounded by the Gulf and the Atlantic, is fifteen miles in average width, covered with stunted yellow pine, and the soil thin and barren. The same barren uniformity characterizes this strip of land, with occasional hummocks, from Indian River to Cape Sable, and it is upon this barren strip that the *Coontee* grows in the greatest abundance. Without this valuable plant, this region would be entirely worthless; but with it, no other equal portion of land can be made more valuable—the only expense being in digging the roots and carrying them to the mill, as new plants shoot forth from every small piece left in the ground. This "Florida Arrow Root" has been made for sale in Florida, for the last ten years—at first only for medical purposes, but recently for manufacturing and household purposes. By facilitating the process of grinding and washing, its production would be greatly cheapened and improved.

Florida Paint Root.—This root grows in great abundance in the flat woods, near the streams, and in the savannahs of the counties of Levy, Marion, and South Florida. It has a top similar to the flag, and a root about the size of a man's thumb, of various lengths, running horizontal, not far below the surface. It is very juicy, and of a deep red color. Hogs are exceedingly fond of it, and fatten on it rapidly, if they are black, or have black hoofs. It is said by the old settlers that hogs with white hoofs seem to founder, and their hoofs come off, which causes them to perish unless fed well till they recover. Even when the animal has only one white hoof, and the others black, the white hoof comes off. The root colors the flesh, bones, and marrow, of hogs that feed upon it, and the urine becomes of the color of blood. There is no doubt this root may be substituted for madder, and become a source of no inconsiderable traffic to the people of Florida. Like the arrow root or compta—it grows spontaneously in great abundance and may be cultivated, if thought advantageous.—*Ocala (Fla.) Mirror.*

ORIGIN OF THE WHEAT PLANT.

Some curious botanical facts have recently been laid before the French Academy relative to the transformation of two grasses, *Ægilops Ovata* and the *Ægilops triaristata*. A gardener, M. Esprit Fabre, of Adge, in France, has, without the aid of books and by simple experiment, brought forward a capital fact showing the mutability of vegetable forms. By experiments, which occupied seven years' time, he proved that the above grasses were capable of being the source of all or the greater part of our species of wheat. He first sowed the seed of the *Ovata* in the fall of 1838. In 1839, the plants grew to a height of two feet, and ripened in the middle of July. The ears here and there had one or two grains in them. The crop was five for one, and the straw was brittle and thin. In 1840, the seed of 1839 produced ears more numerous, and generally each contained a couple of grains of an appearance more like wheat. In 1841, the ears were more like wheat, and each had from two to three grains. The figure of the plant was almost like wheat. In 1842, the fourth year of his experiments, the progress was not so sensible as in the previous year. Many of the plants were attacked by rust. The stalks were like *Ægilops*. The ear gave two or three grains each. In 1843, the stalks grew three feet high. In each ear was two or three well grown grains, and the straw was stronger. The figure of the plant was like wheat. In 1844, all of the ears were filled. In 1845, the seventh year, the plants had reached the condition of true wheat. These experiments were made in an enclosure surrounded by high walls. There was no grass inside of it, and no grain raised near the spot. In 1846, he sowed this grain in a field broad cast, and continued in four years. In 1850, the straw was full straight, over two feet high, and each ear contained two or three dozen grains of perfect wheat. Thus a savage plant, subject to cultivation, changed its entire figure and aspects, and gradually assumed a new character.

Among the recent French inventions, is one for "increasing the produce of autumn wheat," patented by Mr. D'Urcle. The inventor grounds his discovery upon the fact—positively ascertained "by study and repeated experiments"—that autumn wheat is not an annual, but biennial, like the beet-root and carrot class, and he therefore proceeds to develop the alleged biennial properties by a novel plan of planting and treatment, for the increase of the produce. The ground is to be well manured, either before winter or at the beginning of spring, to receive the seed between the 20th of April and the 10th of May, this time being chosen to prevent the chance of blossoming during the year. But the time of sowing may be advanced from year to year; for, if it were not for the present degeneracy of the plant, it might occur now in March. Each grain is sown separately, allowing it a large area of ground if the soil is rich, but diminishing according to its sterility. It is deposited in rows in holes at regular distances, from 9½ to 23½ inches asunder, in each direction, the holes in one row opposite the spaces in the next. Each hole is to contain four or five grains, 2½ inches asunder. When the plants have attained a height of four inches, all but the finest one in each group are pulled up, and this single one is then left for the harvest of the succeeding year. This curious process is stated to increase the produce very greatly.

CONSUMPTION OF TOBACCO.

If the population of the earth be taken at 1000 millions, and the consumption reckoned as equal to that of the kingdom of Denmark, or seventy ounces a head, the produce of the whole world will amount to near two millions of tons (1,953,125,) a year. Seventy ounces a head, of course, far exceeds the average consumption of Europe, in most of the countries of which tobacco is heavily taxed. It is certain, however, on the other hand, that it falls far short of the consumption of Asia, containing the majority of mankind, where women and children smoke as well as men, and where the article is, moreover, untaxed. Near half the British tonnage which "entered inward" or "cleared outward" last year would be required to convey the quantity of this American weed, of which the value, at two-pence a pound, will amount to nearly thirty-six and a half millions sterling, 36,462,500*l*. *Journal of the Statistical Society.*

ZOOLOGY.

ON THE IDENTITY OF STRUCTURE OF PLANTS AND ANIMALS.

The following is an abstract of a recent paper read before the Royal Institution England, by T. H. Huxley, Esq. The author commenced by referring to the researches of Schleiden and Schwann, upon the structure, functions and developement of the cells in plants and animals. Admitting to the fullest extent the service which the cell-theory of Schleiden and Schwann had done in anatomy and physiology, he endeavored to show that it was nevertheless infected by a fundamental error, which had introduced confusion into all later attempts to compare the vegetable with the animal tissues. This error arose from the circumstance that when Schwann wrote, the primordial utricle in the vegetable cell was unknown. Schwann, therefore, who started in his comparison of animal with vegetable tissues from the structure of cartilage, supposed that the corpuscle of the cartilage cavity was homologous with the "nucleus" of the vegetable cell, and that therefore all bodies in animal tissues homologous with the cartilage corpuscles were "nuclei." The latter conclusion is a necessary result of the premises; and therefore the lecturer stated that he had carefully re-examined the structure of cartilage, in order to determine which of its elements corresponded with the primordial utricle of the plant,—the important missing structure of which Schwann had given no account:—working subsequently from cartilage to the different tissues with which it may be traced into direct or indirect continuity, and thus ascertaining the same point for them, the general result of these investigations may be thus expressed:—in all the animal tissues the so-called nucleus (endoplast) is the homologue of the primordial utricle (with nucleus and contents) (endoplast) of the plant, the other histological elements being invariably modifications of the periplastic substance. Upon this view we find that all the discrepancies which had appeared to exist between the animal and vegetable structures disappear, and it becomes easy to trace the *absolute identity* of plan in the two,—the differences between them being produced merely by the nature and form of the deposits in, or modifications of, the periplastic substance. After referring to the various chemical and morphological changes undergone by the periplast and endoplast, the lecturer stated that in both plants and animals there is but one histological element, the endoplast, which does nothing but grow and vegetatively repeat itself; the other element, the periplastic substance, being the subject of all the chemical and morphological metamorphoses in consequence of which specific tissues arise. The differences between the two kingdoms are, mainly: 1. That in the plant the endoplast grows, and, as the primordial utricle, attains a large comparative size:—while in the animal the endoplast remains small, the principal bulk of its tissues being formed by the periplastic substance; and, 2. In the nature of the chemical changes which take place in the periplastic substance in each case. This distinction, however, does not always hold good, the Ascidians furnishing examples of animals whose periplastic substance contains cellulose. The plant, then, is an animal confined in a wooden case, and nature, like Sycorax, holds thousands of "delicate Ariels" imprisoned within every oak. She is jealous of letting us know this, and, among the higher and more conspicuous forms of plants, reveals it only by such obscure manifestations as the shrinking of the sensitive plant, the sudden clasp of the dionœa, or still more slightly, by the phenomena of the cyclosis. But among the immense variety of creatures which belong to the invisible world, she allows more liberty to her dryads; and the protococci, the volvox, and indeed all the Algæ, are, during one period of their existence, as active as animals of a like grade in the scale. True, they are doomed eventually to shut themselves up within their wooden cages and remain quiescent, but in this respect they are no worse off than the polype, or the oyster even. In conclusion, the lecturer stated his opinion that the cell-theory of Schwann consisted of two portions of very unequal value, the one anatomical, the other physiological. So far as it was based upon an ultimate analysis of living beings and was an exhaustive expression of their anatomy, so far will it take its place among the great advances in science. But its value is purely anatomical, and the attempts which have been made by its author, and by others, to base upon it some explanation of the physiological phenomena of living beings by the assumption of cell-force, metabolic-force, &c. &c., cannot be said to be much more philosophical than the old notions of "the actions of the vessels," of which physiologists have lately taken so much pains to rid themselves. The living body has often, and justly, been called "the house we live in;"—suppose that one, ignorant of the mode in which a house is built, were to pull it to pieces, and find it to be composed of bricks and mortar,—would it be very philosophical on his part to suppose that the house was built by *brick-force?* But this is just what has been done with the human body. We have broken it up into "cells," and now we account for its genesis by cell-force.

PISCICULTURE.

In the last number of the Annual of Scientific Discovery, an account was given of the recent experiments in France for extending the production of fish; experiments so satisfactory in their results in their then stage of progress as to lead to well founded hopes that by a little care and exertion, every brook and rivulet might be made to afford a large increase to our means of subsistence.

The place where at the present time the principal experiment is in progress is the village of Huningen and its environs, in Alsace, a few miles from Basle, in Switzerland. The French Government, a few months since, loaned 30,000 francs to MM. Berthot and Detzem, to enable them to make all needful preparations and arrangements to carry on the experiment at this place on a scale that should prove decisive. The Superintendent of this establishment, M. Coste, made a report in February last to the Academy of Sciences upon the progress which he had made, which is published in full in the Polytechnic Journal, for 1853.

His treatment of the spawn of salmon and trout had proved so satisfactory in its results, that he has no doubt of having by June, that is in four months from the date of the report, 600,000 young fish of these two species with which to furnish the rivers, all sufficiently grown to be secure from the ordinary dangers to which the minnow is exposed. In the brooks of Huningen in which the spawn is hatched, over a million of salmon and trout eggs have been placed, of which 120,000 were spawned along the bank of the Rhine, under the eye of the Director.

The enormous productiveness of this establishment may be imagined when a year's space is taken into consideration, for no sooner are the present varieties of fish distributed from the brooks and ponds, than their places will be supplied by the young of the Danube salmon and shad, which spawn only in the spring, thus keeping up a constant succession.

This new branch of industry is already spread at Huningen, over a space some $7\frac{1}{2}$ miles in extent, where the waters of ten natural fountains, that of a small stream passing through the establishment, those of the Rhine and the standing waters of marshy ground, are all found near each other, and at hand to mingle in such proportions as may be necessary for different species. Hopes are entertained that sturgeon and other fish, which require the sea and fresh water by turns, may thus be raised, and that by placing them in the Rhone when young, the bays of the Mediterranean may once more be stocked with fish.

Successful experiments have been also made upon the shores of the Adriatic, in the Pontine marshes, and in the Gulf of Naples, in the artificial production of salt water fish.

MARINE VIVARIUM.

A new feature has lately been added to the London Zoological Gardens, namely, an arrangement for the purpose of exhibiting and preserving marine animals. It consists of a number of large tanks, mainly constructed of glass, to which the name of *Marine Vivarium* has been given. A difficulty which has always been encountered in all attempts to preserve marine animals at a distance from the ocean, has been the necessity of frequently changing the salt water requisite for their further existence. This has been overcome in the following manner. In the course of the experiments, it became known that by aerating the salt water by filtering or agitation, it became fitted for the support of animal life. Here, then, a chance of success to an object long desired seemed to present itself; and the enterprising Secretary of the Zoological Society determined to make a trial on a small scale. He began with the sea anemones and some of the more hardy shell-fish,—and succeeded most satisfactorily. While, however, this experiment was in progress, a fact of much greater importance became known. It had been observed by vegetable physiologists that plants purify a small quantity of water just as they purify the air,—that is, by taking up carbonic acid and giving out oxygen: and here was the explanation of the fact of animals living for any length of time in a limited quantity of water, provided there were plants enough to take up the carbonic acid which the animals threw off, and supply the oxygen which they needed. The question naturally arose,—why should not sea-weeds do the same for sea water as fresh water plants do for fresh water? The experiment was tried by the Secretary, and has proved successful. By arranging sea plants and animals in a limited quantity of sea water, he so maintained the balance of animal and vegetable life, that for several months they required neither fresh water nor any mechanical aeration. It is the adoption of this plan on a large scale that constitutes the novelty of the Vivarium now opened to the public in the Zoological Gardens.

At the present there are six large tanks of glass containing various forms of marine invertebrate animals and fish. These tanks have been arranged in something like zoological order. The first contains a variety of Crustaceans,—crabs, lobsters, and shrimps. Here may be seen in living activity species of these creatures only to be caught by the dredge,—and which have been only occasionally seen when cast up on our coasts or pinned down in our museums.

In a second tank is a collection of Echinodermata. These creatures are familiar in their common types the star-fish and the sea-egg.

A third tank contains a collection of sea anemones, or animal flowers. The more common forms of these lowest members of the great family of Polyps are scarcely unknown to the least curious visitors to our sea coasts; but it has fallen to the lot of few to see them to such advantage as they now may here. In variety of color, they almost vie with a bed of tulips; and they will enable the observer to understand something of the beauty which arrests the attention of the traveller in the South Seas, where these creatures and their allied forms abound.

In a fourth tank is a collection of British Mollusca. Those who gather shells on the sea-shore will recognize many of their old acquaintances in this department,—but no longer as uninhabited dwellings. Each contains its proper tenant. In another tank, a highly interesting group of mollusca—the Nudibranchiate—are to be seen. These have no shells—and are remarkable for their delicate coloring and for the curious forms assumed by their gills or breathing organs, which being placed on the outside of their bodies have got for them their name of naked-gilled.

In the fourth tank are also contained some species of barnacles and sea acorns (*Cirripedia*,) which with their hard molluscous-like shells were once included under the mollusca, but are now known to have an internal structure which allies them with the articulated tribes of animals. In this tank are some small species of sea-fish; including the blenny, the fifteen-spined stickleback (first cousin to the well-known fresh water sticklebacks, which have mostly only three spines), the wrasse and the father-lasher (*Cottus bubalis*). The annelides are represented in several of the tanks by species of aphrodite and the beautiful sabellæ. Many of the leaf-like and vegetable-looking objects at the bottom of the tanks are popularly called sea-weeds, and demand a microscope to make out clearly their animal nature.

One of the most interesting features in this novel exhibition is the restless change of position among the several creatures. The visitor may occupy the whole day in passing inside and outside the building from tank to tank, and yet every time see something new. The tanks, visible on both sides, afford 390 square feet of view, and contain seven tons of sea water. Of the marine fish, of which the *Blennies* and *Cotti* are almost always at the bottom, it may be said that their habits are being now, for the first time, investigated with success; and their activity and rapacity present effects so curious that the most casual observer cannot help being struck with them. This exhibition of living fish and invertebrates, besides exciting much curiosity, will be of most impressive usefulness to the student, to whom they have been only known hitherto by books and dried remains.

RARE SHELL.

At a recent sale of shells in London, being a collection formed by the late Earl Mountnorris, the interest of conchologists was much excited by a species of great rarity and much value, called *Cypræa princeps*, or "The Brindled Cowry of the Persian Gulf." Only one other specimen, formerly belonging to Mr. Broderip, and now in the British Museum, is known, aud from their great beauty and freshness, their very peculiar typical character, and the number of years, nearly half a century, that have elapsed since their discovery, it provoked a strong competition. The first offer for it was twenty guineas. After several biddings it was knocked down at 40*l*.

ON THE WEIGHT OF MAN.

At the British Association, Mr. Milner said that season seemed to have an influence on the weight of man. He had weighed the prisoners in Hull gaol for five years, and had found that they regularly increased in weight from April to November, and decreased in weight from November to March. The diet was the same all the year round, as was also the temperature.

WOOL FELTING.

It is in the fulling, or felting of woolen fabrics that that peculiar body and consistency is produced, for which the best cloths are so highly esteemed. In this process the necessity for well assorted wool becomes peculiarly apparent. Unless the wool possesses naturally a *felting* quality, no beating will ever cause it to become so united as to form one solid body. Microscopic discoveries have been made within the last few years, which have led to a revelation of much of the mystery of felting. Examined through a powerful microscope, the short fiber exhibits the appearance of a continuous vegetable growth, from which there are sprouting, and all tending in one direction from the root to the other extremities, numerous leaves like calices or cups, each terminating in a short point. It is easy to perceive how easily one of these fibers will move in the direction from root to point, while its retraction must be difficult, being obstructed by the tendency of the little branches. In a fiber of merino wool, the number of these serrations or projections amounted to 2,400 in the space of one inch. In a fiber of Saxon wool of acknowledged superior felting quality, there were 2,720 serrations. South Downs' wool, being inferior to these two for felting power, only contained 2,080 serrations in one inch of fiber, while Leicester wool contained no more than 1,860 in one inch, and Leicester wool is known to be but little adapted for felting purposes.

Attempts have long been made to make felting supersede spinning and weaving. It has succeeded in reference to the manufacture of hats, in which rabbit's down is also a material of large consumption. It has also succeeded with regard to beavers and other heavy goods, but its application to superfine cloth remains, at present, an object of interesting experiment, the success of which is doubtful. The greatest objection is the want of that elasticity which is so important an element in all cloths used for close-fitting garments. But there are many purposes to which fine felt may be applied, such as shawls, cloaks, loose overcoats, and all garments on which their is no particular stretch. The greatest perfection yet attained in the felting art, is due to the exertions of the Union Manufacturing Company, Norwalk, Conn. The process of manufacturing felts adopted by this Company, is different from that of any other manufacturers. A number of the fine webs of wool from the carding engine are drawn over a smooth metallic bed, covering a surface proportionate to the width of the piece. The first layer is succeeded by a cross layer of a similar character; this is succeeded by another lengthwise, and then another across, repeating the operation till the requisite thickness is attained. As many as thirty layers are sometimes employed in the manufacture of one thickness of felt. These layers are next subject to the action of a large metallic beater, weighing two tons. This beating is continued until the wool is all consolidated into one compact mass of felt. In some of the goods the wool is dyed first, and the webs being alternately dark and light, stripes and plaids are formed, each bar of color being about an inch and a quarter wide.—*New York Tribune.*

SINGULAR DISCOVERY IN THE PRODUCTION OF SILK.

It has long been known to physiologists that certain coloring matters, if administered to animals along with their food, possessed the property of entering into the system and tinging the bones. In this way the bones of swine have been tinged purple by madder, and instances are on record of other animals being similarly affected. No attempt was made to turn this discovery to account until lately, when Mons. Roulin speculated on what might be the consequences of administering colored food to silkworms just before spinning their cocoons. His first experiments were conducted with indigo, which he mixed in certain proportions with the mulberry-leaves serving the worms for food. The result of this treatment was successful — he obtained blue cocoons. Prosecuting still further his experiments, he sought a red coloring matter, capable of being eaten by the silkworms without injury. He had some difficulty to find such a coloring matter at first, but eventually alighted on the *Bignomia chica.* Small portions of this plant having been added to the mulberry-leaves, the silkworms consumed the mixture, and produced red-colored silk. In this manner the experimentalist, who is still prosecuting his researches, hopes to obtain silk, secreted by the worm, of many other colors.

New Varieties of Silk. — At a late meeting of the Royal Society, England, Mr. Westwood exhibited a new kind of silk in different stages of manufacture, and the fabric produced from it by the natives of tropical Africa, where it was produced. The raw material consisted of a mass of the cocoons of a moth, probably one of the Tineidæ, closely packed together, and in consequence it required to be carded before being spun. Some manufacturers who had seen it, thought it might be advantageously worked, if a supply could be procured.

PRODUCTION OF GANGRENE.

A communication has been recently presented to the French Academy, by Dr. Maisonneuve, on instantaneous gangrene, (*gangrene foudroyante,*) with the development and circulation of putrid gases in the veins (*pneumo-hemi putride*). This gangrene commonly sets in after fractures which are complicated with wounds, and especially when the wounding cause has, by the violence of its action, produced a profound disorganization of the tissues, or when considerable effusions of blood infiltered into the soft parts, are placed in direct communication with the exterior air; then the blood forced from its vessels, or from the tissues crushed by the contusion, having no longer in themselves the organic conditions necessary for life, putrify under the influence of air and humidity; their prompt decomposition engenders putrid gases which infiltrate in the cellular interstices, and their deleterious contact extinguishes the vital forces, in the parts already stupified by the shock. The mortification is not confined to the muscles, the cellular tissues, and the vessels; in the sphacelated veins the blood coagulates and then, soon sharing the general decomposition, the clots putrify and engender putrid gasses, which soon break the weak lien of the clot, penetrate to the liquid blood, mix themselves with it, are carried along in its circulatory movement, and carry death into every part of the body. The Doctor saw this in May, 1861, for the first time: while making profound scarifications to combat emphyseme, numerous bubbles of gas issued from the orifice of the veins; the bistouri divided; the subject died that night; the autopsy, made twenty-eight hours after death, showed that the gangrened centre was the point from whence these gases came, and that they freely circulated in the veins. He has successfully combated it by amputation.

NOTES ON THE RATTLESNAKE.

The following communication was presented to the Boston Society of Natural History, by Dr. W. I. Burnett. Among a number of living reptiles placed at my disposal by Dr. Dearing of Augusta, Ga., for anatomical and physiological uses, were two quite large and beautiful Rattle Snakes (*Crotalis durissimus*), with which I lost no time in making many experiments. — The largest, a little more than four feet in length, and having fourteen rattles,* was killed, and I made a dissection of its mouth in order to learn some details of the anatomical relations of the fangs and poison-apparatus. As the opportunity for the study of the progressive development of these was an unusually good one, I will give the results somewhat in detail.

The two fangs in use with the poison-sacs at their base, presented nothing remarkable, excepting that they were old and worn, and evidently soon to be shed. But directly behind these, the mucous nembrane on each side was crowded with what may be called the *fangs of reserve;* for like successive teeth elsewhere, they are ready for complete development in turn, as fast as those in use passed away.

These were of all sizes from near that of the fangs in use, down to the smallest germ, and I was able to easily count twelve on each side. Their development, studied with the microscope, appeared as follows: First, a minute involution of the mucous membrane (the *tooth-follicle.*) In this is seen a small conical papilla as the first trace of the future fang. This is gradually developed by the aggregation of cells, and when about 1-25 of an inch in length its cavity (*the pulp-cavity*) is occupied with a network of blood-vessels. The growth after this is more rapid and determinate. The epithelial cells covering the apex of the papilla become lineally arranged, and fusing together, form fibers, which, when filled with calcareous salts, constitute the intimate

* The popular belief is that the number of rattles on the tail indicates the years of the snake's life. But according to several observers (Buchanan, Holbrook and Dearing) this is not so; for not only may it loose several of the rattles by accident, but two and even four have been known to form in a single year. One of my own accidentally lost two of its rattles, and it is rare to find specimens having more than ten or twelve.

structure of the enamel. This enamel is formed very early, and sometime before the appearance of the dentine or ivory; so that at one period you find simply the epithelial tooth-sac crowned with a point of enamel. As the tooth-sac increases and is pushed out, the enamel point is more and more elongated, becoming finally very long and acicular, and with the sharpness well known in the perfect fang.

Meanwhile the dentine, or ivory, is formed, and as this process is going on, its edges begin to roll towards each other on the convex and upper surface of the tooth. This rolling of the edges to meet each other, continues gradually with the growth of the tooth; being first a half, and usually at last, a complete canal. This canal is the poison duct; and being thus formed two results ensue: 1st. It is outside, and disconnected with the pulp-cavity, but communicates with the tooth-follicle at its base. 2d. It is only in the ivory substance, terminating externally at the point where this last connects with the enamel; the enamel-point, therefore, being free and solid.

Thus formed, these fangs seem to be in waiting to replace the old ones in the event of their being removed or naturally shed. How this replacement takes place I am unable to say from observation. But it appears to me that the original tooth-follicle becomes the poison-gland or sac; for several of the larger reserve-fangs had each a small sac, embracing its base, and which appeared to be only the primitive tooth-sac; and moreover, the largest pair of these reserve fangs lay directly behind the ones in use. The replacement might, therefore, occur as with the higher animals, — the pair of reserve passing gradually, together with the poison gland, into the places of those removed.

But, however occurring, the substitution is exact and complete, and may take place in a very short time, for Dr. Dearing informed me, that from one of his captive specimens, he extracted the fangs which were exactly replaced in six weeks; this he repeated several times with a like result.

There are many facts tending to show that these fangs are naturally shed once in a while if not regularly; at all events, their points are likely to be broken off by frequent use, and however removed, Nature appears to have provided an ample stock in reserve for their almost indefinite repletion.

The virulence of the poison of this animal is too well known for special description. I will only add there is good reason for the belief that its action is the same upon all living things, vegetables as well as animals. It is even just as fatal to the snake itself, as to other animals; for Dr. Dearing informed me that one of his specimens, after being irritated and annoyed in its cage, in moving suddenly accidentally struck one of its fangs into its own body; it soon rolled over and died as any other animal would have done. Here, then, we have the remarkable, and perhaps unique physiological fact, of a liquid secreted directly from the blood, which proves deadly when introduced into the very source (the blood) from which it was derived!

With the view of ascertaining the power and amount of this poison, Dr. Dearing performed the following experiment; the snake was a very large and vicious one, and very active at the time. He took eight half-grown chickens and allowed the snake to strike each under the wing as fast as they could be presented to him. The first died immediately; the second after a few minutes; the third after ten minutes; the fourth after more than an hour; the fifth after twelve hours; the sixth was sick and drooping for several days, but recovered; the seventh was only slightly affected, and the eighth not at all.

With the remaining specimen I was desirous of performing several experiments as to the action of this poison on the blood. The following is one: The snake was quite active, and as any one approached the cage, began to rattle violently; but twenty-five or thirty drops of chloroform being allowed to fall on his head, one slowly after the other, the sound of his rattle gradually died away, and in a few minutes he was wholly under the effects of this agent. He was then adroitly seized behind the jaws with the thumb and fore finger, and dragged from the cage and allowed to partially resuscitate; in this state a second person held his tail to prevent his coiling around the arm of the first, while a third opened his mouth and with a pair of forceps pressed the fang upward, causing a flow of the poison, which was received on the end of a scalpel. The snake was then returned into the cage.

Blood was then extracted from a finger, for microscopical examination. The smallest quantity of the poison being presented to the blood between the glasses, a change was immediately perceived — the corpuscles ceased to run and pile together, and remained stagnant without any special alteration of structure. The whole appearance was as though the vitality of the blood had been suddenly destroyed, exactly as in death from lightning. This agrees also with another experiment performed on a fowl where the whole mass of the blood appeared quite liquid, and having little coagulable power.

Other and like experiments were performed, but I must omit here their description.

The physiological action of this poison in animals is probably that of a most powerful sedative acting through the blood on the nervous centres.

This is shown by the remarkable fact that its full and complete antidotes are the most active stimulants; of these, *alcohol*, in some shape, is the first. I cannot better illustrate this important point than by the two following cases, furnished me by Dr. Dearing, in whose experience they occurred:

Mr. B. was bitten just above his heel, three quarters of a mile from home. The usual symptoms of acute pain and large swelling immediately followed; he succeeded, however, in reaching his house, but complained of blindness and universal pain. Brandy was then given, to the amount of one quart in an hour, — this produced a little nausea, but not the least intoxication; in the next two hours another quart had been given, followed with relief of pain and subsidence of swelling, but without the least intoxication. Stimulants were kept up in small quantities during the ensuing forty-eight hours, with the gradual passing off of the local and other symptoms. He kept his room the three following days, complaining only of a general soreness. After this he was about as usual; but a few weeks after, his hair fell off entirely.

Miss F. was bitten on her middle finger; the usual severe symptoms immediately followed; but brandy, with the addition of a little ammonia, was freely given, and continued in large doses until relief of symptoms, but without the least appearance of intoxication, although in health the individual could not, probably, have borne a single ounce: the symptoms gradually disappeared, and on the third day the patient was well generally, although the finger sloughed.

These two cases, authentic in every particular, are quite valuable, for aside from their physiological relations, it is of no small importance to know that the sure fatality of such an accident can be fully prevented by so simple a remedy.

I have been desirous of performing some experiments with a view to learn the relations of this poison to the state of anæthesia in animals. I commenced these a few days ago, but the behavior of the snake was far from being commendable or satisfactory, and I shall postpone them for the present.

ON THE COTTON WORM OF THE SOUTHERN STATES.

The following communication on the cotton worm of the Southern States, was recently presented to the Boston Society of Natural History, by Dr. W. I. Burnett:—" This insect appears but little known in science, although its injury to property is perhaps greater and more deplorable than that of any other with which we are acquainted. On the years of its appearance the entire cotton crop of certain districts is often cut short; and in not a few instances single plantations have suffered to the amount of ten to fifteen thousand dollars.

It is one of the span worms or *Geometridæ*, belonging to the same family of insects as the canker worm, which is so much feared with horticulturists at the North. Having only larvæ at my disposal, I am unable to give its generic relations; but I hope at some future time, having obtained a complete suite of these insects in all their conditions, to give a zoological description, if required.

" It is not indigenous to the Southern States, and there is no evidence that it can live naturally north of the shores of Texas. Most probably it is a native of Brazil, or some other equatorial climate in that vicinity; for it is so sensitive to the cold as to quickly die in an atmosphere approaching the freezing point. Its appearance, then, on the southern cotton fields is always one of migration, coming suddenly like a foreign enemy, and always selecting the most thrifty plantations. It is very remarkable, therefore, that it should appear regularly at the intervals of every three years in the same districts, striking first the seaboard and progressing gradually inland as circumstances may favor. But equally remarkable in this connection is the fact, that its most extensive and deplorable ravages occur always after intervals of twenty-one years, or every seventh time of its advent; as shown in the years 1804, 1825, and 1846, during the last half century. These facts are inexplicable unless referable to some peculiar conditions of their economy in their native land. Little is known from what southern direction they come, for like all insects of this family, their movements are made at night, and the seaboard planter often rises in the morning finding whole sections of his plantations covered with the adult insects, busily engaged in depositing their eggs on the tender leaves of the cotton. There is, however, no regularity in the exact month of their coming, for Mr. Chisolm says that on his plantations they came in 1840, quite early, but in 1843, much later, and remained until frost; in 1846, in June; and in 1849 and 1852, in August.

The cotton caterpillar is nearly always accompanied directly by another insect called the boll worm, (probably one of the *Noctuidæ*,) which confines its attacks to the immature lint and seeds of the green pods of the short-stapled variety of cotton; and, as short cotton is mostly cultivated in sections farther south than those of the long-stapled variety, this boll worm is generally seen in Texas and Mississippi six weeks or so before the cotton caterpillar proper appears on the coast of Georgia and Scuth Carolina. Little is known of its habits more than this, for its ravages are comparatively so inconsiderable, that it attracts scarce any attention of the planter. Its concomitancy with the true cotton worm, however, is not a little remarkable, and there is no doubt that it belongs to a different family of insects.

The cotton insect having made its appearance, shows considerable sagacity in always seeking first the most luxuriant fields. The eggs, which are of a dull white color, are deposited singly, or at most, in twos, on the under surface of the most tender leaves. Their period of incubation is quite short, being six or seven days, and the time of hatching is always after sunset or in the night. They then begin to feed ravenously, growing in proportion; their attacks being always confined to the long-stapled variety when accessible, though when hard pushed they will eat the short variety; but never will they eat any thing else, and if their numbers are disproportionate in excess to the cotton at hand, they will die of starvation rather than touch any other vegetable. During their caterpillar state, they are almost wholly unaffected by all changes in the weather, excepting cold; for the heaviest rains, and the severest gales of wind do not stay their movements, or prevent in the least their devastations. Mr. Chisolm says that a very violent hurricane of two or three hours' duration which swept over his plantations in August last, made no impression whatever on their progress. If, however, there occurs even a slight frost, they are killed throughout.

These circumstances are worthy of mention, as bearing upon the probability of their tropical origin. Their larval state is of about ten days duration, and during this time they moult two or three times, changing their colors and general appearance in the same singular manner as the canker worm of the North. The caterpillars, when full grown and well fed, are 16-legged, of the size of a common crow quill, and from an inch and a quarter to an inch and a half in length. It has a reddish head, is whitish below and brownish black above; on each side are two longitudinal, wavy white lines, and another, straight, on the middle of the back. When ready to wind up, they swing down from the cotton plant, and, without any choice, take up indifferently with the nearest objects on which they may rest during this process. Their chrysalis state continues about twelve days; the moths then appear and immediately go about depositing their eggs, after which they die. This perfect state lasts only four or five days. Such is the routine of their reproduction.

When they appear early in the season there are usually three broods; but some years they come so late that only a single new generation is seen. In either case, the last brood almost invariably perishes throughout, being either killed instantly by the frost, or dying from starvation, having eaten all the cotton before their transformations take place. It follows, therefore, that these ravaging insects, as they appear in the cotton fields of the South, do so at the loss of that portion of their race, for they leave no progeny behind them. At the same time this condition of things makes the matter the more deplorable for the planter, for as a suddenly invading foe from foreign parts, he is rendered wholly powerless in averting this regularly periodical destruction of property.

ORIGIN AND PRODUCTION OF GALL NUTS.

The name *Gall* is given indistinctly to various excrescences which supervene upon the members of the vegetable kingdom, in consequence of attacks of insects. Among these morbid productions, some contain immediate principles, which are not without value as reactives and medicaments. Such, for example, is the gall nut (properly so called,) an article of commerce, which furnishes gallic acid and a very pure tannin. In studying the different productions of the same sort, authors heretofore have paid attention only to exterior forms of galls, to the plants which bear, and the insects which cause them. Their development and structure hitherto have been unknown. Logic would require that, in this double study, the organization of these tumors should first be examined, so as to follow with greater facility the phases of their growth. M. de Lecaze Duthiers, a French botanist, has recently published a memoir upon this subject.

Galls are generally considered as purely cellular mosses, which M. Duthiers shows to be a mistake, for they contain the principal elements and the principal tissues which enter into the composition of plants. There are internal and external galls. The cause of external galls is the deposit of a venomous liquor of special specific properties, a real poison secreted by the insect, which deposits it in the plant at the same time with its egg. The form, the consistence, and all the characters of the tumors, vary with the specific properties of the virus which superinduces their appearance. The internal galls seem to owe their appearance (as Reaumer has suggested) to a concentration of the liquids of the plant by the suction of grubs. This concentration, by augmenting the vitality of the part, determines, at the same time, the hypertrophical increase. M. Duthiers thinks a third division may be made for the galls which present the characters of both external and internal productions. These may be called *mixed galls.* The galls in artichokes are in this category; they are caused by the hypertrophy of a bud, in whose centre a small external gall is developed.

NESTS OF HUMMING BIRDS.

At a recent meeting of the London Zoological Society, Mr. Gould, the eminent naturalist, exhibited a collection of the nests of Humming Birds, exemplifying the habitual characteristic structure of several genera. The first group to which his remarks were directed were the Hermit Birds, (*Phaethornis*,) who invariably build at the extremity of leaves, perhaps from the protection which that situation affords against the attack of monkeys and other predatory animals. *Oreotrochilus* builds a beautiful nest attached to the side of a rock. *Heliomaster mesoleucus* makes a nest in a beautiful species of moss of the genus *Usna*, depending from the trees of the Brazilian forest. Most of the nests are cup-shaped, some in forks, some in branches, some on leaves, some in ferns, shallow and delicately formed, ornamented in the most various manner with feathers, or with festoons of moss and of lichen, especially in the genus *Hylocharis.* The differences in the eggs of Humming Birds are not very observable, being invariably two in number, white and oblong, with one supposed exception — namely, a species inhabiting the Upper Amazon, which, according to Mr. Edwards, lays a spotted egg. But the difference of structure of the nests sufficiently corroborate the generic divisions into which these birds have been separated by modern ornithologists. The attachment of the lichen and other ornaments is effected by the use of fine cobwebs. The humming birds generally place their nests in open situations, regardless of the intrusion of man, to which, however, the remote localities occupied by many of the species but little expose them. They have a little sharp note, which, although similar, has sufficient variety to enable the collectors to decide that they are within the range of a new species before they have seen it.

THE GREAT AMERICAN ANT-EATER.

Among the few animals that have hitherto resisted most attempts to bring them alive to Europe, is the Great American Ant-eater (*Myrmecophaga jubata*). The difficulty of procuring for it proper food seems to have been one cause of this failure. The late Earl of Derby on two occasions received living specimens of the curious animal in question, — but each soon died. We have now to record the fact, that one of these singular creatures has at last been secured alive by the Zoological Society, — and is at present in a prosperous condition in their gardens. This specimen was brought from South America with two others that died on the voyage. When first placed in the gardens it appeared exhausted and little disposed to eat, but has since recovered. Its favorite food, since it has been in the gardens, is eggs and milk. It sleeps during the greater part of the day; and seems on the whole an inactive creature, though somewhat additionally active at night. Whilst asleep it covers itself over with its large bushy tail, which acts as a kind of blanket. Under its tail its body lies partially curved, with its fore and hind feet locked in each other. The head is placed between the fore legs. On being disturbed it lifts up its head:—which is the most striking part of the animal, on account of the great length of the snout. The snout and face have no hairs; which gives the head very much the appearance of that of some of the larger grallatorial birds,—as the storks and cranes. The ant-eater has rather long legs and a thin long body. It seems, however, to stand awkwardly,—and its gait is a kind of shuffle. All who have seen it in its native haunts speak of its slow movements and its stupidity of character; and this report the appearance of this specimen in the gardens would confirm. Its tail is very large, and long for its body. Whilst the animal is moving about, the tail appears to occupy more space than all the rest of its body besides.

The large ant-eater belongs to a family of animals, the Edentata, of which there are but few living representatives at the present day. They were, however, at one time numerous,—and numbered amongst them the largest and most powerful animals on the face of the earth. They are almost peculiar to South America; and the extinct forms—which include the Megatherium, the Megalonyx, the Mylodon, and the Glyptodon—have been found on that continent only. The present animal is the largest of the family that is left on the surface of the earth; and it possesses, with all its congeners, great interest on account of its relation to the extraordinary animals whose remains only are left to us.

VIVIPAROUS FISH.

A remarkable fact in Natural History is developed by Prof. Agassiz, in the November number of Silliman's Journal—viz: the existence of *fish producing living young*. Mr. A. C. Jackson, a gentleman attached to the Navy-Yard Commission on the California coast, while fishing in San Salita Bay, caught with a hook and line a fish of the perch family containing several young, properly developed and lively. The occurrence seemed so extraordinary that Mr. Jackson was induced to send the specimens to Prof. Agassiz, at Cambridge. They were examined by the Professor, and are pronounced by him to be an entirely new species. He proposes for them the Generic name of *Embiatoca*, in allusion to their peculiar mode of reproduction.

The body of the fish is compressed, oval, covered with scales of a medium size. The scales are cycloid, differing from those of other fishes which possess an exterior resemblance to this style. The posterior portion of the dorsal fin is supported by numerous articulated branching rays, which are sheathed at the base by two or three rows of scales, separated from those of the body by a rather broad and deep scaleless furrow. This last peculiarity has not yet been observed in any other fish. The alimentary canal is remarkably uniform in width for its whole length. There are no cœcal appendages in any part of the intestine. The ovary consists of a large bag, of a light violet color, clear and transparent, subdivided internally into a number of distinct pouches, opening by wide slits into the lower part of the sac. In each of these pouches, a young fish is wrapped up as in a sheet. All the young are packed closely together, to economize space; some having their heads turned forward, and others backward. The number of young contained in the sac seems to vary. Mr. Jackson counted *nineteen*; Prof. Agassiz has discovered only eight or nine in the specimens he has received.

Of the specimens received here, there are evidently two species, differing from each other by slight physiological peculiarities. The names of *Embiatoca Jacksoni* and *Embiatoca Caryi*, have been given them.

ASTRONOMY AND METEOROLOGY.

NEW PLANETS DISCOVERED DURING THE YEAR 1853.

The number of planetary bodies belonging to the Solar System, has been increased during the year 1853, by the discovery of four new asteroids.

At the commencement of the year 1853, the whole number of asteroidal planets recognized was twenty-three.*

The 22d asteroid was discovered on the night of the 16th of November, 1852, by Mr. Hind, of London, and received the name of Calliope. The 23d asteroid was also discovered by Mr. Hind, on the evening of the 15th of December, 1852, and has received the name of Thalia. It is a star of the 10th–11th magnitude, shining with a pale bluish light.

The 24th asteroidal planet was discovered on the evening of the 5th of April, 1853, by M. Gasparis, of Naples. It has the appearance of a star of the 12th magnitude, and has received the name of Themis.

The 25th asteriod was discovered by M. Chacornac, of Marseilles, on the 6th of April, 1853. It has the appearance of a star of the 9th magnitude and shines with a bluish light. It has received the name of Phocœa.

The 26th asteriod was discovered on the evening of the 5th of May, by M. Luther, of the observatory of Bilk, Germany. It appears like a star of the 10th–11th magnitude, and has received the name of Proserpine.

The 27th asteroidal planet was discovered by Mr. Hind, of London, on the evening of November 8th, 1853, in the constellation Taurus. It is rather brighter then the stars of the 9th magnitude. This planet is the 7th discovered by Mr. Hind.

Mr. Hopkins, in his annual address before the British Association made the following reference to the asteroidal planets: — "All those which have been recently recognized appear like stars of magnitude not lower than the eighth or ninth, and are consequently invisible to the naked eye. The search for them has now assumed, to a consider-

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*See table in Annual of Scientific Discovery, for 1853, p. 359.

able extent, a more systematic form, by a previous mapping of the stars up to a certain magnitude, and contained within a belt of a few degrees in breadth on either side of the ecliptic. Any small planet will in the first instance be inserted in the map as a small star, but will on the re-examination of the same area some time afterwards, be recognized in its true character, from the fact of its having moved from the place in which it was first observed. This mapping of the ecliptic stars from the eighth to higher magnitudes, is still comparatively limited; nor has the length of time during which any one portion, perhaps, of the space has been thus mapped, been sufficiently great to ensure the passage through it, within that time of any planet whose period is as long as the possible periods of those which may yet remain unknown to us. Analogy would therefore lead us to conclude in favor of the probability of their number being much greater than that at present recognized. All those which are now known lie between the orbits of Mars and Jupiter, but many may exist more distant and of much smaller apparent magnitudes; and thus almost the same careful telescopic research may be necessary to make us acquainted with our planetary neighbors as with the remoter regions of space. Nor is the telescopic mode the only one by which we may detect the existence of remoter planets; for as Uranus betrayed the existence of Neptune, so may the latter hereafter reveal to us the retreats in which some more distant member of the system has hitherto hidden himself from the observation of man."

The period of Massilia, the 20th asteroid, differs but 21 days from that of Parthenope, the former being 1422 days nearly. The inclination is less than that of any known planet or comet, which renders the computation of the orbit by the method of Gauss extremely tedious and imperfect.

COMETS OF 1853.

A telescopic comet was discovered near star 63, in the constellation Eridanus, March 8th, 1853, by Mr. Charles Tuttle, of the Cambridge, Mass., Observatory. This comet was considerably condensed towards the center, but no definite nucleus was noticed. This comet was first discovered by Prof. Secchi, of the Observatory of the Collegio Romano, on the 6th of March, and was also independently by Schweitzer, at Moscow, on the 8th, and by Dr. Hartwig, on the 10th. There is some reason for supposing this comet to be identical with that of 1664.

Prof. Schweitzer, at Moscow, discovered the second comet of 1853, on the 4th of April, 1853. It was extremely minute and faint.

The most remarkable comet of the year was discovered on the 10th of June, by M. Klinkerfues, of Gottingen. This comet was clearly visible to the naked eye, and had a well defined nucleus and tail. On the 23d of August, the diameter of the nucleus, as measured at the Washington Observatory, was eleven seconds of arc, and the length of the coma, fifty-two minutes. Its passage of the perihelion was made on the 27th of August. This comet has not been identified with any previous one; its brilliant nucleus and long train, about the time of the perihelion passage, made it a very conspicuous object, and altogether the largest and most beautiful comet that has appeared since the great comet of 1843. According to Mr. Hind, of England, the actual diameter of the bright nucleus was 8000 miles, or about equal to that of the earth, while the tail had a real length of 4,500,000 miles, and a breadth of 250,000, rather over the distance separating the moon from the earth. Its nearest distance to the earth at any one time was 68,000,000 of miles.

On the night of Sept. 11th, 1853, Mr. C. Bruhns, of Berlin, detected, near the forward paw of the *Great Bear*, a large, faint, nebulous comet, resembling a star-cluster. Up to Sept. 17th, no indications of a tail were visible, and the nucleus continued to present the appearance of an unresolved nebula, with numerous points of light.

A telescopic comet was discovered on the 25th of November, by Robert Van Arsdale, Esq., of Newark, N. J., in the constellation of Cassiopea. It is of a small, round, bright appearance, with an exceedingly rapid motion in a direction apparently opposite to that of the sun. After only a short observation it changed its place, very perceptibly.

Biela's Comet.—Prof. Hopkins in his address before the British Association has the following notice of this singular body: "This comet has a period of about six years and a half, and has been observed a considerable number of times on its periodical return to the neighborhood of the sun. It appeared in November, 1845, and in the following January the phenomenon alluded to was observed for the first time. The comet had become divided into two distinct parts with separate nuclei. Sometimes the one and sometimes the other appeared the brighter till their final disappearance. The elements of the orbits of these twin comets were calculated by Prof. Plantamour, from observations made at Geneva, in 1845–6, assuming them to be uninfluenced by each other's attractions. The correctness of these elements could be determined only on the next return of the comet, which took place in the autumn of last year, one of the nuclei having been first seen by Signor Secchi, at Rome, on the 25th of August, and the other on the 15th of September. The subsequent observations made upon them show that the elements of the orbits, as previously calculated from the Geneva observations, were far from exact. A complete discussion of all the observations which have been made on these comets during their last and previous appearances, is now in progress by Prof. Hubbard, of the Washington observatory. The distance between the two nuclei was much increased on their last appearance. Judging from the apparent absence of all influence and sympathy between these bodies, it would seem that their physical divorcement, though without known precedent, is final and complete."

SHOOTING STARS OF AUGUST 10, 1853.

The periodical display of meteors on the 10th and 11th of August, 1853, appeared in its usual form, and in numbers not much diminished. At New Haven, Conn., from midnight of the 10th, until 3 25, A. M., of the 11th of August, 388 meteors were noticed, and their direction recorded. M. Coulvier Gravier, at Paris, reported the hourly number of meteors of the evening of the 9th, to have been 49, and on the 11th, 56. At Aintab, Turkey, the appearance of the meteors in about their usual number, was noticed by the Rev. Mr. Pratt, of the American Mission.

All the observations made during the year 1853, agree with those of previous years, both as regards numbers, general direction, and greater frequency after midnight, and confirm what may be considered as sufficiently well established, the cosmical origin of shooting stars.

ON THE PRIMITIVE FORM AND DIMENSIONS OF THE ASTEROID PLANET.

The following paper was read at the American Association, Cleveland, by Prof. Alexander. Of two supposable forms of equilibrium of a rotating body, that of the asteroid planet was very possibly one of very great ellipticity. The rotation being supposed to take place from W. to E., when the rupture of the planet took place, and the asteroids were thus separated, the fragments derived from the portion farthest from the sun would have a velocity of translation nearly equivalent to the orbitat velocity derived from the portion nearest to the sun, which would have a velocity of translation equivalent to the difference of those same two velocities. Fragments elsewhere originating would be still differently affected. Now the excess of velocity in the first instance would cause the asteroid to describe a new orbit, in which the radius-vector of the original planet would represent, very nearly, the *perihelion distance*, while the difference of velocities would cause the opposite fragment or asteroid to commence *its* motion very nearly in aphelion. The same view of the subject, thus far, has been taken by Dr. Lamont, though he has not included the *great ellipticity* of the original planet as a part of his hypothesis, which seems, nevertheless, to be requisite, in order to an adequate effect. Dr. Lamont has, moreover, designated some of the asteroids, which seem to have originated in the way here specified. Now if (differing somewhat from these) we select those asteroids whose orbits differ much in size, and yet have the perihelion distance in the orbit of one nearly equal to the aphelion distance in that of the other, and knowing the existing orbitual velocities at these points, we may approximate to the difference of velocities of the two fragments in question. With this, and the time of rotation of the planet derived from Kirkwood's Analogy, we may then obtain an approximation to the planet's equatorial diameter; which, however, would most probably be somewhat too small, as the rupture of the planet would not probably occur precisely at the time of its equinox.

Or, also, with the same time of rotation, and a probable mass and density derived from similar sources, we may again obtain the equatorial diameter, and also the ellipticity, and thence the polar diameter.

The equatorial diameter thus obtained, if the density assumed be assumed as uniform, will most probably be too great.

From the mean of two results thus separately obtained, it would at present appear that the equatorial diameter of the planet was about 50,000 miles, while its polar diameter was scarcely greater than the thickness of the bright rings of Saturn.

ON THE PLANET MARS.

M. Arago, in a communication made to the French Academy shortly before his death, made the following remarks in reference to the planet Mars.

After suggesting that the greenish spots visible in Mars probably were produced by a contrast of colors, the learned Academician continued that the red color which covers nearly the whole of Mars' surface is real and permanent; the ancients, even unprovided with telescopes, had attested its existence from the most distant periods of time. Several explanations of this phenomenon have been given; some suggest that it is caused by ocreous soils or red stones, such as are common on this globe; Lambert thought it might possibly arise from the vegetation being all red (!); others invoked the supposed absorbing power of the planet's atmosphere. If Mars has an atmosphere, it does not color the planet. Why not? Because if this atmosphere colored light by absorption, the coloring would be greater on the borders of the planet than on the centre, where the distance to be traversed is less than on the borders; with the telescope precisely the contrary is observed to take place. This observation restores to the planet its color as inherent in its mass, and at the same time confirms the existence of an atmosphere, giving it however a very different action from the one just mentioned, for it diminishes on the borders of the planet, the natural color of the latter. The admeasurement of the rotation of Mars has constantly presented a great difficulty (an uncertainty of some seconds still prevails relative to the real duration of Mars' rotation), in consequence of the dark spot, (these dark spots have always been used to measure this rotation,) chosen by the observer constantly disappearing before it reached the border of the apparent disk. M. Arago attributes this disappearance to the same atmosphere which interposes and diffuses the light, and whose thickness increases with the obliquity of the beams which traverse it.

ON THE PRESENT CONDITION OF THE PLANETS JUPITER AND SATURN.

At the British Association, Mr. Nasmyth presented a paper, in which, after glancing at the theory of the original molten condition of the planets, he stated, that he had been led to some interesting conclusions respecting the present condition of such enormous planets as Jupiter and Saturn, which might tend to explain certain phenomena in respect to their aspect. Assuming the original fluid condition of the earth, and going very far back into the remote and formative periods of the earth's geological history, we may find glimpses of the cause of those tremendous deluges, of which geological phenomena afford such striking evidence, and by whose peculiar dissolving and disintegrating action on the igneous formations which at that early period of the earth's history must have formed the only material of its crust, we may in that respect obtain some insight into the source whence the material which formed the first sedimentary strata was derived. If we only carry our minds back to that early period of the earth's geological history, where the temperature of its surface was so high that no water in its *fluid* form could rest upon it, and follow its condition from such non-oceanic state to that period at which, by reason of the comparatively cooled-down condition of its surface, it began to be visited by partial and transient descents of the ocean, which had till then existed only in the form of a vast vapor envelope to the earth, we shall find in such considerations, not only the most sublime subject of reflection in reference to the primitive condition of the earth, but also, as it appears to me, a very legitimate basis on which to rest our speculations in regard to the probable present condition of Jupiter and Saturn, — both of which great planets, I strongly incline to consider are yet in so hot a condition as not only not to permit of the permanent descent of their oceanic matter, but to cause such to exist suspended as a vast vapor envelope, subject to incessant disturbances by reason of the abortive attempts which such vapor envelope may make in temporary and partial descents upon the hissing-hot surface of the planet. Recurring again to this early period of the earth's geological history, when it was surrounded with a vast vapor envelope, consisting of all the water which now forms the ocean, the exterior portion of this vapor envelope must, by reason of the radiation of its heat into space, have been continually descending in the form of deluges of hot water upon the red-hot surface of the earth. Such an action as this must have produced atmospheric commotions of the most fearful character; and towards the latter days of this state of things, when considerable portions of what was afterwards to form our ocean came down in torrents of water upon the then thin solid crust of the earth, the sudden contraction which such transient visits of the ocean must have produced on the crust of the earth would be followed by tremendous contortions of its surface, and belchings forth of the yet molten matter beneath, such as yields legitimate material for the imagination, and the most sublime subject for reflection. The extraordinary contortions and confusion which the more primitive sedimentary strata, such as the gneiss, schist, and mica slate, are found to have, in a very indistinct degree shadow forth the state of things which must have existed during that period, when the ocean held a very disputed residence on the surface of the earth. Could the surface of the earth have been viewed at that era of its geological history from such a distance as the planet Mars, I doubt not it would have yielded an aspect in no respect very dissimilar to that which we now observe in the case of Jupiter; namely, that while the actual body of the earth would have been hid by the vast vapor envelope then surrounding it, the tremendous convulsions going on within this veil would have been indicated by streaks and disruptions in the belts; and those, again, mottled over with markings, such as we observe in the case of the entire surface of Jupiter; and by reason of the belchings forth of the monstrous volcanoes which at that period must have been so tremendously active on the earth, the vapor envelope would be most probably marked here and there with just such dingy and black-and-white patches, as form so remarkable features about the equatorial region of Jupiter — probably the result of volcanic matter, such as ashes, &c. — which the several volcanoes may from time to time vomit forth, and send so far up into its cloudy atmosphere as to appear on the exteriors, and so cause those remarkable features which so often manifest themselves on the exterior of his vapor envelope; for I doubt if we have ever seen the body of Jupiter yet, which will probably remain veiled from mortal eyes for countless ages to come, or until he be so cooled down as to permit of a permanent residuum on this surface of his ocean that is to be. In applying these views to Saturn, it occurs to me that we may in that respect obtain some glimpse into the nature of those causes which have induced, and are now apparently inducing, those changes in respect to the aspect of his rings, which have, more especially of late, attracted so much attention. If he also be so hot that his future ocean is also suspended as a vast vapor envelope around him, it is possible, I conceive, that some portion of this vapor may migrate, by reason of the peculiar electrical conditions which it is probable his rings may be in, in respect to the body of the planet; and that such migration of vapor in an intensely frozen state, as it must be in such situation, may not only appear from time to time, as the present *phantom ring* does, but also encrust the inner portion of the inner old ring with such coatings of hoar-frost, like crystallised water, as to cause the remarkable whiteness which so peculiarly distinguishes that portion of his rings.

OBSERVATIONS ON THE SUN.

M. Leverrier has presented to the French Academy new tables of the sun, which he is about publishing. Deduced from a comparison of theory with the observations which have been made since 1750 to our day, these tables will present the movement of the sun with as much precision as observation would give. M. Leverrier asserts that theory alone does not suffice to represent the total of observations made during the century just ended, not even if account be made of the influence of all the known masses of our planetary system; so that to make the new tables accord with the reality of facts, he has been obliged to correct the tables empirically, which operation corresponds to an influence whose real cause has not yet been discovered. "I think I have ground to conclude," said M. Leverrier, "that besides the movement whose cause is known to us, the solar perigee undergoes an oscillation whose amplitude is 60, and the period 66⅔ years. When we do not stop at the observations of 1755, 1801, and 1845, but consider besides the intermediate determinations, it will be seen that the greatest equation of the centre also presents a slight secular variation; and further, that the secular variation of that element cannot be entirely produced by the masses at present admitted into the reckoning." M. Leverrier thinks the time has not yet come to indulge in conjectures as to the cause of these errors. Other researches, which demand a great deal of time, and which are already commenced, are indispensable to the clearing up of this subject. *It may be that we know only a small part of the matter contained in the celestial regions.*

ADVANTAGES OF THE CLIMATE OF PERSIA FOR ASTRONOMICAL OBSERVATIONS.

The following extracts are derived from a letter written by the Rev. Mr. Stoddart, an American missionary, to Sir John Herschel, dated Oroomiah, Persia, October, 1852. "No one has ever travelled in this country without being surprised at the distinctness with which distant objects are seen. Mountains fifty, sixty, and even a hundred miles off, are projected with great sharpness of outline on the blue sky: and the snowy peak of Ararat is just as bright and beautiful when two hundred miles distant, as when we stand near its base. This wonderful transparency of the atmosphere frequently deceives the inexperienced traveller; and the clump of trees, indicating a village, which seems to rise only two or three miles before him, he will be often as many hours in reaching. In this connection you will be interested to know that the apparent convergence of the sun's rays, at a point diametrically opposite its disc, which, if I mistake not, Sir David Brewster speaks of as a very rare phenomenon, is here so common that not a week passes in summer, when the whole sky at sunset is not striped with ribbons, very much like the meridians on an artificial globe. But it is after nightfall that our sky appears in its highest brilliancy and beauty. Though accustomed to watch the heavens in different parts of the world, I have never seen anything like the splendor of a Persian summer evening. It is not too much to say that, were it not for the interference of the moon, we should have seventy-five nights in the three summer months, superior for purposes of observation to the very finest nights which favor the astronomer in the New World. When I first came here I brought with me a six-foot Newtonian telescope of five inches aperture, of my own manufacture, and though the mirrors have since been much tarnished, and the instrument otherwise injured, its performance is incomparably superior to what it was in America. Venus sometimes shines with a light so dazzling, that at a distance of thirteen feet from the window I have distinguished the hands of a watch and even the letters of a book. Some few months since, having met with the statement that the satellites of Jupiter had been seen without a glass on Mount Etna, it occurred to me that I was in the most favorable circumstances possible for testing the power of the unassisted eye, and I determined at once to make some experiments on the subject. My attention was, of course, first turned to Jupiter, but for a considerable time with no success. It was always so bright, and shot out so many rays, that it seemed quite impossible to detect any of its moons, even at their greatest elongation from the planet. I varied the experiment in several ways, by looking through the tube of a small telescope, from which the lenses had been taken, and also by placing my eye near the corner of a building, so as to cut off the most brilliant rays of the planet, and yet leave the view unobstructed to the right hand or the left; but in neither case could I find any satellite. Some time after, I was sitting on the terrace as daylight was fading into darkness, and thought I would watch Jupiter from its first distinct appearance till it shone out in its full splendor. This time I was exceedingly gratified, just as stars of the first and second magnitude were beginning to appear, to see two extremely faint points of light near the planet, which I felt sure were satellites. On pointing my telescope towards them, my first impressions were confirmed, and I almost leaped for joy. Since that night I have many times, at the same hour of the evening, had a similar view of these telescopic objects, and think I cannot be mistaken as to the fact of their visibility. I must, however, add that none of my associates, who at my request have attended to the subject, are *sure* that they detect them, though the most sharp-sighted individual feels some confidence that he can do so. As these friends, however, are not practical observers, their failure to see the satellites does not shake at all my belief that I have seen them myself. The time during which these satellites are visible is hardly more than ten minutes. The planet itself soon becomes so bright that they are lost in its rays. I will not stop to discuss the question, in itself a most interesting one, why they are visible at all, when stars of the third and fourth magnitude are not distinguishable, but merely give the facts in the case, knowing that you will reason on them far better than I can. Both the fixed stars and the planets shine here with a beautifully steady light, and there is little twinkling when they are forty degrees above the horizon. Having come to a satisfactory conclusion about the satellites of Jupiter, I turned next to Saturn. This planet rose so late in the night, that I had not seen it while watching Jupiter, and I was very curious to know whether any traces of a ring could be detected by the naked eye. To my surprise and delight, the moment I fixed my eyes steadily upon it, the elongation was very apparent, not like the satellites of Jupiter, at first suspected, *guessed* at, and then pretty clearly discernible, but such a view as was most convincing, and raised my wonder that I had never made the discovery before. I can only account for it from the fact that, though I have looked at the planet here with the telescope many times, I have never scrutinised it carefully with the naked eye. Several of my associates, whose attention I have since called to the planet, at once told me in which direction the longer axis of the ring lay, and that too without any previous knowledge of its position or acquaintance with each other's opinion. This independent collateral testimony is very satisfactory to me. I have somewhere seen it stated that in ancient works on astronomy, written long before the discovery of the telescope, Saturn is represented as of an *oblong* shape; and that it has puzzled astronomers much to account for it. Am I not correct in this impression; and if so, is it not possible that here on these elevated and ancient plains, where shepherds thousands of years ago watched their flocks by night, and studied the wonders of the glorious canopy over their heads, I have found a solution of the question? After examining Saturn I turned to Venus. The most I could determine with my naked eye was, that it shot out rays unequally, and appeared not to be round; but, on taking a dark glass of just the right opacity, I saw the planet as a very minute but beautifully defined crescent. To guard against deception, I turned the glass different ways and used different glasses, and always with the same pleasing result. Let me say here that I find the naked eye superior for these purposes to a telescope formed of spectacle glasses, of six or eight magnifying power. This is not, perhaps, very wonderful, considering that in direct vision both eyes are used, without the straining of any one of the muscles around them, and without spherical or chromatic aberration or the interposition of a dense medium.

SOLAR PHENOMENA.

At a meeting of the Astronomical Society, May 13th, Mr. James Nasmyth presented an account of some experiments which he had tried, with the hope of imitating some of the phenomena of a total solar eclipse, and thus obtaining a sight at the red projections from the edge of the sun. It is, however, evident, that though the image of the sun itself may be completely and exactly concealed by some contrivance in the eye-piece, or permitted to pass through an aperture into a dark chamber, while the equatorial movement is regulated precisely to apparent solar time, yet there will remain a great and, I fear, insurmountable obstacle, in the luminosity of the earth's atmosphere, enlightened by the sun's rays. This difficulty appears to have been overlooked. If a telescope furnished with an eye-piece having a very small field, or half the field covered, be directed to the sky close to the border of the sun, the sun itself being just excluded, the glare is far too powerful to be endured by the eye without the interposition of a pretty deep tint of darkening glass. Such, at least, has been the case under the most favorable circumstances of clear and deep blue sky, during which I have been able to try the experiment. In the autumn of 1851, after my return from observing the total solar eclipse in Sweden, it occurred to me that the best chance of obtaining a sight of these phenomena might be afforded by taking advantage of that state of sky, lovely indeed, but too rarely seen in this country, when detached and sharply defined clouds are slowly moving over the deep blue surface of the heavens. On two or three such occasions, the clock-movement of my equatorial having been carefully regulated, I watched the passing of well-defined clouds over the sun, which certainly seemed to produce a rather darker tint of sky in the immediate vicinity of the sun's edge than any artificial contrivance in the eye-piece. Yet the advantage gained was not such as to give the slightest hope of success. If it is at all possible to render these extremely delicate phenomena visible by artificial means, it will probably be accomplished by erecting a suitable instrument on the top of one of the highest accessible mountains in a fine climate, like that of Oroomiah in Persia, as described by Mr. Stoddart, where the smaller density of the atmosphere and its great dryness exceedingly diminish its illumination by the sun's rays. A telescope of very moderate size might answer the purpose, if equatorially mounted and driven accurately by clock-work.

LUNAR VOLCANOES.

The following observations on the nature of lunar volcanoes have been made by Prof. Secchi, of Rome.

"The first class of the lunar volcanoes possesses a distinctive character; the edges of the craters are almost completely obliterated, so that their border now is a continuation of the plane ground, in which they seem excavated, and a deep well only remains in the place of the ancient mouth of the volcano. Instances of this kind are very frequent near the south pole of the moon, and around the large spot Tycho; but Tycho itself does not belong to this class. The physiognomy of these craters nearly resembles our submarine volcanoes of the Monti Ciminii, to the N. W. of Rome. The country around the craters of Bracciano, Bolsena, and di Vico, is almost flat, and the old openings of the craters are now deep lakes. On this ground we are led to believe that even in the moon many subaqueous volcanoes existed. Another distinct character of these volcanoes of the first class is, that they are in a line, as if they burst from the cracks of the solid body of the crust produced by earlier formations; this is most striking in Arzahel, Alphonsus, and many others, and they seem to follow the cracks made by the *soulevement* which raised Tycho, the lunar Apennines, &c. Some of the higher chains of lunar mountains are seen visibly parallel to the allignment of the craters: this fact also is like that which we observe on the earth; indeed, the large Italian volcanic chain follows the line of the Apennines along this country.

"The second class of lunar volcanoes are those which have their outside edges elevated above the surrounding plane; their form is generally regular, and not broken, as those of the preceding class, and the ground around them is elevated in a radiating disposition, as is visible around Tycho, Copernicus, Aristotle, &c. The regularity of their forms suggests that the ejected matter was not disturbed by the motion of waves, and, consequently, that they were atmospherical volcanoes, like those of the Monti Laziali, Albani, and Tusculani, at the south-east of Rome; the want of breach in the craters seems to indicate that no lava, but only scoriæ and loose matters, have been ejected. The disposition of the soil around them suggests the opinion that they are of a comparatively later epoch, and formed after the crust of the satellite was pretty resistant, and was capable of being elevated all round by a great effort. It is singular, indeed, that this *radiation* of the soil around is found proportional to the magnitude of the central crater. The effect of this *soulevement* extended sometimes to a prodigious distance, comparable to that of the Cordilleras of the Andes on the earth. The greater part of the craters of both the classes now described possesses an insulated rock inside, very seldom appearing (at least in commonly good telescopes) perforated. This bears great analogy with what we see in more than one place in the ancient volcanoes of the earth, where the erupting mouth has been stopped by a dome of trachytic matter as by a stump. Monte Venere, near Rome, is of this formation, and lies in the centre of an immense old crater.

"The third class of lunar craters is very small, and bears a great likeness with those called by geologists adventitious craters, and seems to be of a very late formation, the last efforts of the expiring volcanic force. They are irregularly scattered through all the moon, but occur more frequently at the borders or inside of the old demolished craters, though not concentric with them, and seem to have been produced after the large ones were completely closed, either by trachytic ejection or by becoming lakes. These small craters have very seldom rocks inside, or a flat bottom; but their cavity is conical, and does not exceed in dimension our common volcanoes, which are yet active on the earth. From these facts and observations it appears, that volcanic action has gone on in the moon through all the same stages which it has gone and is going on in the earth, and is there probably completely extinguished, on account of the smaller mass of the moon, which has been cooled very rapidly. This rapidity of cooling, joined with the smaller gravity, may account for the great development of volcanism there, and comparatively fewer Plutonian formations. But extensive instances of this kind are not wanting; the lunar Alps, the Apennines, the Ripheæ, &c., may represent this formation, surrounding vast basins, and having modern volcanoes following the direction of the higher edges of their chains. Professor Ponzi seems to think it unquestionable that water existed at the surface of the moon; the fierce glare of the sunshine is not able to melt the ice there, which is probably at the temperature of the planetary spaces; just as the sun at the surface of the earth is not able to melt our glaciers, which yet possess a certainly higher temperature. Cold, and other unknown causes, may have absorbed and fixed all the atmosphere which anciently existed, as we see that the immense atmosphere which anciently surrounded the earth has been fixed by several chemical processes, and reduced to its actual composition; and it might be possible that this actually existing atmosphere of ours should be all solidified, either by cold or chemical processes, if the earth arrives at the same degree of cold which seems to have place on the moon.

METEROLOGICAL INFLUENCE OF THE SOLAR SPOTS.

M. R. Wolf, in a communication to the Academy, *Comptes Rendus* xxxv., gives the following abstract of his Memoir upon the connection of the Solor Spots with terrestrial magnetism, &c. He observes,

"In the first chapter I have shown (founded upon sixteen different epochs, established by the minimum and maximum of the solar spots) that the mean period of these spots may be put at 11-11 + 0,038 years, nine periods being equivalent to a century. In the second chapter I have established, that in each century the years 0 00, 11-11, 22-22, 33-33, 44-44, 55-56, 66-67, 77-78, 88-89, correspond to the minimum of the solar spots, the interval between the minimum and maximum is variable, the mean being five years. The third chapter contains an enumeration of all the observations of the solar spots, from Fabricius and Scheiner to Schawbe. The fourth chapter shows the remarkable analogies between the solar spots and variable stars, from which an intimate connection may be presumed between these singular phenomena. In the fifth chapter I have shown that my period of 11-111 years corresponds more exactly with the variations in magnetic declination, than the period of 10½ years established by M. Lamont. The magnetic variations accompany the solar spots not only in their regular changes, but even in their minor irregularities: this latter fact is itself sufficient to prove definitely the important relations between them. The sixth chapter gives a comparison between the period of the solar spots, and the meteorological phenomena contained in a Swiss Chronicle for the period 1000 — 1800. It results (conformable to the idea of Sir William Herschel) that the years in which the spots are most numerous, are generally drier and more productive than the others, the latter being more humid and showery. The auroras and earthquakes, indicated in the Chronicle, increase in a striking manner in the years of the spots.

INDICATIONS OF WEATHER AS SHOWN BY ANIMALS, INSECTS, AND PLANTS.

The following interesting communication was made to the American Association, Cleveland, by Mr. W. B. Thomas, of Cincinnati, Ohio.

The possibility of foretelling weather has occupied the attention of observers of natural facts, from the earliest period of our records; the certainty with which anything is arrived at on this subject, like all other parts of natural science, depends upon the knowledge acquired of those things with which nature has most intimately connected it.

Without indulging in any comment, I will state a few particulars in regard to the different indicators with which nature has supplied us.

When a pair of migratory birds have arrived in the Spring, they immediately prepare to build their nest, making a careful reconnoisance of the place, and observing the character of the season that is coming. If it be a windy one, they thatch the straw and leaves on the inside of the nest, between the twigs and the lining; and if it be very windy, they get pliant twigs and bind the nest firmly to the limb, securing all the small twigs with their salivas. If they fear the approach of a rainy season, they build their nests so as to be sheltered from the weather. But if a pleasant one, they build in the fair open place, without taking any of those extra precautions. In recording these facts, we have kept duly registered the name of the bird — the time of arrival in Spring — the commencement of nesting — the materials of nest, and its position — the commencement of laying — number of eggs in each nest — commencement of incubation — appearances of young — departure in Autumn.

But it is our insects and smaller animals which furnish us with the best means of determining the weather.

We will now take the Snails and show the various phenomena they present. These animals do not drink, but imbibe moisture in their bodies during a rain. At regular periods after the rain they exude this moisture from their bodies. We will take, for example, the *Helix alternata*. The first fluid exuded is the pure liquid. When this is exhausted, it then changes to a light red, then deep red, then yellow, and lastly to a dark drown. The *Helix* is very careful not to exude more of its moisture than is necessary. It might exude it all at once, but this is not in conformity to its general character, as this would prove too great an exertion. The *Helix alternata* is never seen abroad, except before a rain, when we find it ascending the bark of trees and getting on the leaves. The Helices *arborea*, *indentata*, *ruderati*, and *minuta*, are also seen ascending the stems of plants two days before a rain. The *Helices clausa*, *ligera*, *Pennsylvanica*, and *elevata*, generally begin to crawl about two days before the rain will descend. They are seen ascending the stems of plants. If it be a long and hard rain, they get on the sheltered side of the leaf, but if a short one, they get on the outside. The *luccinea* have also the same habits, differing only in color of animals, as before the rain it is of a yellow color, while after it is a blue. The *Helices solitaria*, *zaleta*, *albolabris*, and *thyroideus*, not only show signs by means of exuding fluids, but by means of pores and protuberances. Before a rain, the bodies of *zaleta* and *H. thyroideus* have large tubercles rising from them.

These tubercles commence showing themselves ten days previous to the fall of rain they indicate; at the end of each of these tubercles is a pore. At the time of the fall of the rain, these tubercles with their pores opened, are stretched to their utmost to receive the water. Also, for a few days before a rain, a large and deep indention appears in the *H. thyroideus*, beginning on the head between the horns, and ending with the jointure at the shell. The *Helices solitaria* and *zaleta*, a few days before a rain, crawl to the most exposed hillside, where, if they arrive before the rain descends, they seek some crevice in the rocks, and then close the aperture of the shell with glutinous substance, which, when the rain approaches they dissolve, and are then seen crawling about. In the *Helix albolabris*, the tubercles begin to arise after a rain, while before they grew smaller, and at the time of the rain, the body of the snail is filled with cavities to receive the moisture. The *H. zaleta*, *thyroideus* and *albolabris*, move along at the rate of a mile in forty-four hours. They inhabit the most dense forests, and we regard it as a sure indication of a rain to observe them moving towards an exposed situation. The *Helices appressa*, *tridentata*, *falla*, and *paliata*, indicate the weather not only by exuding fluids, but by the color of the animal. After a rain, the animal has a very dark appearance, but it grows of a brighter color as the water is expended; while just before the rain, it is of a yellowish white color. Also just before a rain, striæ are observed to appear from the point of the head to the jointure of the shell. The superior *tentacula* are striated, and the sides are covered with tubercles. These *Helices* move at the rate of a mile in 14 days and 16 hours. If they are observed ascending the cliff, it is a sure indication of a rain. They live in the cavities in the side of cliffs. The *Helix hirsuta* is of a black color after a rain, but before, it is of a brown, tinged with blue around the edges of the animal. The *tentacula* are marked by a cross striæ, and there is also to be seen, a few days before the rain, an indentation which grows deeper as the rain approaches; this Helix also exudes fluids, but not with the changes of color of those before mentioned.

We can also foretell a change of weather by the Wasps and other insects.

The leaves of trees are even good barometers; most of them for a short, light rain, will turn up so as to receive their fill of water; but for a long rain, they are so doubled as to conduct the water away.

The *Rana*, *Bufo* and *Hyla*, are also sure indicators of rain, for, as they do not drink water, but absorb it into their bodies, they are sure to be found out at the time they expect rain.

The *Locusta* and *Gryllus* are also good indicators of a storm. A few hours before the rain they are to be found under the leaves of trees and in the hollow trunks. We have many times found them thus, but we have never known the instinct of these little fellows to lead them to unnecessary caution.

MEDICAL METEOROLOGY.

Our attention has been drawn to a paper in the *Association Medical Journal* on Medical Meteorology. The object of the paper is, to draw the attention of medical men to the importance of the registration of disease in connexion with the conditions of the atmosphere. We have often pointed out the present unsatisfactory method of generalizing with regard to the influence of climate and weather on the results of disease. The following supposed case, from the paper alluded to, illustrates our remarks: — "A patient was seized by an attack of bronchitis on the 7th of April in any year, and during the prevalence of a cold northeasterly wind; that the patient died on the 14th; and that on the 17th the death was registered; but meanwhile, that, on the 13th, the wind had changed to a mild southwesterly breeze; it is obvious that the registration of the death on the 17th could have no value as a medico-meteorological fact." The facts that are wanted to be of value in such a case are, the dates of the first seizure and the state of the weather previous to that time. A moist and warm atmosphere, or a cold and dry one, may suddenly set in and terminate a number of cases which have been very variously commenced. In order to supply the information desired, the *Association Medical Journal* has undertaken to publish Meteorological Tables in connexion with the history of particular cases of disease. In this way we have no doubt that some important facts will be elicited. Already the physiologist is in possession of a large number of facts which show the influence of the great forces of Nature on the life of the organic world; and the prosecution of this subject by the medical man will be but the following out of these researches, and giving to us a more intimate knowledge of the laws which control the existence of organic beings on the earth.—*London Athenæum.*

ON THE RISING OF WATER IN SPRINGS IMMEDIATELY BEFORE RAIN.

The following paper was read to the American Association by Prof. Brocklesby, of Hartford, Conn.

My attention was particularly called to this phenomenon during the close of the summer of 1852, while residing for a few weeks in Rutland, amid the highlands of Vermont.

In the western portion of the town is a lofty hill, rising to the height of about 400 feet above the Otter Creek valley. Near the summit of the hill a small spring bursts forth, the waters of which are conveyed in wooden pipes to the barn yards of two farm houses situated on the slope of the hill; the first being about a quarter of a mile distant from the spring, and the second nearly one-third of a mile. At the latter house I resided.

The waters of the spring are not abundant, and during the summer months frequently fail to supply the aqueduct. Such was the state of the spring when I arrived at Rutland; for the summer had been extremely dry, the brooks were unusually low, and the drought had prevailed so long that even the famed Green Mountains had in many places begun to wear a russet livery. The drought continued, not a drop of rain falling, when one morning a servant, coming in from the barnyard, affirmed that we should soon have rain, as the water was flowing in the aqueduct—the spring having risen *several* inches. The prediction was verified, for within two or three days, rain fell to a considerable depth. In a short time the spring again sank low, and ceased to supply the aqueduct; but one cloudless morning, when there were no visible indications of rain, its waters once more rose—flowing through the entire length of the aqueduct—and, ere twenty-four hours had elapsed, another rain was pouring down upon the hills. On inquiry, it was ascertained from the residents in the vicinity that the phenomenon was one of ordinary occurrence, and that, for the last *twenty years, the approach of rain was expected to be indicated by the rising of the spring.*

Interested by these facts, I sought for others of the like nature, and requested through the public prints information upon this subject from all who happened to possess it,—and also upon collateral points which were conceived to have important relation to this phenomenon. I was rewarded by the knowledge of only one additional instance, existing in Concord, Massachusetts, where a spring that supplies a certain brook, is said to rise perceptibly before a storm.

The cause of this phenomenon has been attributed, by some, to the fall of rain at the distant sources of the spring, a short time previous to its descent in the vicinity of the spring itself; but this view is doubtless erroneous, since it is altogether improbable that rain should fall at two distant localities, year after year, with the same constant period of time between them, and that this interval should be such as to ensure that water falling at the first locality, should *always* arrive through subterraneous channels at the second, before the rain there commenced.

I have not been able to ascertain the state of the barometer, either at Rutland or at Concord, at the times when the phenomenon in question occurs; nevertheless, I believe the true solution will be found in the *diminished atmospheric pressure, which exists before a rain.*

The waters of a spring remain at any given level, because the atmospheric and hydrostatic pressure combined, exactly counterbalance the upward force of the jet. The spring will, therefore, rise either when the force of the jet is increased, while the atmospheric pressure continues the same, or when the latter is diminished, while the former remains constant; and the elevation is greatest of all when the decrease in the density of the atmosphere occurs simultaneously with an increase in the strength of the jet.

The rising of the water in the instances related, cannot, I think, in view of the facts detailed, be fairly attributed to any sudden augmentation of force in the current of the springs, but is to be regarded as the result of diminished atmospheric pressure occurring at the particular times, in perfect accordance with known meteorological laws. I am not aware that it has yet been ascertained whether this phenomenon is local or general. If the latter should be found true, and the explanation given correct, we arrive at the curious discoveries that the springs and fountains of the earth are *natural barometers*, whose indications may, perhaps, be worthy of notice in future physical investigations.

INTERESTING METEOROLOGICAL OBSERVATIONS.

The account of the meteorological observations made during the scientific balloon ascents last year, by Mr. Welsh, of the Kew Observatory, have recently been published under the direction of the Royal Society.

The principal results deduced from the experiments described are thus stated. The temperature of the air decreases uniformly with the height above the earth's surface, until at a certain elevation, varying on different days, the decrease is arrested, and for a space of from 2000 to 3000 feet, the temperature remains nearly constant, or even increases by a small amount; the regular diminution being afterwards resumed, and generally maintained, at a rate slightly less rapid than in the lower part of the atmosphere, and commencing from a higher temperature than would have existed but for the interruption noticed. This interruption in the decrease of temperature is accompanied by a large and abrupt fall in the temperature of the dew-point, or by actual condensation of vapor, from which it may be inferred that the disturbance in the progression of temperature arises from a development of heat in the neighborhood of the plane of condensation. The subsequent falls in the temperature of the dew-point are generally of an abrupt character, and corresponding interruptions in the decreasing progression of temperature are sometimes distinguishable, but in a less degree, as might be expected from the fact, that at lower temperatures the variations in the absolute amount of aqueous vapor are necessarily smaller, and their thermic effects consequently diminished. The analysis of the portions of air collected in the ascents is reported by Professor Miller, of King's College. The proportions of oxygen and nitrogen were determined by detonation with hydrogen in Regnault's endiometer. The volumes of oxygen in the air from different heights are given in the following table:—

	Altitude.	Volume of Oxygen.
Air collected at King's College,	....	20·920
Tube 2,	13,460 feet.	20·888
Tube 3.	18,000 feet.	20·747
Tube (G 1) Torricellian vacuum,	23,630 feet.	18·888

These results confirm the statement made long ago by Gay Lussac, at a time when gaseous analysis was less perfect than at present, that there is no sensible difference in the composition of the atmosphere on the surface and at the greatest heights accessible to man, so far as the proportions of oxygen and nitrogen are concerned. The quantities of air submitted to Professor Miller were too small to admit of the proportion of carbonic acid being determined, but its presence seems to have been shown in all by the formation of a film of carbonate of lead upon a solution of the subacetate, which was introduced to a portion of the air confined over mercury.

GEOGRAPHY AND ANTIQUITIES.

THE ARCTIC SEARCH.

The returns for 1853 from the Arctic expeditions in search of Sir John Franklin have announced to us the greatest victory since Magelhaens doubled the southern point of the continent, and passed into the Pacific ocean. The leading feature of interest lies in the fact, that the problem of a passage for ships between the Atlantic and the Pacific Oceans, north of the American continent — a problem which has engaged the enterprise of maritime nations, and particularly of our own, for upwards of three centuries — has been finally solved. Capt. M'Clure has succeeded in navigating his ship from Behring's Strait, in the west, to within about sixty miles of Melville Straits, — and was, according to the last accounts, waiting only for the disruption of the ice to pass through those straits and return by the eastern outlet to England. The problem had long since been stript of all that portion of its interest which was reflected on it from the field of commercial speculation; but its solution, after ages of such perilous adventure as that by which it has been sought, is a great scientific triumph. When on the eve of sailing, Capt. M'Clure emphatically declared that he would find Sir John Franklin and Capt. Crozier, — or make the northwest passage. He has, geographically speaking, redeemed the latter part of his pledge: — but the fate of those gallant Commanders and their crews is hidden yet amid the dark and labyrinthine ice-paths of the Arctic seas. The scientific secret of centuries has been wrenched at last from the Spirit of the North; — but the human secret which in these latter days the heart of more nations than our own has so yearned to solve, he guards yet, in spite of all questioning, in some one of his drear and inaccessible caves.

It will be remembered by those who have followed the history of the Arctic expeditions, that Capt. M'Clure was first lieutenant of Sir James Ross's ship Enterprise, — and having been promoted, volunteered for the second expedition by way of Behring's Strait. He was appointed to the command of the Investigator, under Capt. Collinson, of the Enterprise; and proceeded with that officer to Behring's Strait in the early part of 1850. Capt. Collinson having failed to penetrate the pack ice, parted from Capt. M'Clure, and sailed to Hong Kong, where he wintered; but the latter, notwithstanding a signal of recall from Capt. Kellett, of the Herald, who was the chief officer on that station, dashed onwards with a bold determination to force a passage to the northeast, — taking on himself all the responsibility of disobeying orders. Fortunately, his daring has been crowned with success; and it is not a little singular that Capt. Kellett, who was the last person seen by Capt. M'Clure when he entered the ice on the west, — should have been the person to rescue him, at the expiration of three years, on the side of Melville Island on the east.

It was observed by Sir Edward Parry, in his first voyage, that the current in the Polar Seas ran from West to East, and that the progress of an exploring vessel would be made most easily in that direction. Following this suggestion, Captain Beechy was sent out in the Blossom, in 1825, and entered the Arctic ocean from Behring's Strait, and carried further the line of American coast upon the charts than had been done before. One of his officers advanced to the point marked Boat Extreme. Since that voyage, in consequence of the experience of Sir George Back, in the Terror, 1836–7, in which that vessel never came to anchor, but spent the winter frozen in the ice, and drifting with it, the opinion of Arctic navigators has been, that much time was saved in the spring by such a system of wintering. Sir John Franklin himself expressed his intention to winter in the ice, under certain circumstances; and it was thus that our own countrymen, in the Advance and Rescue, spent the winter in their expedition for Sir John's relief. In that case the ice took them bodily back by drifting more than a thousand miles, and left them in the waters of Baffin's Bay, about where they were twelve months before.

Commander M'Clure has availed himself of this same Arctic current, flowing from West to East, by wintering in the same manner. That is, he permitted his vessel to be frozen up, without coming to a harbor, in the winter of 1850. As early as the 26th of October of that year, he ascertained that the waters of the strait in which he then was, which he called the Prince of Wales's Strait, communicated with the waters of Barrow's Strait, on the eastern side of the continent. He had therefore made the great discovery, of which we have but now learned, three years ago. This established the existence of a Northwest Passage! Had the sea remained open a few days more, the expedition would have made the passage, — not only in one season, but in the short space of little more than two months and a half.

It appears that the Investigator, after rounding Point Barrow, in August, 1850, and being detained by thick fogs and contrary winds in Colville River, reached the mouth of the Mackenzie River and Cape Bathurst. When at Cape Parry, Capt. M'Clure was induced by the sight of open water to push for Banks's Land, and at the distance of sixty miles fell in with an unknown coast, which he named Baring Island. Passing up a strait between this island and a coast called Prince Albert's Land, he reached lat. 73°, and was impeded by ice from making any further progress. The ship drifted a little to the southward, and was frozen up for the winter. In July of the following year an attempt was made to push northward towards Melville Island, but the ice in lat. 75° 35′ was impenetrable. An attempt was then made to round the southern shore of Baring Island, and with great peril to the vessel Capt. M'Clure succeeded in reaching lat. 74° 6′. Here, however, the ship became frozen in, and has remained ever since. At this point Capt. M'Cure was preparing at all risks to desert the ship, when an officer arrived from the Resolute, with a surgeon, whom Capt. Kellett had sent to report on the health of the crew. In the summer of 1851, Capt. M'Clure made further explorations, and a year ago last spring went across with sledges to the region already explored by the parties from this side, but unfortunately without meeting anything but their farthest deposited memoranda. His winter quarters have been in a bay to which he gives the name of the Bay of Mercy, Baring's Island, at the east end of the cliffs of Banks Land. Banks Land was laid down on the maps, by Sir Edward Parry, who saw it from a distance, in 1820. From this point Com. M'Clure crossed with his crew, but of course without his ship, to Melville Island, last April.

This drifting round from Behring's Straits to Banks Land, and so home across land by way of Davis's Straits, is what has been called "The Discovery of the North-West Passage;"—and so will probably end this "strange, eventful history."

With respect to the navigation of the North-West Passage, which is a subject of great geographical interest, Capt. M'Clure observes:—"A ship stands no chance of getting to the westward by entering the Polar Sea,—the water along shore being very narrow and wind contrary, and the pack impenetrable; but through the Prince of Wales Strait, and by keeping along the American coast, I conceive it practicable. Drift-wood is in great abundance upon the east coast of the Prince of Wales Strait, and on the American shore,—also much game. The hills in this vicinity abound in rein-deer and hares, which remain the entire winter:—we have procured upwards of 4,000 lbs." From the observations which were made, it appears that the set of the currents is decidedly to the eastwsrd. "At one time," says Capt. M'Clure, "we found the set as much as two knots in a perfect calm, and that the flood-tide sets from the westward we have ascertained beyond a doubt, as the opportunities afforded during our detention along the western shore gave ample proof." This is one of the important facts of Capt. M'Clure's enterprise, and establishes the propriety of making any future attempt at a passage which might be required from the side of Behring's Strait.

We now turn to Sir. E. Belcher's despatches;—which, if not so interesting in a geographical point of view as those of Capt. M'Clure, yet contain many important features. At the head of these may be placed,—first, the existence of a polar sea, which Sir Edward feels convinced is now placed beyond a doubt;—and secondly, the discovery of what we would gladly hope may be further traces of Franklin.

When Capt. Inglefield left Beechy Island last year, he brought home the intelligence that Sir E. Belcher had gone up Wellington Channel, and had been absent three weeks. It now appears that he reached Cape Beecher to the north-east, near which, in lat. 76° 52′ and long. 97° W., a locality was found for winter quarters. Apprehensive that the open season was fast approaching to a close, preparations were made for boat and sledge explorations to the northward:—and these were commenced on the 23d of August. On the 25th, when rounding a point where the coast suddenly turns to the eastward, the remains of several well-built Esquimaux houses were discovered. "They were," says Sir E. Belcher, "not simply circles of small stones, but two lines of well laid wall in excavated ground, filled in between by about two feet of fine gravel, well paved, and withal presenting the appearance of great care—more, indeed, than I am willing to attribute to the rude inhabitants or migratory Esquimaux. Bones of deer, wolves, seal, &c., numerous. Coal found." There is no mention of any search having been made for a record, though in all probability this was not neglected; yet the absence of any cairn would seem to render it unlikely that a document existed. It will be observed that Sir E. Belcher does not hazard an opinion, as to whether these huts were built by Franklin's party or not; but if not by Esquimaux, it would be difficult to arrive at any other conclusion.

The explorations of Sir Edward and his officers led to the discovery of various lands, to the most extensive of which the name of North Cornwall was given, and of several islands washed by a sea open to the north, which, as we have stated, Sir E. Belcher regards as the Polar basin. Sir Edward gave the name of Victoria Archipelago to a group of islands in 78° 10′ N. lat.; and the easternmost, forming the channel to Jones's Strait, which communicates with the Polar sea, he named "North Kent." It is important to add, that as early as the 20th of May, he found the sea open in the latitude of Jones's Strait. His words are—"Polar sea as far as the eye could range." He also states that the tides were most apparent, setting from east to west.

Throughout the very interesting search, not a particle of driftwood was noticed since quitting the Esquimaux huts, and not a trace of human beings. Animal life seems also to fail in this district. "If our unfortunate countrymen," says Sir Edward Belcher, "have taken the floe and drifted with it, their case is hopeless. If we may judge from the aspect of the floes, where they had come into collision, or where they piled themselves in layers over forty feet on the northwestern extremities of the islands, the feeling was disheartening."

In regard to the final results of the various expeditions, the editor of the London Athenæum remarks:—It is of course quite possible that intelligence may yet arrive, from Sir E. Belcher or Capt. Kellett, announcing either the discovery of our long-lost countrymen, or that of further tracks of their route and their possible whereabout. We have yet to learn the result of the explorations of Capt. Kellett's officers; and we must not forget, that Capt. Collinson, who entered the ice at Behring's Strait in 1851, may by keeping a high north latitude strike their track. At the same time, although we have always leaned to the side of hope, bearing in mind the amazing quantity of animal life existing for the subsistence of the lost party in the Arctic regions, we cannot lose sight of the facts that the head waters of Wellington Channel have been partly explored without finding any vestige of Franklin or of his ships,—and that the explorations of Capt. M'Clure to the south-west of Melville Island prove beyond a doubt that they cannot be entangled in the ice in that locality. Our heart begins to faint, we must avow, beneath the burden of hope deferred. Vast, however, as is the area which has now been swept by our searching ships, a much larger field yet remains unexamined. We cannot expect, after all that has been done, with the now faint chance of saving life if discovered,—that the Admiralty will continue the search until the ground shall be exhausted; but we would fain have the promising route by Nova Zembla tried, and the Siberean coast explored. Then, if the result of Sir E. Belcher's deliberation at Beechy Island shall be, his return to England, and consequent abandonment of the search for Franklin in the waters to the north of Wellington Channel, shall we be satisfied with the very imperfect search in that direction which still holds out the greatest promise? Surely, when we are told of an open sea in May, and of a Polar basin free from ice, its navigation cannot be either difficult or tedious. Capt. M'Clure has shown us that one north-west passage exists; but we are much mistaken if other and more open passages far to the north across the pole itself will not be found.

MOUND EXPLORATIONS AT THE WEST.

The Wheeling (Va.) Intelligencer, Nov., 1853, publishes the following account of some recent explorations in an ancient mound at Grave Creek.

The mound in which these explorations have been carried, is the second in size of the Grave Creek group, and is distant, in a north-east direction, about one mile from the Mammoth Mound. It is about thirteen feet in height, and two hundred and forty feet in circumference.

In opening this tumulus, a drift was carried in from the southern side to the distance of about twelve feet. On examination, it was found that stone could be traced beneath, and accordingly the excavation was borne down so as to approach it. The stone work proved to have been a vault extending some fifteen or sixteen feet in its greatest diameter, and sinking to the depth of six feet in its center.

It had been constructed by sinking a cist six feet in depth, in a slight natural eminence, then rounding the sides up regularly, and covering the hole with stone, first, however, having deposited the ashes of their victims or friends, as the case may have been. Many of the stones were of large size, and all have been brought from the neighboring hills and creek. They were so firmly held in their places as to require much labor to remove them. They appear to have been placed on their edges, till within two or three feet of the center, where they are found lying flat.

On removing the stone, a stratum of ashes—supposed to be human—varying from one to four inches in thickness, was discovered. Specimens of these we have now before us, and the action of acid clearly indicates the presence of lime. But this is not all; particles of bone and charcoal are found intermingled with the ashes. Beneath the ashes was formed, first, a stratum of light brown clay, and then a similar deposite of sand.

The most singular and interesting feature of the mound was the center. Immediately beneath the ashes, and at the depth of eighteen feet from the summit of the mound, was discovered that which the gentleman conducting the examination believes to have been the altar. Covering a space of about three feet, directly in the center, was found, as already stated, several layers of large flat stone. Lifting these, appeared the usual deposite of ashes, which, on removal, revealed a well formed, compact body of white clay, some four inches in thickness, eighteen inches in breadth, and two feet in length. This was found, on careful examination, to rest upon a stratum of four inches in thickness, of very coarse sand. This was unmistakably the altar; and the mound, beyond all question, one of sacrifice. Its location outside of the general system of works on these flats, the peculiar construction of the vault, the unusual quantity of ashes found therein, with many other striking and concurring facts, clearly indicate the character and purpose of these quiet sleepers of the plain. Upon this point, however, we will not venture further until the explorations shall be completed.

Before entering fully upon the vault, the remains of a human skeleton, showing strong indications of fire, were found, and near by, two copper wristlets of very neat and truly artistic execution. These interesting relics are now before us, and excite, by their mysterious history, emotions of wonder and admiration. They are evidently of pure copper, and heavily coated with the green oxide of that metal. They are about $2\frac{1}{2}$ by $3\frac{1}{2}$ inches in their dimensions. A large flint spear point was found near the remains of the skeleton.

Before closing this hurried and imperfect notice, we will embrace the occasion to say, that a smaller mound, situated about one hundred and fifty yards south of the large tumulus, was opened at the same time the other researches were in progress. In it were found two human skeletons, in a tolerably good state of preservation. They appear to have been interred in a sitting posture, within what might be termed stone coffins. With these were discovered some bone instruments—one in the shape of a spoon, and a very handsome stone pipe.

THE SNOWY MOUNTAINS OF EASTERN AFRICA.

It is now upwards of four years since intelligence reached Europe of the discovery of snowy mountains in Eastern Africa. The discovery was in itself so remarkable, that the report, appearing as it did in rather an unscientific dress, did not at first gain universal credence. It was, however, subsequently confirmed by repeated journeys in that region. It need scarcely be added, that the mountains here alluded to are Kilimanjaro and Kenia, discovered by the missionaries Rebmann and Krapf, stationed at Rabbai Empia, near Mombas. Kilimanjaro lies in about 3½° south latitude and 37° east longitude, and about 160 geographical miles west-north-west from Mombas; and is an isolated, very conspicuous peak somewhat like Mount Ararat,—probably connected, on its western side, with the table-lands of Inner Africa. The missionaries have become acquainted with its eastern, southern, and northern aspects,—whereas the other peak, Mount Kenia, has been seen only from the south, at a distance of six days' journey, or about 80 geographical miles. It lies in about 1° south latitude and 38½° east longitude. Whether it forms an isolated peak similar to Kilimanjaro, or is connected with other mountains in the north, remained unknown to Dr. Krapf.

The missionaries, those pioneers of geographical discovery, commenced their journeys in 1847; and though the results of their labors are not exceeded in geographical interest and importance by any other discoveries made in recent times, it must be much regretted that they have hitherto failed in attracting scientific explorers to that very promising region.

Some additional information respecting this region has been published by Mr. Peterman, in the London Athenæum. He says as follows:—Capt. J. H. Short, who has been for some time in command of various vessels belonging to His Highness the Imaum of Muskat, has favored me with an account, from his personal experience, of the East African coast from Brava, north of the equator, to Delagoa Bay in the south, comprising the Zanzibar, Mozambique and Sofala coasts. This account contains important information respecting the hydrography of this extensive tract, its inhabitants, natural productions, and climate, as well as its commercial relations. Right under the equator, the Juba or Jub, a considerable river, enters the Indian Ocean. "The entrance of this river," says Capt. Short, "is open to the sea, and may be approached with safety in the fine weather season. I have ascended this river to a great distance, and found the natives quiet and ready to trade, particularly in cotton prints. It is not very high land, and the pasture is good. But at a distance inland I perceived high mountains, with white tops, lying north and south. They are said to contain mines. I was informed by the natives that the river extended far inland, and branched off in various directions. I ascended the river in a small schooner, and had ample room to beat about, taking the ground occasionally but not hurting the vessel,—the depth of water being good for small vessels. At some distance from the entrance a hard red iron-ore-like reef across the river exists, but a passage between may be found. My crew consisted of natives of the coast of Zanzibar, who stood the fatigue well." Capt. Short estimates the distance which he sailed up the river to be about 210 miles from its mouth, bearing about from west-north-west to north-west. From that point, the white-topped mountains bore to the southward of west a little, distance about 60 miles.

INFLUENCE OF THE MOON UPON THE CLOUDS.

The following paper was read at the Cleveland meeting of the American Association, by Prof. E. Loomis.

Sir John Herschel, in his " Outlines of Astronomy," page 261, has the following remarkable language : " The heat of the moon is much more readily absorbed in traversing transparent media, than direct solar heat, and is extinguished in the upper regions of our atmosphere, never reaching the surface of the earth at all. Some probability is given to this by the *tendency to disappearance of clouds under the full moon*, a meteorological *fact*, (for as such we think it fully entitles to rank,) for which it is necessary to seek a cause, and for which no other rational explanation seems to offer." In a note on the same page, he informs us that this fact rests upon " his own observations, made quite independently of any knowledge of such a tendency having been observed by others." Humboldt, however, in his personal narrative, speaks of it as well known to the pilots and seamen of Spanish America.

Having made a pretty extensive comparison of observations several years since, for the purpose of determining the influence of the moon's phases upon the fall of rain, I was led to distrust the preceding conclusion of Sir John Herschel, and have accordingly sought for observations by which its accuracy might be tested. For this purpose, I turned to the Greenwich Meteorological Observations, where we find the amount of cloudiness of the sky recorded every two hours, night and day, for a period of some years. I arranged all the observations in a tabular form, showing in one column, the average amount of cloudiness on the day of each full moon for the whole period; the second column shows the amount of cloudiness on the day after full moon; the succeeding columns show the degree of cloudiness on the second day after full moon ; the third, fourth, etc., days up to the last quarter; and other columns show the cloudiness for days preceding the full. In the accompanying table, in like manner, the observations are arranged for new moon, and also for the preceding and following days. I then took the average of all the numbers in each column and obtained the following results :

	Average Cloudiness.		Average Cloudiness.
Full moon	6.8	Day of new moon	6.8
First day after full	6.7	First day after new	6.6
Second day after	6.1	Second day after	6.6
Third day after	6.9	Third day after	6.6
Fourth day after	7.0	Fourth day after	6.8
Fifth day after	6.9	Fifth day after	6.5
Sixth day after	6.9	Sixth day after	6.4
Third quarter	6.9	First quarter	6.7
Sixth day before new	6.6	Sixth day before full	6.6
Fifth day before	6.5	Fifth day before	7.0
Fourth day before	6.3	Fourth day before	6.6
Third day before	6.6	Third day before	6.5
Second day before	6.6	Second day before	6.8
First day before	6.4	First day before	7.6

These numbers indicate but slight deviation from 6.7, which is the average cloudiness of the whole period, (10 representing a sky perfectly overcast.) In other words, exactly two-thirds of the sky at Greenwich is, upon an average, covered, with clouds. The greatest departure from the mean, occurs on the second day after full, when the average is 6.1 This might be suspected to indicate a law of nature; but such a conclusion is discountenanced by the fact that the amount of cloudiness on the different years was very unequal. In 1844, the average cloudiness for the second day after full was only 4.7, which is 2.0 below the average result of the same year. In 1842, the average for the second day after full was 5.7 or 1.0 below the general mean. The average of the remaining five years is 6.5, which is only 0.2 below the general mean for the entire period.

If we divide the whole month into four parts, in such a manner that the middle of the intervals shall correspond to new moon, first quarter, full moon and last quarter, we shall obtain the average cloudiness at new moon 6.6, first quarter 6.7, full moon 6.7, and last quarter 6.—results which may be pronounced entirely identical, and seem to demonstrate that Sir John Herschel's meteorological *fact* is unmingled *moonshine*.

It may possibly be objected that my mode of discussing these observations, is calculated to conceal the fact claimed by Sir John Herschel; inasmuch as I have employed the average cloudiness of each entire day, whereas the full moon is only claimed to exert an influence when she is above the horizon. I do not admit the force of the objection; for if the full moon, when above the horizon, exerts an influence to dissipate the clouds, such an influence ought to appear in the average cloudiness of the twenty-four hours. This conclusion can only be avoided, by supposing that the full moon, when below the horizon, exerts a positive influence upon the clouds, contrary to what is produced when she is above the horizon, and the one influence ought to be just as palpable as the other, and ought not to have escaped the notice of so shrewd an observer as Sir John Herschel.

In order, however, not to leave any room for cavil, on this point, I have compared the observations made at midnight, on the days of new moon, first quarter, full moon, and last quarter, for the entire period of seven years.

According to these observations, the average cloudiness of midnight on the day of new moon is 6.7 ; at the first quarter, 6.7 ; at full moon, 6.6 ; at the last quarter, 6.1. The first three numbers may be pronounced identical with the average cloudiness of the entire period, as already explained. The last might be suspected as indicating a general law; but if we compare the months for each year separately, we shall find that they range from 5.0 to 8.0, showing that causes which are independent of the moon's age exert a powerful influence upon the degree of cloudiness. Moreover, we see that in 1841 and 1842, the sky was remarkably clear at the last quarter, while the average of the remaining year is 6.5, almost indentical with the results at the other periods of the moon.

This comparison therefore leads us to the same result as the former, viz: that the Greenwich observations, which furnish the degree of cloudiness of the sky every two hours, night and day, for some years, give no countenance to the *fact* claimed by Sir John Herschel; and we have another example of the danger of drawing general conclusions from observations loosely treasured up in memory, without testing them by reference to recorded tables.

ON THE TIDES OF THE WESTERN COAST OF THE UNITED STATES.

At the Cleveland meeting of the American Association, Prof. A. D. Bache, Superintendent of the U. S. Coast Survey, presented a communication with the above title, of which the following is an abstract: On the Atlantic, Gulf, and Pacific Coasts of the United States, there are three quite different cases of the problem of the tides. On the Atlantic, though the diurnal inequality is well marked both in interval and height, much better so than on the Coast of Europe, it requires large and carefully made observations to give the laws of the phenomena. On the Gulf of Mexico, west of St. George's Island, the semidiurnal tides nearly disappear. On the Western Coast there are two tides each day, but the diurnal inequality is very large.

The study of the tidal phenomena then is very important to navigation, for in San Francisco Bay, a rock which has three and a half feet of water upon it at the morning highwater, may be awash at high water of the afternoon. Charts which are reduced in the ordinary way to mean low water, will have no accurate significance, the soundings being liable to an average error at either low water of the day of 1.18 ft.

The observations now discussed were made by the officers of the U. S. Coast Survey, in January, 1852, and January, 1853. They were made hourly, except near the times of high and low water; the period of mean it was attempted to determine with precision. These tides obviously present a case of large diurnal inequality in height, which is at a maximum for both high and low water, when the moon's declination is a maximum, and a minimum when it is zero. The inequality of interval amounts, when greatest, to two hours for high water, and more than an hour for low water.

The results for the *half-monthly inequality*, both time and height, and of high and low water, are remarkably regular, considering the small number of observations used to obtain them. The constants may therefore with tolerable accuracy be derived from them. The mean lunitudal interval is 12h. 05m., and corresponds to 0 hours of the moon's age. The tide therefore belongs to the next preceding transit of the moon, and not to the fifth preceding, as found by Mr. Lubbock for the coast of Great Britain.

The inequalities in intervals of high water, and in the height of low water, were shown to increase together; and so for the inequalities in height of high water, and in interval of low water, the first have the same sign as the moon's declination. The inequality in the height of low water is in general greater than that of high water, exceeding it when at the maximum in the ratio of two to one, nearly. The same ratio nearly exists between the greatest inequality in interval of high water, compared with that of low. The form of daily curves and the peculiarities of the daily inequalities may all be explained with numerical precision by the interference of a diurnal wave, following the semi-diurnal at a distance of seven hours and a half, in the part of the lunation when that difference is nearly constant. This was illustrated by diagrams. The diurnal inequality in height was shown to follow approximately the law of the sine of twice the moon's declination. When the moon's declination is north, the highest of the two high waters of the day is the one which occurs about twelve hours after upper culmination.

DISCOVERIES AT NINEVEH.

Within the last year, a most important addition to our knowledge of Assyrian history has been made by Colonel Rawlinson, who has deciphered the annals of Sennacherib, king of Assyria, from the marbles of Nineveh. In one short passage of these annals, is contained a synchronism of the greatest value in determining the date of that reign. By means of this passage, coupled with what Herodotus says of Sennacherib and Sethos, we are enabled to connect together definite points of Assyrian, Judæan, Tyrian, and Egyptian history, in one particular year, the date of which we shall be able to establish with perfect clearness. The passage referred to, synchronizes the third year of Sennacherib in Nineveh, the fourteenth of Hezekiah in Jerusalem, the last of Ilulæus in Sidon.

THE JACQUARD LOOM.

Two nieces of Jacquard, the well-known inventor of the loom which bears his name, have been compelled, by poverty, to offer for sale the Gold Medal bestowed by Louis the Eighteenth on their uncle. The sum asked was simply the intrinsic value of the gold, 20*l*. The Chamber of Commerce, of Lyons, becoming acquainted with the circumstance, agreed to become the purchasers of it for 24*l*. "Such," says the French Journal, the *Cosmos*, "is the gratitude of the manufacturing interest of Lyons, for a man to whom it owes so large a portion of its splendor."

NEW SCIENTIFIC INSTITUTION.

During the past year, an institution of somewhat singular character has been established by a company in London, incorporated under the title of "The Royal Panopticon of Science and Art." The objects of the Institution are somewhat similar to the well-known Polytechnic Institution, of London. A building, of a Saracenic structure of the 14th or 15th century has been erected, which is thus described in the Literary Gazette. "The building appears to the visitor, on entering, to be a lofty, star-domed, galleried temple, sparkling with all the gold and colors of the Alhambra, but characterized by an admirable taste and uniformity of style. It is lit from the top, and from a few side windows in two octagonal galleries, and all the glass is either colored, ground, or enamelled. In order to darken the building for exhibition purposes, an apparatus has been fitted to the windows by which they can all be closed simultaneously. For artificial light, the gas is to be used in chains of single suspended argand lamps of Saracenic character, 200 to 300 in number, and an electric stream of light will expand its rays, if practicable, from the dome. In the centre of the ground-floor is constructed a fountain of very novel pattern, suggested to the architect by one at the Castello di Ziza, Palermo. It has a large centre jet, with eight surrounding disc jets, and, like the magic bottle of M. Houdin, it will throw up streams of different colored waters at the will of the exhibitor. Around the fountain will be placed various pieces of machinery in motion, and occasional instruction will be offered, with the aid of these, in different processes of mechanical engineering. The remainder of the ground-floor will be occupied by casts of eminent works of British sculptors.

The galleries are to be let off for bazaar counters—much of the space has already been secured—but no articles are to be exhibited or sold, unless they are manufactured publicly on the spot. The crafts will be of the most miscellaneous description, in order to furnish a variety of subjects. One counter, for example, has been taken by an ivory turner; another by an artificial flower maker; a third, strange to say, by a hatter, who speculates, with some acumen on the principle, that the public will be most interested in the manfacture of articles familiar to them.

The principal feature in the way of pictorial illustration, will be an Optical Diorama on a very large scale; and to this, a spacious central recess on the eastern side of the building, facing the entrance, is appropriated. Scenic representations are to be here given, exceeding in dimensions anything of the kind yet exhibited. There is scarcely any movement in nature, says Mr. Clarke, the inventor, which may not be portrayed by this kind of Diorama; and it is already contemplated to give a representation of Handel's *Acis and Galatea*, with moving figures of the size of life. In the recess, behind the sliding field of the Diorama, an enormous organ is being erected, equal in power to any instrument in Europe.

For popular experimental lectures on astronomy, chemistry, optics, mechanics, &c., there are two spacious theatres and a laboratory. The steam-engine, the telegraph, the lathe, and the loom, will be exhibited in all their various modifications, and an electrical machine is being constructed of proportions far exceeding anything of the kind ever known or contemplated before. The glass plate already in the building, is ten feet in diameter! The machine will be worked by a steam-engine.

The front attic of the Panopticon building is occupied by a beautifully constructed suite of photographic rooms, and classes have been formed for instruction and practice in the art. Classes are also forming in the chemical department, for quantitative and qualitative analyses, and for assays of ores."

ON THE CHARACTER OF THE FOSSILS OF THE POTSDAM SANDSTONE.

Most of our readers are aware that the Potsdam sandstone lies at the base of the fossiliferous rocks; being the oldest rock in which organic remains have yet been found. In America almost its only fossils are *Graptolites*, and a small *Lingula*. (Dr. D. Owen informs us that it is more fossiliferous in the Far West.) In Russia, where it is readily recognized, it holds the same place in the geological scale as in this country, and its characteristic fossils are a *Lingula* and an *Obolus*.

Such being the antiquity of this rock, it is not surprising that the discovery made by Mr. Logan, some two years since, in Canada, of several series of impressions in the Potsdam sandstone, evidently the tracks or traces of some animal of a higher organization than a mollusk, should have excited great interest in the minds of geologists.

These tracks were at that time, carefully examined by Prof. Owen, and pronounced to be *reptilian* and *chelonean*, i. e. made by tortoises. To this decision Agassiz did not subscribe; for, although he had not had the opportunity for the careful and determinative study of the impressions enjoyed by Owen, he said he could not attribute them to tortoises, and thought Owen would regret making such an assertion.

The result has been in favor of the opinion expressed by Prof. Agassiz, for in the Journal of the Geological Society for August, Prof. Owen, without making the slightest allusion to his former expressed opinion, announces to the world that the impressions are *Crustacean*.

PATENTS.

TABLE, SHOWING THE NUMBER OF PATENTS, RE-ISSUES, DESIGNS AND ADDITIONAL IMPROVEMENTS, GRANTED AT THE PATENT OFFICE, IN WASHINGTON, DURING THE YEAR 1853.

Whole number of Patents,	856
Re-issues,	26
Designs,	75
Additional Improvements,	1
Total,	958

TABLE, SHOWING THE NUMBER OF PATENTS ISSUED TO CITIZENS OF DIFFERENT STATES, DURING THE YEAR 1853.

Maine,	22	North Carolina,	4	Ohio,	69
New Hampshire,	16	South Carolina,	2	Indiana,	21
Vermont,	14	Georgia,	5	Illinois,	28
Massachusetts,	155	Alabama,	1	Missouri,	3
Rhode Island,	15	Mississippi,	1	Michigan,	10
Connecticut,	46	Louisiana,	7	Wisconsin,	1
New York,	272	Kentucky,	9	Iowa,	2
New Jersey,	19	Florida,	0	California,	1
Pennsylvania,	152	Texas,	1	District of Columbia,	11
Delaware,	0	Arkansas,	0	Foreign,	28
Maryland,	13	Tennessee,	3	Total,	958
Virginia,	24				

OBITUARY

OF PERSONS EMINENT IN SCIENCE. 1853.

Joaquin Acosta, Bogota, South America; a geographer and naturalist.

Prof. C. B. Adams, Professor of Natural History in Amherst College, and well-known for his collections and writings on Conchology.

Francis Dominique Arago, the French mathematician, astronomer and statesman; one of the most eminent men of the 19th century.

Dr. Bailey, an English medical writer.

Dr. Lewis C. Beck, Professor of Chemistry, Albany Medical College, N. Y.

Lieut. M. Belloit, an officer of the French navy, distinguished for his researches for Sir John Franklin. Drowned while attached to Kennedy's expedition.

Prof. Benedict, formerly Ast. U. S. Coast Survey.

Prof. Charles Caldwell, of Kentucky.

Dr. Bransby Cooper, an eminent English medical writer and surgeon.
M. Crentzfeldt, botanist to the Gunnison expedition; massacred by the Indians.
Samuel Dakin, of N. Y. Patentee of the Sectional Dry Dock.
Hon. John Delafield, an eminent agriculturist of New York. President of the Agricultural College.
M. Emile Deville and *M. Duret*, French explorers of the interior of Brazil.
Earl Ducie, President of the Royal Agricultural Society, England.
Prof. Farrar, of Cambridge, Mass.
Dr. James H. Gray. A member of the American Association for the Promotion of Science. Killed at Norwalk, Conn.
Capt. Gunnison, U. S. A., murdered, while conducting an exploring expedition for locating the Pacific Rail Road, by the Utah Indians, near the Great Salt Lake.
Dr. Harless, an eminent German medical writer, Professor in the University of Bonn.
Auguste St. Hilaire, an eminent French botanist.
Lieut. A. C. Jackson, U. S. N.
Capt. Edward Johnson, Superintendent of the Compass Department, R. N.
M. Jussieu, the botanist. President of the French Academy.
Lieut. Kern, U. S. Top. Eng. Murdered by the Indians while attached to the Gunnison expedition.
M. Auguste Laurent, formerly Assayer of the Mint of France, and an eminent chemist.
M. Laurillard, Conservator of the Cabinet of Comparative Anatomy, *Jardin des Plantes*, Paris.
W. Gibbs McNeil, an eminent American engineer, constructor of the U. S. dry dock at Brooklyn, and other national works.
Dexter Marsh, a naturalist, well-known for his collection of the New Red Sandstone fossils of the Connecticut valley.
Thomas Norris, F. R. S., a scientific connoisseur, well-known in England.
M. Orfilla, the French toxicologist.
Dr. Overweg, the celebrated African traveller.
Dr. Perida, author of the Materia Medica.
Dr. Pierson, of Salem, Mass. Member of the American Academy. Killed at Norwalk, Conn.
Dr. Presl, of Prague, an eminent German botanist.
M. Reitz, a German explorer of Central Africa.
John W. Remington, the inventor of the bridge known by his name.
Mr. Schlatter, an *attache* and draughtsman of the U. S. Geological Survey at Portage Lake. Frozen to death.
Hezekiah C. Seymour, New York, State Engineer.
Mr. Shaw, an eminent English agricultural writer.
C. A. Shelton, an eminent agriculturist, botanist and naturalist, killed by a steamboat explosion in California.
Dr. Junius Smith, an eminent agriculturist, well-known as the cultivator of the tea plant in South Carolina.
Anthony D. Stanley, Professor of Mathematics, Yale College.
Lieut. Strangford, R. N., Superintendent of Chronometers.
E. H. Strickland, an eminent English geologist; killed on a railroad.
J. E. Teschemacher, an eminent geologist and naturalist. Member of the Boston Society of Natural History.
Rev. Charles Turner, F. R. S., an English scientific writer.
Sears C. Walker, a distinguished American astronomer and mathematician, Ast. U. S. Coast Survey.
Dr. Walpers, of Berlin, botanist.
John P. Wetherill, President of the Academy of Natural Sciences, Philadelphia.
Capt. Warner, the inventor of the so-called "long-range."
Leopold Von Buck, the distinguished German geologist
Admiral Zahrtmann of Copenhagen, a Danish geographer and hydrographer.

LIST OF BOOKS, PAMPHLETS, &c.,

ON MATTERS PERTAINING TO SCIENCE, PUBLISHED IN THE UNITED STATES, DURING THE YEAR 1853.

MECHANICS AND USEFUL ARTS.

Agricultural Reports to the Legislature of Massachusetts, with Proceedings of the State Board, for 1853.
American Engineer, Draughtsman's and Mechanic's Assistant. Byrne & Brown, Philadelphia.
Architectural, Engineering and Mechanical Drawing Book. Barnes & Cook, New York.
Art and Industry, as represented in the New York Crystal Palace. Edited by Horace Greely. Redfield, New York.
Field. City Architecture. Putnam, New York.
Fowler. Gravel Wall and Octagon Mode of Building. Fowler & Wells, New York.
Hinkley. Table of Prime Numbers.
Larkin's Brass and Iron Founders' Manual. Hart, Philadelphia.
Mechanics, their Principles and Practical Applications. Byrne, Ed. Dewitt & Davenport, New York.
Patent Office Report, for 1852. Mechanical. Hodges. Pub. Doc.
" " " " Agricultural. " " "
Rudiments of the Art of Building. Bullock. Stringer & Townsend, New York.
Smith's Landscape Gardening. Saxton, New York.
Stewart's Naval and Mail Steamers of the United States. 30 plates. Norton, New York.
Templeton, W. Practical Examinator on Steam and the Steam Engine. Baird, Philadelphia.
Ure's Dictionary of Arts, Manufactures, and Sciences, New Ed. Appleton & Co., New York.

PHYSICS.

Aubisson's Treatise on Hydraulics. Bennet, Translator. Little & Brown, Boston.
Colburn, J. The Locomotive Engine. Baird, Philadelphia.
Huff's Electro-Physiology. Appleton & Co., New York.
Lyon's Treatise on Lightning Conductors. Putnam, New York.
" Tables of Excavations and Embankments. Baird, Philadelphia.
Turnbull. The Electro-Magnetic Telegraph. New Ed. Hart, Philadelphia.

CHEMISTRY.

Breed, Dr. Daniel, Editor and Translator of Lowig's Organic and Physiological Chemistry. Hart, Philadelphia.
Byrne's Complete Distiller. Baird, Philadelphia.
Chrysty's Chemistry of Agriculture. Ward & Taylor, Philadelphia.
Croucher and Le Gray. Plain Directions for Obtaining Photographic Pictures. Hart, Philadelphia.

Humphrey, S. D. American Hand Book of the Daguerreotype. New York.
Humphrey's Daguerrean Journal. 1853.
Napier's Chemistry applied to Dyeing. Baird, Philadelphia.
Napier's Manual of Electro-Metallurgy. Baird, Philadelphia.
Piggott, Dr. Chemistry and Metallurgy as applied to the Study and Practice of Dental Surgery. Lindsay & Blakiston, Philadelphia.
Regnault's Elements of Chemistry. Booth & Taber, Eds. Philadelphia.
Ruffins, Edward. Essay on Calcareous Manures. Randolph, Richmond, Va.
Smith. Dyer's Instructor. Baird, Philadelphia.
Stockhard's Field Lectures. Teschemacher, Ed. Bartlett, Cambridge, Mass.

ZOOLOGY AND BOTANY.

Barrel, S. F. and Girard, Charles. Catalogue of North American Serpents. Smithsonian Contributions.
Cassin's Birds of California.
Comstock's Readings in Zoology. Newman & Iverson, New York.
Charlton, W. The Cold Grapery. Riker, New York.
Darlington, W. Flora Cestrica, for the Young Botanist. Lindsay & Blakiston, Philadelphia.
Girard, Charles. Bibliographia Americana, Historico Naturalis. Smithsonian Contributions.
Hall, Jas., Prof. Nat. His. of New York. Palæontology, Vol. II.
Headland's Action of Medicines on the System. Lindsay & Co., Philadelphia.
Heule, Prof. J. Treatise on General Pathology. " "
Langstroth. Hive and the Honey Bee. Hopkins & Co., Northampton, Mass.
Hermann, Dr. A. L. Catalogue of the Oological Collection in the Academy of Natural Sciences, Philadelphia.
Leidy, J. Ancient Fauna of Nebraska. Smithsonian Contributions.
" Extinct Species of American Ox. Smithsonian Contributions.
Melshumer. Catalogue of North American Coleoptera. Smithsonian Contributions.
Phelps' Bee Keeper's Chart. Saxton, New York.
Quimby's Mysteries of Beekeeping. Saxton, New York.
Roberts, on the Potatoe Rot. Saxton, New York.
Schleideus. Poetry of the Vegetable World. Moore & Anderson, Cinn.
Simpson. Synopsis of the Marine Invertebrata of the Bay of Fundy. Smithsonian Contributions.
Storer, Dr. Fishes of Massachusetts. American Academy Publications.
Torrey, Dr. J. Observations on the *Bateis Maratima* of Linnæus. Smithsonian Contributions.
Torrey, Dr. J. On the *Darlingtoniæ Californica.* Smithsonian Contributions.
Warren, Dr. J. C. Address before the Boston Society of Natural History.
Woodworth's Wonders of the Insect World.

GEOLOGY.

Crofton's Genesis and Geology, with Introduction by President Hitchcock. Phillips, Sampson & Co., Boston.
Dana, James D. On Coral Reefs and Islands. Putnam, New York.
Gray. Elements of Geology. Harpers, New York.
Hitchcock's Outlines of the Geology of the Globe. Phillips & Sampson, Boston.
" Report on certain points of the Geology of Massachusetts. Pub. Doc.
Lyell's Principles of Geology. Appleton & Co., New York.
Marcou. Geological Map of the United States, and British Provinces of North America, with explanatory text. Gould & Lincoln, Boston.
Mining Journal. New York. W. Tenney, Editor.
Norwood, Dr. Report on the Progress of the Geological Survey of Illinois.

ASTRONOMY AND METEOROLOGY.

American Almanac. 1854. Phillips & Sampson, Boston.
American Ephemeris and Nautical Almanac, for 1855. Pub. Doc.
Annals of the Astronomical Observatory at Georgetown, D. C. No. 1.

Bache, A. D. Report of the U. S. Coast Survey, for 1851.
" " " " " " " " Plates accompanying.
Herndon, Lieut. On the Valley of the Amazon. Pub. Doc.
Occultations of Planets and Stars in 1854. Smithsonian Contributions.
Smithsonian Contributions to Knowledge. Vol. V.
Winslow, C. F. Cosmography, or Philosophical Views of the Universe. Crosby & Nichols, Boston.

MISCELLANEOUS.

Abstract of the Seventh Census. Pub. Doc.
Bulletin of the American Geographical Society. Vol. I. Part 2.
Downing, A. J. Rural Essays. Curtis, Ed. Putnam, New York.
Illustrated Record of the Industry of all Nations. B. Silliman, Jr., and C. G. Goodrich, Eds. Putnam, New York.
Maury, Lieut. M. F. On the Valley of the Amazon.
New York. Sixty-sixth Annual Report of the Regents of the University of.
Ranking's Half-Yearly Abstract of the Medical Sciences. Lindsay & Blakiston, Philadelphia.
Report. Smithsonian Institution. 1852
Schoolcraft, H. On the Indian Tribes of the United States. Lippincott & Co., Philadelphia. New Ed.
Tome's Dental Surgery. Lindsay & Blakiston, New York.
Transactions, New York State Medical Society.
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Timb's Year Book of Facts. Hart, Philadelphia.
Wells, D. A. Annual of Scientific Discovery for 1853. Gould & Lincoln, Boston.

GENERAL INDEX.