ANNUAL RECORD

OF

SCIENCE AND INDUSTRY

FOR 1873.

EDITED BY

SPENCER F. BAIRD,

WITH THE ASSISTANCE OF EMINENT MEN OF SCIENCE.

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PREFACE.

THE present volume is the third of a series in which it is proposed to present, year by year, the principal discoveries in the various branches of science, theoretical and applied—the selection of subjects being made, primarily, on the ground of their supposed importance, as marking the stages of scientific advancement; and, secondarily, as being of interest to the general reader. A general summary of progress for the year in the different departments precedes the volume, and is intended to give a connected and systematic sketch of the more important announcements, and usually contains much matter not presented in the body of the work.

It will, of course, be readily understood that, in the compass of a single duodecimo volume, it is impossible to do more than to touch very briefly upon what appear to be the more noteworthy subjects. As far as the specialist is concerned, he must necessarily have recourse, for full information, to the Journals or Year-Books devoted to his particular department, of which scarcely any branch of science is at present destitute. The aggregate of announcements of original investigations and discoveries for any given year, contained in these works, would alone fill many volumes.

As no person, however learned, is competent to decide upon the relative importance of facts and discoveries in departments other than his own, the editor would be far from arrogating to himself even an average ability in this respect. He has, however, been so fortunate as to secure the collaboration of some of the most eminent men of science in this country; and among those to whom he has been indebted for communications of original discoveries, abstracts of what has been done by others, or summaries of progress in their respective departments, he is permitted to mention the names of Professors Henry, Gill, Harkness, Abbe, Newcomb, Clark, and Hayden, of Washington; Professors Wahl, G. F. Barker, Cope, and Leidy, of Philadelphia; Dr. Charles Rau, of New York; Dr. A. S. Packard, of Salem; Professor W. O. Atwater, of Middletown; Professors Verrill, Marsh, and Dana, of New Haven; Professors Agassiz, Gray, and Watson, of Cambridge; Professor T. Sterry Hunt, of Boston; Professor Himes, of Carlisle, Pa.; Dr. Alfred W. Bennett, of London; and several other collaborators who prefer to remain unnamed for the present.

In addition to the large number of scientific serials enumerated at the end of the volume as received regularly by mail, expressly for service in preparing the *Record*, free access has been allowed by its Secretary to the unrivaled library of publications of learned societies belonging to the Smithsonian Institution.

The plan adopted in printing the *Record*, and the multiplicity of subjects sometimes contained in a single article, has prevented a satisfactory systematic arrangement in the body of the work, some paragraphs, indeed, being inserted by mistake, in the wrong division. By means, however, of the analytical table of Contents, with cross references, and a copious alphabetical Index, it is hoped that any subject or name can readily be found.

SPENCER F. BAIRD.

SMITHSONIAN INSTITUTION, WASHINGTON, *February* 10, 1875.

TABLE OF CONTENTS.*

* In the arrangement of articles in the body of the work, it was found to be difficult to place them in systematic sequence, especially as many of them belonged really under more than one subject. The present systematic Table of Contents is intended to remedy any misplacement, and bring together under one head all articles or paragraphs belonging together, repeating the references when necessary. The references in Roman letters preceding the page references of the respective headings relate to the pages of the introductory "Summary."

GENERAL SUMMARY

OF

SCIENTIFIC AND INDUSTRIAL PROGRESS DURING THE YEAR 1873.

ASTRONOMY.

OUR *Astronomical* review for the year 1873 begins with the consideration of the nebulæ. Among those that have attracted special attention during a number of years, the most interesting is that in the great southern constellation of Argo. According to the observations of Mr. Abbott, of Tasmania, during the past few years, the dark spaces in this nebula are extending, and becoming more defined and filling up with small stars, thus adding a very remarkable instance to the few cases known in other portions of the heavens of rapid changes in the configuration of a nebula.

One of the most valuable additions to the list of stellar atlases is the new one by Heis, in which the magnitude of every star has been independently determined by himself, and whose distinguishing feature is the delineation of the Milky Way, so far as it is possible to see it from northern latitudes.

Some very valuable maps have been prepared by Mr. Proctor and others, in England, showing the distribution of the stars and nebulæ, from the study of which interesting conclusions may be hoped for.

Among the fixed stars, the principal work of the year has been, on the one hand, the continuation of the observations of the southern zones by Dr. Gould at Cordoba, South America; and on the other hand, the publication by the United States Naval Observatory of Yarnall's catalogue of over ten thousand stars.

The accurate observations of double stars, published from time to time during the past ten years by Dembowski, have seemed to him to require a corresponding and thorough investigation of the errors of the filarmicrometer, and his results must be considered as of great value in reference to this question.

A complete catalogue of all double stars hitherto observed as such has been promised as a posthumous work of the late Sir John Herschel. Meanwhile an equally complete catalogue has been prepared for publication by Mr. Burnham, of Chicago. Either of these works will evidently correspond to a long-recognized need of the astronomers at work in this field.

In the line of new discovery, it is probable that the event first in the order of interest is the discovery of a companion to Procyon, made in March last by Struve at Poulkova. The interest attaching to this discovery arises from the probability that the newly found companion is the satellite which gives a minute circular movement to the bright star. This motion has been very clearly indicated by observations made during the last hundred years or more, the researches of Dr. Auwers showing the period of revolution to be about forty years; but the satellite whose attraction was supposed to cause the motion had never been found. More observations will have to be made on the satellite found by Struve before it can be certainly decided whether it is really the disturbing body, and it may be hoped that these will be speedily furnished by the great Washington telescope.

In the planetary system, we note the determination of the mass of Jupiter by Krüger, who bases his computation upon the perturbation of the asteroid Themis; the publication by the Smithsonian Institution of Newcomb's tables of Uranus; the publication by Hirn of a masterly disquisition on the theory of the rings of Saturn; the numerous investigations, especially those of Klinkerfues, on Biela's comet, and its connection with the meteoric train and with Pogson's comet; the investigations of Von Asten in reference to a new method of computing the perturbations of Encke's comet, have a direct bearing upon the question of the existence of a resisting medium in space.

The phenomena of nutation and precession have been investigated by Dr. Nyren, whose results, deduced from the observations made by the elder Struve with the prime vertical transit, do not differ materially from those of C. H. F. Peters. The existence of a periodical change in the latitudes of points on the earth's surface seems highly probable.

A highly valuable discovery has been made of a manuscript by Schröter, of a volume of at least two hundred pages octavo, with nearly two hundred drawings relating to spots on the planet Mars. The publication of this important work has been undertaken by the Belgian Academy of Sciences.

The general mechanical problems relating to the stability of the solar system have received much attention from Mr. Stockwell in a memoir published by the Smithsonian Institution.

The mathematical theory of the motion of the moon is, as announced by Professor Airy, in an extremely unsatisfactory condition, and he expresses grave doubts as to the value of any attempts that have been made to restore ancient historical dates by reference to astronomical computations of recorded eclipses of the sun or moon, a doubt which extends even to his own previous investigations, which latter have been very generally accepted as valuable contributions to ancient chronology.

The existence of an atmosphere around the moon has been rendered quite probable by the investigation of Neison, who has shown that one whose density is the four-hundredth part of that of the earth will by its refraction explain certain anomalies in the observations of occultations of stars.

In reference to solar physics, the year has witnessed important contributions, among which will perhaps take first rank that full discussion that has been carried on in reference to the various theories of the physical constitution of the sun, that has been prolonged throughout nearly the whole year at the successive sessions of the Paris Academy of Sciences. In this very important discussion, nearly every question relating in any way to the problems of solar physics and the spectroscopic method of research has been fully debated. In connection with this, it is announced that Faye, abandoning the theory of uprushing gases, has virtually adopted, in the essential points, that proposed by English observers.

Zöllner has contributed important ideas on this matter in successive papers on the temperature of the sun, and the influence of temperature on the spectrum lines and bands.

The observations of Rosa, which in the hands of Secchi appeared to give as a result a variation in the solar diameter depending on the configuration of the solar spots, have been completely analyzed by Auwers, who, from an investigation of all reliable observations of the solar diameter, demonstrates that we have no reason to believe in such a variability.

The discoveries of small planets between Mars and Jupiter have not been so numerous as in the past year, only five having certainly been added, though a sixth is suspected. The following is the complete list, showing the numbers and dates of discovery of these new additions to our system:

No.	Name.	Discoverer.	Date.
129.	Antigone	Dr. C. H. F. Peters	February 5, 1873.
130.	Electra	Dr. C. H. F. Peters	February 17, "
131.	Vala	Borelli	May 20, "
132.	(Not named)	Watson	July 29, "
133?	(Not named)	Watson	August 16, "
134.	Sophrosyne	Luther	September 27, "

It is still doubtful whether Nos. 132 and 133 are not the same planet. If they are not, the former must be considered as lost. It was only observed on the night of its discovery, cloudy weather preventing its being followed. On the 16th of August, Professor Watson, as he supposed, again picked it up, and followed it several weeks. On calculating a circular orbit from this last series, the observation of the 29th of July was not well represented; but it is quite possible that all the observations may be represented by an elliptic orbit, and thus all the observations prove to be made on the same planet.

The number of comets seen during the year amounts to the unusual number of seven. Of these there were three periodic ones, which had been observed at previous returns to their perihelion, and for which the time of the present re-appearance had been predicted with more or less accuracy, while the other four were, so far as is yet known, entirely new. One of the four, however, appears to be of very short period, returning every five years, so that it is curious that it has never before been seen. The following is the complete list of comets seen:

	Discoverer.	Date when first seen.	Comet.
I.	Stephan, at Marseilles	April 3	Tempel's Comet of 1867.
II.	Tempel, at Milan	July 3	New comet of short period.
III.	Borelli, at Marseilles	Aug. 20	New parabolic comet.
IV.	Henry, at Paris	Aug. 23	New comet.
V.	Stephan, at Marseilles	Sept. 1	Brorsen's comet of 1846.
VI.	Stephan, at Marseilles	Sept. 3	Faye's comet of 1844.
VII.	Coggia, at Marseilles	Nov. 10	Probably a new parabolic comet.

The one event which has most engaged the attention of the official astronomers of all civilized countries, and which must continue to engage it for some time to come, is the transit of Venus over the disk of the sun, which is to occur December 8, 1874. This phenomenon is not visible either in America or Western Europe, as it begins several hours after the sun has set in Washington on December 8th, and ends several hours before it rises on the 9th. To see it, parties must be dispatched to Asia, and to the islands of the Indian and Pacific oceans; and the organization and equipment of these parties form a labor demanding great care and foresight from all who have it in hand. The governments of Russia, Germany, France, England, and America are all making preparations on the most extensive scale to observe the phenomenon, and it is likely that one or more of the minor nations will join as auxiliaries. The Russians will occupy some twenty-five stations scattered throughout the eastern half of Siberia. Three different methods of observation are proposed, all of which will be employed; but only one method will be applied at any one station. These three methods are:

1. Contact observations, in which the exact moment at which the dark body of Venus enters wholly within the bright disk of the sun is carefully noted.

2. Heliometer measures of the apparent angular distance between the limbs of Venus and the sun, taken during the whole time that the planet is projected on the sun.

3. Photographing the sun with Venus on its disk as often as possible during the transit, and afterward measuring these photographs.

The Germans will also employ all three methods of observation. They propose to send a party to Pekin, and to occupy Kerguelen's Land in the Indian Ocean, one of the Auckland Islands, south of New Zealand, and also Mauritius. The rench propose to equip six stations, but the modes of observation seem to be left to the choice of the parties themselves. Little is known of the state of their preparations. The English, under the lead of the Astronomer Royal, are disposed to depend mainly on contact observations. But Mr. De la Rue, the most successful astronomical photographer of England, has been urging the propriety of photographic determinations, and several photo-heliographs are being put into operation under his direction for use at the various stations.

Among the expeditions to be sent out from Great Britain, one is quite remarkable in being carried out entirely at the expense of a private gentleman. Lord Lindsay, a young Scotch nobleman of astronomical tastes, is making the most extensive preparations to send out a party to the Mauritius, completely equipped with every appliance for making observations by all three methods.

Our own country is preparing to make the necessary observations on a scale second to no other. It is proposed to equip eight stations, of which three will be in the northern, and five in the southern hemisphere. The northern stations will be Wladiwostock, in Siberia, Yokohama or Nagasaki, in Japan, and Pekin. In the South Pacific, parties will occupy Kerguelen's Land, Hobart-Town, some point in New Zealand, and one in one of the neighboring islands. The fifth station is not yet selected. In order to facilitate the organization, equipment, and training of the parties, a uniform system of observations will be made at all the stations, which will comprise observations of contacts at the beginning and end of the transit, and the taking of photographs during its entire continuance.

In relation to the observatories and astronomers of the world, we note the complete reorganization of French observatories under the general directorship of Le Verrier.

The lamented cessation of the private observatory of Mr. Warren de la Rue, and the donation of its entire equipment to Oxford University, is announced. The new observatory at Oxford will be devoted to physical astronomy.

In our own country, Mr. Lick, of San Francisco, offers one million dollars as an endowment for a very superior astronomical institution at the most proper point in the Western Territories. But for the American public, the first event in the order of interest is perhaps the successful erection at the National Observatory of the most powerful refracting telescope ever made. Not the least interesting circumstance connected with this instrument is the fact that it is almost wholly the product of American genius, and of genius developed under most unfavorable circumstances. Most of the great optical houses of Europe have existed for generations, and the successful establishment of a new one is comparatively rare. But the founder of the American house of Alvan

Clark & Sons still lives; and though he never enjoyed the advantage of a technical education in his difficult art, he has pursued it with a success entirely without parallel. We have no doubt that the new Washington telescope is the most perfect ever produced. Whether it will fully equal in power the great reflectors of Rosse and Lassell can only be determined by trial; it is, however, certain that, while it can not fall far short in this respect, it will be far ahead of them in general convenience of management, and consequent effectiveness.

The completion of the great telescope of the Naval Observatory is now at once to be followed by the construction of an equally large instrument ordered by Mr. M'Cormick, to be presented to the University of Virginia.

Dr. Henry Draper, of the New York University, has finished the construction of a silvered-glass reflecting telescope of twenty-eight inches' aperture, which is now mounted equatorially at his country seat at Hastings, in a new dome adjoining that containing his sixteen-inch reflector, whose construction was fully explained in a memoir published by the Smithsonian Institution in 1864, and with which telescope his well-known lunar photographs were taken. The new telescope is so arranged as to be easily converted into either a direct vision, a Newtonian, or a Cassegranian, as the astronomer may desire; it is intended to be used especially in celestial photography, in all the details of which Dr. Draper is an acknowledged expert. The method of depositing the silver film chosen by Dr. Draper gives one of unusual hardness and reflecting power, such that the light or space penetrating power of this telescope equals, if it does not surpass, that of the great Clark refractor at Washington.

The fires during the past two years in Boston and Chicago have seriously crippled the resources of the observatories at those two places, and we learn that the latter has virtually ceased all scientific work. On the other hand, a small observatory has been erected in connection with the Columbia College of New York City. The Dudley Observatory at Albany has undergone a complete change in its position, in that it has become subject to the board of trustees of the new university organized at Albany by the co-operation of various colleges in or near that city.

The new observatory building at Cincinnati has been dedicated with appropriate ceremonies.

A remarkable instance of American scientific enterprise is found in the recent redetermination of the difference of longitude between the observatories of Greenwich and Paris, carried out by Mr. J. E. Hilgard under the auspices of the Coast Survey, incidentally to a redetermination of the transatlantic longitude. As many of our readers may be aware, the first determination of the longitude of any point on the American continent from Greenwich by the Atlantic cable was made by Dr. Gould in 1866. When the French cable from Brest to St. Pierre, and thence to Duxbury, Massachusetts, was got into operation, it was judged advisable to make a separate determination by that means, as a test of the correctness of the results. But the longitude came out more than half a second greater by the last determination, which, however, depended on the longitude of Paris from Greenwich. To discover where the error lay, it was determined to make a third determination, in which signals should be exchanged simultaneously between Greenwich, Paris, and Brest, while being sent across the Atlantic. The result showed that the longitude of Paris from Greenwich, as determined by Airy and Le Verrier twenty years ago, was more than one third of a second of time, or about one twelfth of a mile, in error. When this error was corrected, and some other points settled, the results of the three determinations became remarkably accordant, and settled the longitude of the Naval Observatory from Greenwich within a hundred feet.

The *Necrology* of the past year embraces the names of the following astronomers: Kaiser, Donati, Chacornac, Schweizer, and Chevallier.

TERRESTRIAL PHYSICS.

Earthquakes, as a problem of *Terrestrial Physics*, and distinct from their geological relations, have been elucidated by the memoir of Seebach on the earthquake of March 6, 1872, by the notes of Graves on the electric earth currents produced by them, and by the notes of Professor Niles on the phenomena observed at Monson, Massachusetts. But the crowning work of the year on this subject is that of Mallet.

In *Terrestrial Magnetism* the most important place must be given to the great work of Sabine, on the magnetic chart for the northern hemisphere, constituting his thirteenth contribution to this science. The chart drawn by him represents the magnetic condition of the northern hemisphere for the year 1845, and is based upon all the observations made between 1805 and 1872. As to the exhaustive nature of the labors accomplished by him, this work ranks with that of Hansteen (whose recent death is fresh in our memory), while in accuracy, of course, surpassing that, because of the vastly increased number of accurate observations.

The subject of ground currents on electric telegraph wires has received considerable attention both in America and England, and has been discussed in the most lucid manner at the meetings of the London Society of Telegraph Engineers; from which it seems evident that the subject requires for further elucidation a greatly increased number of carefully made observations, such as those of Airy, at Greenwich, and of Graves, at Valentia.

METEOROLOGY.

In regard to *Meteorological* matters, the year 1873 will probably long be signalized especially as the year of the meeting of the International Congress at Vienna. This body continued in session during the first half of the month of September, and its deliberations were greatly facilitated by the very general consideration that had during the previous year been given to the subjects which it was intended should be brought up for the decision of the Congress. Although in most matters the Congress declined to give at once a decisive vote with regard to the details of the meteorological work recommended by the various nations of Europe there assembled, yet the matters brought before it were referred to appropriate committees, and the entire influence of the meteorologists there present were so decidedly given in favor of a nearer approach to uniformity in all meteorological observations and publications, that it is probable that there will therefore be brought about a very marked improvement in this respect during the coming few years. While recognizing the importance of many matters of scientific detail coming before the attention of the Congress, we will probably not be far wrong in attributing the greatest importance to the impetus given by this Congress to a system of synchronous observations throughout the world.

The presence of the distinguished chief of the Weather Bureau of the United States Army Signal Office was sufficient to call forth a unanimous vote on the part of the Congress, expressing its sense of the importance of synchronous observations to the study of the phenomena of storms; and to the personal exertions of General Myer is due the establishing at that meeting of an agreement between the heads of the weather bureaus of England, Russia, Turkey, and the United States, by which a uniform system of observations was agreed upon. Into this arrangement, subsequently, Holland, Spain, Portugal, the Netherlands, Norway, Sweden, and China have also entered; so that, beginning with the first of January, 1874, we shall witness a system of synchronous observations made throughout almost the entire northern hemisphere at seven hours and thirty-five minutes A.M., Washington time. As other nations and the private meteorological observers, as well as other official observers of the governments, enter into this system of observations (which, undoubtedly, will eventually extend to the ocean as well as to the land), we shall soon realize to the fullest extent the great power conferred upon the human race through the application of electricity to the telegraph, since it will become possible ere long to follow almost any disturbance that may occur any where on the northern hemisphere from its inception to its maturity and final decay. Hopes have been widely expressed that, through such a system of world-wide observations, it may become possible to predict for Europe many of the storms which are supposed to pass from America across the Atlantic. But without attributing too much importance to such a beneficial system of storm warnings (since it is highly probable that most of our American storms die out before reaching the coast of Europe), there still remains enough of possible benefit to be derived, both to meteorological study and to the commercial interests of mankind, to justify almost any labor that looks to the completion of so magnificent a system of storm studies, and the Army Signal Office is to be congratulated upon the success which has attended its labors in this direction. It is, perhaps, not too much to say that such success as has been attained could scarcely have been hoped for under any combination of favoring circumstances different from that that has in so remarkable a manner centred about the Chief Signal Officer. It is to be hoped that the great obstacle to the most perfect development of the system of synchronous observations, viz., the telegraphic difficulties, may ere long be entirely removed.

To the publications of the Army Signal Office during the past year there has been added the "Monthly Weather Review," in which is given a condensed statement of the more important meteorological features of the month, accompanied with monthly charts of rain-fall, temperature, storms, etc., supplemented by an annual statistical report, giving, besides the weather items, also a general review of all the influences of the weather upon the various branches of human industry.

The national importance of meteorological questions has been acknowledged by the establishment of several new systems of meteoric observation, of which we may mention first in chronological order the establishment, under Dr. B. A. Gould, Director of the National Observatory at Cordoba, of a meteorological system extending throughout the Argentine Confederacy, and which, though not at present supplemented by a system of telegraphic storm warnings, may reasonably hope to be so whenever the knowledge of the meteorology of that region justifies it, and the commercial interests of the country demand it.

In Sweden, a Royal Meteorological Institute has been established under the superintendency of Rubenson.

In China, under the Bureau of Internal Revenue, a system of telescopic storm warnings has been authorized and placed in the hands of Mr. Campbell.

The Meteorological Office of Denmark, established in 1872, has published its first annual report, from which it appears that America is to be specially benefited by its system, in that five permanent stations are established in the Danish colonies in Greenland, and those previously established in the West Indies are maintained with excellent efficiency.

The system of stations of the Army Signal Office has received a very great extension, in that a connection has been established between this branch of the government service and the life-saving stations of the Treasury Department. By this means a continuous telegraphic connection is provided for from Cape Hatteras to Cape Cod, within which region about twenty-five coast stations are included, and the entire line of telegraph is daily patroled by the officers of the government. Signal stations have also been established in Cuba and Hayti.

A highly important addition has also been made to the interior stations of this country in the establishing of three observers on the summit of Pike's Peak, Colorado, the reports from which will be of as great interest, both to the public at large and to scientists, as are those from the summit of Mount Washington.

The system of daily reports of the height of water in rivers and harbors, has received a wide extension by the addition of about forty stations during the season of navigation along the Mississippi River and its tributaries, and the reports from these constitute one of the most remarkable features of the activity of the service, giving us, as is given nowhere else in the world, a daily graphical view of the motion of the waves of high and low water down the valleys of those rivers.

At the suggestion of the United States Fish Commissioner, Professor Baird, the signal service has also added to its other labors the daily observation of the temperature of the water at such of its stations as are in the neighborhood of rivers, lakes, or oceans. We are here again brought into contact with one of the most interesting and as yet little-known features of terrestrial physics, and valuable results can not but be expected to flow from these observations.

The rapid growth of the meteorological system of the Army Signal Office has justified the important action lately taken by the Secretary of the Smithsonian Institution, by which he has transferred the entire meteorological system, fostered by him with so great care during the past thirty years, to the care of the chief signal officer of the army. By this arrangement, a staff of about five hundred volunteer observers is added to the corps of this branch of the government service. Inasmuch as the relations of the government with these gentlemen is to be of a purely private and unofficial character, it is confidently expected that there will thereby result a decided advantage to the study of meteorology in the United States, in that the enthusiasm of amateurs will every where be stimulated to the point of doing good work.

Among the stations thus transferred by the Smithsonian Institution are some in the extreme northern portion of British America, and others in Mexico and Central America, and at various points in our own territory not yet reached by telegraph.

The meteorologists of this country have long awaited with pleasant expectations the publication of a new edition of the well-known work on the winds of the northern hemisphere by Professor Coffin, and much concern has been expressed at his untimely death, before the completion of the great work that he had in hand. It is, however, gratifying to be able to state that the Smithsonian Institution has been so fortunate as to secure the services of Dr. Woeikof, of St. Petersburg, well known for numerous contributions to meteorological science, and who, making a stay of some months in this country, has consented to superintend the final preparation of Professor Coffin's work for the press: its appearance may be expected during the year 1874.

Meteorological literature, under the stimulus of the national systems of practical meteorology which now are supported by every civilized nation on the globe, yearly increases in bulk and variety. While it might appear invidious to make a comparison between the labors of so many investigators, it may, on the other hand, not be amiss to specify the following among the most interesting investigations of the past year.

The connection between sun spots and terrestrial phenomena has received careful attention from Messrs. Lockyer and Meldrum, the former of whom announces, as a principle in science, the idea that scientific progress consists essentially in hunting after cycles in the phenomena of nature, and then tracing these cycles to their ultimate causes, in accordance with which he gave a ready, though it seems somewhat premature acquiescence to the suggestion of Meldrum, that the cyclones of the Indian seas exhibited a periodical fluctuation as to their resemblance and severity, coinciding with the fluctuation in the spots of the sun. The attempt to establish a similar periodicity for the rain-fall of India was made by Meldrum, and the same attempt in Europe was made by Symons, Jelinek, and others. These, however, were but partially successful. The careful conclusion of Jelinek being that the chances were equally divided between the existence and non-existence of such connection. On the other hand, it being apparent that the influence of solar spots, if it existed at all, should be most apparent in the temperature of the atmosphere, Köppen has undertaken to investigate this point in a more thorough manner than had hitherto been done. Although numerous and able men had for the past twenty-five years studied the subject, and generally arrived at positive conclusions as to the actual existence of such connection, yet it seemed to Köppen that the study should be based upon a broader field of observations, and he accordingly, instead of confining himself to the observations of any one country, has endeavored to get rid of all local climatic influences, by embracing in his computations every accessible observation of the temperature made during the past one hundred and fifty years in the northern hemisphere. This immense mass of material has been handled by him with the most consummate skill; and his conclusions, which will be found in detail in the subsequent part of this work, must be considered as proving in the most irrefragable manner the actual existence of a slight period in the temperature of the earth, following the changes in the solar spots at an interval of from one to three years.

Mühry has contributed an important chapter to our knowledge of clouds and cloud formations, by calling attention to an almost forgotten observation made by Meissner in the course of his researches on ozone, from which it would seem that in an atmosphere having no oxygen there can be formed no true clouds, since only in the presence of oxygen are the true vapor vesicles observed. And, again, he has contributed a most important theory as to the origin of atmospheric electricity, in that he finds it to be in some sort a conversion of the heat radiated from the sun into electricity, which exists in greatest intensity at the surface of the earth, and acts inductively upon the atmosphere above. The suggestion lies not far off that in this electricity we find the principal disturbing agent acting upon the magnetic needle.

Among the most memorable storms of the past year, the so-called Nova Scotia cyclone takes precedence. According to the short preliminary memoir of Abbe, this storm was first heard of at a point east or northeast of the West India islands on the 13th of August, passing thence west and northwestward between the Bermudas and the coasts of the United States; it turned, as cyclones usually do, northeastward, and although its centre, advancing nearly parallel to the coast of Nova Scotia, was at a distance of several hundred miles therefrom, yet were the winds experienced in that province so severe as to utterly destroy all the shipping in its harbors, and cause an immense destruction of life and property on land. When last heard from, this cyclone was some distance east of Newfoundland, and it appears possible that it preserved its integrity until reaching the coast of Norway, some two weeks after its first appearance. Professor Abbe suggests that probably an important class of cyclones originate on the coast of Senegambia.

Baron Maydell has studied the connection between the direction of the movement of storm centres and the direction of the line joining the position of the storm centre at any moment, and the region of anomalous high temperature.

One of the most thorough and therefore valuable investigations that has ever been made into the connection between meteorological phenomena and agricultural statistics has been lately published by General Rawson, Governor of Barbadoes, who has in a most exhaustive manner shown the influence of the rain-fall on the sugar crop of that island, and has even prepared tables by which one can predict, with a certain degree of accuracy, the crop that may be expected to follow the season in which a given amount of rain falls.

The investigation of the atmosphere by means of the balloon has been steadily prosecuted in Europe, especially in France by Janssen; while in America a great deal of interest was excited upon the subject by the announcement that the *Graphic* newspaper company of New York would furnish the well-known aeronaut, Professor Wise, with unlimited funds, in order to enable him to make a voyage from America to Europe. Notwithstanding the utter failure of this attempt—which is to be lamented in a scientific point of view, since, had the balloon made a voyage of above twenty-four hours' duration, the observations connected therewith could not have failed to have been of great advantage—there has still been derived much benefit from the discussions which took place in relation to the subject of a westerly current of air, on the part of several scientific gentlemen, before the day of ascension arrived. Among the contributions to our knowledge upon this subject may be especially cited a short paper by Professor Newton, of Yale College, whose observations relative to the movements of the clouds of meteoric smoke, under the influence of the currents of air prevailing in the higher regions of the atmosphere, showed conclusively that no constant westerly current exists there. The frequent ascensions of Mr. King, of Boston, have generally been utilized by him during the past year, as in previous years, to a less extent in furthering our meteorological knowledge. He has to this end again relied upon the services of Mr. Holden, of Boston, an experienced aeronaut, and fully imbued with Mr. King's enthusiasm as to the prospective usefulness of the balloon in its legitimate field of work.

Among the publications of the British meteorological committee, that of the meteorology of the North Atlantic equatorial region especially claims our attention, as being an earnest of the work that is promised for the whole North Atlantic Ocean.

Meteorologists have during the year been called on to deplore the death of J. H. Coffin and Charles Smallwood.

The connections between climate and disease have been investigated by numerous persons, among whom we may mention Molner on the influence of barometric depressions, as observed in the hospitals of Austria; and Prestel on the influence of the winds, as observed in Friesland. The annual report of the Philadelphia Board of Health contains also very instructive diagrams, showing the connection between mortality and temperature.

The labors of Mühry, in regard to atmospheric electricity, have already been referred to, and it remains only to be stated that the intimate connection assigned by him as existing between electrical and magnetical phenomena, on the one hand, and solar spots on the other, receives further confirmation from the observations of Dr. Wislicenus, of St. Louis, whose observations on atmospheric electricity, continued now for thirteen years, show a variation that seems to point directly to the solar-spot period, agreeing therein exactly with the researches of Loomis on auroras. On the other hand, Broun maintains the existence of a variation in magnetic phenomena, having for its period twenty-six days, and therefore pointing toward the solar diurnal revolution rather than to the solar spots as its origin.

In the study of auroras, we notice that the review, by Donati, of Florence, of the phenomena attending the aurora of February 4, 1872, has called forth encomiums from observers in all parts of the globe. On the other hand, the extensive tables of Professor Lovering, of Cambridge, Massachusetts, have enabled Professor Loomis to review and extend his investigations into the periodicity of the auroral phenomena, and to establish with great probability some of the details of the connection between solar spots and auroral phenomena.

ELECTRICITY.

In *Electrical Science*, one of the most important steps taken has been the founding, in 1872, of the new society of telegraph engineers in London, from whose proceedings numerous extracts will be found in our pages.

An excellent memoir on electrical dissipation, by Boboulieff, has appeared in the Journal of the St. Petersburg societies of physics and chemistry; and in the same city has been successfully tried the new method of electric illumination, by Ladiguin, which, in connection with the newly invented magneto-electric machine of Gramme, promises to fully realize the long-deferred expectations of the advocates of this method of illumination. The curious effect of light in increasing the electrical resistance of a bar of selenium has been quantitatively investigated by Lieutenant Sale, R. E., and has been proposed as the basis of a new photometer. The allied action of heat has been extensively studied by Benoist for high temperatures. The intimate theoretical connection between these phenomena promises at no distant day to lead to more satisfactory views of the true nature of the electric force.

The theory of Edlund as to the nature of electricity has been mathematically developed by himself and others, showing a remarkable agreement with observations. On the other hand, the profound work of Maxwell has, with equal success, developed what may be called the vibratory theory. The general dissemination of the results of the studies of the past thirty years has been greatly facilitated by the publication of the admirable works of Thomson, Jenkin, and Maxwell.

The brilliant experiments of Le Roux on peripolar induction, as well as the new magneto-electric machine of Gramme, have prepared the way for an exact determination of the coefficient of equivalency of force and electricity. The effect of galvanic currents on the dimensions and elasticity of metallic conductors has been studied by Streintz and Mayer respectively. The observations by Villari on the time required to magnetize and demagnetize glass gives us a new relation between the electric and molecular forces.

During the year there have passed away Sir Francis Ronalds and August de la Rive, names equally honored in their respective countries.

The older theories of the nature of molecules and molecular actions seem at present to be giving way before the surprising success of the advocates of the dynamical theory of the constitution of gases, the principles of which theory have been established by Stephan, Clausius, Meyer, Maxwell, and others, upon an exceedingly firm basis. The recent address of Maxwell on molecules gives the most recent results of the studies of these investigators.

PHYSICS.

In the allied departments of *Optics* and *Acoustics* the activity has been very considerable, and we can here only mention those items that have a comparatively important and permanent bearing upon the progress of science: such are Weinhold's investigations into the measurements of high temperatures; J. W. Draper's Essays upon the actinic, optic, and thermic powers of different portions of the spectrum; and Henry Draper's photographs and measurements of the diffraction spectrum.

One of the most remarkable discoveries, interesting alike to the practical photographer and the physicist, is announced in a short dispatch from Dr. Vogel, of Berlin. This consists in the invention of chemical compounds, that may at will be made sensitive to the rays of greatest or least refrangibility.

Lord Rayleigh has submitted a short but important and suggestive memoir on the reflection of sound waves from a surface composed of numerous regularly arranged smaller surfaces.

Professor Mayer, of the Stevens Institute of Technology, has made known a method of analysis of sounds, and has applied it to the investigation of the complicated sounds that occur in nature. Especial interest attaches to his investigations on the antennæ of insects, considered as the organ of hearing.

The interesting phenomena of the vibration of cords attached to and vibrating with a diapason have been investigated with much success by Mercadier and Gripon.

Professor Henry has continued his observations on abnormal phenomena of sound in connection with fog signals.

Barrett has investigated certain remarkable molecular changes occurring in iron wire at a low red heat, by which it appears that instead of expanding continuously for every additional degree of heat imparted to it, there is a certain temperature corresponding to the red-hot state at which a sudden contraction takes place when the wire is being heated; but a sudden elongation is observed when the wire is being cooled. Barrett associates these phenomena with others observed by Tait in thermo-electric experiments, and concludes that both lines of inquiry show that a profound molecular disturbance takes place in iron at a low red heat.

CHEMISTRY AND METALLURGY.

During the past year much has been done in all departments of *Chemistry*. In chemical physics, especially, good work has been accomplished. The field of thermo-chemistry has been considerably enlarged, the chief workers in it being Thomson and Berthelot. Thomson has investigated the affinity of hydrogen for the non-metallic elements, the formation and decomposition of formic acid, and the formation of the sulphur acids. The first and last named investigations have led to the most interesting results, perhaps, it being shown on the one hand that the affinity of hydrogen for the first member of each of the four natural groups of non-metallic elements is positive, but diminishes with the higher members as their atomic weights increase; and, on the other hand, that the total heat of formation of the sulphur acids decreases with every additional atom of sulphur. Berthelot's work has been mainly on the state of various salts and of the hydracids in solution in water. As regards salts, confirmation is given of the view that when two salts react upon each other in solution, the stronger acid seeks the stronger base, and *vice versa*. Some desirable determinations of specific heat have been made. Mixter and Dana have determined this constant for silicon, zirconium, and boron, and shown that these elements, like carbon, are exceptions to Dulong and Petit's law of equality for atomic heats. Dewar, determining the specific heat of carbon at high temperatures (2100° C., etc.), does much, however, to confirm Weber's view that at such temperatures the element should agree with the law of Dulong and Petit. It is to be hoped that Dewar will extend his experiments to the other exceptions to this law.

Other very important work in chemical physics has been done by Dr. Draper, whose papers on actino-chemistry have attracted much attention. Draper shows that, contrary to a widely prevalent conception, all the rays of the solar spectrum have actinic power, and can produce chemical change. This rule applies to the invisible as well as to the visible portions of the spectrum. In any selected case, the particular rays producing the change depend upon the nature of the substance upon which they act. Champion and Pellet's experiments on the vibratory motions of detonating bodies are also worthy of notice. These gentlemen have investigated the effects produced by the explosion of a variety of such substances upon a series of sensitive flames, and have shown that essentially different sets of vibrations occur in the different cases.

In *general inorganic chemistry* many investigations have been made. A number of the rarer metals have been re-examined, and several new determinations of atomic weights deduced. That of yttrium has been fixed by Cleve and Hoeglund at 59.7, and that of erbium, by the same experimenters, at 113.7. These metals seem in many respects to belong in the same group with zinc, magnesium, and cadmium. Indium has at last been definitely placed by Roessler. It forms a true alum, like aluminum and iron. Liechti and Kempe have described the chloride of molybdenum, and Atterberg has investigated some glucinum compounds. At the present rate, even though most chemists prefer to work in the field of organic chemistry, we shall not have very long to wait for an intelligible classification of the metals.

During the year, ammonia has been made the subject of considerable study. Donkin, by the action of induced electricity upon nitrogen and hydrogen, mixed in the proper proportions, has succeeded in performing the synthesis of the gas, obtaining it, however, only in very small quantities. Gore has investigated the solvent properties of anhydrous liquefied ammonia upon about two hundred and fifty substances. Among many other bodies, potassium, sodium, iodine, sulphur, and phosphorus were found to be soluble. It will be remembered that several years ago much interest was awakened by Graham's discoveries concerning the occlusion of hydrogen by palladium. Graham thought that a definite alloy was produced; but Roberts and Wright have recently shown that the supposition was incorrect. These chemists have determined the specific heat of palladium charged with hydrogen, and have shown that the latter element can not be regarded as existent in the palladium in the solid form. In this connection, Troost and Hautefeuille's experiments upon the solution of gases in iron, cast iron, and steel must be noted. These metals, at high temperatures, have long been known to absorb various gases, emitting them again upon cooling. But the authors above named have shown that the disengagements of gases often noticed in making large castings are not due to this cause alone, and that the phenomena are sometimes attended by a change in the composition of the metal. For example, they found that when iron rich in carbon was kept fused in a highly silicious crucible, the silica of the crucible was partially reduced, the iron becoming richer in silicon, while carbonic oxide was evolved. Troost and Hautefeuille also made an analysis of the gases contained in a sample of pig-iron weighing five hundred grammes. This sample, heated to 800° C., in vacuo, for 190 hours, gave off 16.7 cubic centimeters of gas, consisting of carbonic acid, 0.6; carbonic oxide, 2.8; hydrogen, 12.3; and nitrogen, 1.

In addition to the work already described, a vast amount of detail work has been accomplished by chemists all over the world. A variety of papers upon ozone have been published, and an immense number of inorganic compounds described. In our own country, Wolcott Gibbs has put forward some important work upon the ammonio-cobalt bases, and Messrs. Carrington Bolton and Morton, of New York, have carried out some quite elaborate investigations upon the fluorescent spectra of many uranium compounds.

But it is to *Organic Chemistry*, as usual, that the most attention has been paid. The greater simplicity of the work, and the readier applicability of modern atomistic views, seem to have a great fascination for European chemists. In the direction of synthesis, a number of interesting things have been achieved. Jungfleisch has managed to obtain by synthesis both modifications of tartaric acid, beginning with the elements for a starting-point. Brodie, by the action of electricity upon a mixture of carbonic oxide and hydrogen, has succeeded in obtaining marsh-gas, while carbonic acid and hydrogen, under similar circumstances, gave him formic acid. When the electricity was allowed to act upon pure, dry carbonic oxide, contraction ensued, and small quantities of some new, solid oxides of carbon were produced. These oxides appear to form regular homologous series, just as the hydrocarbons do. In addition to these discoveries, Aronheim has achieved the synthesis of naphthaline and phenyl-butylene; Graebe, the synthesis of phenanthrene; and Basarow, that of parabanic acid.

Some of the most interesting work of the year has been done by Gladstone and Tribe, by means of their "copper zinc couple." These chemists, having found that zinc upon which a little copper had been deposited was able to decompose water at ordinary temperatures, carried the observation over into the field of organic chemistry by investigating the action of the "couple" upon various organic liquids, such as, for instance, the iodides of methyl, ethyl, propyl, and amyl. A variety of interesting reactions occurred, the hydrides of the radicals being formed, and usually some quantity of the more complex organo-metallic zinc radicals appearing also. Zinc-propyl was one of the more striking of the compounds thus obtained. In the hands of Thorpe, the same "copper zinc couple" has been made of service in analytical chemistry, in the estimation quantitatively of nitric, chloric, and iodic acids. The "couple" was found to transform the nitric acid of nitrates into ammonia, which is easy to determine; while it acted as a reducing agent upon chloric and iodic acids, enabling the chemist subsequently to estimate chlorine and iodine in the ordinary way.

In the series of the alcohol radicals much work has been recently done, although most of it is in detail uninteresting to ordinary readers. Grimshaw's study of ethyl-amyl, Lieben and Rossi's work upon butyl compounds, and Cahours' researches among the compounds of propyl deserve special notice. Cahours in particular has obtained striking results, having examined, besides many other bodies, compounds of propyl with sulphur, boron, silicon, mercury, zinc, tin, aluminum, and glucinum. Grünzweig's investigation of butyric acid, and the labors of Pierre and Puchot upon the same substance, and upon propionic acid also, must not be overlooked. Pierre and Puchot in their work have obtained results of great interest in connection with the law of boiling-points; showing that the constant differences commonly supposed to exist between the boiling-points of homologous substances are not always to be depended upon. Several new organic compounds containing silicon have been obtained, Troost and Hautefeuille (who seem always to work together), and Ladenburg, being the chief explorers in this direction. The ground thus far covered in the study of these compounds has been well described by Dr. Emerson Reynolds, who delivered before the Royal Institution a lecture upon "Alcohols from Flint and Quartz." The lecturer, after pointing out the striking similarities between silicon and carbon by themselves, showed that the same resemblances extended even to their compounds, describing the most important among those thus far discovered. He also announced that he had succeeded in obtaining the silicon analogue of cyanogen, a compound which awaits further investigation.

In other departments of organic chemistry, Mayer and Wright have well studied some of the derivatives of morphine. Doubtless, in a very few years, we shall be able to produce artificially not only this valuable alkaloid, but also others, such as quinine, caffeine, etc. Hlasiwetz and Habermann have continued their researches upon the proteine compounds, obtaining results of some interest concerning caseine. But the most bulky work of the year in organic chemistry has been among the so-called aromatic compounds. Unfortunately, however, many of the German workers in this field seem to have a mania for obtaining new compounds, and then leaving them very imperfectly described. In consequence, much of their work will have to be done over again. In this group of compounds, isomeric bodies have already been multiplied to an alarming extent. One excellent investigation in this field has been that of Wright, on cymene from different sources. Another paper of great value is that of Dale and Schorlemmer upon aurine, one of the important coloring matters derivable from coal-tar. Quite naturally, the synthesis of alizarine, a year or two ago by Graebe and Liebermann, has stimulated work among the other compounds of the quinine group; and Dr. Russell, chairman of the chemical section in the British Association, made this group the subject of his address. W. H. Perkin, long famous for his discoveries among the coal-tar colors, has been also working in the same line of investigation, and has described a new coloring matter obtained in the manufacture of alizarine. This new substance he terms anthro-purpurine; and the frontispiece to his paper (in the *Journal* of the Chemical Society for May) consists of a leaf to which are glued little scraps of cloth dyed respectively with alizarine and with the body in question. Those dyed with anthro-purpurine are, if any thing, a little the brighter.

Several quite important papers upon *Physiological Chemistry* have appeared during the year. Among them may be mentioned that of Alexander Schmidt on the coagulation of fibrine, that of Carl Voit on the use of gelatine in nutrition, Aubert's on the quantity of carbonic acid excreted by the human skin, and Bunge's on the importance of common salt and the behavior of potassium compounds in the human body. Pettenkofer and Voit also publish some results of experiments upon feeding with flesh and fat, showing that fattening is best produced by beginning with a liberal diet rich in nitrogenous matter, and moderately so in fats; and, as the animal frame enlarges, increasing the proportion of fatty food and diminishing the quantity of albuminoids.

In *Technical Chemistry* there are many signs of progress. A large number of chemical patents are annually issued, both in this country and in Europe, and large manufacturing corporations are rapidly learning the advantages to be reaped from the employment of able chemists. It is even reported that one of our leading American railway companies has employed a chemist, at a liberal salary, to devote himself entirely to the work of their road. A peculiar substance, called suint, has been extensively studied of late. This substance, which forms about one third of the weight of raw wool, is rich in potash salts, which, taken up by the sheep from the soil, are excreted with their sweat, and remain attached to the fleece. This suint, which was formerly wasted, has for some time been utilized as a source of potash compounds, and is now found to be a most available material for the manufacture of potassium ferrocyanide. In the production of the caustic alkalies a little improvement is suggested by Pollacci. Some years ago Wöhler proposed to obtain these substances by igniting the nitrates with metallic copper, and treating the product with water; but, unfortunately, the alkalies thus prepared were always contaminated with some oxide of copper. Pollacci substitutes iron filings for copper in this process, and claims to obtain the caustic soda and potash quite pure. The refuse of wool, horn, feathers, leather, skins, sponge, etc., material rich in nitrogen, but hitherto of little or no use except for fertilizing, has at last been utilized by L'Hote. He mixes the material first with a solution of caustic soda in ten parts of water, and allows the mass to digest until it has acquired a pasty consistence. He then adds quicklime and distills, beginning at a low temperature, and increasing to a red heat. The vapors, rich in ammonia, are passed into common sulphuric acid, and ammonium sulphate, a substance of great commercial value, is thus obtained. The residuum in the retort consists mainly of sodium carbonate and lime, which, by treatment with water, may be made to give back the caustic soda used at the beginning of the operation.

Some interesting facts concerning *Metallurgy* have been made public. Percy, for instance, has shown that manganese may be used instead of nickel in the manufacture of German silver, the product being quite undistinguishable from the alloy in general use. Bajault and Roche have described a new process for the manufacture of steel. A mixture of pulverized iron ore and molten pig-iron is cast in metallic moulds, which form a part of the final ingots. These ingots are then heated to redness in a peculiar furnace for a considerable time, carbonic oxide is given off, and crude steel is formed. This crude steel can then be cast in the ordinary way. By this process any degree of carbonation can be produced in the steel, the proportions of cast iron and ore being readily fixed beforehand.

One more striking contribution to chemical technology remains to be noticed—Dr. Sprengel's paper upon "a new class of explosives, which are non-explosive during manufacture, storage, and transport." Dr. Sprengel finds it possible to devise many explosive mixtures of substances, which, apart from each other, are non-explosive, and which need not be mixed until the combination is to be used. For instance, mixtures of many organic compounds, notably some hydrocarbons, with nitric acid, both ingredients being non-explosive, will explode with great violence when ignited by a detonating cap. The mixture of nitro-benzol with the acid seems to be about thirty-eight per cent. more violent as an explosive agent than nitro-glycerine; both of the original substances being quite harmless. Picric acid mixed with nitric acid is also a terribly violent detonator. In this mixture the heat given out is something immense. In one instance a metallic cartridge was charged with it, and fired from a rifle. On extracting the cartridge-case the upper half of it was found to have been melted; while grains of sand, which had been added to the explosive mixture, and some of which remained in the cartridge, were "fused together as if struck by lightning." Obviously this principle of mixing non-explosive agents to form explosives is capable of great extension. At present there are some trifling practical disadvantages in the way of using such mixtures. Soon, doubtless, these disadvantages will be overcome, and the art of blasting will be revolutionized.

GEOLOGY AND MINERALOGY.

In American *Geology*, important results have been obtained in the West. In the survey of the Territories under Dr. Hayden in 1872, the geology of the Snake River division was confided to Professor Bradley, who has within the last few months given us a summary of the work done. It had for many years been known that strata characterized by organic remains of the Potsdam period were not wanting in the Rocky Mountains, and the observations of Professor Bradley now make known the existence in the Wahsatch Mountains of a large development of the Lower and Middle Cambrian rocks of Sedgwick, the Primal and Auroral of Rogers. The ancient gneisses of the Wahsatch, with high westerly dips, are overlaid by a great mass of paleozoic strata, dipping eastward, and consisting at the base of from 1000 to 1500 feet of quartzites and conglomerates, regarded as of Potsdam age, followed by 3000 feet of magnesian limestones and calcareous shales, which afford numerous organic forms about the age of the Calciferous and Chazy divisions of the New York system. These correspond to the Levis division of the so-called Quebec group, or the Auroral of Rogers, Mr. Meek having recognized therein many of the forms so well described by Billings from the vicinity of Quebec. Toward the summit of this fossiliferous series forms referred to the Niagara have been recognized, and in some of them, according to Tenney, corals of Lower Helderberg age. Above these are 2000 feet of sandstones, probably Devonian, followed by 3000 feet of limestones abounding in the remains of the Carboniferous period. We find no notice in this region of the existence of the second fauna, corresponding to the Trenton, Utica, and Hudson River rocks of New York, the Matinal of Rogers, the Upper Cambrian of Sedgwick, or Siluro-Cambrian. In the apparent absence of these Siluro-Cambrian rocks, which are widely spread throughout the great North American paleozoic basin, we see a resemblance to northeastern America where, also, the rocks of the first and third paleozoic faunas occur to the exclusion of the second fauna. This great thickness of paleozoic strata is not every where seen in this region, since, according to Mr. Bradley, in the Teton Mountains the whole of the Cambrian rocks are represented by 700 feet of quartzites and shaly limestones, overlaid by 600 feet of vesicular magnesian limestones with crinoids, probably of Niagara age, which are followed in their turn by the same Carboniferous limestones as before, with a thickness of 2000 feet or more. Although the Levis limestones are generally conformable with the Potsdam sandstone in this region, they are in one place seen to rest unconformably upon the upturned sandstone. In western Wyoming, Professor T. B. Comstock, the geologist to the late expedition under General Ord, shows in the Wind River Mountains a remarkable series, all apparently conformable, and resting at an angle of about 20° upon the older crystalline rocks. At the base are Lower Cambrian rocks, followed by strata with Oriskany fossils, and by Carboniferous limestones. Above these are bright red Triassic sandstones, lighter red Jurassic rocks, and Cretaceous strata, the latter with lignites and coal. Overlying these, in a nearly horizontal attitude, are fresh-water sandstones, conglomerates, and marls, probably of Upper Eocene age. Of the volcanic rocks of the region, a hornblendic trachyte is said to overlie the Cretaceous, while there are outbursts of much earlier date, and others of Post-pliocene age.

The volcanic activity of the great plains of the Snake River basin was also, according to Bradley, comparatively recent, and the movements of the surface were still later, as is shown by the fact that basalts and porphyries, interstratified with Pliocene sandstones and limestones, are found upheaved at the base of the foot-hills. The boiling springs in the basin of the Upper Madison River rise from sandstones which appear to have been deposited in a volcanic crater of large dimensions, and the subterranean fire still heats the water which sinks into these porous beds, causing it to rise again heated to a point above the boiling-point at this altitude (about 200° Fahr.). The sandstones are perforated and eroded by the solvent power of these heated waters, which dissolve the silica to deposit it again in the vicinity as the water cools. Gelatinous vegetable forms grow in all these pools where the water is not in such violent ebullition as to break them up and destroy them. They are sometimes broad, thick sheets or branching sponge-like forms, green or rusty-brown in color, and sometimes white and fibrous. The latter, which grow most abundantly in the rapidly flowing outlets of the pools, are constantly incrusted with silica, and as constantly reproduced. The larvæ of *Helicopsyche* were also met with in a pool at 180° Fahr., and living diatoms in water at over 100° Fahr. The deposited silica has in some parts cemented sand and gravel beds into hard conglomerates, and even into perfect quartzites, and the silicification of wood in all its stages is seen in the pools. In this connection we may notice the investigations by John Arthur Phillips of the well-known silicified woods from the auriferous gravels of California, probably, according to Newberry, of later Pliocene age. Some of the trunks were silicified without previous change, while others were first converted more or less completely into lignite before silicification. In the latter case an amount of carbonaceous matter, equal to about fourteen per cent., is still preserved. The replacing silica, nearly pure and slightly hydrated, in all cases retains somewhat over one half per cent. of alkalies, the potash predominating over the soda.

It is to be noticed that in this Rocky Mountain region the crystalline strata are more ancient than the Potsdam. The same thing has been shown with regard to the quartzites and talco-quartzose schists of Sauk and of Dodge counties, Wisconsin. The former of these had been referred by Hall to the Huronian, but by most other geologists both have been regarded as altered Potsdam or St. Peter's sandstone. Professor Roland Irving has pointed out that these rocks are in both localities unconformably overlaid by the Potsdam sandstone, and thus confirms the view of Professor Hall.

In the east, Mr. Ford has studied farther the Lower Cambrian rocks of Troy, New York, which, either by a dislocation, or by an overturned and denuded fold, are made to directly overlie, in apparent conformity, the Cambro-Silurian strata (Utica and Hudson River slates); the whole of the strata dipping to the eastward. These older, though overlying rocks, contain forms belonging to the fauna which Mr. Billings has named Lower Potsdam, including trilobites of the genera *Microdiscus*, *Conocephalites*, *Olenellus*, and *Agnostus*. This fauna is distinct from that of the true Potsdam of New York and Wisconsin, as well as from the Menevian of Massachusetts, New Brunswick, and Newfoundland. Its relation to these is yet to be determined, though it is closely allied to both. This fauna is also found in Georgia, Vermont, and in the Strait of Belle Isle, besides which a large extent of rocks on the south side of the St. Lawrence below Quebec, formerly mapped as the Quebec group, is now referred to the Lower Potsdam.

Professor Hall has again called attention to the distinctness and importance of the Lower Helderberg group of limestones, which some have attempted to confound with the Niagara, apparently because in the valley of the Ohio the two series, reduced in volume, are in immediate contact. Hall reiterates, what he had long since shown, that they are widely different in their fauna, and in central New York are separated by the great non-fossiliferous Onondaga or Salina formation; while to the eastward, where this and even the underlying Niagara is wanting, the Lower Helderberg appears as a great fossiliferous limestone formation, which to the north and east rests directly upon the rocks of the second fauna, and even upon the older crystalline rocks (see the *Record* for 1872, p. xxxv–xxxvii). Hunt, in this connection, calls attention to the absence over New England and the British maritime provinces of the second or Trenton fauna, and, except to the far eastward, of the third or Medina-Niagara fauna. The Lower Helderberg, corresponding to the Ludlow rocks of British geologists, really includes a fourth paleozoic fauna, and is the upper division of the true Silurian, while the Medina-Niagara group is the lower division; the interval between the two presenting a great paleontological and chronological break, which is marked in central New York and western Ontario by the deposition of the dolomites, salt, and gypsum of the Salina formation.

Professor Newberry, in discussing the often-observed cycles of deposition in stratified rocks, has pointed out that the invasion of the sea, resulting from a subsiding continent, produces first a sheet of sea-beach sand and gravel, followed by off-shore deposits. To these succeed the limestones deposited in the open sea, which are followed by the mixed sediments of shaly or earthy limestones, the product of the retreating sea, completing the cycle of deposition; after which ages may elapse before a second submergence permits the deposition of a new series, characterized by a new fauna and a new flora. In this connection Hunt has insisted upon the importance of the deposits from evaporating inland seas, marked by magnesian limestones, often with gypsum and salt, and in some cases destitute of animal life, which, as in the case between the Niagara and the Lower Helderberg, gave rise to a paleontological break.

The phenomena of the disintegration of crystalline rocks, as seen in the Blue Ridge, have been discussed by Dr. Hunt. The process was one of chemical change, resulting in the decomposition of the feldspars and hornblende, removing the alkalies, lime, and magnesia, and a portion of silica, and converting the rocks, to a depth in some cases of a hundred feet or more, into a soft, reddish clay; in which the unchanged veins and layers of quartz still remain to show the highly inclined position of the strata. This action took place under the influence of a highly carbonated and moist atmosphere, and was already at work in early paleozoic times. From the clays thus produced were derived the argillaceous rocks of the various geological periods up to the present, while the separated quartz and the dissolved and precipitated silica have formed the various silicious rocks, sandstones, quartzites, and cherts. To the alkaline and earthy carbonates produced in this process of decay are due the limestones and dolomites of the paleozoic sea; while the iron dissolved out by organic agency from the decayed materials has furnished not only the deposits of iron in various forms which appear at different horizons in the paleozoic series, but also the great accumulations of limonite ores found along the base of the Blue Ridge. Some of these have been directly derived from the decomposed rocks, while others are due to secondary changes in the paleozoic iron-bearing strata.

This decay of the crystalline rocks was, in his opinion, universal, but the softened materials to the north and east have been removed by aqueous and, in some cases, by glacial erosion from the surface, leaving bare the hard, unchanged portions. As late as the Miocene, he conceives that the hills of New England were covered with decayed materials like the Blue Ridge of to-day, and from these came deposits of clays and ores like those of Brandon, Vermont, which are vestiges of formations that were swept away during the great submergence at the close of the Pliocene; since which time no considerable decomposition has gone on, as is clear from the preservation of the glacial scratches. He, however, supposes this process of decay to have been continuous up to a comparatively recent period. As we go southward, where erosion was less active, we find the partially disintegrated portions of the rocks undisturbed, and finally the completely decomposed strata still in place, showing that this region has not for long ages been exposed to erosion or denudation. The permeability of this superficial coating, due to its peculiar structure and its vegetable covering, has prevented its degradation by atmospheric waters. This decay and disintegration was, according to Dr. Hunt, a necessary preliminary to glacial and erosive action, which removed already softened materials. Mr. Burbank has, in this connection, furnished an important contribution to our notions of the superficial drift-deposits, by showing that in some parts of North Carolina, where the hardened crystalline granitic rocks are incompletely decayed, the change, extending from natural joints, produces a concentric exfoliation, leaving rounded nuclear masses of unchanged rock, like the boulders of decomposition described by Hartt in Brazil. He concludes that the boulders of our northern glacial drift are due to such a process, and that the glacial action which displaced the already softened and disintegrated rocks did not produce the great mass of glacial drift by mechanical abrasion of hard rocks. As regards glacial action, the extreme views of those who assert the existence of immense continental glaciers, or of an ice-cap covering the greater part of the northern and southern hemispheres, while strongly defended in some quarters, are rejected by many. Foremost among its opponents is Dawson, who maintains that the glacial phenomena seen over northeastern America are to be ascribed in great part to the action of polar ice borne over the submerged land by the polar current. He, however, at the same time admits the existence of local glaciers in the mountainous regions, which were the cause of some of the phenomena observed. He has shown that a portion, at least, of the so-called glacial drift is clearly a submarine accumulation. Similar views are held by most of the English geologists, in opposition to those of Ramsay and Giekie, who are partisans of the hypothesis of land-glaciation. The careful studies of Searles V. Wood on the glacial deposits of southern England seem to be conclusive in favor of its submarine origin, and of the agency of floating ice from local glaciers in the distribution of the glacial drift. As regards the supposed power of land-glaciers to excavate valleys and lake-basins, Phillips of Oxford, in his address before the British Association in August, 1873, remarks that it is "a proposition which can not be accepted until we possess more knowledge than has yet been attained regarding the resistance offered by ice to a crushing force, its tensile strength, the measure of its resistance to shearing, and other data requisite for a just estimate of the problem, which is distinctly a mechanical one. At present it would appear that under a column of its own substance 1000 feet high, ice would not retain its solidity; if so, it could not propagate a greater pressure in any direction."

A small but valuable geological map of the United States, prepared for General Walker, the superintendent of the Ninth

Census of the United States, accompanies his report. This map, which was compiled by Professor C. W. Hitchcock and Professor W. P. Blake, is on a scale of about ninety miles to an inch (measuring only thirty-four by twenty-eight inches), and, although confessedly incomplete, is the best geological map which we have of the whole Union. The geological divisions are indicated by nine colors, representing, 1st, Eozoic; 2d, Silurian; 3d, Devonian and Lower Carboniferous; 4th, Coal measures; 5th, Triassic and Jurassic; 6th, Cretaceous; 7th, Tertiary; 8th, Alluvial; 9th, Volcanic. Professor Blake has here given us for the first time a connected view of the present state of our geological knowledge of the western half of our country; while Professor Hitchcock, as General Walker informs us, has made use, in the compilation of his portion of the map, of a great quantity of material, "both printed and in manuscript from the best geologists, collected by him for the purpose of constructing a complete geological atlas of North America," which will probably soon appear. In a future geological map of the United States, it will be desirable to separate what is here called the Silurian into at least four divisions: 1st, The Primal and Auroral of Rogers, the Lower and Middle Cambrian of Sedgwick; 2d, The Matinal of Rogers, the Upper Cambrian of Sedgwick (these two divisions being generally included under the erroneous name of Lower Silurian); 3d, The Medina, Clinton, Niagara, and Salina formations; and, 4th, The Lower Helderberg—constituting together the true Silurian. These four great groups of strata, widely unlike in their distribution, their fauna, and their geognostical relations, mark four well-defined periods in the geological history of the continent. At a later time it will be possible to subdivide in like manner the Eozoic rocks, and to define the limits of the Laurentian, Huronian, Montalban, and Norian series.

Economic Geology and Mineralogy.—The work of developing the deposits of crystalline iron ores, which lie on all sides around the rim of the great paleozoic basin, has been stimulated by the great rise in the price of English iron. The amount of ore raised from the mines of Lake Superior in 1873 was somewhat over one million of tons, equal to two thirds that amount of metallic iron; while the production of crystalline ores from Missouri, New York, Canada, and New Jersey has also been increased; and the scarcely less valuable brown hematite ores of the great Appalachian valley, from Vermont to Alabama, are also extensively mined.

The recent completion of the Chesapeake and Ohio Railroad, from the Ohio to tide-water, has made more accessible the very valuable coal-field along the Kanawha, in West Virginia, from which certain valuable kinds of coal are now shipped to Richmond, Virginia, and thence to New York. The opening of new railroads in southeastern Ohio has also rendered more accessible the remarkable coal-field of the Hocking valley in that state, and large quantities of free-burning coal of great excellence are now shipped to the north and northwest from this region. The coals of the Cretaceous formation in the Rocky Mountain region are in great part of the nature of lignite, and, although capable of being used for the generation of steam and for domestic purposes, are unfit for smelting operations in shaft or blast furnaces, and can not be made into coke. To supply these wants, charcoal has hitherto been used in Nevada, while coke is shipped at great cost from Connellsville, Pennsylvania, to Utah. Mr. Eclers has lately discovered that the Cretaceous coal from Trinidad, Colorado, yields an excellent coke, which it is thought may be fit even for iron-smelting. Other discoveries of a similar kind are reported in that region, a fact of great importance for the metallurgical industry of the West.

The deposits of native copper on the south shore of Lake Superior continue to be worked with great success, and the Calumet and Hecla mine will yield for the year not less than 10,000 tons of metallic copper. Attention has been called by Dr. Hunt to the copper ores in the crystalline rocks of the Blue Ridge, especially those of Ducktown, Polk County, Tennessee; of Ore Knob, Ashe County, North Carolina; and of Carroll County, Virginia. He concludes that these great accumulations of sulphuretted ores, even when, as at Ducktown, apparently conformable to the inclosing rocks, are really of posterior origin, and are concretionary deposits, similar in the manner of their formation to transverse lodes. The mine recently opened at Ore Knob, in North Carolina, is itself clearly a fissure-lode of great length and breadth, occupied by a massive ore, yielding twenty-five per cent. of copper, for which extensive works for the extraction of the metal by a humid process are now being erected. The deposits throughout this region may be made to furnish large supplies both of copper and of sulphuric acid, which latter can be utilized in the treatment of the phosphate of lime found near Charleston, South Carolina. This material is there interstratified down to considerable depths with the marls of the region, and apparently in vast and almost inexhaustible quantities. Its value for the manufacture of fertilizers is now well known, and it is shipped in great quantities both to the Northern States and to England; besides which a large amount is manufactured into superphosphate at Charleston for the home market. The evidence accumulated goes to show that this massive and impure phosphate of lime, to which the name of coprolite, or manure-stone, may still be given, is not of excrementitious origin, though fossil excrements certainly occur in many rocks, but has been deposited from solution by a process of concretion which, though little understood, is perhaps analogous to that by which flints are formed. This view is advocated by Sollas, from his study of the coprolites from the greensand in England, which, according to him, result from the petrifaction of sponges by dissolved phosphatic matter. The relation between these ancient deposits and the guano of the Chincha Islands is closer than might be at first suspected, since the latter, according to Edwards, is not excrementitious, as commonly supposed, but rather a stratified deposit of phosphatized sponges and other low organized forms.

The subject of descriptive *Mineralogy* has, of course, received much attention on the part of mineralogists and chemists throughout the world; and the new species discovered, with new localities for those already known, are quite numerous. For full details relating to this department of science, reference must be made to the journals specially or incidentally devoted to the subject; although some indications in reference to American mineralogy may not here be amiss. Two new species have been published by Mr. Goldschmidt: the first, *Trautwinite*, a combination of chromic oxide, ferrous oxide, and magnesia, and *Stibioferrite*, both from California.

Mr. Durant, in the Proceedings of the California Academy of Sciences, has described *Aragolite*, a new hydrocarbon similar to *Idriolite*, occurring in bright-yellow masses, impregnating crystalline silicious dolomite, and associated with cinnabarite.

Dr. Endlich has named a species *Pealite*, from the collections made in Dr. Hayden's expedition, this appearing to be a variety of opal, from the Geyser region of the Yellowstone.

Petersen has published *Guadalcazarite*, from Mexico, which contains selenium and cadmium.

The most elaborate mineralogical paper which has appeared in the United States during the year is one upon *Corundum*, by Dr. F. A. Genth, and published in the Proceedings of the American Philosophical Society. In this occur several new species, such as *Kerrite*, *Maconite*, *Willcoxite*, and *Dudleyite*. Professor Silliman, in the *American Journal of Science*, also describes a new species, under the name of *Priceite*, from Lone Ranch, Curry County, Oregon, and which had been already referred to by Mr. A. W. Chase as an Oregon borate of lime or morphite.

GEOGRAPHY.

In the department of *Geography*, and its various subdivisions, the record of 1873 is quite full; although no very important advances in our knowledge have been brought about, with the exception of that furnished by the voyage of the *Polaris*, to which reference will be made hereafter.

Geodesy, Hydrography, and Navigation. The average amount of work connected with geodetic operations in different parts of the world has been accomplished, the various state and national surveys, both in Europe and America, having been carried forward at the usual rate.

The labors of the United States Coast Survey along the coast, and in the interior by the Engineer Bureau along the Lakes, and in the Rocky Mountains by Lieutenant Wheeler, Professor Hayden, and Major Powell, to which reference will be made again, have established with great precision many important geographical positions, and connected them by triangulation.

The shore outlines of several of the Aleutian Islands have been defined by Mr. Dall during the year, under the auspices of the United States Coast Survey.

The French arc of the meridian, or the meridian of Paris, has been extended during 1873 from Spain across the Mediterranean, and now reaches from Shetland in the north to Algiers in the south, an extent of 30°.

A committee of geodesists held a meeting at Vienna during the summer, for the purpose of measuring another arc of the meridian, to extend from Christiania in the north to Palermo in the south, and possibly still farther, across the Mediterranean. The object is to establish a new determination of the meter, in which all the governments of Europe propose to unite. Although Great Britain was not represented in the congress, it is expected that she will also assist in the enterprise.

Mr. Gardner, the geographer of Professor Hayden's expedition, has published what he considers an improved method of taking barometric altitudes in the Rocky Mountains.

Professor Rogers presented a paper before the American Association for the Advancement of Science, at the Portland meeting, upon a method of fixing a ship's place at sea, which he considers free from some of the errors which have frequently led to so disastrous results.

Should we include the apparatus for taking soundings at sea under the head of geodesy and hydrography, we may refer to the sounding-lines used by the *Challenger*, which are said to be much stronger than any previously employed. In the construction of these the best Italian hemp was used, subsequently treated with a coating of equal parts of beeswax and sweet-oil. As the result of this mode of preparation, with a decrease of 15 per cent. in weight of material, an increase of strength has been gained of from 100 to 200 per cent.; and the rapidity with which the line runs out is at least 20 per cent. greater than that of lines of the old construction.

Another important improvement in sounding-lines is that suggested by Sir William Thomson, in the use of steel piano wire instead of cord, the advantages of which are that there is a much less amount of friction and greater precision of observation. The results of its use by the inventor about Madeira and in the Pacific on board the steamer *Tuscarora*, in its cruise of the past summer, are such as to show that this apparatus is most valuable and efficient, and bids fair to replace all others. A weight of from twenty to forty pounds is quite sufficient to carry the wire to a depth of several thousand fathoms, whereas with the hempen rope a ball weighing several hundred pounds is necessary.

Under the general head of *Physical Geography* we have nothing of special interest to report, although attention has been called to the influence of marine vegetation in enlarging the coast-line, as shown in the Indian Ocean, especially in the island of Sumatra, where the outgrowth of the mangroves along the shore results in the accumulation of other vegetation and the subsequent formation of soil, and the reclamation of a considerable extent of land from the sea. This is seen elsewhere, and may be noted on a large scale in the islands off the coast of Florida.

Numerous articles have appeared during the year, showing the relation of forests to rain-fall, and an earnest effort has been made to induce the State of New York to take possession, by means suggested, of the head waters of the Hudson River in the Adirondack region, and to prevent the timber from being removed. It is urged that the continuance of the navigability of the Hudson is intimately connected with this precautionary measure, the experience of other parts of the world showing that, even although there may be no absolute variation in the rain-fall in a given region, its denudation of forest growth causes the water to run off very rapidly, producing dangerous freshets, to be followed by a period of extreme low water; whereas under normal conditions the moisture is held for a time in the forest soil as in a sponge, and gives off its supply gradually and uniformly throughout the year. The experience of the island of Santa Cruz is adduced as a warning of the results following the removal of forests, in respect to which it is stated that for many years, while covered with trees, the whole of this island was fertile and habitable, whereas in consequence of the gradual destruction of the forests the island is rapidly drying up, and, unless precautionary steps are taken, bids fair to become an uninhabitable desert.

As a preliminary to the subject of *Explorations and Researches*, we may refer to several communications which have appeared in reference to great areas of the earth's surface at present unexplored, a writer in *The Academy* remarking that of these there are four, of great extent, never traversed by civilized man, constituting in all about one-seventeenth part of the globe. Of these the greatest is the antarctic region, the next that about the north pole, the third is in Central Africa, and the fourth in Western Australia. To the south polar region the nearest approach was made by Ross in 1842, in latitude 78° 10′, south of New Zealand, while the nearest to the north pole was by Captain Hall, in 82° 16′. The unexplored portion of Africa reaches on the west very closely to the coast, that near the equator having been driven inland by Du Chaillu and Walker. The expedition under Lieutenant Grandy will probably successfully pierce the centre of this portion. In Australia the unknown area lies to the west of the tract explored from south to north by Stuart in 1861. The combined areas of uninvestigated regions, according to the writer referred to, amount to over eleven and a half millions of square miles.

In proceeding to consider the special explorations made in the different parts of the world, we begin with those of the ocean in general; and of these the most notable is that of the *Challenger*, of which a detailed account will be found on page 243. We may mention, however, briefly, that this steamer of 2300 tons, fitted out with every means for scientific research, under Captain Nares, and with Professor Wyville Thomson as scientific director, left Portsmouth on the 21st of December, 1872, and after entering the Mediterranean, and making some magnetic observations there, sailed thence for Madeira and Teneriffe; after which she proceeded to Sombrero in the West Indies, and to St. Thomas. On the 24th of March she left St. Thomas for Bermuda; from this island to a point off the American coast, near New York, and thence to Halifax. From Halifax she went back again to Bermuda, and from Bermuda to the Azores; from the Azores to Madeira, and from Madeira to the Cape Verde Islands, which she left on the 27th of July for Bahia in Brazil; thence proceeding, by way of Tristan d'Acunha, to the Cape of Good Hope, where she arrived safely.

The results of this expedition, so far, have been of great service in establishing the true contour of the Atlantic seabed, in determining points of temperature and currents, and in bringing to light vast numbers of new and interesting animal forms.

In the way of explorations of the Mediterranean, the principal labor has been that prosecuted by M. Lacaze-Duthiers on the *Narval*, a French vessel employed in the hydrographic survey of the coast of Algeria. The special object of M. Duthiers was the re-examination of the coral banks investigated by him in 1860 to 1862; this was successfully accomplished, and resulted in securing much interesting information in regard to the growth of coral animals in general. Dr. Carpenter had announced, as the result of his observations in the Mediterranean in 1871, that animal life was very much restricted in that sea, owing to the great accumulation of carbonic acid, induced by the want of circulation of the water in consequence of the bar across the entrance at the Strait of Gibraltar; and he further stated that animal life below 150 fathoms was very scanty, and still more so at 200 fathoms. Lacaze-Duthiers, however, as the result of his labors, does not concur in this generalization, as very large collections of specimens, including several novelties, were obtained.

A report has been published by Dr. Oscar Schmidt of explorations in the Adriatic made in 1870 on the Austrian steamer *Trieste.* An interesting result of his researches was the discovery of *Bathybius* at depths of fifty fathoms or more, and also of a second protozoan organism, which he calls *Rhabdolithus.*

Explorations off the coast of North America during 1873 have been very extensive, and fruitful in important results. A report of explorations in 1872, on the Canadian vessel *Stella Maris*, has been published by Mr. Whiteaves, an interesting fact recorded therein being the existence of a temperature of 32° at the bottom of the sea near Bonaventure Island. The labors of Mr. Whiteaves were continued in 1873, and, as before, were prosecuted in the Gulf of St. Lawrence. Two weeks were devoted to the investigation of the greatest depths, between Anticosti and the Gaspé peninsula. The northern entrance to the Bay of Chaleur was examined on the second cruise. The third extended between Cape Breton and Prince Edward's Island, and the fourth included both sides of Northumberland Strait, from Pictou to Miramichi Bay. Numerous collections were made on this expedition, and much important information secured in regard to the oyster beds of New Brunswick and Prince Edward's Island.

The most notable exploration, however, on the American coast, was that prosecuted by the United States Fish Commission, under the direction of Professor Baird and Professor Verrill. Peak's Island, in Portland harbor, was selected as the centre of operations for the summer, and afforded the opportunity for the gathering of a large number of specialists, either connected directly with the service, or joining it for the sake of the facilities given for the study of marine life.

The United States steam-tug *Blue Light*, properly equipped and fitted for the service, and under the command of Captain L. A. Beardslee, U. S. N., was placed at the disposal of the Commission by the Secretary of the Navy, and was constantly employed in its labors from the beginning of July until toward the middle of September. All the apparatus for deep-sea research used by the foreign expeditions was employed in this exploration, and the results promise to be of the utmost importance, both in their scientific and economical relationships.

The primary object of the Commission was, of course, the determination of questions connected with the fisheries of the coast, and the boundaries, limitations, and conditions influencing them; but collaterally, also, an exhaustive investigation of the currents, ocean temperatures, chemical composition of the water, and every thing bearing upon or connected with the fauna or flora of the sea.

In addition to the *Blue Light*, the service for a month, of the United States steamer *Bache* was granted to the Commission by the Superintendent of the Coast Survey, the vessel being under command of Captain Howell. Dr. Packard took charge of the biological investigation on board this vessel, in behalf of the Commission, assisted by Mr. Cook. As the cruises of the *Bache* were considerably outside of the limits possible for the *Blue Light*, a large part of the region between Cape Cod and the Georges, off the coasts of Massachusetts, New Hampshire, and Maine, was explored. The results secured by this expedition were too extensive to be stated within the limits of our Summary, and the detailed account must be looked for in the reports of the Commission and in a lecture extra of the *New York Tribune* published in September last.

Of deep-sea explorations on the Pacific coast, those of most interest were prosecuted under the direction of the Coast Survey and the Navy Department. Mr. William H. Dall, in charge of the Coast Survey vessel the *Yukon*, was engaged in surveying the westernmost of the Aleutian Islands and their approaches, with special reference to the question of a deep-sea cable between the United States and Japan; and at the same time some interesting facts were collected in regard to the physical condition of the sea bottom, which will be found detailed on page 246.

The exploration on the part of the United States Navy was conducted on board the steamer *Tuscarora*, under Commander Belknap, and resulted in obtaining sections of several important lines of soundings. Specimens of the sea bottom collected by the *Tuscarora*, and forwarded to the Bureau of Navigation, have been transmitted by Commodore Ammers to the National Museum for investigation.

Of late years the unknown regions about the north pole have occupied much attention on the part of geographers, whose interest has been greatly intensified by the wonderful experiences of the *Polaris* and her party, which prove that the "proper gateway to the pole," as maintained by Mr. Clements R. Markham, of London, and other British authorities, is by way of Smith's Sound, or along the track of the *Polaris;* although others, as Captain T. C. Wells, still insist that the Spitzbergen seas offer superior advantages. Although our knowledge of this region rests almost exclusively upon the discoveries of America, Great Britain manifests a laudable inclination to enter the field; and it is quite probable that early in 1874 an expedition, either public or private, will be sent out from England to Smith's Sound. A movement looking toward securing government aid has been commenced by the Royal Geographical and the Royal Societies of London; and although, when approached on the subject in 1873, the British authorities decided that the *Challenger* expedition was all that could be undertaken at that time, it is hoped that a polar exploration will be authorized for 1874.

The history of *arctic exploration* as actually prosecuted during the year 1873 contains several very interesting chapters, embracing rather the completion and results of enterprises commenced previously than new enterprises begun. By far the most important results are connected with the history of the *Polaris*, the American vessel which, as our readers are aware, left Washington in midsummer of 1871, under Captain Charles F. Hall.

No advices were received of this vessel until the spring of 1873, when the public was startled by the announcement that a portion of her crew had been picked up adrift on the coast of Labrador and brought into the harbor of St. John's, Newfoundland. This fact having been properly authenticated, the Secretary of the Navy sent a steamer, the *Frolic*, to St. John's for the purpose of bringing the rescued party to Washington, where an examination by a Commission appointed for the purpose gave to the public, in authentic form, the history of the expedition, which will be found detailed at length on page 237. To sum up briefly the general record, we may state that the vessel proceeded with but little impediment as far north as latitude 82° 16′, which point was attained on the 30th day of August, and where further progress was arrested by the ice, and it became necessary to go into winter-quarters. These were established in Thank God Harbor, in Polaris Bay; and after every thing was in order, Captain Hall started on a sledge journey to the north. He returned after the lapse of two weeks; and shortly after going on board his vessel, died of an attack of hemiplegia.

The party spent the winter at this point, and as early as possible in the following summer made several attempts by boat and sledge to proceed northward, but being unable to make headway, finally reached the vicinity of Littleton Island, about sixty miles north of Northumberland Island. Here, on one occasion, being threatened with the ice, nineteen of the party went from the vessel to an adjacent floe for the purpose of removing provisions and supplies which were thrown over from the vessel. While this was in progress a storm arose, which tore the vessel from her fastenings to the ice, leaving the nineteen persons still upon the floe, who, after drifting for fifteen hundred miles, during a period of about six months, were rescued, as stated, by the crew of the sealing steamer *Tigress*.

The dangerous situation of the *Polaris*, and the uncertainty in regard to the party remaining on board, induced the Secretary of the Navy to send a relief expedition, consisting of the *Juniata* and the *Tigress*, the latter having been purchased for the purpose.

In the mean time the party on the *Polaris* went ashore, and established a second winter camp, and early in the following June started out in two boats for the western side of Baffin's Bay, in hopes of meeting some whaling vessel. They were found and picked up by a Dundee whaling steamer, the *Ravenscraig*, from which vessel they were transferred to the *Arctic* and the *Intrepid*, and carried in safety to Dundee, Scotland, from which point they returned to Washington. The only casualty during the expedition consisted in the death of Captain Hall.

Although many of the records and a large portion of the natural-history collections were lost, the general results were of the highest value, and will form the subject of a special report on the part of Dr. Bessels, the chief of the scientific corps. They embrace determinations of the tides, the magnetism, the meteorology, the hydrography, and the natural history of the polar regions.

A notable move in the way of arctic search was also made by some Dundee steam whaling vessels, of which eight were fitted out, and met with more or less success. One of these, the *Arctic*, was accompanied by Captain Markham, of the Royal Navy, who visited the Greenland seas for the purpose of familiarizing himself with the details of arctic travel, expecting to be connected with the anticipated British expedition in 1874. This vessel touched at several portions of the North, especially the old encampment of Captain Parry, of fifty years ago, where they found stores and supplies in good condition, including meat cans, with the contents still perfectly palatable. It was to this vessel that the *Polaris* crew was transferred from the *Ravenscraig* and taken to Scotland.

Less productive in scientific results than the voyage of the *Polaris* was the Swedish expedition under Professor Nordenskjöld, which had for its object the prosecution of arctic search to the north of Spitzbergen by means of sledges drawn by reindeer. This expedition proceeded to Spitzbergen during the summer of 1872, but was unfortunately beset by the ice earlier in the season than was anticipated; and a supply vessel, only intended to carry provisions and stores for the benefit of the exploring party, was itself caught in the ice and obliged to pass the winter there. Notwithstanding this great increase of the force, by the judicious efforts of its officers, all were kept in perfect health and condition—but one man dying, and he of consumption.

Professor Nordenskjöld found that his anticipation of successful exploration by sledges could not be realized—the ice proving too rough in some places, and too soft in others. The highest point attained by him was 80° 30′. Finding this enterprise unsuccessful, the expedition returned home in the summer of 1873.

Many interesting facts were obtained in regard to meteorological and other physical phenomena, considered of great value by Dove and others, and some collections in natural history were made, although nothing of any very great moment. It was, however, fully established that no reliance can be placed upon sledge journeys, whether drawn by dogs, reindeer, or men, for extended polar explorations, although as a collateral they may be of much advantage.

Simultaneously with the ice embargo of the government expedition, several Norwegian whalers were detained in the same manner, and although some of them succeeded in getting away, the remainder were obliged to remain during the winter, and, we regret to say, all died of scurvy and other diseases.

Another arctic expedition was that of Mr. Leigh Smith, who left Dundee on the 10th of May for Spitzbergen, having chartered the steam yacht *Diana* of Mr. Lamont for the purpose. His own vessel, the *Sampson*, was also dispatched for Spitzbergen as a relief vessel, and spent most of the season in a very successful seal-hunt.

Mr. Smith proceeded to Seven Islands, in latitude 80° 50′, and made that the centre of research, the highest point attained being 81°. Numerous specimens of the walrus and the polar bear were secured, and some observations were made on polarity, magnetism, etc. The anticipated results were interfered with by the stormy weather of the season, and the expedition returned to Dundee on the 27th of September. Among the practical discoveries by Mr. Smith was that of banks of codfish, which it is quite likely may become the subject of a profitable fishery. Captain Wells, who accompanied Mr. Smith, still remains of the opinion that the Spitzbergen route to the pole is the most eligible.

Another expedition to Spitzbergen was that of Dr. Richard von Drasche, who left Tromsö on the 30th of June, in a small vessel, with the special object of making some geological explorations, and, reaching the southern part of West Spitzbergen on the 10th of July, arrived in Bell Sound on the 16th. Here he met Professor Nordenskjöld, then on a boat expedition to the North. Much of the time was spent at Amsterdam Island and Prince Charles Foreland, the expedition returning to Hammerfest on the 27th of August.

Nothing very definite has so far been brought to light in 1873 in reference to the region east of Spitzbergen, although visited by many Norwegian hunting and fishing vessels. It is, however, probable that Professor Mohn, of Christiania, who is in communication with most of these parties, will before long make some communication as to their results.

Of Nova Zembla and the Sea of Kara, nothing new is known, although, as having been visited equally with the seas east of Spitzbergen by Norwegian vessels, something may yet be learned.

The Russian Siberian arctic expedition, under Tschekanowski, and well provided with specialists, reached Jerbochotscho, the last Russian settlement on the Tunguska (lat. 61° 17′ N.), on the 20th of June, and proceeded to the exploration of the surrounding country. Much information was obtained in regard to geology and natural history, and large collections sent to St. Petersburg. The party expected to return to Irkutsk about the end of October, and then soon to start again on a united journey to a station on the Tunguska, from which to carry on the exploration of the Olenek and Lena. The prime object of the expedition appears to be principally the accurate determination of the courses of the two rivers just mentioned.

No advices whatever were received during 1873 from the *Tegethoff*, of the Austrian expedition, which left Bremerhaven on the 13th of June, 1872, under Payer and Weyprecht. The party expected to winter on the coast of Siberia, and thence extend their travels northward. The vessel was last met with on the 29th of August, steaming eastward, off Cape

Nassau, Nova Zembla. We trust that the next communication will be of a successful enterprise in that unknown region. No apprehension seems to be entertained of any disaster to the party.

In connection with the problems of arctic discovery, the occurrence of drift-wood in the northern seas, and the determination of its origin and character, are matters of much interest, this having been found by the *Polaris* party in considerable quantity in Polaris Bay, and existing in very great abundance on the shores of Nova Zembla. The first-mentioned specimens have not yet been critically examined; the last consist mainly of willow, although pieces of beech nearly a foot in diameter, and several species of pine, have been observed. It is supposed that a large portion of this material must have been derived from the Petschora, Obi, and Yenisei rivers of Siberia, showing the existence of a current from the mouths of those streams. None of it is believed to have been furnished by the Gulf Stream.

The first portion of the report of the great German expedition to East Greenland in 1869–70, under Captain Koldeway, on board the *Hansa* and the *Germania*, has been published, and is devoted principally to the account of preparations for the voyage and the special history of the *Hansa*. It will be remembered that this vessel was wrecked, and that her crew had a somewhat similar experience to that of the *Polaris* party, drifting for nearly the same period, from the coast of East Greenland down nearly to its eastern extremity, covering, however, in the same time only about half the number of miles. A second division of the report, including the botany and the zoology, is about making its appearance.

Dr. Neumayer, of Vienna, has continued his efforts to induce the Austrian government to make an exploration of the antarctic region, but little of any special moment having been done in that part of the world since Ross' expedition in 1842.

It is more than likely that the transit of Venus in 1874 will be made the occasion on the part of several nations to visit the antarctic regions. As preliminary to this and to the transit work, an elaborate document has been printed by the Board of Trade of England in reference to the meteorology of the antarctic portion of the globe.

The year 1873 will long be marked for the extent and importance of the geographical and other explorations prosecuted in various parts of North America, the number being so great that we can but briefly allude to the more important. We have already referred to the hydrographic results of Mr. Dall's labors in the Aleutian Islands; and we may add in continuation that some very important collections in the line of geology, natural history, and archæology were secured. Complete collections of birds and their eggs, and mammals, were obtained, as well as invertebrates in very great number and variety; but perhaps the most interesting of all were the prehistoric remains found in caves in Unalashka.

Mr. Henry Elliott, to whose residence in the Pribalov, or Fur-Seal Islands, in Behring Sea, as assistant treasury agent, we referred in the *Annual* for 1872, remained there until the summer of 1873, when he returned, bringing the results of his labors. These consisted of numerous sketches illustrating the topography of the island, the natural history of the seal and the walrus, and the incidents attendant upon their capture, and, with the accompanying descriptive matter, furnish very important and valuable information in regard to an interest which brings a large income to the United States government. This material has been put to press by the Secretary of the Treasury, and will shortly be published. Mr. Elliott brought back with him, in continuation of the labors of 1872, large collections in natural history, especially of the birds and their eggs, which, taken in connection with what Mr. Dall has also done, leaves little more to be desired as to a knowledge of the land vertebrates found in the Aleutian Islands.

In British North America, a great deal of activity has also been manifested by our brethren of the Dominion. The labors of the Geological Survey of Canada have been extended far to the west. Vancouver Island was surveyed in considerable part by Mr. George Richardson, resulting in the discovery of important beds of iron, coal, and limestone.

Mr. Selwyn, the chief of the Geological Survey, has prosecuted a preliminary examination of the Hudson's Bay Territory from Fort Garry to the upper waters, to the north, of the Saskatchewan, a distance of 1056 miles, extending over

$18\frac{1}{4}$ degrees of longitude, the whole accomplished in forty days of actual travel. The return journey, of about 1400 miles, occupied thirty-five days. The necessary rapidity of this journey of course did not permit a very minute investigation of the country; but among other practical results, two seams of bituminous coal, one of them measuring from eighteen to twenty feet in thickness, were discovered between the Saskatchewan and the Rocky Mountains, a fact of much importance in connection with the location of the Canadian Pacific Railway in that vicinity.

Mr. G. N. Dawson, geologist of the British division of the North American Boundary Commission, to which reference is made farther on, was also engaged in the geological exploration of the region extending from the Lake of the Woods to a considerable distance westward. Lignite-bearing strata were found on the Souris River, and on some of the northwestern tributaries of the Missouri, a fact likely to be of much interest in the future settlement of the country.

Professor Bell has completed the examination necessary for a geological map of the country lying to the north and west of Lake Superior, and overlapping the region explored by Mr. Dawson.

Official surveys for the line of the Canadian Pacific Railroad have also been prosecuted, resulting in what is asserted to be a practicable route, free from many of the general objections; and Mr. Charles Horetzky, a member of the survey, took numerous photographs of the scenery along the route. We regret to learn that, by a fire in Ottawa, the greater part of the notes and maps of this survey have been destroyed, possibly making it necessary to repeat the reconnoissance.

The labors of the Canadian Geological Survey in the better-known portions of the Dominion are of less general interest, although adding considerably to the details of our information. The coal-fields of Cape Breton have been thoroughly investigated during the present season by Mr. Charles Robb, and his report is expected to prove of much statistical and practical importance.

We next proceed to the consideration of the more important enterprises of the United States south of the forty-ninth parallel.

The first of these to be mentioned is the International

Northern Boundary Survey, intended to complete the labor of establishing the true northern boundary between the United States and British America. Many years ago the eastern section, from Maine to the Lake of the Woods, was defined by Colonel J. D. Graham and others; while the marking of the western, extending from the Pacific coast to the Rocky Mountains, was brought to a close in 1861, under the Commissionership of Mr. Archibald Campbell.

The labor upon the remainder of the line, between the Rocky Mountains and the Lake of the Woods, was undertaken in 1872, also under the direction of Mr. Archibald Campbell as Commissioner, and prosecuted vigorously in 1873. Major Twining, a prominent officer of the Engineers, had charge of the physical work, while the natural-history survey was intrusted to Dr. Elliott Coues, a surgeon of the United States Army, and a well-known naturalist.

During the year 1872, the interval between Pembina and the Lake of the Woods was carefully marked out; and in 1873 several hundred miles have been carried farther to the west, and it is thought that the work will be mainly completed in another season. Thanks to the facilities furnished by Mr. Campbell, Dr. Coues was enabled to make very extensive collections in natural history, and his report to the Commissioner will doubtless present facts of much interest.

Another expedition of great magnitude was that fitted out by the War Department for the protection of the surveying parties of the Northern Pacific Railway, consisting of about 2000 men in all. This force was placed in charge of General Stanley, and concentrated at Fort Abraham Lincoln, on the Missouri. It was composed of ten companies of cavalry, under the command of Colonel Custer, and three battalions of infantry, and was ninety-six days in the field. A large portion of the railroad-line was located by the engineers accompanying the party, less trouble having been had with the Indians than was anticipated.

In accordance with the liberal policy of the Secretary of War, a scientific party accompanied this expedition, consisting of Mr. J. A. Allen, of Cambridge, as naturalist in chief, and Mr. C. W. Bennett as assistant naturalist; Dr. L. R. Nettre as mineralogist; Mr. Konopicky as artist; and Mr. Pywell, as photographer. The region traversed proved to be less rich in natural objects than was anticipated, but large collections were made; and the report to be made by Mr. Allen will prove an important contribution to science.

Another War Department expedition was that under the direction of Captain Jones, U. S. Engineers, having for its object the determination of a suitable pass through the Wind River Mountains. This accomplished its mission; and in the observations and collections made by Dr. C. C. Parry, Mr. J. D. Putnam, Professor Comstock, and other civilian officers of the party, much was done in addition for science in general.

Pre-eminent in the magnitude of their general results—geographical, geological, physical, and biological—are the two great expeditions of Dr. Hayden and Lieutenant Wheeler, which have been carried on in continuation of the labors of previous years, for the details of which we refer to the articles on pages 226, 232, 236, 248, and 251, respectively. The results accomplished by these expeditions have been of the highest importance.

The labors of Major Powell have also been prosecuted with zeal, especially in the way of completing the great map of the Colorado Valley, and securing reliable information and collections relating to the Ute and other tribes of Indians.

Professor Marsh and party returned to New Haven, November 7th, after an absence of five months in the Rocky Mountain region and on the Pacific coast. The present expedition had the same object in view as those of previous years, viz., a study of the vertebrate fossils of the West, especially those of the Cretaceous and Tertiary formations. The first explorations of the year were made in the Pliocene deposits near the Niobrara River. The party fitted out in June at Fort McPherson, Nebraska, and, accompanied by an escort of two companies of U. S. cavalry, proceeded to the Niobrara, and worked in that country for several weeks. Owing to hostile Indians, the explorations of the party here were attended with much difficulty and danger, but were on the whole quite successful. Many new animals were discovered, and ample material secured for a full investigation of those previously known from that region.

A second expedition was made in August from Fort Bridger, Wyoming, and large collections of Eocene fossil vertebrates were obtained, especially of the *Dinocerata*, *Quadrumana*, and *Cheiroptera*, which had first been brought to light by the researches of the party in previous years. A third trip was made in September to the Tertiary beds of Idaho and Oregon, where some interesting discoveries were made. The party went from Oregon to San Francisco by sea, narrowly escaping shipwreck, and then returned East by rail. On the way, short visits were made to localities in the Miocene of Colorado and the Cretaceous of Kansas, to complete investigations began last year. The expedition as a whole was very successful, not merely on account of the large number of new animals discovered, but also on account of the extensive collections made to complete the study of those previously found. All the collections secured are now in the museum of Yale College.

In Middle America, the principal fact is the completion of the surveys for the Interoceanic Canal, several different lines, as the Isthmus of Darien, the Isthmus of Nicaragua, and the Isthmus of Tehuantepec, having been surveyed by United States naval officers. The reports of these gentlemen are now in the hands of the committee appointed for their criticism, and will be made the subject of a careful comparison; and the best route for the canal, with the possibilities of its construction, will doubtless soon be officially presented.

Professor William M. Gabb, of Philadelphia, was engaged during the year in carrying on a very important exploration in Costa Rica, in the vicinity of the projected railway, and in the interest of both the railway and the government. He was accompanied, as zoologist, by Mr. J. Zeledon, an attaché of the Smithsonian Institution, and a native of Costa Rica. A very extensive collection of natural history and ethnology has been already forwarded by Mr. Gabb to Washington, for the purpose of being investigated and described. This expedition, in the magnitude of its zoological and geological collations, promises to be of great importance.

Mr. Osbert Salvin, well known from his explorations in Central America, has returned to that country, with a view of clearing up some questions connected with its natural history, and, in his specialty of birds and butterflies, will doubtless obtain important results.

In the way of explorations in South America, we have to record a second visit by Professor Orton to the region of the Andes. His first exploration, some years ago, having been made *via* Guayaquil and Quito, and thence down the Amazon, he reversed the route on the present occasion, proceeding directly from New York to Para, and thence up the river. He has lately returned to Poughkeepsie, and resumed his duties as a professor in Vassar College.

The South American governments exhibit a laudable disposition to acquire a knowledge of their internal resources, partially with a view of inducing European and American immigration, Peru especially having undertaken this labor on a very large scale, by the appointment of a corps of English scientists for the purpose.

A noteworthy incident of the Fourth of July was the ascent of the highest mountain in Peru by a party of American engineers engaged in constructing a trans-Andean railway. In the Galera Pass of the Andes is situated what is claimed to be the highest village in the world, being 15,580 feet above the level of the sea. The altitude of the peak ascended was found to be 17,574 feet. At two o'clock P.M. the thermometer indicated a temperature of plus 36°, with a barometric pressure of eight pounds to the square inch.

A "Coast Pilot" of the coast of Brazil has lately been published by the United States Hydrographic Office, which will doubtless be of much service to navigators.

Of explorations in the Polynesian regions we have the report of the expedition of Dr. Bernstein to the Moluccas, and of Meyer, D'Albertis, and McCleur in New Guinea, with no specially important discoveries on their part, although to ornithologists the acquisition of some new species of birds of paradise is an interesting fact.

From Beccari, an Italian traveler in New Guinea, advices have been received to the date of the 27th of August, written at Tual, in the island of Kei Dulan, where he had just arrived from the island of Aru. He announced at that date the acquisition of large numbers of plants, about 600 specimens of birds, mostly in skins, and some skeletons, representing about 125 species. He had also secured exhaustive collections in all other branches of natural science, among them some interesting crania.

Accounts of the journey of the Archimandrite Palladius, and that of the Abbé David, in China, have been published, as well as further details of the explorations of Baron von Richtofen. All these constitute interesting additions to our knowledge of the geography as well as the geology and natural history of the great Asiatic empire. Collections of the Abbé David, made within the last few years, have been rich in remarkable specimens of natural history; and we regret to announce that all the results of his later labors in China were lost by the upsetting of the boat containing the collections, on one of the Chinese rivers.

Some interesting and important geographical discoveries have been made on the banks of the Upper Irtish by Messrs. Matusoffsky and Miroschnichenko, under the direction of Poltoratsky. In this exploration the Altai Mountains were visited, and astronomical positions and altitudes of various towns, lakes, and mountains ascertained. Some of the peaks of these mountains rise to a height of 12,000 feet, or considerably above the level of the snow-line.

Palestine has during the year been the subject of several investigations, consisting especially in the labors of the British and American Exploration Societies. By an arrangement between the two bodies, the region east of the Jordan and the Dead Sea has been assigned especially to the American Society, and the report of Lieutenant Steever, U. S. A., recently received and published in New York, contains gratifying evidence of activity. On the 19th of March the expedition left Beirout for the plains of Moab, and a camp was established at Hetbon for the purpose of prosecuting the triangulation and survey of the country. In the course of five months some six hundred square miles were triangulated, and the details of an accurate map on the scale of one inch to the mile have been obtained. Numerous sketches were made by Professor Paine and his party in the vicinity of the camp, and many problems were solved that have long perplexed the historian. The expedition got back to Beirout on the 17th of September, after which Lieutenant Steever returned to the United States, with a view of laying before the committee the results of his labors and of securing the means of further research.

Dr. Beke, under the impression that the true position of Mount Sinai has not been satisfactorily established, and that the elevation supposed to be entitled to that name is at some distance from it, after much effort, has secured the means of visiting the peninsula for the purpose of determining for himself this interesting fact.

The Russian campaign during the last summer, which resulted in the capture of Khiva, has also been directly and indirectly the means of important geographical discovery, which will be presented in proper form in due course of time. The chief political result has been the expansion of the Russian sway over the right bank of the Oxus, east of the Aral River. The region has hitherto been proverbially unsafe for travelers; and it is quite a remarkable fact that newspaper correspondents write freely from points where, a year ago, they would have ventured upon it at the peril of their lives.

The interior of Yemen, in the southern part of the Arabian peninsula, has been explored by Holloway, who expects to clear up many problems in reference to the geography of the region.

As usual, numerous explorations have been prosecuted in Africa, but without any very startling result, nothing at all equal to the discovery of Livingstone in 1872 by Stanley being recorded. Livingstone-search expeditions, one under Lieutenant Cameron, by way of Zanzibar, and one under Lieutenant Grandy, by way of the Congo, have been heard of at various points, but nothing very important has been developed by their labors.*

The French expedition, under Compiègne and Marche, left the Gaboon on the 3d of May, and arrived at the village of Doninalonga on the 10th of June. After spending some months in the study of the country, these gentlemen started again on the 15th of October for the upper part of the Ogowé, known as the Okanda.

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* As this Summary is passing through the press, telegraphic advices have been received in England from Zanzibar announcing the death of Dr. Livingstone in Lobiser on the 15th of August last. In this it is stated that Livingstone died after crossing "Mars Les," with water at one time for three hours above his waist. Members of Lieutenant Cameron's party were suffering from fever and ophthalmia, but would await the arrival of the remains, and bring them to Ujiji, whence they would be conveyed to Zanzibar for transfer to England.

Sir Samuel Baker and his wife have returned to England, after their long stay in Africa, which they spent in the interest of the Khedive of Egypt for commercial and political purposes. The objects of the expedition were successfully accomplished, and a large part of the adjacent African territory was thoroughly explored, and brought under the dominion of the Khedive.

The news from Dr. Nachtigal, who has been exploring the region about Baghirmi to the southeast of Lake Tchad, is not very recent.

A most important enterprise in the way of African research was that which was commenced in December, 1873, by Dr. Gerhard Rohlfs, having for its object the exploration of the Lybian Desert and its oases. This is prosecuted under the auspices of the Khedive of Egypt, and is provided with every thing necessary for successful work, including a large caravan of camels carrying water-tanks, so as to be independent of any other means of water supply. Dr. Rohlfs is accompanied by Dr. Ascherson, Dr. Zittel, and other eminent German naturalists.

From Australia there is little note of results actually accomplished, although we have an interesting report of the work done by Mr. Giles in 1872.

In his last African exploration, Dr. Schweinfürth discovered a river, believed to be previously unknown, and called by him the Uëlle, and in regard to which it is still a problem whether it connects with the Scharí, emptying into Lake Tchad, or with the Ogowaí, a tributary of the Atlantic Ocean. Another problem still unsolved is as to whether the Albert Nyanza connects or not with the Tanganyika. The Lualaba of Livingstone is considered by the German geographers to be a tributary of the Congo, and not of the Nile.

With a view of settling these and other interesting questions, Dr. Bastian, of the Geographical Society of Berlin, interested himself in the formation of a new body, or rather a committee from the Geographical Societies of Dresden, Leipzig, Berlin, Hamburg, Frankfort-on-the-Main, and Munich, which was entitled the African Society, and having for its special object the prosecution of researches in Western Africa, as the portion of the continent where its efforts would be most productive of results. An expedition on the part of this society left for its field of labor on the 30th of May, under the charge of Dr. Paul Güssfeldt, of Berlin, assisted by Messrs. Von Hattorf and Görschen. One division, accompanied by Dr. Bastian, went by way of Lisbon to Cabinda, at the mouth of the Congo; while Güssfeldt and Von Hattorf, sailing in the *Nigritia* for Sierra Leone, were unfortunately wrecked on the passage. This took place, however, near the shore, and although the instruments were not saved, no lives were lost. New apparatus, however, was promptly transmitted to the party, which duly started forth on its mission, and news of a successful result to their labors is shortly expected.

ANTHROPOLOGY.

During 1873 *Anthropological* and *Ethnological studies* have been vigorously pursued in Europe, and the literature relating to these sciences has received valuable additions. Darwinism, especially, continues to be a favorite topic of discussion, and essays in various languages, supporting or combating that theory, are constantly leaving the press. Much attention is paid to the comparison of skulls, either of various races of man, or of those of man and of the higher animals. The Anthropological Societies of Great Britain and Ireland, of France, of Germany (with branch societies at Berlin, Stuttgart, Danzig, Freiburg, Hamburg, Mainz, Heidelberg, and Göttingen), have continued their labors with great activity. Concerning the Anthropological Society of Great Britain and Ireland, not long ago established by a union of the Anthropological and Ethnological Societies of London, it must be mentioned that a separation again has taken place, a number of its members having seceded and formed the London Anthropological Society. An Anthropological Society has been founded at Stockholm, Sweden, by the exertions of Dr. Gustav Retzius, son of the well-known anatomist, Andres Retzius. The first meeting took place on the 15th of March of this year. The next International Anthropological Congress will be held at Stockholm in 1874. The European periodical publications relating to anthropology, ethnology, etc., have appeared as before, and contain a great amount of interesting information.

Some of the more important results of practical research are here given:

Additional traces of lacustrine constructions have been discovered by Mr. Von Schab near the Isle of Roses (Roseninsel), in Lake Starenberg, Bavaria. Their existence was pointed out in 1864 by Professors Von Siebold and Desor. Objects of stone and bronze have been found, but none of iron. Professor Desor's view, that the island in question is of artificial origin, like the crannoges in Ireland, is not confirmed by Mr. Von Schab.

Remains of palafittes also have been pointed out in various mountain lakes of Austria by Count F. von Wurmbrand and Dr. M. Much. The most important of these pile-works is situated in the *Mondsee* (moon-lake), near its outlet. It covers an area of 3000 square meters, and contains, on a moderate calculation, 5000 piles. Among the objects found at this place are highly finished pierced axes of serpentine, wedges, grinding-stones, and vessels of clay largely mixed with calcareous sand. The larger fabrics of clay are without ornamentation, but the smaller ones show concentric circles and various other geometrical patterns. All this earthenware, though made without the assistance of the turner's wheel, is distinguished for elegance of shape. Of particular interest are some vessels of pure clay, provided with massive handles. They show the unmistakable traces of long exposure to heat, and in one particles of molten brass or copper were found, a circumstance which proves that they served as melting-pots. This station, it is supposed, belonged originally to the stone age, while its later inhabitants were acquainted with the use of bronze. The above-named gentlemen will continue their researches.

Mr. Frank Calvert claims to have discovered in the vicinity of the Dardanelles conclusive evidence of the existence of man during the miocene period of the tertiary formation. He says: "From the face of a cliff composed of strata of that period, at a geological depth of 800 feet, I have myself extracted a fragment of the joint of a bone of either a dinotherium or a mastodon, on the convex side of which is deeply incised the unmistakable figure of a horned quadruped, with arched neck, lozenge-shaped chest, long body, straight forelegs, and broad feet. There are also traces of seven or eight other figures, which, together with the hindquarters of the first, are nearly obliterated. I have also found, not far from the site of the engraved bone, in different parts of the same cliff, a flint flake and some bones of animals, fractured longitudinally, obviously by the hand of man, for the purpose of extracting the marrow, according to the practice of all primitive races. There can be no doubt as to the geological character of the formation from which I disinterred these interesting relics." It seems, however, that Mr. Calvert's conclusions thus far have not been generally accepted; doubts even existing as to the artificial character of the supposed engraving.

The well-known *Matériaux* (second number, 1873) contain descriptions and drawings (by Mr. Alphonse Baux) of a collection of Japanese arrow-heads made of chalcedony, jasper, and flint, which are identical with those found in this country. These weapons, it is stated, are quite common in the island of Jesso, where they are found in the soil after heavy rains. They are not used at present in any part of Japan. It appears, however, that they were employed by the Aïnos, the primitive inhabitants of Japan, now driven into the interior.

Mr. Louis Lartet records the discovery in Palestine of various traces of a prehistoric population, resembling in its habits the reindeer-hunters who once dwelt in the caves and under the rock-shelters of Dordogne. A station near Mount Lebanon has furnished chipped knives and scrapers of flint perfectly resembling those of the south of France. They were associated with the broken and calcined bones of animals. Implements of the same character have occurred near Bethlehem, together with large disk-shaped objects of flint perfectly resembling certain paleolithic types of Europe. Dolmens have been noticed in various parts of Palestine. None of the traces just mentioned are ascribed to the Jews; but it is considered as probable that the country was inhabited, before the arrival of the Hebrews, by tribes who used chipped-flint implements exclusively, and by others who were in the habit of erecting, for purposes of sepulture, dolmens analogous to those of France and Algiers.

General Faidherbe read before the Anthropological Society of Paris a paper on the megalithic monuments of Africa. Dolmens occur at Tunis, Constantine, Algiers, and Tangier; but they are wanting all the distance between Algiers and

Tangier. Light-haired populations with an European cast of features live in the neighborhood of the dolmens, and General Faidherbe considers it as probable that these monuments owe their origin to a light-haired race coming from the north of Europe.

Mr. E. Rivière, who is about to publish a work on the celebrated caves of Mentone, Italy (where a complete human skeleton, accompanied by flint implements, skulls, etc., was found in 1872), continues his researches at that place. Every day he collects no less than one hundred and fifty pieces, such as bones, flints, shells, and even human remains. Only a short time ago he discovered human bones in juxtaposition with pierced shells and stag's teeth, also perforated to serve as ornaments or amulets. According to the latest accounts, he has brought to light a second human skeleton, accompanied by the bones of the cave-bear, cave-hyena, urus, horse, etc., together with numerous implements of flint and bone. No traces of pottery thus far have been found in these caves.

The discoveries of Dr. Henry Schliemann in the plain of Troy, Asia Minor, have attracted much attention. He made in the preceding year excavations north of the village of Bunarbashi, and to the east of the Scamander River, which resulted, according to his opinion, in the discovery of the site of ancient Troy. Whether or not Dr. Schliemann has been successful in pointing out the place where Homer's renowned city stood, his researches have, nevertheless, led to important results, disclosing, as it were, three different phases of civilization in tolerably distinct layers on the same spot. The upper stratum contained no remains of stone buildings, wood having doubtless been used in their erection. In the next were found the ruins of dwellings made of sun-burned bricks, together with stone and copper implements and pottery, of a character to impress the explorer with the belief that these relics were left by a people of the Aryan stock. The lowest layer, finally, disclosed massive masonry, consisting of large stone blocks joined with clay. Here were also found the remains of what Dr. Schliemann supposes to have been a tower, which was built upon the natural rock. The pottery found among these débris, which he ascribes to the Troyans, indicated taste, and, in general, a state of civilization far surpassing that of the races who left their tokens in the upper layers. From certain symbolic designs in the ornamentation of the pottery, Dr. Schliemann arrives at the conclusion that the Troyans were of Aryan origin like their ruder successors.

While engaged in excavating during the month of July of this year, Dr. Schliemann came upon a deposit of highly interesting objects, namely, a flat copper article in the shape of a large waiter, probably a shield; a copper kettle with horizontal handles; a large copper plate, upon which a silver vase was fastened; a copper vase; a globular bottle of pure gold, with zigzag ornamentation; silver vases; drinking-vessels of gold and silver; a great variety of silver and gold ornaments (finger and ear rings, bracelets, diadems, etc.); lance-heads and knives of copper (bronze?); and other interesting relics. These objects lay close together, as though they had been contained in a wooden chest. This valuable find is supposed by Dr. Schliemann to constitute the treasure of Priamus, and to have been left behind when the city was destroyed. Dr. Schliemann is about to publish (Brockhaus, Leipzig) a work containing a minute account of his explorations in the "plain of Troy." This will be accompanied with an atlas of 216 photographic plates.

Two important collections of Old World ethnology have lately been added to the art treasures of America, the first of them being that obtained by General Di Cesnola, U. S. Consul at Cyprus, on the site of the Idalium and other localities, and embracing a great variety of objects of Phœnician, Greek, Roman, and other periods. Amid much competition on the part of foreign museums, Mr. Johnson, of New York, took the responsibility of offering $50,000 on behalf of the Metropolitan Museum of Art in New York; and this proposition having been accepted, the collection was brought over from London, and is now in the building belonging to the above-mentioned institution.

The second collection is that of Egyptian antiquities made by Mr. Hay, and for a time on exhibition at the Crystal Palace in London, and which was purchased by Mr. Samuel A. Way, of Boston, and now on exhibition in the building of the American Athenæum in Boston. With these, and the Abbott cabinet of Egyptian antiquities in possession of the New York

Historical Society, America possesses a series of illustrations of Egyptian art not surpassed by any European collection; and it is to be hoped that in time all other branches of antiquity will be equally well represented in America. The Peabody Museum in Cambridge has already a representation of the Stone Age of Europe scarcely surpassed by any museum in Europe.

A second part of the great work of the Imperial Archæological Society of St. Petersburg upon the antiquities of the Scythia of Herodotus has lately been published, and includes elaborate figures and descriptions of numerous articles obtained from the mounds in the steppes of the Black Sea.

The occurrence in various localities in Europe, always under circumstances indicating great antiquity, of certain human cranium, has been recorded in the earlier volumes of the *Annual Record;* and M. Quatrefages, in a recent memoir, considers these as representing a peculiar type, which he calls the Canstadt race, and including several well-known skulls, such as the Neanderthal, Engis, Nagy Kâp, and others. The peculiarity of these specimens consists in enormous frontal sinuses and other characteristic features.

The interest of Biblical scholars and ethnologists has been greatly excited by the publication of the translation of an Assyrian tablet, as rendered by Mr. Henry Smith, of the British Museum, this giving a circumstantial account of the deluge, which, though differing somewhat in details from the Mosaic account, exhibits sufficient similitude to indicate a common origin. The tablet containing this account, as contained in the British Museum, is quite imperfect; but during a recent visit to ancient Assyria, for the purpose of further exploration, Mr. Smith was so fortunate as to discover the remaining fragment, by which he is now enabled to complete the history.

A contribution to the early history of man consists in the discovery of his remains in the bone breccia of Corsica, associated with the bones of Lagomys and other sub-arctic animals, proving conclusively that at the time when these remains were embedded the climate of the country was very different from that which prevails at present, and belonging rather to the post-glacial period, and corresponding probably to that of the reindeer period in France.

A very important contribution to the question of the antiquity of man in Europe is furnished by the result of recent explorations in the Settle bone-cave in Yorkshire, where a fragment of bone unmistakably human was found, under circumstances proving that it must have been deposited during the glacial period.

Anthropological research has been prosecuted in America during the year with much zeal, and new pages are continually laid bare in reference to the history of man on the American continent. Mounds have been opened, graves emptied of their contents, and shell-heaps—especially those of Oregon and California—have been investigated with unusually rich results. Some very remarkable remains of implements and other objects have been disinterred in Washington Territory, Oregon, and California. Mr. Dall has brought from the Aleutian Islands large numbers of prehistoric objects found buried in the caves of Unalashka and elsewhere. The explorations of Professor Powell in Colorado, in continuation of those of previous years, have furnished an exhaustive representation of illustrations of the habits and characteristics of the Utes, embracing dresses, ornaments, implements, utensils, weapons of war and the chase, etc. A most interesting discovery has been made by Professor Kerr, of North Carolina, of ancient mica mines in the western part of that state. The existence of mica in the mounds of the West has long been an interesting fact, but without any explanation of the source whence this was derived. According to Professor Kerr, the aboriginal excavations for mica are very numerous in North Carolina, and were made on a large scale; and there seems to be no reasonable doubt that from them were obtained the plates of mica found among the remains of so many of the early nations of North America.

The expedition of the *Polaris*, and that of the vessels which went in search of her, have also furnished some interesting objects, including many remains of implements of modern origin; but a more special result was the discovery in Polaris Bay, latitude 81° 34′, of Esquimau sledge runners, and other articles; as also the remains of stone houses, showing that these people lived that distance to the north, and probably still farther.

ZOOLOGY.

The year has been characterized by the appearance of several works of great importance that tend to revolutionize, in a degree, the science of *Zoology*, and that evidence the flow of a counter-current in the ordinary channels of zoological thought. Much of this tendency is undoubtedly due to the influence of Darwin's writings, and much to improved methods of research in studying the tissues of animals, and in cutting and staining sections of the soft-bodied creatures, such as worms, and the eggs of the lower animals, as well as the embryos of the vertebrate animals.

The influence of Mr. Darwin's work is noticeable in the entirely new path by which naturalists approach the study of the instinct or mental nature of animals. The key-note to the subject is that the instincts of animals are the result or sum of inherited habits; *i. e.*, that the present mental or instinctive processes of animals are the result of a slow growth, through many generations, of what were originally quite simple mental acts. More is, perhaps, being done in the way of observation and experiment than ever before, and we would refer the reader to numerous articles in *Nature*, by Mr. Darwin, Mr. Spalding, and others, on this interesting subject.

In the physiology of the lower animals, the brilliant researches of Professor A. M. Mayer on the sense of hearing in insects will receive much attention, while the studies of M. Simon on the blind insects inhabiting European caves bears on the subject of the sense of sight. M. G. Pouchet concludes from his experiments on the influence of light on certain dipterous larvæ wanting external organs of sight, that dipterous larvæ generally perceive not only light, but also appreciate the direction whence the light comes.

The anatomy of the brains of certain quadrupeds has been studied by Professor B. G. Wilder, while the physiology or topography of the different mental traits in man has received attention from Fritsch, Hitzig, Jackson, and Ferrier; and from their researches some are led to think that we may ultimately be able to assign the various mental faculties to definite portions of the brain.

The vexed question of spontaneous generation has, since the appearance of Bastian's "Beginnings of Life," been suffered to remain at rest, only to be revived by several English writers, who dispute several alleged facts stated by Bastian, and Mr. E. Ray Lankester seems quite positive that Mr. Bastian is incorrect in several of his observations. In this connection certain observations published in the *Monthly Microscopical Journal* have some significance. Messrs. Dallinger and Drysdale studied a cercomonad, or infusorial being, with an oval body, and provided with two actively moving flagella, or lash-like filaments, at one end. This was the mature form; while other forms, some differing in size and shape, and with one flagellum at each end, others amœboid, with or without a flagellum, and still others cyst-like, and smooth and globular, occurred. All these forms were found to be phases in the life of the original cercomonad. The sporules discharged by these encysted forms of this infusorian were only visible with a $\frac{1}{50}$th objective, and a magnifying power of 2500 diameters. "The development of these granules was now watched with the greatest care. In six hours they had increased to a decidedly perceptible degree, though still far smaller than the minute and familiar *Bacterium termo* of Cohn; an hour or two later they began to reassume an oval shape; in nine hours from the first they had become rather larger than *B. termo*, and had become flagellate, and begun to move freely; the bodies became vacuolate, and in something less than twelve hours the normal parent form was assumed. This history was traced carefully and repeatedly, and with unvarying results. The effects of heat and desiccation were also tried; and it was found that, although drying slowly upon a glass slide and exposure to a dry heat of 121° C. entirely destroyed all the adult forms, yet, after moistening again with distilled water, and watching the field for some hours, growing points were in some instances discovered exactly resembling an early stage of the developing sporules, which points matured into the flagellate state. Further experiments demonstrated that a heat, without dryness, of 66° C. destroys all the adult forms, while young monads appear and develop in an infusion which has been heated to 127° C., suggesting that the sporales are uninjured by a temperature which is destructive to the adult." Dr. Ward, in reviewing this article in the *American Naturalist*, observes "that after this history—whose importance, if verified by subsequent observation, can scarcely be overestimated—a history of a monad multiplying by subdivision, reproducing by conjugation (a true sexual reproduction of an extremely simple type), and actually seen to develop from sporules invisible under the powers usually employed in such investigations, and indestructible by heat which is fatal to the adult forms, it seems almost a waste of time to read of experiments with boiled infusions in sealed flasks, and we are rather inclined to wait patiently until Powell and Lealand or Tolles, or some one else, shall give us a lens capable of reading the life-history, whatever it may be, of Bacteria and Vitriones."

An excellent paper has appeared in the *Quarterly Journal of Microscopical Science* on that other much-agitated subject, *Protoplasm*, entitled "Cell Theories," by Dr. Cleland. It is evident, from his review of the works of Stricker, Beale, and Bennett, that "the protoplasmic element has assumed an enormous importance, casting the nucleus into the shade, while the reign of cell-walls has come to an end altogether." In other words, it is not the cell, but the "nitrogenous substance of an albuminoid character" which is of importance. But yet to speak of life as a property of protoplasm, as Huxley does, is in his opinion untrue. This substance is variable in appearance and behavior, as is well illustrated by Heidenhain's observations on the differences in both salivary and gastric secreting corpuscles in states of activity and rest. "How, then," asks Dr. Cleland, "shall we say that in its different conditions the material which constitutes the mass of such corpuscles is one and the same chemical substance? We shall, indeed, take a very imperfect view of the living units to which an unhappy chance has given the unfortunate name of cells, if we say that because neither cell-wall nor nucleus is an essential element, therefore life is a property of protoplasm."

That it is impossible for naturalists to tell the difference between the lowest animals and the lowest plants seems agreed upon. Haeckel has even, as others before him had done, referred such forms to a distinct kingdom in nature. The last essential difference thought to exist between animals and plants of the lowest order was, perhaps, removed by Professor Draper, who shows that plants, as well as animals, exhale carbonic acid. His article was published in 1872. During the past year an interesting series of articles by Claude Bernard have appeared in *Revue des Cours Scientifique*, on the phenomena of life common to animals and vegetables. He contends that "a fundamental conception dominates general physiology—that of the unity of nutrition in all living beings."

M. Felix Plateau continues his interesting physico-chemical investigations upon the aquatic articulates, particularly the insects. Having previously experimented on the causes of the death of the fresh-water Articulata in sea-water, and of the marine Articulata in fresh water, in the second part of his investigations he takes up three other interesting questions: First, he details certain experiments on the time during which the aquatic Articulata can remain in the water without coming to the surface to breathe. He finds that terrestrial Coleoptera (beetles) resist complete submersion during a very long time, *i. e.*, for three to four days. It seems that swimming aquatic Coleoptera and Hemiptera, far from presenting a greater resistance to asphyxia by submersion, are no better endowed in this respect than terrestrial insects, and even perish in most cases much more rapidly. The cause of this unexpected inferiority of the aquatic insects seems to consist exclusively in their greater activity in the water, and, consequently, in a more rapid expenditure of oxygen. Secondly, he finds that aquatic Articulata can exist for an indefinite period in water, kept by means of melting ice at a temperature of 32° Fahr. But if the same insects are placed in ice at 32°, they die within less than half an hour. The primary cause of rapid death when Articulata are fixed in ice seems to be the absolute privation of movement, and the consequent absorption of the corporeal heat, without any possible restitution. Thirdly, he has endeavored to ascertain the highest temperature which our fresh-water insects, Arachnida and Crustacea, can endure—in other words, what is the temperature of the hottest water in which they can live. He finds that it is between 92° and 115° Fahr. These temperatures, he remarks, correspond with those of a certain number of known thermal springs, in the waters of which we may meet with articulate animals, wherever the salts or gases in solution have no injurious action upon them. Finally, he finds that the highest temperature that aquatic animals, whether vertebrate, articulate, or molluscous, are able to support, probably does not exceed 115° Fahr.

Of kindred interest are the results of the studies of Professor Moebius on the lower animals of the Baltic. By far the greater number of the Invertebrata of the Baltic are also inhabitants of the North Atlantic Ocean. Of many of them we know that they are spread into the icy Polar Sea, and as far as the African coast. With regard to the shell-bearing mollusca, this has been demonstrated in detail in the work entitled "Fauna of the Bay of Kiel." This wide distribution of the Baltic animals, their ability to live in warm, temperate, and cold seas, becomes intelligible when we have made ourselves acquainted with the temperature which they have to endure in the Baltic. In the physico-chemical section of this report, it is shown by a table (xxxii.), founded upon three years' observation by Dr. H. A. Meyer, that the differences of temperature in the superficial layer of the waters of the bay rose to 14.9°–20° (=26.8°–36° Fahr.), attained 13.3°–17.3° (=23.9°–31.14° Fahr.) at five fathoms, and even at a depth of 16 fathoms still amounted to 9.2°–12.2° (=16.56°–21.96° Fahr.). In all the strata of the water, even in the deepest, at the cold season, the animals of the Baltic have to endure a temperature which sinks to the freezing-point of salt water, therefore below zero (=32° Fahr.). In summer and autumn, on the contrary, they are exposed to a pretty high temperature. The different temperatures which the individuals of a species experience in the course of a year in the Baltic are undergone *at the same time* by other individuals of the same species which live in the Mediterranean, the North Sea, and the North Polar Sea. *The Baltic contains only a selection of such Atlantic and polar animals as are capable of supporting great differences of temperature.* For this reason they may be called *eurythermal* animals, in contradistinction to those animals which thrive only in warm or cold and tolerably constant temperatures, such as the tropical and exclusively arctic marine animals, both of which may on this account be denominated *stenothermal* animals.

All the marine animals of the Baltic have, further, the faculty of living in sea-water containing a variable amount of salt; those Baltic animals which also occur in the Mediterranean can bear a larger amount of salt than the Atlantic

Ocean contains. This faculty of the Baltic animals is by no means indicated by calling them brackish-water animals; on the contrary, this expression carries our thoughts away from one of their most remarkable peculiarities; for animals which can live not only in *slightly*, but also in *strongly* salt water, are not brackish-water, but *euryhaline* animals.

A very perfectly euryhaline animal is *Hydrobia ulvæ.* This shell becomes developed in the slightly salt water near Gothland to the same size as in more than normally salt lakes on the shore of the North Sea. He then concludes that because the Baltic animals are eurythermal and euryhaline, they are therefore capable of living both at small and great depths, and of maintaining their ground throughout long geological periods.

An interesting physiological fact has been discovered by Professor Schneider, who finds that in the young or *ammocœtes* stage of the Lamprey eel, the thyroid gland performs its functions during a long period of life, and exists in a highly developed form. This is a remarkable fact, and is the only case known of the gland's performing its function after the young vertebrate has passed beyond its embryonic life. But what this function is, Schneider does not state. It is well known that the thyroid gland is an *embryonic* organ, probably, like the suprarenal capsule, of use to the embryo, but, with the exception of the larval *Petromyzon*, or Lamprey, of no use to the vertebrate animal after it is born.

The singular mode of respiration in certain lizards, the *Psammodromis*, has engaged the attention of M. J. Jullien. He states that these animals do not swallow the air like the Batrachians (toads and frogs), but when they respire, certain muscular bundles traversing the lungs contract (as the heart itself would do), the air is expelled, and after the contraction re-enters the lungs by virtue of the elasticity of the thorax, aided no doubt by the elevator muscles of the ribs. When, he says, we observe one of these lizards breathing, the longest respiratory period is that of expiration, followed immediately by a sudden inspiration. When a mammal respires, the contrary is the case—a long inspiration precedes a shorter expiration. The respiration of these lizards therefore, in his view, differs profoundly, both from an anatomical and a physiological point of view, from that of Mammalia and

Birds. It belongs to an intermediate type, which must take its place below that of the two classes just mentioned, and above that of the Batrachians.

Some observations on the mode of walking of the Armadillos have been made by Mr. Bartlett, of the London Zoological Gardens. He observes that two species of *Chætophractus* walk on the tips of their toes, like species of *Xenurus*, while certain other forms, as *Euphractus*, a member of the same family, and three species of another family, the *Tatusiadæ*, walk on the palms of the forefeet, with the claws spread out, and the tips elevated from the soil.

Of the physiological laws governing the size of the individual, we know comparatively little. The matter may be approached by a study of the changes in size and weight of insects while passing through their metamorphoses, for virtually the larva of an insect is a different animal from the pupa or chrysalis, differing anatomically and in its habits; so with the imago or adult, as compared with the chrysalis. The experiments of the distinguished English anatomist and physiologist, Newport, had shown that in the pupal state respiration still goes on, though to a diminished extent, so that the carbonic acid and water excreted by the pupa, being uncompensated by food, must be a dead loss of matter to the insect. As preliminary to the study of this subject, Mr. Meldola has published in the *Annals and Magazine of Natural History* an article in which he confirms Newport's statement that there is a loss of substance in the pupal state. He also finds that this loss is different in amount in individuals of the same species exposed to the same temperature, and that it is less in amount than that occurring in the same species in the perfect state or in a dead pupa by desiccation—the comparisons extending in all cases over equal periods of time. They prove also, he adds, what is far more important to our present inquiry, that the variation in loss is sufficient in amount to lead us to expect the size, or at least the specific gravity, of the imago to be sensibly influenced by it.

Of kindred interest are certain inquiries which occasionally come up as to the mode of production of sex. It is evident that the origin of sex, as that of species, is in some way dependent on physical laws. Mrs. Treat and Mr. Riley discuss the subject in the *American Naturalist.* The former thinks that sex is determined by differences in the amount of food, and states her belief that by starving caterpillars, males are the result. The editors of the same journal, and also Mr. Riley, state the well-known fact that the sex of insects is known to be determined when or very soon after the insect leaves the egg, and that the sexes are probably determined at the time of conception.

The subject of embryology, always of great interest to the philosophical naturalist, has acquired a new value in the light of the theory of descent. The essential point of inquiry now engaging the attention of embryologists, and for which we are especially indebted to the Russians and Germans, is as to the primary number of germinal layers of cells in the embryo, and whether the germs of all animals are alike at first. The extreme difficulty of these studies may be imagined. By making transverse sections of eggs hardened by alcohol and various chemical substances, and by the use of different chemical reagents, we have, however, been able to advance in a wonderful degree the study of the earliest changes in the germ of the articulates, mollusca, and especially the vertebrates, while the minute eggs and embryos of the lower animals afford by their transparency optical sections. Of almost startling interest are the results of Miklucho Macleay and Haeckel's studies on the embryology of the sponges. They show that the germs resemble the young of certain radiates, and are made up of two layers of cells. This, while proving that the sponges are animals comparable in structure with certain low radiate animals, such as the hydra (they even regard them as homologous in structure with the radiates), shows that the view of Carter, Lieberkühn, and James Clark, that they are compound infusoria, is no longer tenable. In fact, Haeckel insists that the sponges are not Protozoa. But it also seems that the "gastrula," or free swimming germ of the sponge, is homologous with the "planula," or free swimming germ of the acalephs. Haeckel, from the closeness of the homologies which he claims to exist between the adult sponges and acalephs, places them together in the zoophytes. He claims that the famous "germ-layer" theory which Huxley, in 1849, and afterward the distinguished Russian embryologist, Kowalevsky, applied to the invertebrates as well as vertebrates, also applies to the sponges.

Thus the germs of all animals (the amœba and infusoria excepted) are alike, consisting of a sac composed of two layers of cells. The theory he derives from this fact is stated under the head of Zoology in this *Record*.

Among the papers of interest which have appeared during the year on the embryology of the lower animals, is an article by E. Ray Lankester in the *Annals and Magazine of Natural History*, being zoological observations made at Dohrn's Zoological Station at Naples. In this paper he shows that certain mollusks originate the same as in the worms and vertebrates, *i. e.*, from two primitive layers of cells; and that, as shown by Kowalevsky in other mollusks, there is an invagination or in-pushing of these cells at one pole, just as in *Amphioxus*, the lowest vertebrate. He also agrees that the whole animal series above the Protozoa agree in possessing these two primitive layers at one time of their development.

The embryology of the spiders is discussed at length, with many drawings in illustration, by M. Balbiani in the *Annales des Sciences Naturelles.*

An important paper on the embryology of the bony fishes, from a study of the brook trout, is published by Dr. Oellacher in Siebold & Kölliker's *Journal of Scientific Zoology*, while there are several short but important papers by F. M. Balfour, in the *Quarterly Journal of Microscopical Science*, on the development of the layers of the blastoderm of the hen's egg—an important contribution to the germ-layer theory; also an illustrated paper by the same author on the disappearance of the primitive groove in the embryo chick, and a very interesting illustrated paper on the development of the blood-vessels in the chick.

Before turning to what has been done in systematic zoology during the year, we may briefly notice the establishment of biological institutions, which either aid zoologists in developing our knowledge of structural and systematic zoology, and of the geographical distribution of animals, or which combine original research with educational advantages of a high order. Such are the Zoological Station founded at Naples by Dr. Anton Dohrn, the Anderson School of Natural History at Penikese Island, in Buzzard's Bay, and the United States Fish Commission, which has its head-quarters at different points along the coast of the Northern Atlantic States.

The Zoological Station at Naples is designed for advanced students of different countries. They are provided with tables, and have access to the immense material dredged in the Bay of Naples, so rich in marine life. The animals are preserved alive in large aquaria, water flowing through them in pipes leading from the sea. The facilities thus afforded are very great, while the effect of having scientists of various nationalities working side by side will have an important effect in harmonizing their results. No lectures are given, and the institution is not designed to be directly educational.

The idea of the Anderson School of Natural History, so named from Mr. John Anderson, the founder, was undoubtedly suggested by the Naples Zoological Station. The suggestion was first made by Professor N. S. Shaler, who planned out a school for sea-side instruction, and had obtained the use of a building at Nantucket. Obliged, however, to go to Europe for his health, Professor Agassiz, then just returned from the *Hassler* expedition, went on with the plan, which was changed through the instrumentality of Mr. Anderson. The school became the educational branch of the Museum of Comparative Zoology at Cambridge. Laboratories were erected, fifty students, mostly college professors and normal-school teachers, accommodated, who were taught to observe for themselves. The nature of the course of instruction was such as was introduced by the late Professor Agassiz into this country, *i. e.*, the study of zoology from the specimens, and not from books. They thus learned the art of observing for themselves, gaining an insight into the modes and difficulties of research, and obtaining some idea of the vast extent of the field of biology. Besides the laboratory instruction, and frequent dredging excursions in the yacht *Sprite*, lectures on surface geology, glacial phenomena, the embryology and structure of vertebrates and articulates, physiology, physical geography, on the microscope and its construction, with practical lessons in its use, and other subjects, were given by Professors Agassiz, Guyot, Wilder, Brewer, Packard, and others. It is stated that Mr. Alexander Agassiz succeeds his father as director of the school.

The United States Fish Commissioner, Professor Baird, during the past summer had his head-quarters at Peak's Island, in Portland harbor. He was assisted by Professor

Verrill, of Yale College, Dr. A. S. Packard, of Salem, and other specialists. Immense collections of animals were dredged, many new to science, and much practical information relating to the food of fishes obtained, aside from the more immediate objects of the Commission. Many naturalists, mostly professors of colleges, availed themselves of the great advantages presented by this school of science, as it practically is, and the effect of the Commission upon the educational interests of the country will be widely felt.

Coming now to the lowest organisms, we would advert to a memoir laid before the Berlin Academy, in which the venerable Ehrenberg gives the results of his microscopical studies since 1836. He intimates that the distribution of warm and cold currents is now beginning to be understood, while the dispersion and relative abundance of deep-sea life, and the formation of silicious and calcareous ooze and muds, need much more study. We know not, he says, what forms of being, minute or gigantic, exist throughout the abyssal depths. The abundant occurrence of *Peridinia* in the flints of the deep-sea chalk, as well as the living luminous animals on the ocean's surface, and even at the deep bottom off Florida, point to a possibly periodic and even permanent strong light in those depths, enabling the creatures of the great deep to have the use of their visual organs.

Our knowledge of the Sponges has been greatly advanced by the great work of Haeckel on the Calcareous Sponges, in three octavo volumes, and also by the papers of Carter, Sars, Wyville Thomson of the *Challenger*, and others. Several new and interesting forms have been obtained by the United States Fish Commission in deep water off the coast of Maine, among them the glass-sponge, or *Hyalonema longissimum* of Sars, heretofore found only in deep water off Norway.

It is well known that certain sponges by boring into shells absorb their substance, and cause them to rapidly disintegrate, until the shell is destroyed. Such is, for example, *Cliona celata* of the English coast, which attacks the oyster shell, and, after having absorbed the whole valve, grows into a shapeless mass. Another sponge, *Halichondria suberea*, Johnst., is a species which attacks univalve shells, but often retains more or less of the outward form of the shell, and almost always that of the internal cavity; for a hermit crab generally inhabits the latter, and so prevents the sponge from encroaching in this direction. Mr. H. J. Carter finds (*Annals and Mag. of Nat. Hist.*, Jan.) that the flexible polyp, *Hydractinia echinata*, has the power of transforming the calcareous shell on which it may be growing into its own horn-like frame.

Among the sponges thus far obtained by the British exploring vessel *Challenger*, under Professor Wyville Thomson, is a Venus' Flower-basket, or *Euplectella*, from off the coast of Portugal, which it is impossible to distinguish from the *Euplectella aspergillum* of the Philippines.

A valuable contribution to the subject of the development of the coral polyp has been published by M. Lacaze-Duthiers in his new *Archives de Zoologie expèrimentale.* He confirms the statements of Dana that though polyps are true radiates, still they have something of the antero-posterior (or head-and-tail) polarity, with also the right and left, which is eminently characteristic of the animal type. Still later he has communicated to the French Academy further researches on the coral polyps. He finds that the primary calcareous particles are deposited in the internal layers of the walls of the body, *i. e.*, in the endoderm. He studied it on the coast of Algeria; and in localities where, as he writes, Professor Carpenter found nothing, he has discovered several new generic types of corals.

It appears that the late Professor Sars, from a posthumous work on the animals of Norway, edited by his son, had detected on the coast of Norway a species of the coral *Mopsea*, which he calls *M. borealis.* Before this the genus was supposed to be exclusively tropical, none having been found before north of the Mediterranean Sea and Florida. Another coral, which occurs in the arctic fauna of the Gulf of Maine, is the *Deltocyathus Agassizii*, which was found about twenty miles east of Cape Cod by the United States Fish Commission. It has heretofore been known to exist only in deep water off Florida. A Fungia-like coral, named by Sars *Fungiacythus fragilis*, has been found at great depths off the coast of Norway. It belongs to the free cup corals, of which there are now few living representatives, and those confined to the tropical seas.

Among the discoveries of the United States Fish Commission is that of a sand-star, *Amphiura Otteri* of Ljungmann, which occurred off Cape Cod in company with the *Deltocyathus.* It has heretofore only been obtained in 550 fathoms off the coast of Portugal by the Swedish naturalists on the corvette *Josephine.*

The sea-urchins, or *Echini*, have been monographed by Mr. Alexander Agassiz in a splendidly printed and illustrated work, of which two volumes have appeared during the year. The work, which will be a classic in zoology, already contains over fifty plates, some of them heliotypes and Woodburytypes. As the author visited all the European museums, and consulted the types in them, while his work is based on the unrivaled collections in the Museum of Comparative Zoology, the work must for a long time remain the standard authority on this subject. M. A. F. Marion publishes a note on the hybrids which he obtained by artificial impregnation between two sea-urchins, *Sphærechinus brevispinosas* and *Toxopneustes lividus.* He only succeeded in rearing the Pluteus form of larva, as it is impossible to carry these delicate organisms further along in their development.

The literature of the *Mollusca* has been extended by the usual number of special papers on shell-fish, though we do not recall any of special value relative to their development, except some brief notes by E. Ray Lankester, and one or two others. Professor Morse, in his paper on the "Systematic Position of Brachiopods," in a note reviews what has been said regarding the affinities of *Dentalium*, the tooth shell, and suggests that they bear some relations to the Tetrabranchiate Cephalopods "in the numerous and retractile tentacles, the dorsal turn of the shell, and the strict identity between a peculiar bilateral cartilaginous body which occurs in the head of *Dentalium* as well as in the head of *Nautilus pompilius.*" A large beak of a Cephalopod, indicating that the animal must have been between twenty and thirty feet long, and found in the North Atlantic, is figured and noticed by Dr. Packard in the *American Naturalist.* This colossal cuttlefish is referred by Steenstrup to *Architeuthis dux.* Mr. W. H. Dall contributes a note to the same journal on colossal Octopi in the Pacific. But the actual occurrence of an immense squid on the coast of Newfoundland has been stated by Mr. Alexander Murray, of the Canadian Geological

Survey. Some fishermen cut off the arm of a squid, and afterward found the animal dead on the shore. The total length of the body is seven feet, and its circumference five. Around the head are eight large arms, each six or seven feet in length, the largest nine inches in circumference. Besides these were two longer tentacles, each twenty-four feet in length. Mr. Murray, in a letter to the late Professor Agassiz, published in the *American Naturalist*, states that individuals measured by fishermen on the coast of Labrador measured in one case eighty, and in another ninety feet in length.

Great activity has been manifested by naturalists in furthering our knowledge of the structure and relationship of the worms, among which are now included by some naturalists the *Polyzoa* as well as *Brachiopoda*. Among the former, a most remarkable form has been described by Professor M. Sars under the name of *Rhabdopleura mirabilis*. Though the genus was first described by the English naturalist Allman, Sars and his son have, from a study of the living animal, improved greatly Allman's first description. It is a small creeping "moss-animal," which at intervals sends up tubes in which the individuals live. These individuals differ in nearly all their essential points from the ordinary Polyzoa, so much so that they can with difficulty be referred to the class of Polyzoa. First, he says, they have no "endocyst," or mantle, which all other Polyzoa have. Having no mantle, with no muscles for the retraction of the animal within its tube, it is in this way allied to the Hydroid polyp. Retraction is effected by a contractile cord, at the end of which the animal is suspended. It is thus, he concludes, intermediate between the Hydrozoa and Polyzoa, or forms a transition from one to the other. The *Rhabdopleura* is, he continues, as quoted by his son, G. O. Sars, undoubtedly, like many other animals which at present inhabit the greater depths of the sea, "*a very old form*, which in its organization has still retained several features from the time when the animal type that we call Polyzoa first developed itself from a lower type." Thus, he says, and it seems that Sars was an evolutionist, unlike many of his fellow Scandinavian zoologists, the questions regarding the position of this animal can only be "properly answered through the medium of the Darwinian theory." In his view, the Polyzoa in the earliest primordial times (for fossil remains of them are found in the lowest Silurian formations) were developed from the Hydroid polyps by transmutation. "We have in the *Rhabdopleura* manifestly such a form of Polyzoa in course of development out of a form of Hydrozoa." Finally he calls attention to the interesting fact that the crown of tentacles of this animal is like that of most fresh-water Polyzoa, and in this respect is higher than the marine forms. "It is, however, possible," he says, "that the first is properly the original form, from which the latter has subsequently arisen." The fresh waters appear, as Haeckel lately has remarked, to contain the direct descendants of some of the eldest animal forms which, by reason of the less complicated accidents of the fresh waters, have often in the "struggle for life" only slightly altered their original more simple structure; as, for instance, among the Cœlenterates, the *Hydra;* among the Rhizopods, the *Actinophrys*, *Gromia*, and the shell-less *Radiolaria* lately discovered by Focke; among the fish, the *Ganoida*, etc. The deep-sea Polyzoa dredged by Pourtalès off Florida have been described by Professor Smitt in the Swedish Transactions.

Turning now to Professor Morse's work on the "Systematic Position of the Brachiopods," we meet with the iconoclastic statement that "the Brachiopoda are true worms, with possibly some affinities to the Crustacea, and that they have no relations to the Mollusca, save what many other worms may possess in common with them." He not only regards them as worms, but as belonging to the highest division of them, the Chætopods, represented by the marine forms, such as *Nereis*, *Amphitrite*, *Sabella*, and less perfectly by the common earthworm. He regards the Brachiopods as a synthetic or comprehensive type, saying that "while we do not find them in all their characters resembling any one group of worms, I have endeavored to show that all their features, to a greater or less degree, are shared by one or the other of the various groups of the Vermes, with one or two features shared by the Arthropods." In his belief the ancient Chætopod worms culminated in two parallel lines, on the one hand in the Brachiopods, and on the other in the fixed and highly cephalized Chætopods. The divergence of the Brachiopods having been attained in more ancient times, a few degraded features are yet retained, whose relationships we find in the lower Vermes; while from their later divergence the fixed and cephalized Annelides are more closely allied to the present free Chætopods. The facts, whatever some may think of the author's conclusions, are mostly new, and presented by the author with great skill and interest, while many naturalists will believe that Professor Morse has demonstrated the worm-like nature of these animals. A second memoir, in quarto, on the embryology of our common Brachiopod, the *Terebratulina*, has subsequently appeared in the "Memoirs of the Boston Society of Natural History," which goes to confirm the worm origin of these animals. Brief papers relating to the classification of the Brachiopods have been published by Professors King and Gill, and Mr. Dall.

Further contributions to the minute anatomy of the *Tæniæ*, or tape-worms, have been made by Dr. Nitsche, and appear in Siebold & Kölliker's celebrated journal, while a résumé of Dr. Krabbe's work on the tape-worms of birds appears in Gervais' *Journal de Zoologie*. It seems by his account that more than half of the known species of these Cestoid worms inhabit birds; the number of known species of Cestoids amounting to over 300. The tape-worms are naturally more abundant in the aquatic birds, which prey on fish, than the land birds, while they are less abundant in the birds of prey and the graminivorous birds, which is the more remarkable because they especially favor the carnivorous mammals. While Küchenmeister has found that the *Cysticercus* of the slug (*Limax*) transforms into the *Tænia* of the common European sandpiper, Dr. Krabbe has found that the young of the *Tænia* of the heron is an animal found in the tench, and described under a different name by Nordmann. Dr. Cauvet contributes a notice of the *Tænia* (*T. mediocanellata*) so abundant in the French army in Algeria.

Further observations have been made on the singular metamorphoses and habits of the Trematode worms. O. von Linstow decides that there must be two modes of transport of the young Distomum, or Cercaria-form, into the bodies of fishes. In the first case the fish eats a snail (*Paludina*) containing encysted *Cercariæ;* the *Cercariæ* are set free by the digestion of the cysts, and attain their sexual state in the intestine of the fish. In the second case the fish (*Acerina cernua*) eats a mollusk containing free *Cercariæ*, or else these larvæ pass directly into the fish. They pierce the intestine, and encyst themselves on the outside of the wall of that organ. During their course through the intestine they increase in size, because they find suitable nourishment there. Further remarks on this subject may be found in the translation of the article in the *Annals and Magazine of Natural History*.

Coming to the higher worms, we have the beautiful and elaborate work of the late Professor Claparède, which has been noticed in its place farther on in the *Record*.

The most important works of the year on *Crustacea* are those of Alphonse Milne-Edwards and Professor Owen, on the anatomy of the king-crab, and by Professor S. I. Smith on the metamorphosis of the American lobster. The blind Crustacea have been described by A. S. Packard, Jr., from caves in Indiana. The *Challenger* party have dredged from the depths of the Atlantic several interesting Decapod Crustacea, especially those allied to *Astacus*, and among the lower Crustacea a gigantic Amphipod allied to the pelagic forms *Hyperia* and *Phronima*. The eyes of this animal are very remarkable, extending as two enormous faceted lobes on all the anterior part of the body, like the eyes of *Æglina* among the Trilobites. The *Cyami*, or whale-lice, have been revised by Dr. Lütken, and new species described by him and Mr. Dall. The naked barnacles, or *Rhizocephala*, have been studied by M. Girard from a developmental and anatomical point of view. M. Hesse has continued his accounts of the Copepods and other Crustacea from the coast of France, and Mr. Brady his notices of English Entomostraca.

The literature of *Entomology*, always so extensive compared with that of other departments of natural history, shows that special students have been as busy as ever, while several papers of much general interest have appeared during the year. Numerous descriptive papers from the hands of Le Conte, Scudder, Grote, Thomas, Hagen, Henry Edwards, Cresson, Riley, Packard, and others, refer to American forms; while notes and papers relative to the habits of insects may be found in the *Canadian Entomologist*, and in the state entomological reports of Riley, Le Baron, and Packard, for the states of Missouri, Illinois, and Massachusetts respectively;

and the reports of Mr. T. Glover in the monthly agricultural reports. The largest general work that has appeared is a quarto volume on the Grasshoppers (*Acrydii*), by Rev. Cyrus Thomas, forming a part of the volume on Zoology of Hayden's "Geological Survey of the Territories." The first work on insects printed in California is a credit to California science. It is a serial work on California Moths, by Mr. Stretch, illustrated by plates executed in San Francisco. Many new Coleoptera and systematic notices of different families have been published by Drs. Le Conte and Horne, and Mr. Crotch. The Mexican Ichneumons have been described by Mr. Cresson, and new moths described by Messrs. Grote and Packard. A work of great practical use, especially to those situated away from scientific libraries, is an "Annual Record of Progress in Entomology in America," published by the Peabody Academy of Science, and sustained by the leading entomologists of the United States. It contains all the references to papers and notes relating in any way to the insects of this country. Important works published in Europe on the insects of North America are Loew's description of our Diptera, and Zeller's work on our moths, particularly those found in Texas. Mr. Scudder has published an elaborate paper on the fossil Myriopods of Nova Scotia discovered by Dr. Dawson. The Smithsonian Institution has published a valuable pamphlet of instructions for collecting insects, prepared by Dr. A. S. Packard.

As regards the *Arachnida* (mites and spiders), several papers have appeared on the mites. M. Mégnin discovers that a species of *Hypopus* is but an immature stage of the genus *Tyroglyphus*, of which the sugar and cheese mites are familiar examples. Among the eleven species of *Hypopus* described by Dufour, he recognizes six, which he does not doubt are the early stages of different mites. An important paper on cave-bearing spiders and their allies has appeared from the pen of M. Simon, and a fellow-countryman of his has described a number of new cave beetles from Southern Europe.

No important paper on the embryology of the higher insects has appeared during the year. A notice of a so-called "hypermetamorphosis" in a common May-fly of France (*Palingenia virgo*) has been contributed by M. Joly. He has ascertained that its larva, when just hatched, has no visible nervous system, no circulatory apparatus, and no organs of respiration. In this and other respects he confirms the statement of Lubbock, who studied similar stages of *Chloëon*, though in a more thorough and philosophical spirit than Joly.

Some new observations of Dr. Bertkau on the respiratory organs of the spiders confirm Leuckart's statement that the different aerial organs coexist in these animals, one set of organs being lung-like, formed by the modification of tracheæ, while the true tracheæ also supply the blood with air. He establishes the fact that the spiders (*Araneina*) have four stigmata, of which the two anterior are situated at the anterior part of the abdomen. The two others are placed either immediately behind these or farther back, at the extremity of the abdomen. In this latter case they unite to form a fissure in the median line. The first pair of stigmata always leads to "lungs;" the second to "lungs" (in *Mygale*), or, more frequently, to tracheæ. When the second pair of stigmata is anterior, the tracheæ to which they correspond always present two principal trunks—one directed forward, furnishing trachean tubes to the cephalo-thorax (*Dysdera* and *Segestria*), while the other passes backward and supplies the abdomen. When the second pair of stigmata is situated at the extremity of the abdomen, and the two trunks must necessarily go forward, it is the external one which corresponds to the posterior trunk of *Dysdera* and *Segestria*.

Another contribution to the subject of phosphorescence in animals is afforded by the studies of Robin and Laboulbène on the phosphorescent organs of the Cucuyo beetle, or firefly of Cuba. They examined males alone. It is well known that two luminous eye-like spots occur on the prothorax, and a third on the under side between the thorax and abdomen. Under the transparent spots on the thorax is a mass of fat in connection with tracheæ and fine nerves, and the same kind of phosphorescent organ, as the fatty body permeated with nerves and tracheæ may be called, was found in the base of the abdomen. On removing these organs from the body of the living insect, they shone brilliantly for some minutes. The authors confirm the statements of Brown and Linnæus that the insect produces its light at will; and the former ask whether the voluntary freeing of the matter produced relatively to the rest of the substance of the cells consists in an intercellular oozing out of the exudation, or whether it takes place in the cells themselves? They can say nothing precise on this point; but the principle which renders luminous for several minutes the substance of broken cells acts like *noctilucine*, a phosphorescent coagulable azotized (*azoté*) principle obtained by Phipson in 1871 from the luminous mucus of certain *Scolopendræ*, fishes, etc.

The *Vertebrate* animals of our country have been noticed in various papers by Messrs. Leidy, Marsh, Cope, Gill, Putnam, Coues, Allen, Baird, Ridgway, Merriam, and others; while the fossil forms have been described by Leidy and Cope in extensive and fully illustrated works published by Hayden's Survey of the Territories. The fossils of Europe and other countries have been studied by a number of naturalists, including Professor Owen, A. Milne-Edwards, Gervais, Capellini, and others. Foremost among the important discoveries is that of a type of a new sub-class of birds, having teeth, the *Odontornithes* of Marsh. A large number of remarkable forms, some serving as intermediate links between orders and sub-orders of vertebrates, have been discovered by Messrs. Marsh and Cope in the Rocky Mountain tertiary and cretaceous rocks. These authors have published important papers on the gigantic mammals called *Eobasileus*, etc. The splendid monograph of Professor Leidy on the extinct vertebrate fauna of the West is one of the products of Hayden's Survey of the Territories. The same author has also written on the extinct mammals of California, on fossil vertebrates from the miocene rocks of Virginia, and fossil fishes from Wyoming Territory. Professor Marsh has during the past season made very extensive private collections of vertebrate fossils in the far West. Among a large number of new mammals obtained by Mr. Cope in the Hayden explorations in the "bad lands" of Colorado are a series of horned species related to the rhinoceros, but possessing some features resembling the elephant. They stood high on the legs and had short feet, but possessed osseous horns in pairs on different parts of the head. One of the largest species (*Miobasileus ophryas*) had a huge horn over each eye, while another had one on each side of the nose, and more than a foot in length, resembling those on the back part of the head of the ox, etc. A third one, of larger size than the last, had rudimental horns on the nose. Still another was about as large as the elephant. Its cheek-bones were enormously expanded, and its horns were flat. A fifth had triangular horns, turned outward. The four last species have been placed in the new genus *Symborodon.* Among a number of remains of fossil vertebrates from the phosphate beds of the French eocene formation are those of a Lemurian monkey, called by the discoverer, M. Delfortrie, *Palæolemur.* He also thinks that these low monkeys were characteristic animals of the Paris basin. M. Gervais thinks that this French Lemur is allied rather to the living forms of Indo-Africa, or *Galago*, than the forms found in Madagascar.

The *Fishes* have engaged the attention of Dr. Günther, Mr. Putnam, and others. A new ganoid has been discovered in Russia, allied to an American form. Mr. Putnam has published a paper on the species of *Liparis*, and of *Myxine* and *Bdellostoma*, and found that the species of *Myxine* have a great geographical range. The *Amphioxus* has been studied afresh by Dr. Stieda, of Dorpat. This animal, the lowest vertebrate, is cosmopolitan in its distribution. He finds that the male and female Lancelet can not be externally distinguished from each other, but a microscopical examination settles the question at once, and Owen's suggestion that this animal may prove to be the larva of some larger unknown fish is rendered impossible. That, however, a fish called *Leptocephalus*, which presents many signs of immaturity, such as a very imperfect skeleton, the vertebral column being represented only by a dorsal cord and some membranous parts, and other characters of such a nature as to lead Kölliker to regard it as the type of a separate order—that this is the young of some well-known higher fishes has for some time been supposed by ichthyologists. Indeed, Professor Gill has for a long time seen in it a very young *Conger*, M. Dareste following him in this view. Both this and the Leptocephalus have a swimming-bladder, in relation with some red bodies, and in other respects the Leptocephalus seems the young of the Conger-eel. They also think that the other so-called species of Leptocephalus are immature forms. An important illustrated memoir on the scales, and a short paper on the structure and development of the fins of the bony fishes, have been published by M. Baudelot, in Lacaze-

Duthiers' *Archives* (April, 1873); while Gervais' *Journal de Zoologie* contains an abstract of the Italian anatomist's (Dr. Leone de Sanctis) paper on the embryonic development of the electrical organs of the Torpedo. He finds that they are developed from the "middle" embryonic layer of cells of embryologists. They arise from the subcutaneous connective tissue. This median layer furnishes the abundant nervous tissue of the peripheral nerves, which forms the essential part of the organ.

A number of faunal lists and notes on the habits of *Birds* have appeared in the *American Naturalist*, and the valuable work of Dr. E. Coues, entitled "A Key to the Birds of North America," will for a long time to come remain the most compact manual of American ornithology that the student can procure.

BOTANY.

In the field of *Botany* the English systematic botanists have been especially busy. The most important of their works has been a continuation of the "Genera Plantarum," by Bentham and Hooker (devoted mainly to the large and difficult orders *Rubiaceæ* and *Compositæ*), and the cognate article upon the classification, history, and geographical distribution of the latter order, by Mr. George Bentham, in the Journal of the Linnæan Society. The elaboration of the *Rubiaceæ* was done by Dr. J. D. Hooker, that of the *Compositæ* by Mr. Bentham, who has followed a system of classification differing widely in some respects from that of De Candolle and other botanists, with a large reduction in the number of genera. In his later article, he explains at length the principles of the arrangement adopted by him, discusses the relative value of the characters that have been relied upon for distinguishing tribes and genera, and considers the conjectural history of the order, as deducible from its present geographical distribution, which is given with full detail. Several of the new genera and species of the "Genera Plantarum" are illustrated by Dr. Hooker in an issue of his "Icones Plantarum."

Mr. Bentham's anniversary address as president of the Linnæan Society was, like his previous ones, a production of great interest and value, and is occupied in large part by the question of the gymnospermy of conifers and their allies, with reference to the recent conclusions of Professor Strasburger, of Jena, and the attendant question of the derivative origin of forms and organs. The same diligent worker has also published during the year a sixth volume of the "Flora Australiensis," including the orders from *Thymeleæ* to *Amaryllideæ*. In this he was aided by Baron von Müller, of Melbourne, Victoria.

An English translation of the "Descriptive and Analytical Botany" of Le Maout and Decaisne has been made by Mrs. J. D. Hooker, with modifications, additions, and an appendix by Dr. Hooker, thus supplying a want that has long been felt by English students of general botany. Dr. J. G. Baker, besides a revision of the *Scilleæ* and *Chlorogaleæ* in the Journal of the Linnæan Society, has edited the *Compositæ* for Eichler's (Martius') "Flora Brasiliensis," and W. P. Hiern has published in the Transactions of the Cambridge Philosophical Society a complete and extended monograph of the *Ebenaceæ*.

The seventeenth and final volume of De Candolle's "Prodromus" has recently appeared, completing the dicotyledonous orders, with the exception of the *Artocarpiæ*, and so far finishing the work begun by the father fifty years ago. The entire class of monocotyledonous plants, however, still remains untouched. Little else in systematic botany has appeared on the Continent beyond some articles in the journals—as by Otto Boeckeler, in "Linnæa," upon the *Cyperaceæ;* and by Dr. Wawra, in the "Flora," upon the flora of the Hawaian Islands. Dr. J. Müller, of Geneva, however, has contributed to the "Flora Brasiliensis" a thick fascicle, containing two tribes (*Phyllantheæ* and *Crotoneæ*) of the order *Euphorbiaceæ;* and Maximowicz and Herder, of St. Petersburg, have continued their contributions to the botany of Eastern Asia, including general revisions of *Lespedeza* and some other genera.

In cryptogamic and physiological botany, Dr. E. Bornet gives in the "Annales des Sciences Naturelles" the results of his researches into the composition of lichens, apparently establishing as a fact, what had before been suggested by De Bary and partially developed by Schwendener, that lichens of every description are of a composite character and formed of filamentous, fruit-bearing tissue parasitic upon green cells, the former being *fungi*, the latter *algæ*—or, in other words, that every lichen is simply some fungus living upon some species of alga. Van Tieghem has continued his study of the embryo, showing how far its several members (cotyledons, plumule, caudicle, and radicle) are independent of each other, and capable separately of developing a complete plant, and also the nature of their connection with the albumen when present. Professor Müller, of Lipstadt, has published a compend of the observations that have been made on the fertilization of flowers by the agency of insects, with many original facts and numerous illustrations, having reference to the peculiar structural modifications which exist in insects adapting them to this end, as well as in flowers. Dr. B. Sanderson, of University College, London, in a paper before the British Association, shows that in cases of irritability and motion in plants, there exist electrical currents similar to those accompanying living animal muscle and nerve, and, so far as investigations have gone, governed by the same laws.

In America, the Smithsonian Institution has published a contribution by Dr. H. C. Wood, Jr., upon the Fresh-water Algæ of North America, supplementing the "Nereis Boreali-Americana" of Harvey, and illustrated by excellent colored lithographic plates. It describes all the known genera and species, and a copious bibliography of previous authors is added. In the Transactions of the St. Louis Academy, Dr. George Engelmann has given his "Notes upon the Genus Yucca," defining the species, and explaining the mode of fertilization of the flower, which was previously unknown. Dr. Asa Gray contributes to the Proceedings of the American Academy characters of some new genera and species, and notes upon *Compositæ*, having reference chiefly to the bearing of Bentham's revision of the order upon the American flora, with a revision of the genus *Bigelovia* (or *Linosyris*). In the same Proceedings has appeared a revision, by Sereno Watson, of the large and somewhat difficult genera *Lupinus*, *Potentilla*, and *Œnothera*, which have long needed re-elaboration. A revision of the section *Avicularia* of the genus *Polygonum*, and descriptions of a number of new plants from Arizona or the adjacent region, by the same hand, have appeared in the *American Naturalist*, as also an anatomical study of species of *Lemna* by Professor T. D. Biscoe. Some new ferns of the United States and Mexico have been described by Professor D. C. Eaton, and a hundred and fifty new species of fungi by Charles W. Peck in the Bulletin of the Buffalo Society of Natural History. Rev. W. J. Berkely has also continued in "Grevillea" his notices of North American fungi. Catalogues have been published of E. Hall's Texan collection of 1872 by Dr. Gray, and of Hayden's collection of the same year in the Yellowstone region by Dr. J. M. Coulter. A work upon the flora of Colorado, by Professor T. C. Porter and Dr. Coulter, is in an advanced stage of progress. A full list of the new phenogamous genera and species of the United States that have been published during the year may be seen elsewhere in this volume.

Investigations in the field have been carried on quite extensively the past season in connection with government surveys in the Western Territories. A very large collection has been made by Dr. J. T. Rothrock and Mr. J. Wolffe, under Lieutenant G. M. Wheeler, in Southern Colorado. Dr. C. C. Parry has collected in Northern Wyoming and Montana; Dr. Coulter has again accompanied Dr. Hayden's survey; Mr. J. A. Allen has collected on the line of the Northern Pacific Railroad; and Mr. Dall in the Aleutian Islands.

Botanical science in this country has suffered a serious loss in the deaths of Dr. John Torrey, of New York; William S. Sullivant, of Ohio; and Elias Durand, of Philadelphia, who have been more or less closely identified with it for many years.

AGRICULTURE AND RURAL ECONOMY.

Much the largest part of the progress in *Agricultural science* comes from researches made in Europe, especially in the agricultural experiment stations which have, during the last two decades, been steadily increasing in numbers, activity, and usefulness. These experiment stations consist of chemical laboratories connected with stables, fields, gardens, or greenhouses, where men of the highest scientific attainments and practical skill are engaged in the study of problems of importance in agriculture. Of these experiment stations, there are in the various countries of Europe some seventy, of which about half have been founded during the past five years. The majority are German, there being some thirty in the kingdoms of Prussia and Saxony alone. The work of these stations consists for the most part of experiments on the nutrition and growth of animals and plants, and investigations of soils, fodder materials, and especially commercial fertilizers.

In animal nutrition, important series of experiments have been and are still being made by Henneberg, director of the station at Weende, in Hanover; Kühn, of the station at Möckern, in Saxony; Stohmann, of Leipzig; Wolff, of Hohenheim; Hoffmeister, of Dresden, and others. Some of the principal subjects are the digestibility of different kinds of food by different domestic animals; the effects of different kinds and quantities of food upon the quantity and quality of milk produced by cows and goats, and the functions of the various food ingredients in the animal economy.

The experiments on the digestibility of food are made by analyzing the food and solid excrement, the difference being the amount digested. At the station at Weende there have been completed up to the present time nearly seventy feeding experiments with oxen, involving observations of this sort. In general about half of the hay and straw consumed by the animals was digested. The difference in digestibility of hay and straw is much less than has been supposed. The greater value of the hay as fodder depends chiefly upon its greater content of digestible nitrogenous matters.

The experiments on milk production have been made by feeding cows and goats with rations varying in amount and composition, the food given and the milk produced being accurately measured and analyzed. A large number have been made, and with the utmost care and accuracy. It is found that, in general, while the total quantity of the milk is increased up to a certain point by large and rich food rations, and while as the milk increases in quantity it also grows somewhat richer, and contains a larger percentage of dry matter, yet beyond this limit a further increase in the quantity or richness of the food is without effect on the milk.

It is further found that attempts to change the composition of the organic substance of the milk, the relative amounts of caseine and fat, by increasing the amounts of fats or albuminoids in the food, are of no avail. The practical inference from these experiments is that, as regards milk production, too high feeding is wasteful, and that, for milk richer in butter or caseine, recourse must be had to different breeds of cattle rather than to alterations in the composition of the fodder.

A most interesting feature of some of the feeding experiments is the use of the so-called "respiration apparatus" devised by Pettenkofer of Munich. Besides the one in use by Pettenkofer, three others are already in operation in the German experiment stations. The apparatus consists of a large air-tight chest or compartment, in which the animal is kept while under experiment. Arrangements are made for supplying food and water, and for collecting the solid and liquid excrement, while the supply of air is constantly renewed by a current which is analyzed before and after passing through the compartment, and thus the products of respiration are determined. By this means the amount and composition of the food, and of all the products of its transformation in the animal's body, may be determined. From these data are inferred the functions of the different food ingredients in the animal economy. This method of experimenting is comparatively new and very complicated. It gives promise of results of great importance for the theory of cattle-feeding.

The most important experiments in vegetable nutrition and growth may be divided into two general classes: those performed in natural soils, as in gardens and fields, for the purpose of observing the effect of different fertilizers and methods of culture on the growth of different crops; and those in which plants are grown in artificial soils or in water, to which are added the various chemical elements found to be taken by plants from the soil—the object being to determine which of these are essential to the growth of the plant, and what are the functions of each in the vegetable economy. Knop, Sachs, Nobbe, Hellriegel, and Wolff are among the most prominent in these investigations. Nobbe, of the station at Tharand, in Saxony, has lately completed a series of experiments upon the function of potassium in the growth of buckwheat and rye. The plants were raised in solutions containing all the essential ingredients of plant food, except that, in some cases, potassium was omitted. The plants grown with the full list of food ingredients were normal and healthy, while those deprived of potash were dwarfed, sickly, and abnormal. It appeared that in the latter there was no formation of starch. The general result of the experiments was that the building of starch in the chlorophyl grains, and, in consequence, the growth of the plant, is dependent upon the co-operation of potassium in the cell fluid. The functions of the other ingredients of the food of the plant are being studied, and with promise of most interesting results.

One very important function of the experiment stations, especially in Germany, is the control of the trade in commercial fertilizers, which is exercised by means of chemical analyses made at the stations. The value of these manures is dependent upon their composition, and, by these analyses, frauds are detected, and the relative values of good wares determined. The saving to the agricultural communities where the stations exist, by the exercise of this control, and the consequent improvement of the quality of the fertilizers used, amounts to many times the whole cost of the stations.

In Germany this control system is being extended to the examination of seeds sold for sowing, and several stations have been started during the past two or three years for this especial object.

Among the stations lately established is one at Lodi, in Northern Italy, for experiments in dairying, and especially cheese manufacture.

Besides the labors of the experiment stations, those of Boussingault, in France, who still continues his very valuable researches, and of Voelcker, in England, who works under the auspices of the Royal Agricultural Society, are too important to be overlooked. It is also a cause of great gratification to the friends of agricultural science that Mr. Lawes, who, in conjunction with Dr. Gilbert, has been carrying on for more than a score of years the well-known experiments at Rothamstead, in England, has provided by a munificent bequest for their continuance after his death. We also take great pleasure in recording the fact that at a Farmers' Convention, held under the auspices of the Board of Agriculture of Connecticut, in December, 1873, steps were taken toward the establishment of an experiment station in that state.

PISCICULTURE AND THE FISHERIES.

The subject of fish-culture and the fisheries continues to increase in importance, and in view of the economical value of the products of the sea and the interior waters, and in the amount of capital and effort directed toward their acquisition, this interest is amply justified.

Several exhibitions during 1873 have been made of fishery products and interests, the most important being that at Vienna during the past summer. Legislation has also been initiated or continued looking toward the judicial determination of the rights of the general public and of the individual, the most important step in this direction being the decision of the United States Supreme Court in reference to the obligation of the corporation controlling the dam across the Connecticut River at Holyoke to construct a suitable fish-way. This river in former years abounded in shad and salmon from its mouth to its sources, and furnished a vast amount of excellent food to a large population. The erection of dams along its course obstructed the upward movement of the anadromous fish, with the result of finally exterminating the salmon, and of reducing the supply of shad to a minimum. The most considerable of these obstructions, and the first met with above tide-water, was the great dam at Holyoke. An Act of the Massachusetts Legislature, authorizing the Fish Commissioners of that state to require the construction of a fish-way over this dam, was resisted by the company, and the case carried successively to the Supreme Courts of Massachusetts and of the United States, judgment being given by both tribunals against the company, which was thus obliged to yield. A fish-way was constructed during 1873 upon the plan of Mr. E. A. Brackett, of Massachusetts, which, it is hoped, will answer the purpose in view.

In no country, however, has the subject of the fisheries and their legal relations been more thoroughly considered than in Germany; and a very elaborate system of regulations is now under discussion, which, it is expected, will be the most complete in existence.

The number of states having Fish Commissioners for the improvement and regulation of the fisheries within their borders has been increased during the year by the addition of

Pennsylvania, Ohio, and Michigan; so that at the present time all the New England and Middle States except Delaware, and all the states bordering on the great lakes with the exception of Indiana, Illinois, Wisconsin, and Minnesota, are provided with these important state officers. Movements are in progress, however, which it is probable will result during 1874 in the appointment of Commissioners in Minnesota, Illinois, Maryland, Virginia, North Carolina, and possibly Iowa.

Numerous statistical publications in reference to the fisheries of the Old World and the New have made their appearance, although mostly relating to 1872. We have also a very elaborate communication from Dr. Francis Day on the fresh-water fisheries of India, and another by the Minister of Marine and the Fisheries of Canada. It is to be regretted that no provision is made by the United States government for the collection and publication of accurate and exhaustive details on this branch of industry, so ably worked up by France, Norway, and other foreign nations.

The special fisheries of the world have been prosecuted with their average success. The herring has furnished provision and employment for immense numbers of people both in Europe and America. The Astrachan herring (*Alosa caspica*), a species probably like our fresh-water herring or alewife, which was, up to the years 1854 and 1855, only used in extracting the oil, has taken a prominent place as a food fish since that time. The Russian name, *bescheuka* (the furious fish), seems to have incited a prejudice against it; but through the efforts of Mr. Baer, and a board of commissioners appointed to investigate the fisheries of Russia, the prejudice was largely overcome, and, under the name of herring, as a salted fish it has become an important element in the Caspian fisheries. In 1858 there were salted in the rivers of Astrachan 43,000,000 of this fish. The number in 1871 was 140,000,000; and in 1872, 160,000,000; while in 1872 only 30,000 were used for oil.

The cod fisheries of both the Atlantic and Pacific have also been abundantly worked. The occurrence of cod in immense numbers in the Pacific is a fact of recent appreciation; and it is satisfactory to know that, should the supply from the Atlantic be at all seriously impaired, the deficiency can be made up from the Pacific. According to a San Francisco journal, 583,000 cod-fish were taken by seven vessels off the coast of Alaska in the summer of 1873. No estimate can at present be formed of the captures off the Banks of Newfoundland and the coast of Norway. New cod banks have lately been discovered off the coast of Spitzbergen.

The trade in frozen herring off the coast of Maine and in the Bay of Fundy continues to be of great importance. This comparatively new interest has been increasing gradually for many years, and now employs a large force during the winter season. The fish are taken in gill-nets and immediately frozen, and then shipped to the western markets of Portland, Boston, New York, etc. The Bay of Fundy is particularly favorable for this trade; and the recent establishment of a signal station at Eastport has been of great moment, by enabling those engaged in the business to anticipate the occurrence of a period of hot or cold weather in time to take measures to protect themselves from loss. The application of the signal telegraph in the service of the fisheries in the United States is comparatively recent, and promises to be of great benefit by communicating information of the occurrence of schools of fish along the coast, and of their movements, to those interested in their capture.

Another application of the signal telegraph is made by the dealers in fish both on the lakes and the sea-board, who regulate their orders and shipments of fresh fish by the knowledge thus obtained of impending atmospheric conditions.

The American salmon trade continues to increase, and the number of establishments engaged in canning and preparing them for market on the Columbia River and in Puget Sound becomes larger every year. It would almost seem that the vast numbers taken for this purpose must soon bring about their extermination, but as yet no perceptible decrease is reported. Numbers of these fish are brought fresh to the East in refrigerator cars to supply the market earlier than the period during which the eastern salmon can be taken.

In view of the great increase of the halibut fisheries off the coast of the United States, the hardy fishermen of Cape Ann, who more especially carry on this branch of industry, are obliged to resort to distant seas to obtain a supply; and even Greenland is not too far for their efforts. The coast of Iceland, too, has also been visited by a Gloucester vessel for this purpose; but, although the halibut were abundant, the stormy nature of the region and other impediments rendered it impracticable to continue the effort.

A rapidly increasing trade is that connected with the menhaden, mossbunker, or pogy (*Brevoortia menhaden*), a large species of the herring family valuable for the oil and scrap—the refuse after extracting the oil from the boiled fish, which is used in direct applications to the land, or in the manufacture of fertilizers. Some idea of the magnitude of the interest may be learned from the fact that in 1873 sixty-two factories were in operation on the coast of New York and of New England, requiring the use of 383 sailing-vessels and 20 steamers, the factories and vessels employing 2306 men, with an investment of $2,388,000. The total catch of fish amounted to 1,193,100 barrels (250 fish to the barrel), yielding 2,214,800 gallons of oil, and 36,299 tons of guano. The oil is used principally in dressing leather, and to some extent in rope-making and for painting, but not as yet for lubricating.

Another increasing fishery in the United States is that relating to the sturgeon, which, though abundant, has been but little utilized, thousands annually taken in pursuit of other fish having usually been thrown aside as worthless. Now several dealers on the lakes, especially the Messrs. Schacht, of Sandusky, are entering into the trade, and manufacture caviar, isinglass, and dried smoked meat in great quantities.

The demand for fish-sounds continues very great, and the shores of New England and the provinces are carefully gleaned of all air-bladders procurable of the cod family. Of the species, the bladder of the hake is most sought after, bringing about one dollar a pound, and is used chiefly, it is said, in the manufacture of gum-drops.

The seal fishery during 1873 has also been very productive, the number taken at the Fur-Seal Islands in the Behring Sea being up to the maximum—namely, 100,000. The seals resort by millions to these islands, and it is said that a considerably larger number might be caught without any detriment to the trade. The capture of the hair-seals off the coasts of Labrador and Newfoundland, although less extensive than in 1872, has also been a source of very great profit. This business is now carried on entirely by steamers, of which not less than twenty belonging to Newfoundland were occupied, some of them getting two full cargoes. The largest catch of any vessel, it is believed, was about 42,000; these having been taken in the course of a few weeks, and, from the skins and the oil, yielding an immense profit.

The rapid decrease of lobsters on the coast of the United States, and the extent of the interest connected with canning them as an article of food, has induced a special effort to bring back the supply. The amount of this interest may be appreciated when we are told that during 1873 more than twenty thousand tons of canned lobsters were brought into the United States, or shipped elsewhere, from the shores of New Brunswick and Nova Scotia alone. An ordinance has been issued by the Canadian authorities prohibiting, under severe penalties, the capture of any lobsters weighing less than a pound and a half; and Massachusetts will probably enact a law prescribing a limit of size—namely, a minimum of eleven inches in length. In Maine, the legislation anticipated is that of a close time of two or three months in the summer, when none shall be taken, but imposing no restriction at other seasons as to size or weight.

The oyster fisheries, as far as the canning interest is concerned, suffered a severe shock during the financial panic, from which it has not yet recovered, although the consumption of the oyster while fresh is perhaps as great as usual. Vessels now carry entire cargoes from Maryland and Virginia to England, where they are becoming an established article of trade.

It will be of interest to announce that the United States Fish Commission is experimenting on a method of effectually freeing beds of planted oysters from the ravages of the starfish, so destructive to them.

Much valuable information has been obtained in reference to the fishery statistics, and the conditions affecting the fisheries generally, by the labors of the United States Fish Commission, which continued its investigations under the direction of the Commissioner, Professor S. F. Baird, assisted by Professor Verrill, on the coast of Maine during the summer of 1873. Detailed information was obtained in reference to the habits of the herring, cod, and other useful food fishes, which will have an important bearing on these interests. Numerous questions in reference to the preservation and reproduction of lobsters and oysters were also met. One result was the frequent capture of two-year-old shad in gill-nets many miles out to sea.

In connection with the subject of the fisheries, the modern methods of preserving fish fresh for an indefinite period of time should not be lost sight of, especially as their introduction has imparted immense activity to the trade in fresh fish, and enables the dealers to supply salmon, shad, Spanish mackerel, bluefish, striped bass, etc., at all seasons of the year.

Of these devices there are two principally in use, one consisting in placing the fish in sealed metal boxes in a mixture of ice and salt; and the other, much more convenient, being the construction of a chamber inclosed within double walls, and filled with the same mixture. The fish are placed in the centre apartment, the temperature of which can be readily maintained at from 18° to 25° above zero, and are preserved indefinitely. It is only necessary to renew the supply of the mixture every week or month, according to the mass, and the temperature above referred to can be kept up indefinitely. Some establishments in New York and elsewhere keep many thousands of pounds of fish in this way, subject to call at any time.

The various methods of increasing artificially the supply of fish and other marine animals, technically known as *Pisciculture*, have been prosecuted with increasing vigor during the year 1873, the earlier experiences warranting the adoption of more enlarged plans for securing the desired result. Associations have been formed, and state commissions appointed, while numerous private establishments have been erected. The most important action in this direction is that taken by the United States Fish Commission, established in 1871, which is now largely occupied with this work, in addition to special researches in reference to the condition of the fishing interest on the sea-coast and lakes.

The measures adopted have had more special relation to the multiplication of shad, salmon, and whitefish; and in these operations the United States Commission was fortunate in securing the assistance of Mr. Seth Green, Dr. J. H. Slack, Mr. Livingston Stone, and other fish-culturists. Its operations have been conducted on a much larger scale than by any other nation, and with very gratifying success.

With a view of securing a sufficient supply of the eggs of the California salmon, Mr. Livingston Stone, as in the previous year, was sent out to the United States salmon-breeding camp on the McCloud River, near Mount Shasta, where he obtained about a million and a half of eggs, which were shipped to the East (a portion to Utah), and about half of them successfully hatched out, at various state and private establishments, and placed in different streams in the Northern, Middle, and Western States. The more important waters supplied are several streams in Maine and Massachusetts, the Connecticut, Hudson, Delaware, and Potomac rivers, Lake Champlain, Lake Ontario, Lake Erie, and Lake Michigan, and the Ohio River.

During the year, also, the establishment at Bucksport, Maine, under Mr. Atkins, continued its operations on an enlarged scale and with very satisfactory success. While the salmon are seined when wanted on the McCloud, at this establishment they are purchased living from the fishermen, who capture them in weirs in the months of June and July, and place them in a large pond, to await the period of reproduction. Here they remain until October or November, when the instinct of spawning seizes them, and they run down into the outlet of the pond, where the hatching-works are situated. The spawn is removed by gentle pressure into a vessel, and fertilized, and the parent fish returned alive to the water, and allowed ultimately to run down to the sea. Previously, however, they are marked by a label, so as to determine whether any come back again; and in this event to ascertain the growth and increase of weight in the interval, their original length and weight being recorded.

These eggs are then brought forward to a proper degree of development, and finally distributed to State Commissioners, by whom the operation is completed, and the young placed in the public waters of the states. It is expected that, as the result of the operations of these two establishments during 1873, not far from three million (3,000,000) young salmon will be planted in the eastern, middle, and northern waters of the United States, including those placed in the tributaries of the Great Salt Lake.

Another enterprise of a similar character has been the erection of an establishment for the hatching of the eggs of landlocked salmon on Sebec Lake, in Maine, in which the Commissioners of Massachusetts and Connecticut have united with the United States Commissioner. It is hoped that, when this is fairly in operation, a large supply of this most valuable food fish will be secured.

Operations looking toward the multiplication of shad in American waters, both on the part of the United States and of some of the states themselves, have also been conducted on a large scale. The work was prosecuted by the United States on many of the coast streams from the Savannah River to the Penobscot, and large numbers of young fish were not only turned into the water at the points where they were hatched, but transferred to tributaries of the Mississippi and of the great lakes. A successful shipment was also made to the Sacramento River of 35,000, and a small number to the Jordan, a tributary of Great Salt Lake.

As in previous years, Massachusetts, Connecticut, and New York carried on similar operations for the benefit of the local waters, while a beginning was made in the same direction by the Commissioners of Pennsylvania in the Susquehanna River.

The cultivation of whitefish has also been prosecuted with great zeal, particularly by the States of Michigan and New York, while a considerable number belonging to the United States Commission was sent to the Commissioners of California, and by them successfully planted in the waters of Clear Lake.

The operations in connection with whitefish have of late years been prosecuted on a very large scale by the State of New York, under the direction of Mr. Seth Green. In 1872 the state hatching-house at Caledonia contained about 3,000,000, which were duly planted when hatched. The number was less in 1873. In 1872 the United States Commission engaged the services of Mr. N. W. Clark, in connection with the whitefish eggs, and transmitted about 400,000 to the State Commissioner in California. In 1873 the State of Michigan collected a large number of these eggs for introduction into its own and adjacent waters. This fish, as is well known, is the most important of any species taken in the lakes, and it is fortunate that the method of their artificial propagation proves successful, and promises so satisfactory results. Only by such a process can the enormous waste and drain caused by the fisheries as at present prosecuted be met and replaced, an expenditure of ten or fifteen thousand dollars per annum being sufficient to secure the return in value of many hundred thousand dollars in productive results.

The discovery of a species of grayling (*Thymallus tricolor*) in certain rivers of Michigan, has suggested the importance of making this fish more widely known, by introducing it into appropriate waters elsewhere. Fish of this genus are much esteemed in Europe, both as an article of food and as furnishing excellent sport in their capture; and the American variety will probably be much sought after when arrangements can be made to supply the spawn in sufficient quantity.

A very important advance in the artificial propagation of fish was made by Seth Green and party while in the service of the United States Commission, in the discovery that striped bass, or rock-fish (*Roccus linealus*), may be bred as easily and in much the same manner as the shad; special effort will probably be made during the coming year toward increasing the supply of this most valuable fish.

MECHANICS AND ENGINEERING.

A review of the condition of the *Iron* producing and manufacturing industries for the year (1873) presents a picture of great prostration. From the statistics of the American Iron and Steel Association, it appears that fully *one half* of the furnaces have been blown out; while the rolling-mills are either working on short time or are bare of orders, and the mining of iron ore has slackened to a corresponding degree.

This condition of things, so very different from the unexampled prosperity of the preceding year, is to be attributed to the great restriction of the building operations of railroads—and especially of Western roads—and the present almost absolute suspension of farther railway extension as one of the immediate results of the present financial crisis.

During the year 1872 forty new furnaces were erected in various parts of the United States, and the erection of others was undertaken; and the extension of rolling-mills, etc., kept pace with the increased producing capacity which they represented; while the furnaces and mills were worked to their utmost to meet the orders which came in upon them.

The production of pig-iron in the United States for 1872 was 2,830,070 net tons, or 2,526,848 gross tons. In 1873, the ascertained production during the first six months of the year was 1,393,075 net tons; and the estimated production for the entire year 1873 is 2,695,434 net tons, or 2,406,637 gross tons; showing a probable decrease in production, as compared with that of the previous year, of 134,636 net tons. It is regarded as probable that, had not the financial crisis intervened, the total iron production for the year 1873 would have exceeded 3,000,000 tons. The estimated capacity of all the furnaces in the United States is 4,371,277 net tons. The total number of furnaces in the United States, exclusive of abandoned and projected furnaces, is 636. The total number finished and put in blast in 1873 is 42, of which a number are among the largest in the country.

The American make of rails during the year 1873 will probably be about 850,000 tons (of which 120,000 tons will be Bessemer rails), as compared with 941,992 tons produced in 1872, showing a decrease of nearly 100,000 tons.

The product of the forges and bloomeries of the country is estimated for 1873 at about 50,000 tons, against 58,000 in 1872.

Concerning the production of steel, it appears that, while there is the same falling off in the figures indicating total production as compared with the previous year (28,000 tons as compared to 32,000), the introduction of improved processes for its manufacture (the Bessemer and Siemens-Martin processes) show an encouraging development, as the summary below appended indicates.

There are eight Bessemer works for the conversion of steel and the rolling of rails at present in working condition in the United States. These are located at the following places: Troy, N. Y.; Johnstown, Pa.; Bethlehem, Pa.; Harrisburg, Pa.; Newburg, Ohio; Chicago, Ill.; and Joliet, in the same state; while the capacity of the Harrisburg works is in course of being doubled by the erection of a new plant, and the Edgar Thompson Steel Works, near Pittsburgh, Pa., will be completed in 1874. The total capacity of the Bessemer works now in operation in the country is 170,000 tons.

The following table is a copy from the official report of the Secretary of the American Iron and Steel Association, and is a summary in net tons of the ascertained and estimated production of iron and steel in the United States in 1872 and 1873, to wit:

	1872.	1873.
Iron and steel rails	941,992	850,000
Other rolled and hammered iron	1,000,000	980,000
Forges and bloomeries	58,000	50,000
Cast steel	32,000	228,000
Bessemer steel	110,500	140,000
Siemens-Martin steel	3,000	3,500
Pig-iron	2,830,070	2,695,434

In the department of railway construction—the most sensitive test of the prosperity of the iron-producing interests of the country—a corresponding decrease is observable. The culmination of railroad construction in this country was attained in 1871, when 7779 miles of road were constructed. In 1872 a decline was inaugurated, the figures falling to 6427 miles; while in the year 1873 a decrease of 50 per cent. on the figures of the preceding year fully indicates the prime cause of the present prostration of the iron industry of the country.

Aside from the extension of the lines of railroad in the country, the statistics of which are noted elsewhere, the interest of the engineering public has been centred upon the progress of a number of tunnel and bridge constructions, which have been, in the main, steadily pushed toward completion.

Of these, perhaps the most prominently before the public is the Hoosac Tunnel, which is now practically finished—the actual tunneling work having been finished November 27, 1873. It is, however, not anticipated that the tunnel will be ready for the passage of trains until about the month of July, 1874. Aside from the magnitude of the work, the probabilities are that no engineering task ever prosecuted to a successful conclusion can point to so many vicissitudes in its career. It was undertaken some twenty years ago, and repeatedly abandoned, until contracted for by the Messrs. Shanly in the year 1869. These gentlemen have, in the face of many natural obstacles, carried the work to its successful termination. The total length of tunnel is 25,031 feet, or four and three-quarter miles. It is twenty-six feet in width, and varies in height from twenty-three to twenty-six feet wherever a brick arch is used. Passing through solid rock excavation, the section is reduced to twenty-four feet wide by twenty feet high. Another engineering enterprise of some magnitude, the Cleveland Water-works Tunnel, which has had a history almost as checkered as the enterprise above alluded to, has likewise been completed during the year. The capacity of the tunnel is from sixty to seventy million gallons of water daily: amply sufficient to supply the city when it shall have a population of a million, should that time ever arrive.

The completion of the Underground Railways through the city of Baltimore during the past year is worthy of record, not so much on account of the novelty or magnitude of the undertaking, as because this is the first systematic movement in the country to inaugurate the underground-railway system, which has been long since adopted very extensively abroad, as the most rational solution of the problem of railway transit through populous cities.

The tunnels in question form two distinct lines, whereby nearly all the railroads centring in the city have been brought into connection, greatly adding to public convenience and facilitating business intercourse. Their total length is three and one-half miles, of which about two miles are closed tunnels, and the remainder open cuts, over which the streets are carried on bridges.

The work upon the great steel bridge at St. Louis is not completed, but is being pushed steadily forward, as is also the work upon the tunnel connecting with it.

Of engineering enterprises which have been projected, perhaps the most interesting is the proposal to pierce the Rocky Mountains with a tunnel. The objects and advantages to be gained therefrom are stated to be the development of new mineral veins, and of the resources of that region of country, by increasing the facilities of transportation. If ever completed, it will be carried through from a point near Black Hawk, and will come out in the Middle Park. The tunnel will be twelve miles long. It is declared that work from the Middle Park will be commenced early next year, and that already much of the preliminary preparation has been made.

The production of *Coal* in the United States for the year just passed will, in consequence of the serious prostration of the iron producing and manufacturing industries, fall somewhat below the figures of 1872, as a natural consequence.

In this connection, the most instructive feature of the subject for our yearly summary of progress is to be found in the very general attention to the utility and expediency of introducing into American mines the system of mining coal with the aid of coal-cutting machines, which have proved themselves so economical and such practical solvers of labor difficulties abroad. The subject has been the theme of discussion before several of the American engineering societies during the year, and the system generally pronounced to be susceptible of much less utility here than abroad; inasmuch as the economy of such machinery, according to the best-informed judges, will be in the inverse ratio to the thickness of the veins on which it is employed. In most American localities where the mining of coal is largely carried on, the veins are of considerable, often, indeed, of enormous thickness, as compared with those of European countries; the waste is therefore less, the production far greater with equal labor, and consequently the necessity for machine-work less urgent than there. In the Indiana coal-mining district, however, where the coal seams are comparatively thin, coal-cutting machinery of American design was introduced during the last year, and from the statements of the mine owners, has proved itself to be very advantageous on the score of economy. It is probable, therefore, that the success of this first experiment will inaugurate the general introduction of such machinery in this country where the conditions are similar; so that our next year's summary may find this innovation to be a very general practice. This inference is warranted by the statement that in England, where these machines have been very largely introduced during the past year, and where the coal seams have an average thickness of from two to three feet, it is estimated that 60,000 men only would be required, with their aid, to raise the 120,000,000 tons annually put out, instead of the 360,000 now called for.

In connection with the same subject, the question of the utilization of the coal-waste, or slack, can not be passed by without a brief notice of the attempts which have been made during the past year to solve this puzzling problem. The chief difficulty in the path of inventors in this field has been the very important one of cost of production; and it may be said, without fear of contradiction, that the quality of the material produced has been but a secondary consideration in the question when compared with this. The last year has, however, witnessed some great improvements in this direction, which have received a full share of public attention. At the fair of the American Institute in New York, there was on exhibition the model of a machine for producing artificial fuel which in some respects surpassed any thing hitherto devised. The process in question is the invention of Mr. E. F. Loiseau, who has given many years' attention to the subject. The composition of the fuel is coal-slack and common yellow clay, moistened with milk of lime. The manufacture is carried on automatically, the crude materials entering the apparatus at one end, and emerging finished and ready for shipment at the other. The only manual labor employed is in supplying the crude materials. Great expectations are entertained of the success of the process here alluded to. By this process the lumps are made of egg-shape and waterproofed, and as but five per cent. of clay is used to convert them, the heating power of the product is not materially reduced.

As the result of a series of researches upon proper fog-signals, made in behalf of the Light-house Board, Professor Henry has lately announced that the only instruments giving sufficient agitation to the air, to be efficient for fog-signals, are those in which the sound is reinforced by resounding cavities. The simplest of these instruments is the ordinary steam-whistle, those employed by the Board being from eight to eighteen inches in diameter, with a corresponding height, and driven by a pressure of steam of from sixty to seventy-five pounds. This instrument has the advantage of giving a sound of equal intensity in every azimuth. The Daboll air-trumpet, in which the vibrations are produced by a steel reed put in motion by air condensed by a caloric engine, gives the greatest amount of sound with a given amount of power; but the instrument which exhibits the greatest penetrating power of sound, without regard to the energy expended, is the siren trumpet, in which the vibrations are produced by streams of steam passing from a boiler, with a pressure of seventy pounds to the square inch, through orifices in a plate, before which revolves another plate having corresponding holes, so as alternately to interrupt and permit the flow of steam. This instrument has been constructed, under the auspices of the Light-house Board, by Messrs. Brown, of New York, and has lately been highly approved by Professor Tyndall in a report to the British Trinity Board.

TECHNOLOGY.

In *Technology*, the past year produced no remarkable or revolutionizing inventions, but numerous advances in various arts by the introduction of improved machinery and methods are noticeable in many directions.

In the operation and control of railway trains, both in the United States and abroad (though to a greater extent with us), great improvements have been made within the year. These arise from the very great interest lately taken by the managers of railroads in improved methods of braking and switching trains. The substitution of power-brakes for the hand-brakes has become very general upon American railroads, especially upon the Eastern roads. The principle upon which these improved appliances operate is either with compressed air, as in the Westinghouse; with vacuum, as in the Smith; or with water pressure, as in the Henderson and other forms of hydraulic brakes. The interest which this subject is attracting among railway managers is evidenced by the fact that at the recent meeting of the American Railway Master Mechanics' Association, where this subject attracted much discussion, the opinion was unanimously expressed that, in view of the security and certainty with which they permitted the trains to be controlled, the several forms of continuous power-brakes were infinitely to be preferred to the hand-brake. The last year likewise witnessed the introduction of the air-brake upon the English roads, where it has met with great success and popular approval. The increasing interest manifested on all sides in securing additional safety in railway travel, and the notable improvement in the mechanical devices to effect this object, are matters of congratulation.

The subject of effecting some mode of transit in large cities which shall cheaply and more efficiently replace the horse-cars—a subject of importance at all times—has received during the past year a larger share of attention than it might otherwise have attracted, owing to the widespread contagion among the horses. The result of this condition of things was in one respect beneficial, inasmuch as it has brought out several excellent devices for rapid transit in cities, the necessities or advantages of which might otherwise have waited long for recognition. The so-called "fireless locomotive" is an invention of this class, which is said to be in successful operation in the cities of Chicago and New Orleans, and has attracted during the last few months much attention from the engineering press. Briefly described, it consists of a boiler and the usual machinery on a small scale. To this boiler, which is three fourths filled with cold water, the steam for the trip is supplied before starting from a large supply-boiler located at the dépôt. Instead, therefore, of generating steam with the aid of a fire in the usual manner, a steam pressure equivalent to 170 to 180 pounds is stored up in the manner indicated, and thus fuel, fire, and fireman are dispensed with. Where it has been employed it is highly spoken of as a substitute for the dummy engine. Any rate of speed up to twenty miles per hour can be obtained from them.

Mr. Frederick Ransome, of England, whose name is well known to the engineering world in connection with the manufacture of artificial stone, has but recently returned from a visit to this country, the object of which was to introduce his improved process, which has been so favorably commented upon in England. The so-called "Ransome stone," for many years largely and successfully employed in construction abroad, and for some years to a slight degree introduced in the United States, was made by injecting a block of sand, cemented by silicated alkali, with chloride of calcium; by which an insoluble silicate of lime was formed in the interior, thus making it extremely hard and unalterable. The resulting chloride of sodium was subsequently washed out with water. To avoid the addition of chloride of calcium and subsequent washing, Mr. Ransome's new process employs suitable quantities of lime, and a natural soluble silica (infusorial earth), with sand and a solution of silicate of soda or potassa;

which are moulded and allowed to harden gradually as silicate of lime is formed, by the decomposition of the alkaline silicate produced by the action of the lime. The chemical reactions involved in the production of the "Apoenite stone," as the new product is called, are such that the whole of the alkali is combined, and none left free to effloresce, as is the case with the "Ransome stone;" hence no after-washing is needed.

The part taken by American exhibitors in the great Industrial Exposition just closed was altogether unworthy of the commanding position which this country occupies in the estimation of the world. The manufacturing industries of the country were but meagrely represented; but, despite the incompleteness of the display, the American department of the great fair, especially that portion of it relating to the mechanic arts, was the object of much interest and attraction to visitors. The comments of the foreign engineering press upon the originality of design, directness of conception, and true mechanical adaptation displayed by the few exhibits there exposed, as well as the recognition which they received at the hands of the authorities, all render it manifest that, as was the acknowledged fact at Paris in 1867, upon the field of invention and machine construction America held the first rank. While the meagreness of the American display at Vienna may therefore be justly a matter of regret, we may feel gratified at the praise bestowed upon that which was displayed.

The movement for the Centennial Exhibition, to be held in Philadelphia in 1876, has been vigorously pushed during the year. The formal transfer of the grounds from the city of Philadelphia to the Centennial Commission took place on the 4th of July, 1873, in the presence of an immense concourse, and with imposing ceremonies. The design of the building has likewise been decided upon, and the organization of state societies to forward the interests of the important project has been effected.

During the last year the demand for and supply of artificial *Alizarine* have very largely increased, though its manufacture can be said to have just fairly begun. The value of madder has decreased to such an extent by the competition with the manufactured article, that it has become a question whether it will remunerate the growers to continue its production in the future. Last year it is estimated that over one fourth of the total quantity of this dye-stuff employed was the artificial product. There can remain no doubt that the industry which has developed so greatly within the past year or two will in the near future entirely extinguish the growing of the madder in Europe at least, thus turning thousands of acres of land and laborers into other and more profitable channels of production.

In the *Soda* manufacture, the past year has largely witnessed the introduction of the new ammonia process, which bids fair to make in time as radical a change in this vast and leading chemical industry as the one above noted. In many parts of Germany and in Switzerland soda-works upon the new plan are in operation, some of them producing as much as fifteen tons per day. The new process possesses the one great advantage over the Leblanc, so universally in use up to the present time, in that the conversion of the common salt into soda is *direct*. The whole process depends upon the treatment of a strong solution of common salt with bicarbonate of ammonia; the resultant of the reaction being the precipitation of the sodium as bicarbonate, and the formation of a chloride of ammonium. From this last, the ammonia is again recovered for a second operation by treatment with caustic lime, while the sodium bicarbonate is converted into the simple carbonate—the soda of commerce—by heating, the carbonic acid evolved being employed to unite again with the regained ammonia.

The opinion of the judges at the late Vienna Exposition, of which Professor A. W. Hoffmann was president, was to the effect that the new process—which has grown into a flourishing industry almost before its existence is generally known—was destined in the near future to entirely exclude that of Leblanc.

In the field of *Illumination*, the year 1873 may point to several decided advances. The process of Tessié du Mothay, which during the past few years has been the topic of so much and varying criticism, has been very thoroughly tested in Vienna for the illumination of dépôts and other large public buildings, and with most excellent effect. The unfavorable comments made upon the oxygen illumination process, after its withdrawal from the public streets of Paris, upon which it was placed awhile for trial, have done more, perhaps, than any thing else to divert public interest from it; but the Vienna experiments, involving, as they do, numerous modifications upon the original plan, are declared to have proved so strikingly successful as to leave no doubt of the entire practicability of the system, within limits of reasonable economy.

The old plan as practiced in Paris, and likewise in New York, involved the carbureting of the coal-gas, previous to combustion, with oxygen — a process attended with inconvenience, both on the score of introducing an additional item of expense and complicated apparatus. The burner employed, also, was of the argand pattern, the oxygen being introduced into the interior of the gas flame, which was of a tapering, cylindrical form. The concentrated character of the light afforded by this arrangement of burner was of a nature to seriously pain the eyes of the beholder after a time, and it was from this cause open to objection.

The experimental trials which have proved so successful in Vienna, under the intelligent direction of Herr Bernhard Andrae, have shown that, where the oxygen system is to be largely employed, it will be far more practical and economical to modify the existing gas-works so as to produce a very rich gas, than to employ the old plan of carbureting with benzine, or with compressed boghead cannel-gas, heretofore in practice. In addition, the argand form for the burner, and the method of supplying the gases, have been much improved and modified.

In the plan found most satisfactory in Vienna, the central position is given to the burning gas, and the oxygen is admitted to the exterior, while the flame proper has the broad-surfaced flat form afforded by the well-known Scotch burner. The latter is made in the ordinary way, the oxygen being brought to the flame by a peculiar attachment separate from it. One of the existing gas-works has been so modified as to produce a rich gas, thus obviating the necessity of carbureting, and an oxygen gas-works has been located beside it. Thus, with all the factors at hand, which are of value in estimating the practicability of the new process, the favorable judgment which has been expressed must be regarded with interest by all who give the subject of illumination even passing attention.

Several of the large dépôts of Vienna are illuminated, with satisfactory results, upon the modified plan here described. Open, unprotected flames, fed with oxygen, illuminate the entrance and exit galleries, and the vast interior of these buildings, with a light of exquisite mildness, brilliancy, and whiteness of color, with none of the glare which, with the central burners of the old plan, produced a painful impression upon the eye.

It is to be hoped that the success which the oxygen light has met with in Vienna will stimulate its American advocates to emulate so desirable a consummation.

Another very decided advance in the field of illumination is afforded by the dynamo-electric machine of M. Gramme, which, though for some time before the scientific world, has only during the last year attracted the attention which its remarkable capabilities deserve. The description of the machine belongs properly in our department of Physics, where it will be found. The luminous effects produced through its instrumentality leave little to be desired. A large Gramme machine, which was exhibited in London, produced a light equal to about eight thousand candles, and still larger machines are being made which Mr. Crookes expects to give a light equal to twenty-five thousand candles.

A seeming solution of the problem of electrical illumination for city and domestic purposes, which shall avoid the difficulty of the concentrated brilliancy, trouble of adjustment, and complication of various forms of the electric light, is furnished by Mr. A. Ladiguin, of St. Petersburg. The machine is driven by an engine, the luminous effect being produced by a single piece of carbon, or other bad conductor, connected with the machine, and placed in a glass tube exhausted of air, filled with some gas which will not combine with carbon at a high temperature, and then hermetically sealed. The carbon is gradually and equably heated, and is said to emit a soft, steady, and continuous light. One machine, driven by a three-horse-power engine, is said to be capable of lighting many hundreds of such lanterns, which will burn under water, and in mines as well as in the house. Should the claims made for it prove to be literally true, the new light possesses many and decided advantages over coal-gas; especially will this be manifested in the score of economy, the cost of the electric light being, according to the inventor's statement, about one fifth that of ordinary coal-gas.

Before leaving the subject of illumination, it would not be amiss to call attention to the improvements made in the mechanical details of the gas-works, and especially in the numerous endeavors which have been made, with considerable show of success, to introduce machinery for charging and drawing the retorts. In this connection, the names of Somerville, Rowland, and Havens are especially deserving of mention.

In the preparation of chlorine, the most noticeable innovation announced during the year just past is the new process of Mr. Weldon, in which magnesia is employed along with the manganese.

Within a short interval, quite a number of improved methods for this purpose have been made public, some of which—notably the first process of Mr. Weldon, those of Mr. Deacon, and of M. Tessié du Mothay—have already come quite extensively into use.

For the sake of comparison, the accompanying brief description of these recent advances may be of interest; for although, strictly speaking, only the one alluded to at the outset received its first announcement during the past year, they have nearly all received more or less modification within that period, and may be appropriately alluded to in the record of progress for 1873.

The process of Du Mothay is designed to produce chlorine continuously from a given supply of manganese. This is effected by passing a stream of hydrochloric-acid gas over a mixture of the binoxide of manganese and lime heated to low redness, and then, at the same temperature, passing a stream of air over the residue in the retorts, by which the chlorine in the manganese and calcium chlorides is liberated, and passed with the first product into chambers for the preparation of bleaching lime. The revivification of the manganese peroxide, the chief feature of the process, is effected by the presence of the atmosphere. There are no data at hand to enable us to determine how complete this regenerating process is found to be in practice.

The process of Deacon consists in passing a mixture of hydrochloric-acid gas and air over pieces of clay impregnated with sulphate of copper, and heated to about 400° C. (752° Fahr.). This method possesses several very advantageous features, and has been introduced into three or four of the largest English works, giving much satisfaction.

The first of Weldon's processes consisted in passing air into the chloride of manganese solution, with the addition of milk of lime. In his second method, which is the one alluded to at the outset, magnesia is employed along with the manganese, and, from a theoretical stand-point, is a perfect solution of the problem. The following is the process in brief: Hydrochloric acid is allowed to act upon a mixture of magnesia and binoxide of manganese, generating chlorine, and leaving behind a mixture of the chlorides of magnesia and manganese. This residue is evaporated to dryness, and heated to a high heat in a current of air, by which treatment the chlorides are decomposed with the liberation of chlorine, and the magnesia and manganese again regenerated, to be treated as before.

It will be seen from this description that the process is a continuous one, the chlorine being generated by the use of hydrochloric acid and heat alone upon the magnesia and manganese mixture. This chlorine is derived from two sources —the first portion, formed by the action of the acid upon the magnesia and binoxide of manganese, is pure; the other, however, which is obtained from the evaporation and roasting of the two chlorides, and which forms by far the greater quantity, is diluted with air and nitrogen. Such dilution, for many purposes in the arts, is no disadvantage. It would be of value to know from those who have adopted this interesting plan how perfect the regeneration of the materials really is—inasmuch as the experience in related operations (notably in the continuous production of oxygen gas) is not of a very encouraging character.

Among the most interesting and important of the exhibits at the recent Exhibitions at Vienna and London, must be named the various articles fabricated of the new alloy, phosphor-bronze, which is now attracting much attention on the part of machinists and manufacturers.

The material in question owes its origin to the discovery some time since made by MM. Montefiore-Levi and Künzel, that the density and toughness of ordinary bronze is notably increased by the addition to its composition of phosphorus (in the form of phosphor-copper). Since the first announcement of its claims, the material has been subjected to very thorough tests—both under governmental and private direction—and with the most flattering results.

It is claimed that by judiciously varying the proportion of phosphorus in the manufacture, an alloy of almost any desired quality can be produced, thus opening for it a field of great utility from the variety of its possible applications. Unlike other alloys, it can be remelted without serious deterioration of quality, while heavy steel castings, when worn or broken, are comparatively worthless. A great variety of objects made of the material, on exhibition at the above-named cities and elsewhere, have been enumerated, of which we will only present some of the more interesting. It has been employed with advantage for the great bearings of the plates in general rolling-mills, and for conical gearing in universal rolling-mills—for which it is much superior to both cast iron and ordinary bronze. A just idea of its value may be formed from the fact that at the Vienna Exposition it obtained the following awards: In group 1—for cog-wheels, tuyeres, and bearings—the diploma of merit; in group 7—for revolvers and parts of harness—the medal of progress; and in group 12—for its application to guns, etc.—the medal of merit.

A great variety of objects hitherto made of iron or steel may with advantage be cast of phosphor-bronze, and in many cases only require to be polished to be ready for use; in addition to which they will not corrode.

Its great fluidity, compactness, fine grain, and beautiful color, adapt it admirably for decorative work; and the perfection of the castings materially lessens the expense of subsequent chasing and finishing.

The Belgian government has adopted the phosphor-bronze for small arms, and for the harness-metal of its cavalry. From the brief space of time during which it has been before the mechanical world, no less than from the modifications of which its physical properties are susceptible by slight variations in its constitution, it is fair to presume that the uses to which it may be advantageously applied have as yet by no means been fully recognized.

ANNUAL RECORD

OF

SCIENCE AND INDUSTRY.

1873.

A. MATHEMATICS AND ASTRONOMY.

PROFESSOR HEIS'S STAR ATLAS.

A NEW star atlas of high scientific and practical value has been recently published by Professor Heis, of Münster. This work consists of twelve sheets, and contains 5421 stars and nebulæ—*i. e.*, all that are visible to the sharpest vision in the northern hemisphere. While in many respects similar to the standard atlas of Argelander (his *Uranometria Nova*), it differs, and is perhaps an improvement on it, in that it contains many more of the fainter stars, and especially that the Milky Way is skillfully delineated, with all its variations of outline and brightness. Such an atlas becomes invaluable to those who interest themselves in the recently developed department of meteoric astronomy.

AMERICAN STAR CATALOGUE.

The largest catalogue of stars ever prepared in America has been published by the United States Naval Observatory at Washington.

This work embodies all the valuable observations made since the foundation of the observatory, in 1842, with the meridian instruments, consisting of the work of the well-known astronomers Coffin, Hubbard, Ferguson, Newcomb, Hall, Harkness, and Yarnall. Over fifteen years of labor have been devoted to it by Professor Yarnall and his assistants, and he has himself made nearly one half of the observations. The catalogue is based on over eighty thousand observations of more than ten thousand stars, many of them being quite faint, and in extreme southern latitudes, such as have never, or rarely, hitherto been observed.

Professor Yarnall has made an elaborate comparison of his results with the position of the stars given in the *American Nautical Almanac*, and finds that but very small systematic differences exist. Americans will be pleased to welcome this valuable addition to astronomical literature.

AMATEUR ASTRONOMY IN AMERICA.

Mr. C. W. Burnham, of Chicago, has communicated to the London Astronomical Society a list of eighty-one new double stars discovered by him. Mr. Burnham is an amateur astronomer—one of the few in this country who have succeeded in bringing their enthusiasm up to the "useful-work" point. He has consulted almost all the good modern catalogues of double stars in order to ascertain that those discovered by him to be double were not already recorded in the annals of astronomy. Chicago is to be congratulated that, amid her business and her losses, one of her citizens is able to apply his leisure to the pursuit of so ennobling a study.

THE VARIABLE SIZE OF THE SUN.

Secchi, the astronomer of Rome, has concluded, from certain observations made during the past year, that he is justified in affirming that there is a periodic variability in the size of the sun. The many startling revelations of science during the past ten years have prepared the way for the acceptance of even this conclusion, though the observations on which Secchi founds his belief are as yet so few as to still leave room for some possible doubt on the subject. It would seem that the outer surface of the sun—the photosphere as seen by us—is a gaseous envelope in a state of continual and perhaps periodic change, such that the diameter of the solar orb, as measured by the aid of the telescope, is least in the region of the greatest spot activity—that is, the solar equatorial belt does not bulge out as does that of the earth, but, on the contrary, the solar polar axis is the longest diameter of that body. The excess of the polar over the equatorial diameter is, however, a very small quantity, and may be referred either to tides in the photosphere or to the influence of the solar spots themselves.—*Mem. Soc. Spectroscopiste Italiani, Sept.* 9, 1872.

SOLAR SPOTS AND PROTUBERANCES.

Père Secchi has lately presented to the French Academy a paper containing some new generalizations on the relations of the solar spots to the protuberances visible with the spectroscope. He begins by referring to the small number of protuberances during the last four months, especially near the poles of the sun, where they were both few and faint. This diminution in the number of protuberances coincides with a diminution in the number of spots. He is led to the following conclusions respecting the relations between these two phenomena:

1. The regions of faculæ and spots are richest in protuberances.

2. There are two kinds of protuberances: the one thin and feeble, spread out like our thin cirrus clouds in the atmosphere; the others, more dense, compact, and brilliant, having a thready structure, and a peculiar optical character.

3. The spectral analysis of this last class shows that their spectrum is very complicated, and that they contain a number of substances, while the others show only the lines of hydrogen and the line D^3.

A careful study during two consecutive years of observation has convinced Père Secchi that it is these brilliant and complicated protuberances with which the spots are connected. Two well-established and very general phenomena have confirmed this conclusion. First, although the hydrogen protuberances are seen all around the solar disk, yet the spots are confined to a determinate region, from which it follows that a hydrogenic eruption can not produce a spot. Second, the brilliant eruptions with numerous metallic rays are confined to the latitudes of the spots. These two facts led him to suspect that the cause of the spots is connected with the spectral constitution of the protuberances. He therefore carefully noted all the eruptions having this character, which for brevity he calls metallic, and he found that whenever one of these eruptions is seen on the eastern edge of the sun, a spot is sure to appear on the day following. This connection has been so uniform that for several months he has been able to predict the appearance of a spot by simple examination of the spectrum of the eruption. Afterward, by examining his older observations, he has found a hundred similar verifications. In fact, it is hardly necessary to examine the spectrum of the eruption, its peculiar physical character being nearly as good. In the first place, the light of the jets exhibits a great brilliancy. The hydrogen ray C assumes a very deep and singular tint. The flames are very dense, terminating in sharp and often straight points; when bent back, they are very unstable, changing from one instant to another. The height of the jet is generally but not always considerable; sometimes the jets are low, but very sharply terminated.

From a comparison of these spectra with those of the spots, Secchi concludes that the spectrum of the metallic protuberances is the same with that of the spot, which on the edge of the sun appears by its direct rays, while on the disk the rays are reversed. The spots are produced by masses of metallic vapor bursting out from the interior of the sun. These vapors need not rise to a great elevation; it is sufficient if they rise above the general level of the photosphere. They then rest suspended and floating in the photosphere itself like islands, but being sunk to its level they look like cavities. These masses are of course coated, and therefore absorb the rays of light and heat, but the surrounding photospheric mass gradually encroaches upon and dissolves them.

Secchi finally remarks that there are still some details to be explained which will require time to work up. He differs completely from Faye, who attributes the spots to revolving storms or solar cyclones, stating that there are not more than five or six cases of spots showing a motion of revolution in the course of a year.

SECCHI ON SOLAR PROTUBERANCES.

The observations of solar protuberances by Secchi for the latter half of 1872 have been published, and form a very valuable contribution to what he styles "solar meteorology." The conclusions to which he has been led are thus epitomized:

1. The protuberances from August 13 to December 31,

1872, embracing five revolutions of the sun, have been less numerous than during the four preceding rotations, averaging respectively 159 and 261 per revolution.

2. There has been a corresponding diminution in the number of the spots.

3. The jets inclined in the direction of the reigning solar current have been less numerous, many being in an opposite direction.

4. The number of jets turned toward the poles has been 292, that of those turned toward the equator 89, while 46 had a double inclination. Of the number 89, the greater part were within thirty degrees of the solar equator. Beyond thirty degrees the jets were almost exclusively turned toward the poles, and it is remarkable that the direction of these is opposed to that of the lower portions of the chromosphere.

Secchi's conclusions regarding the connection between solar spots and protuberances are especially remarkable. After recounting the results to which he was led some years ago in regard to the regions rich in spots and protuberances, and in regard to the heavy metallic and the lighter gaseous jets, he proceeds to state that the metallic jets are those that are connected with the solar spots, and so intimate is this connection that whenever he detected the top of one as it came into sight above the eastern limb of the sun, he has been able to safely predict the approaching solar spot at its base. The gaseous or hydrogen jets are not capable of producing spots.

So familiar has Secchi become with the appearance of these phenomena that he is able, without the spectroscope, and by a simple examination of the physical appearance of the jets, to determine their nature. He finds in the recent observations of Professor Young a complete confirmation of his own view that the spectrum of the metallic protuberances is the spectrum of the interior of the solar spots, the lines being in the one case seen direct and bright, and in the other reversed and dark. On this principle Secchi founds his theory of the constitution and explanation of the phenomena of the solar spots, which are, in brief, according to him, but clouds of cooler metallic vapor pushed up through and floating above the solar photosphere. A more detailed explanation of his views is promised shortly.—6 *B*, 1873, 251.

NOVEL RELATIONS AMONG THE PLANETS.

At the recent meeting of the National Academy of Science, at Washington, a most eloquent and elaborate essay was read by Professor Stephen Alexander, the astronomer, of Princeton, New Jersey. Some twenty years ago Professor Alexander communicated to the scientific world an original classification of the nebulæ, in which, among other things, but by a different process of reasoning, he anticipated the recent conclusion of Proctor that our Milky Way is a spiral nebula. Since then Professor Alexander has been busily engaged on the plans and the erection of the magnificent observatory at Princeton, which the college owes to the munificence and scientific interest of General Halsted. Notwithstanding the heavy duties imposed upon him as a teacher, Professor Alexander, who is now the oldest of living American astronomers, has found time to engage in the laborious numerical computations incident to one of the most difficult problems that offer themselves to the consideration of astronomers, while at the same time it is by far the grandest. This is nothing less than the discovery of those laws which governed the original formation of the universe, and especially of our planetary system. To this investigation Kepler gave many years of patient toil, and though he honestly threw away as too artificial the many curious laws that he at one time thought he had discovered, yet there remained the so-called "Three Laws of Kepler" to challenge a Newton to find out their hidden meaning, and to reveal to him the truth of the law of gravitation. Next Bode found the famous relation between the radii of the planetary orbits, which contributed so much to the discovery of the planet Neptune, and of the group of asteroids between Mars and Jupiter. Since Bode's day, Kirkwood and Chase have worked with some success upon the planetary harmonics; but, outstripping both in the exactness of his results, comes the veteran Alexander. It would be impossible here to give even a small portion of the innumerable remarkable coincidences and verifications that have been revealed to the professor—we say "revealed" advisedly, although it is evident that he has pursued a strictly logical, and in many cases a purely inductive, method—in the discovery of the wonderful ratios that he has shown to exist not only between the planetary motions, but also between those of the satellites.

Among the twenty-five classes of facts supporting his theories, perhaps the explanation of the tilting of the planes of the orbits of Uranus's satellites, and of the axis of revolution of Venus, may be considered most surprising. If we consider these new ratios and novel relations to be the direct results of the physical forces that were active in the original formation of the planetary system, then certainly the elaborate work of Alexander, in so far as it brings these ratios to our attention, must be considered as the most valuable step that has yet been made toward the discovery of the underlying physical laws. We can indeed most fully sympathize with the eloquence with which he said: "I have not troubled you with the repetition of many, and perhaps foolish, things that the discoverer of these laws did and said, but when he saw this result" (alluding to the relations between Mercury and Venus) "there was a raising of the eyes to heaven and a clasping of the hands together, while the lips uttered, 'Glory!'"

NEW ASTEROIDS.

Professor Peters, director of the Litchfield Observatory of Hamilton College, Clinton, New York, discovered on the night of February 17 a new asteroid, which is the one hundred and thirtieth of this group of bodies, and we believe the twentieth that has been discovered by Professor Peters. It will be remembered that, in order to at once follow up the discovery of a new member of this group of minute planets by numerous precise observations, an arrangement has been made with the telegraph companies by which the news is at once telegraphed to Europe. The present is the second occasion that the Smithsonian Institution has had for thus making use of the Atlantic cable.—4 *D*, *March*, 1873.

THE MASS OF JUPITER.

This important element of astronomical calculations has been quite recently determined by Professor Kruger, the director of the observatory at Helsingfors. Kruger has sought to make a new and independent determination of the mass of this planet by investigating the effects of its attractions upon the movements of the asteroid Themis. The result is singularly in accordance with those that have been hitherto accepted, and is based on all the observations made during the seventeen years 1853–1870, and gives the mass of Jupiter as $\frac{1}{1047.538 \pm 0.192}$. The result recently obtained by Möller from his study of the movements of Faye's comet was 1047.788 ± 0.186. The most generally used by astronomers was long since determined by Bessel from observations of Jupiter's satellites, and is 1047.879 ± 0.159.—1 *B*, *March* 2, 1873.

CHANGES ON JUPITER'S SURFACE.

Tacchini reports that, during January, 1873, he has observed quite remarkable changes in the appearance of the belts of Jupiter. The belts were no longer parallel to his equator as usual; but from the equator southward were seen numerous brilliant white spots, and also many black spots surrounded by white. These, and other appearances, are evidently due to some peculiar alterations in the planet, and Tacchini calls upon all having good telescopes to give special attention to this planet.

MOONS OF URANUS.

Observations of the planet Uranus, at the Bothkamp Observatory, in the spring of 1871, revealed occasionally, under favorable conditions, small stars near it, two of which certainly, and two others probably, were satellites. Their periods of revolution were fixed, by calculations of Vogel, at 13.462, 8.705, 4.15, and 2.54 days respectively.—19 *C*, *November* 23, 1872, 383.

WHITE APPEARANCES IN THE MOON.

A writer in *Nature* suggests that the white telescopic appearance in many parts of the moon's surface, resembling snow, may be really a coating of salt on extinct volcanoes of that satellite. The dazzling, snow-white effect of the mountains is commented upon; and it is thought that a clew to the phenomenon is furnished by the late eruptions of Mount Vesuvius. In this instance a crust of crystals of salt was formed over the entire surface of the lava on cooling.—12 *A*, *January* 16, 1876, 221.

PAPERS ON THE TRANSIT OF VENUS.

Part II. of papers relating to the transit of Venus in 1874 has been published by the Navy Department, and is occupied principally by a series of charts and tables prepared by Mr. George W. Hill for facilitating the predictions of the several phases of the transit. It is accompanied by four charts representing the exterior and interior contact of both ingress and egress, full directions being given for using them.

THE ORIGIN OF METEORS AND COMETS.

Proctor has recently advanced an idea as to the origin of comets and meteors that may seem to be but the revival of an old opinion, and one supposed to have been exploded. The researches of Schiaparelli and Newton and others, in that they showed the meteors to be regular members of the solar system, seem to have temporarily satisfied the inquiry as to the remote origin of these bodies. The former astronomer assumes them to exist generally throughout the interstellar spaces, and to be successively drawn to one and then to another sun, while Proctor reasons that these bodies are now found to travel in groups or streams, that it is difficult to conceive how our sun could draw a connected stream of meteors to itself at any given epoch, and that if these bodies were ejected from the self-luminous stars, we may with equal plausibility suppose similar bodies to have been ejected from the planets of our own system when they were in a molten condition. He accordingly shows the very moderate degree of force required to eject a meteor from the surfaces of the outer planets, and examines the orbits of such periodical comets and meteors as are at present known. In accordance with the suggestion of A. S. Herschel, he deduces the interesting conclusion that the comets expelled from Jupiter would mostly have a direct motion, or one in the same direction as his own, while those ejected from Neptune would be as likely to have a retrograde as a direct motion. Proctor concludes that many comets have sprung from Jupiter and Neptune, and at least one from Uranus—the latter being the well-known November meteor stream, or the Leonides, which Hind has shown to be connected with Tempel's comet.—5 *A, January*, 1873.

METEORIC SHOWER OF NOVEMBER 27, 1872.

The scientific journals of Europe contain copious accounts of the great meteoric shower on the evening of November 27, only the end of which was seen in this country. Professor Bruhns writes that at the Leipsic Observatory seven hundred meteors fell, in the south and southeast, in the course of thirty-five minutes. Between eight and nine o'clock an observer, looking north, counted at the rate of twenty per minute. About one out of six was as bright as a star of the first magnitude, and most of the remainder were between the second and third, only about one third of the whole being fainter than the third magnitude. The brighter ones were generally yellow, though sometimes green.

The accounts from France and from all parts of Germany are of the same general nature; but it seems that in Italy—owing, perhaps, to the clearer sky—the phenomenon appeared to better advantage. At the Observatory of Moncalieri thirty-three thousand meteors were counted in six hours, showing the shower to have been one of the most remarkable of recent times.

BIELA'S COMET IN ITS NEWEST ASPECT.

On the evening of the 27th of November, 1872, Europeans were favored with a shower of falling stars, which has now become one of the most interesting of all on record. From the great shower of 1833 dates the revival of a more intelligent interest in the subject of shooting-stars, until at last the studies of Newton of New Haven, Weiss of Vienna, and Schiaparelli of Milan have led to quite an exact knowledge of the nature of these bodies. When finally there could no longer be any doubt that some, if not all, of these meteors were related in a peculiar and intimate manner to the comets, it became possible, in 1868, for Professor Weiss to state the probable connection between Biela's comet and the meteors that had been often observed about the first of December, and to predict that we should probably experience a star-shower in 1872 on passing near to that comet. The shower came as predicted—it was well seen in the early evening twilight at stations in our Atlantic States, and was very brilliant in Europe.

This preliminary verification of the views of Professor Weiss was, however, not the most interesting circumstance. No sooner had Klinkerfues, of Göttingen, determined the apparent radiant point of the meteors, than he computed their orbit about the sun, and finding that they really moved in a path nearly coincident with that of Biela's comet, he proceeded to reason upon their probable future course. He states that he concluded that if the observed meteors radiated from the point observed by him, they must be moving toward the opposite point of the sky, which was near the star Theta Centauri, in the southern heavens, and that, if looked for soon enough, they might possibly be seen as a faint cloud in that region. The idea was sufficiently bold, yet so interesting and novel that Professor Klinkerfues felt himself warranted in sending to the director of the observatory at Madras the following remarkable telegram: "Göttingen, November 30. Biela touched Earth on the 27th. Search near Theta Centauri."

With a faith equal to that of Galle, when he searched for and found the planet Neptune predicted by Le Verrier, Pogson now turned his telescope upon the spot indicated, and, the third time of searching, at last beheld the comet as a very faint, diffuse spot of light. The observations of position made by Pogson, and now received by mail, have been subjected to a careful study by Oppolzer, of Vienna, and he concludes that there is every reason to believe this to be one of the two portions of Biela's comet, both of which have been lost to telescopic sight for twenty years. The other portion will very probably continue to elude the powers of theoretical astronomy to trace its path and discover its whereabouts, yet it is by no means improbable that it may be discovered by some of the many busy comet-hunters.

It will be seen that the history of Biela's comet may be thus epitomized. It pursued an elliptic orbit, in obedience to the law of gravitation, until 1845, when it was by some unknown force divided into two portions. These were seen in 1853, by which time they had separated several millions of miles from each other. For twenty years they have not been again seen. Meantime the study of the shooting-stars taught us that the latter were often fragments or the minute components of comets.

The observations of the star-shower of 1872 (November 27) show that the earth then passed through a portion of a comet, which must have been formerly a part of Biela's comet; and finally, the same observations enabled the astronomer to predict and to discover the lost comet.

The conclusion of the whole matter may be accepted by astronomers in the expression—comets become star-showers when the earth passes through them, and showers of shooting-stars are comets. It is not yet known that mankind received any harm from the events of November 27, 1872!

ANOTHER COMETARY STAR SHOWER.

Mr. Hind, superintendent of the *British Nautical Almanac*, appears to have added another to the known cases of the coincidence of showers of shooting-stars with the passage of the earth near or through a comet. It will be remembered that the meteors of the 12th of November had already been supposed, with good reason, to be a portion of the first comet of 1866, or Tempel's comet, which had at some previous time become separated therefrom. Now, however, Mr. Hind has, with the assistance of Mr. Williams, the secretary of the Royal Astronomical Society, and an accomplished Chinese scholar, succeeded in tracing the orbit of a comet observed in China in 1366, and in showing its probable connection with a great shower of meteors also observed in that country in October of the same year. The same comet was also observed in 868 both in Europe and China.

The systematic re-appearance of the November meteors at intervals of about 33.3 years was first demonstrated by Professor Newton, of Yale College, who also thus gave the first clew to their real nature. Mr. Hind's research is valuable in adding not only another ancient date, as preserved in the chronicles of China, but especially in having ascertained the date at which Tempel's comet was seen both as a comet and as a star shower, very much as has recently happened to Biela's comet.—*Monthly Notices Royal Astron. Soc.*

NEW THEORY OF THE AURORA.

Professor Foster, of Bern, Switzerland, has lately developed the new theory of the origin of the aurora as it had been propounded in London by Professor Glaisher in 1869.

According to this theory, the aurora is the result of a secondary or induced current of electricity, produced by sudden changes in the earth's magnetic condition. The cause of the latter changes is not yet understood; that they exist, however, is abundantly proved by the automatic records of the observatory at Greenwich. Glaisher's theory assumes these changes in the earth's condition as the cause of the atmospheric currents, and of the magnetic disturbances.

The theory of De La Rive, which for years has been considered the most plausible, on the contrary, considers the atmospheric currents as the primary cause, and the terrestrial phenomena as the result.—*Mittheil. naturforsch. Gesellschaft, Berne,* 1871, 745.

GROUND CURRENTS AND THE AURORA OF 1872.

The journal of the London Society of Telegraph Engineers contains a very interesting summary of the phenomena of "ground currents," as observed in connection with the aurora of 1872, February 4. Not only was this aurora one of the most remarkable of recent years, because of the wide extent of its visibility, but it seems to have been attended with electrical disturbances that are, as yet, unparalleled in the annals of science for their intensity, if not for their duration and geographical extent. The above-mentioned journal gives a fac-simile of the automatic photographic records kept at the Royal Observatory, Greenwich, during the day of the aurora, and from this the exact nature of the electrical disturbance may be deduced. It appears that all the telegraph lines of the world were more or less affected on the day in question, and that all those running east and west, or nearly so, and especially the ocean cables, were rendered temporarily useless for business purposes from the disturbance caused by these extraneous currents of electricity, which are supposed to enter the line *via* the earth plate, or ground connection at each end of the line, and which either overpower or partially mask the effects produced by the current let on from a galvanic battery by the operator in the ordinary course of sending dispatches. The origin of the currents thus flowing through the telegraph wires or cables from one continent to the other is, so far, quite unknown, and though several hypotheses seem plausible, yet there are still wanting those accurate observations on which to base a correct explanation. The Greenwich records show the current to have produced effects similar to those resulting by a zinc current flowing from the east or northeast to the west or southwest.

The observations on the Red Sea cable showed the strongest current to have equaled that produced by one hundred and seventy Daniell's cells. On the Persian Gulf cable and the Atlantic cable the ground currents were equal to eighty Minotti cells. It would possibly be to the advantage of all concerned in telegraphy if systematic study, on an extended scale, of these earth currents could be instituted. The thorough understanding of the subject would doubtless lead to the invention of some method of ameliorating the disturbing effects of these currents on the business of the various companies.

REORGANIZATION OF FRENCH OBSERVATORIES.

A decree of February 17, 1873, on the part of the French government, reorganizes the Paris Observatory, and places it upon a basis of extended usefulness. This establishment is one of the most important of its class in the world, and has always gathered to itself a large share of the attention of astronomers. For many years it was directed by Professor Le Verrier, who, however, was accused of administering it in an arbitrary and harsh manner, and to the injury of the reputation of himself and his subordinates, and he was accordingly displaced some years ago, and Professor Delauney established in his stead. The new incumbent did not enjoy his honors very long, as he was drowned in the summer of 1872, by the upsetting of a boat, on the coast of France.

No formal appointment of a director was made immediately after the death of Delauney, occasion being taken by the government to refer the whole subject to a commission, whose report is made the basis of the decree referred to. This provides that the astronomical personnel shall be dependent upon the Minister of Public Instruction, and shall consist of titular astronomers, adjunct astronomers, and assistant astronomers, these to be distributed among the different observatories, with especial reference to their fitness for their several positions.

The Observatory of Paris is to have an astronomical director, six titular astronomers, ten adjunct astronomers, and a certain number of assistant astronomers, together with a secretary and a financial agent. The general operations of the observatory, however, are to be controlled by a scientific council, consisting of the director, certain chief astronomers, and six counselors of the observatory chosen among the savants eminent for their labors in mathematical, astronomical, and physical science, and four of them, at least, to belong to the Academy of Sciences or to the Bureau of Longitudes. Each year one of these goes out of office, but may be rechosen by the minister. The higher officers of the observatory are to be appointed by the President of the republic, on the nomination of the minister and with the advice of the General Assembly; the lower grades are appointed by the minister, on the nomination of the director.

The annual salaries of the titular astronomers vary from six to eight thousand francs, those of the adjunct astronomers from thirty-five hundred to six thousand, and of the assistants from one thousand to thirty-five hundred. The personnel of the Observatory of Paris is named in the decree of the same date, Professor LeVerrier being again placed at the head. His functions, however, as far as concerns the control of the force, are limited, and largely dependent upon the consent of the council of the observatory. M. Stephan is named as director at Marseilles, and M. Marié-Davy director of the Meteorological Observatory at Montsouris.—3 *B, February* 20, 1873, 297.

THE CINCINNATI OBSERVATORY.

The Cincinnati Observatory, founded by Professor O. M. Mitchell, is, we learn, to be removed, and established in a manner worthy the wealth of Cincinnati. From the drawings that we have been permitted to see, it may be judged that the dome of the new building will be thirty-five feet in diameter in the inside, or the largest in the world. Of course such a structure will be too expensive to be made a plaything; and, if the telescope be proportionately large, Cincinnati may yet rival Washington in its superiority.

We understand from Professor Abbe, of the Weather Bureau of the Army Signal-office, who, it will be remembered, continued until lately to be the director of the observatory at Cincinnati, that in 1871 the Astronomical Society, in conjunction with the heirs of Nicholas Longworth, presented to that city the former valuable site on Mount Adams, as well as the instruments and library of the original observatory, on condition that the city agree to maintain the institution for scientific purposes, and in some new and appropriate location. The new site was highly approved of by Professor Abbe, and was donated by John Kilgour, Esq., who also added thereto the sum of ten thousand dollars to provide for the new building, this being an element in the improvement of a large area of land that he has laid out as a beautiful suburban park. The observatory is now under the control of the Board of Trustees of the University of Cincinnati, a body of about twenty men, who are authorized to mould into a homogeneous institution the numerous bequests that the city has received at various times for educational purposes.

COLUMBIA COLLEGE OBSERVATORY.

From a recent communication in *Cap and Gown*, we learn that there has been erected a small observatory on the Columbia College campus for educational and, we hope, also for scientific purposes. The observatory is furnished with an equatorial, accompanied by a seven-prism spectroscope, by Clark, and a position micrometer, besides an altazimuth and a zenith telescope.

REGULATION OF TIME BY OBSERVATORIES.

During the past few years inconveniences arising from the constant changes of local time, and the conflicting errors of local clocks on connecting railroads, have been felt with increasing frequency by the traveling public, and still more by the roads themselves.

The aid of astronomical science has been lately invoked by some of the leading railroads, and several observatories have been requested to furnish exact time by the telegraph; but to how very great an extent abstract science has been thus already utilized few even of those who benefit by it are perhaps aware.

From an article by Professor Langley, in the November number of *Silliman's Journal*, describing the system introduced at the Alleghany (Pittsburgh) Observatory, we learn that the exact time is thence daily distributed by electricity over some thousand miles of main and branch roads by a purely automatic process. For technical details the article cited may be referred to; and we briefly state that continuous lines of telegraph, which extend from New York on the east, and Chicago on the west, are carried into the observatory at Pittsburgh, where the wires terminate in its principal mean-time standard clock, which is made to send an electric impulse through them with every swing of its pendulum. An audible sound is thus made simultaneously at every station on the Southern lines connecting New York with the West, and a clock regulated with astronomical exactness is thus virtually to be *heard ticking* in New York and Chicago, and at hundreds of intermediate points, at the same instant. The means employed are here alluded to, however, less in connection with the abstract interest of the method itself than to that of the practical and economical results which are secured by such uniformity and exactness, hitherto generally unattained. Among the competing lines for the immense amount of railway freight which passes between the East and West, those which can be run with a regularity most like clock-work will be the favored ones; but this essential benefit, growing out of such a system of time distribution, is still second to its utility as a security against accident, and for the preservation of human life.

The special apparatus of the observatory devoted to these ends is the gift of W. Shaw, Esq., of Pittsburgh; but a recognition is due to the intelligent policy which has led the managers of these roads to avail themselves of scientific help so extensively in promoting both the safety of passengers and the rapidity and economy of transportation.

NEW OBSERVATORY AT TASHKEND.

An astronomical and meteorological observatory is about to be erected by the Russian government at Tashkend, in Central Asia, about 100 miles northwest of Khokan.—12 *A, November* 25, 1872, 71.

NEW TABLES OF URANUS.

Professor Newcomb's *New Tables of the Motions of Uranus*, which were prepared at the expense of the Smithsonian

Institution, have lately been published by it. The first recorded observation of Uranus was made by Flamstead in 1690, who, however, considered the star as fixed. It was Sir William Herschel who, by the power of his telescopes, first saw its planetary disk, and by its movements proved it to be really a member of the solar system. The observed movements of Uranus, however, differed to so great a degree from those predicted by the theory of gravitation, that a certain mystery hung about it until Le Verrier in France and Adams in England showed that the planet was subject to the attraction of a more distant planetary body, whose position these geometers predicted with sufficient accuracy to allow of the actual discovery of the new planet, Neptune. Professor Newcomb has already, by using all known observations of Neptune, compiled the very accurate tables for computing the motions of that planet that have been used in the *American Nautical Almanac*. Having thus provided for the most distant member of our system, he has now returned to Uranus, and finds that his present tables (which will complete the survey of the solar system) represent quite completely the hitherto inexplicable movements of that body. There remains, therefore, but slight prospect that there exists a still more distant undiscovered planet of any considerable mass.

TELEGRAPHIC LONGITUDES IN SOUTH AMERICA.

The use of electricity in determining geographical longitudes keeps rapid pace with the continual extension of telegraph lines and cables over the world. We lately chronicled the third determination of the difference of longitude between Washington and Greenwich, which datum, so highly important to astronomy, may now be considered as known to within the twentieth part of a second of time. The union of London with Teheran, Persia, and through it with Madras, India, was completed in the latter part of 1871, and a telegraphic circuit of 3870 miles of wire was used in the longitude determination. The longitude of San Francisco from Washington has been determined over a circuit of 3000 miles by the astronomers of the Coast Survey. The net-work thus gradually girdling the northern hemisphere now begins to be supplemented by the detached portions of what may at some distant day become the connected links of a similar series of longitudes in the southern hemisphere. In Southern Africa and in Australia the telegraph lines already offer facilities for most extensive geographical operations; but we believe the principle work that has as yet been done in the southern hemisphere has been recently effected by Dr. Gould, the director of the National Observatory at Cordoba. During the past year he has made such determinations between his own central observatory and the cities of Buenos Ayres and Rosario to the eastward. As the result of this work, he announces an error of one minute of time in the relative longitude of these places as given on the best maps. Preparations have also been made for longitude work between Cordoba and Santiago de Chili, but the accounts of the results of this work have not yet been received.

NEW LIVERPOOL OBSERVATORY.

One of the most important services that astronomy has rendered to mankind consists in the contributions it has made to the progress of navigation, and the increased security of life and property. In this field England has always taken the lead, and the efforts of Mr. Hartnup at Liverpool are a worthy continuation of the labors of Flamstead, Bradley, and Airy. While the Greenwich Observatory has caused a great improvement in the general standard of the chronometers bought for the use of the government vessels, Mr. Hartnup has sought to effect a similar reform for the mercantile marine. He has insisted on the vital importance to ship-masters, as well as to owners and insurance companies, of the careful determination of the rates of their chronometers as affected by temperature. The makers of these instruments, and the astronomers who use them carefully, have always known that which captains of vessels have been very slow to profit by — *i. e.*, that the chronometers are, when made, so adjusted that they keep perfect time at two temperatures, such as 55° and 85° Fahr., while between these limits they gain, and beyond them they lose, on the true time. It is rare that this variation in the chronometer rate can be safely overlooked by a careful navigator, though it is frequently done by those whose vessels do not carry a precious burden of one or two thousand souls. The only excuse for this neglect is the positive assurance of the maker that the chronometer is perfectly reliable—an assurance that is often fortified by very deceitful figures. The difficulty and expense of a searching investigation into the errors to which every chronometer is liable have long been supposed by the trade to stand in the way of the introduction of such chronometers only as were of approved reliability. In order to obviate the difficulty as far as possible, the Liverpool Observatory has been constructed by Mr. Hartnup specially for the purpose of studying the rates of the chronometers that may be sent thither by captains sailing from that port. The expense of the examination given to such chronometers is comparatively trifling; and the number of chronometers submitted to him has annually increased, until, by reason of the recent regulations at that port, the number of examinations has amounted to between one and two thousand annually, the same instruments having been repeatedly submitted to him. The process pursued by Mr. Hartnup consists in exposing each chronometer for a week to a uniform temperature of 55°, and determining its rate each day; it is then for another week exposed to a temperature of 70°, and then to one of 85°; the next week it is returned to the temperature of 70°, and the last or fifth week it is exposed to the temperature of 55°, as at first. By means of general laws regulating the rates of chronometers, it is now possible to determine what the rate will be at other temperatures than the three above mentioned, and, knowing these, the navigator is able to apply the proper correction to his time-keeper so exactly that he need never mistake his position upon the ocean.

The records of the Liverpool Observatory for the past year show—1. That the rates of about ten per cent. of chronometers tested (those of the mercantile marine very generally have the ordinary compensation balance) are so irregular as to render the instruments entirely unfit for nautical purposes. 2. The error of adjustment for temperature of the remaining ninety per cent. is often so erroneous as to produce *a change of daily rate of many seconds*, when the temperature varies but little from either of the two standard points of 55° and 85°, or thereabouts. 3. That the best-made and most carefully adjusted instruments gain, on the average, daily six tenths of a second more at a temperature of 70° than at 55° or 85°. 4. That those that have the same rate at 55° and

70°, or at 70° and 85°, lose when exposed to temperatures beyond these limits at the rate of 1.5 seconds daily for a change of fifteen degrees in temperature. 5. That when the connection between temperature and daily rate has been well determined, it will remain constant in good instruments for a long time, which need in general to be examined only once in one, two, or three years.

The vital importance of this subject to the interest of safe, speedy navigation, will be impressed upon every one by the disaster that befell the *Atlantic*, consequent upon being some twenty miles (or ninety seconds of time) out in her reckoning.

REPORT OF THE ALLEGHANY OBSERVATORY.

Professor Langley, as director of the Alleghany University, at Pittsburgh, in his report recently published refers with satisfaction to the recovery of the fine object-glass of the telescope of the university, which was stolen on the 8th of July, 1872. When recovered it was somewhat scratched, and was placed in the hands of Messrs. A. Clark & Sons, who succeeded in restoring it nearly to its pristine condition. The observatory has been very active during the year, both in a utilitarian and a purely scientific point of view. One of its labors consisted in a connection with Austin, Texas, by a telegraphic circuit of about three thousand miles, for the purpose of determining, with the co-operation of the Cambridge Observatory, the longitude of that point, so that it might serve as a base for the future settlement of western longitudes.

The observatory has also been constantly employed in furnishing time signals to the lines of railroads that pass through Pittsburgh, these being sent at all hours of day and night to Harrisburg, Philadelphia, New York, and many other points in the East and West as far as Chicago. The entire movement of freight and passenger traffic over this great system of roads is now regulated by a single clock at the Alleghany Observatory, which may thus be considered as having its beats rendered audible at every railroad and telegraph office on the routes named.

In addition to this class of labor, extensive observations have been made with a zenith telescope, and remeasurements of the longitude sheets of 1869, while observations have been made with a meridian instrument nearly every fair night in the year with the aid of the chronograph.

Professor Langley expects his establishment to be more and more confined in the future to the duties of a physical observatory, and occupied less with the cataloguing of the stars than with the study of the physical constitution of the heavenly bodies, especially that of the sun.

ORBIT OF JUPITER.

Le Verrier announces that having considered, in Chapter XVIII. of his *Astronomical Researches*, the inequalities of Jupiter and Saturn in so far as they mutually depend on each other, and in Chapter XIX. the secular variations of the elements of the orbits of Jupiter, Saturn, Uranus, and Neptune, he now presents to the Academy of Sciences at Paris the complete theory of the motion of Jupiter, constituting Chapter XX. of his *Researches*.—6 *B*, 1873, 678.

NEWCOMB'S CATALOGUE OF FUNDAMENTAL STARS.

The United States Naval Observatory has published, as an appendix to the volume of Washington observations for 1870, a recent research by Professor Newcomb, resulting in a catalogue of the positions of thirty-two fundamental stars. This work is specially interesting as giving the first published results arrived at by Auwers, of Berlin, in his new reduction of the invaluable observations made by Bradley, at Greenwich, in the middle of the last century. The right ascensions adopted by Newcomb depend especially on the meridian observations made at Greenwich, Palermo, Königsberg, Dorpat, Abo, Poulkova, and Washington, in which selection is recognized a wise discrimination in favor of using only the work of the acknowledged standard meridian instruments. The object of the investigation of Professor Newcomb has been especially to obtain results as free as possible from any periodic or systematic error, and he has handled his material in an original manner. Having newer and, in some respects, far better data than that used by Dr. Gould in compiling his standard right ascensions, Professor Newcomb's results will probably be accepted as of the highest value. The memoir concludes with full tables of the mean places of the stars for each fifth year from 1750 to 1900.

ABSORPTION OF THE SOLAR ATMOSPHERE.

Dr. H. C. Vogel, the director of the private observatory of Herr von Bülow, at Bothkamp, has made a first attempt to accurately determine the relative chemical intensity of the solar rays from different points of the sun's disk. His results, though only preliminary, show that the sun's atmosphere absorbs the chemical rays more rapidly than the visual rays, or, more accurately, that the relative action on silver chloride of the rays that reach us from the sun's limb, as compared with that of those that come from the centre of his disk, is less than their relative action on the optic nerve. The rays from the sun's limb have a photographic intensity of only fourteen per cent. of those from the centre. The intensity diminishes as we proceed toward the limb very nearly as the sine of the distance from the centre. Vogel especially suggests the importance of determining for the solar atmosphere its transparency to special spectral lines, as by applying the above method of study we may be able to arrive at a direct determination of the solar atmospheric absorption precisely as is done for the earth's atmosphere.—*Sachsc. Gesellschaft*, 1872.

MEASUREMENT OF AN ARC OF THE MERIDIAN.

In *Ocean Highways* we find a notice of the great work undertaken in the way of measuring a segment of the meridian in the centre of Europe, and of obtaining by these measurements a European meter, with the co-operation of all the states. A congress was lately held at Vienna with special reference to this object, at which all the European states were represented, with the exception of England and France. Adopting for the European measure of length the meter which Vice-Admiral Mathieu and his commission had already fixed, it was decided to begin the measurement of a central European segment of a meridian having its northern end at Christiania and its southern end at Palermo. Six French commissioners are to assist in the work of the congress, two of them chosen by the War Department, two by the Paris Observatory, and two by the Academy of Sciences.

A correspondent of the same journal strongly urges upon the English government to unite with all the other European governments in this geodesic congress, especially in view of the fact that the geodesy of England needs to be united with that of Europe across the Channel.—6 *A*, *July*, 1873, 176.

LOGARITHMIC TABLES.

Mr. Glaisher has contributed a number of interesting articles on the history of the published tables of the logarithms, from which we make a few extracts.

The system of logarithms now most commonly used was invented by Briggs, and differs somewhat from those proposed by Napier, the original inventor of this ingenious device. Briggs published a small table of logarithms in 1617, and a larger one in 1624, in which latter are given, to ten places of decimals, the logarithms of all numbers from one to ten thousand, and from seventy thousand to one hundred thousand. In 1628, Vlacq published in Holland a similar ten-place logarithmic table of all numbers from one to one hundred thousand, in which the portion from ten thousand to seventy thousand is given as computed by himself, the remaining portion being taken from Briggs' table. These great works of Briggs and Vlacq have now for two hundred and fifty years been of daily use among mathematicians, astronomers, navigators, surveyors, and all others who have occasion to use logarithmic tables; for it appears from Mr. Glaisher's very careful bibliography that of all the innumerable smaller logarithmic tables that have been published, not a single one has been computed anew, all being merely abbreviations of the great works of Briggs and Vlacq.

One of the most curious facts brought out in the course of Mr. Glaisher's studies is the slow successive approach to absolute accuracy. Taking the seven-figure logarithmic tables, for instance, we find that in Vlacq one hundred and twenty-three errors occur, affecting the first seven out of the ten places of decimals given by him. Taylor's seven-figure tables, published in 1792, contain six errors; in 1794, the first edition of Vega had twenty-three errors; the second edition, in 1797, had five errors; the tables of Babbage, in 1827, one; Hasler, in 1830, two; Callet, in 1855, two; Bremiker, in 1857, none; Schoon, in 1860, none; Callet, in 1862, none.

Mr. Glaisher, with much force, urges the propriety of the publication by some permanent society, or some other high authority in science, of a new edition of the ten-figure logarithmic tables of Vlacq. He maintains that the business interests of trade have to some extent caused this interval of two hundred and fifty years to elapse between the original imperfect and the present perfect set of tables, and that perfection in these matters can only be attained by the action of a permanent scientific or national authority, which shall conscientiously publish, from time to time, such errors as may be discovered in the new tables.—*Monthly Notices Roy. Ast. Soc.*, 1873.

IMPORTANT ASTRONOMICAL DISCOVERY.

A discovery, which, if confirmed, is one of the most important of the year, is announced from the Poulkova Observatory. It is that of a minute companion to the bright star Procyon. It derives its importance from being supposed to be the body whose attraction has caused certain irregularities in the motion of Procyon which have been known to exist for several years. This discovery is so near a counterpart to a similar one made in the case of Sirius, that it may not be uninteresting to narrate some circumstances connected with and growing out of the latter.

It has been known for about forty years that the well-known star Sirius, the brightest in the heavens, was subject to an oscillating motion which could be accounted for by supposing a satellite moving around it. The orbit of the satellite was calculated by Peters and Auwers, though no one had ever seen it. But when Alvan Clark & Sons, of Cambridge, completed their great object-glass of eighteen inches' diameter in 1862, they turned it on Sirius, and saw a satellite, which, as it afterward proved, was in the direction of that suspected. Its motion has since corresponded so nearly with that of the calculated body as to leave no serious doubt of their identity. For this discovery, as well as for making the telescope, Alvan Clark received the La Lande medal from the French Academy of Sciences in the year following.

It was afterward found, by the very profound and minute investigations of Dr. Auwers, that the movements of Procyon could be accounted for by the attraction of a satellite revolving round it in forty years. There could be no doubt of the actual existence of the satellite; but whether any telescope would ever show it could not be settled except by trial. When, in 1870, Professor Newcomb negotiated the contract for the great Washington telescope with Messrs. Clark, he advised them that their first duty with the new object-glass would be to discover this satellite. But while the object-glass was being finished last summer and autumn, the star was not in a position in which the trial tube could be pointed at it during the night; and, after its position was improved, the Clarks were too busy in finishing the iron and brass work of the telescope, and too fearful of risking the glass by carrying it about, to point it at any thing.

Meanwhile it is likely that Struve had heard of the intention of the Washington astronomer to make the discovery of the satellite in question the first test of the new telescope when it should be mounted, and therefore determined to see if he could not anticipate the discovery with his own smaller glass. On the 29th of March last he was successful so far as to find a satellite in the direction of that predicted; and, we remark, direction alone, and not distance, can be predicted in such a case. It must now be determined whether it is moving around the bright star in the proper way—a question which the Washington telescope, if successfully mounted, will speedily settle.

THE ERUPTION OF VESUVIUS.

Palmieri, the famous investigator of the volcanic phenomena of Vesuvius, has just written to the Paris Academy of Sciences, through Monsieur St. Claire Deville, that since the publication of the work compiled by him on the phenomena of the recent eruption of Vesuvius, "I have made a great number of spectroscopic researches upon the vapors of the so-called fumaroles, or little vents, and I have found in most of them the presence of thallium; and I have also found in these vapors other products and substances quite rare at Vesuvius —among them boracic acid. Other substances that I have found are mentioned in a printed memoir, where is also given a confirmation of some of your observations, especially on carbonic acid gas. Since the last great eruption of 1872, Vesuvius has gradually attained a state of extraordinary repose. On the borders of the crater and its interior are some fumaroles still active, but for some months most of these have disappeared, and at present the vapor comes and goes abundantly only from the base of the crater, where the vertical depth is about seven hundred and fifty feet. The instruments of the observatory on Mount Vesuvius, the seismograph and the magnetic apparatus, after the violent agitation that they experienced in the month of April last, have little by little come to an absolute rest; but to-day (early in July, 1873) they commence to be feebly agitated in such a way that the phenomena seem after a period of degrees about to increase in intensity, but fire has not yet appeared in the interior of the crater."

In remarking on the above, St. Claire Deville adds that, conforming to the thought that seems to inspire the last phrase of the letter, he is disposed to admit that the approaching period of activity that will probably be experienced by the volcano will be that which he calls the "Strombolian," and which consists in small eruptions, which will proceed from the centre of the crater at the summit of the mountain. This will be a repetition of the phenomena of July, 1856, one year after the great eruption of 1855, and which he was able to predict in advance. Monsieur Elie de Beaumont observed that the labors of Deville have inaugurated a new manner of studying volcanic phenomena, and a new special method of observing them; they compare worthily with those that Boussingault has so happily executed in order to determine the volatile products of the great volcanoes of the Andes, being himself inspired by the first trials, made long ago by Sir Humphrey Davy. That vigilant observer of Vesuvius, Palmieri, has also entered this path of research, following Fouqué in his researches on Etna, Santorin, and the Caldeiras of the Azores, whose researches were lately published in the *Comptes Rendus*, in a memoir replete with interest. The employment of the spectroscope gives to the new school of Vulcanologists an instrument the power of which is equal to its delicacy, and which in the hands of Palmieri, has already furnished valuable results. The presence in the sublimations of the fumaroles of Vesuvius of the metal thallium, which was lately obtained by Lamy from certain pyritic formations of Belgium, and other countries of Europe, confirms in an unexpected manner the relations already indicated between the volcanic emanations and the metalliferous strata that have been introduced (injected?) into the crust of the earth. The presence of boric acid, now established among the products of Vesuvius, bears directly on the connection already suspected between the volcanoes of Central Italy and the hot springs of Tuscany, the products of which latter, concentrated in the lagoons, form one of the principal deposits of borax at present resorted to for that article.—6 *B*, 1873, 361.

ROTATION OF THE EARTH ON ITS AXIS.

It is well known that the astonishing accuracy attained by Struve in his observations with the prime vertical transit, and the remarkable agreement of the results obtained by him in his determination with it of the so-called constant of aberration, led him to hope for a similarly happy result in the application of the same astronomical instrument to the determination of the nutation. Struve contemplated the frequent observation of three well-selected stars during a space of nineteen years, in order to follow the nutation of the earth's axis through all its changes. His death, indeed, prevented the perfect accomplishment of this tedious work; but the observations that he did make run through a period of fifteen years, and have been supplemented by those of the other astronomers at the Imperial Observatory of Russia, so that the nutation has lately been deduced from these observations, with all desirable accuracy, by Dr. M. Nyren. "Without doubt," says Dr. Nyren, "we have here the most accurate series of observations of so great an extent that as yet exists." The probable error of a single determination of the zenith distance of a star amounts to but 0.1″. The accuracy of this long series of observations has led Nyren to not only develop anew the mathematical principles respecting the movements of the earth's axis in space, in which he introduces such slight refinements as have been suggested by the progress of science since the appearance of the classical works of Dr. C. A. F. Peters, but also to attempt a solution of a problem first proposed by Euler, who demonstrated that if the earth's axis of rotation does not correspond to the axis of greatest moment of inertia, then it will not be fixed in reference to the earth's solid body, but will describe a small circle about a line very nearly coinciding with the principal axis of inertia. By this movement, the latitudes of places are all subject to a slight periodic change. Peters had deduced from his observations with the Poulkova vertical circle the extent of this periodicity, and he concluded the radius of the circle described by the North Pole to be 0.079″, and the period of this revolution to be about ten months. Nyren finds the same period of about ten months, but for the radius of the circle 0.040″. He does not, however, consider it proper to dwell upon this small quantity as having a real existence, notwithstanding the remarkably small probable error attached to it; for he shows by the study of all the earlier observations of Struve, with the same instrument, that these give larger, and, indeed, too large values to the same quantity; and that, further, in the careful study of the individual discordances, we find certain indubitable evidences of the existence of constant sources of error, which, whether they consist in irregular refractions or in changes within the interior of the earth, must be further investigated before we can safely assume the certainty of a real periodic variation in the terrestrial latitudes. Nyren seems inclined to believe that the origin of these apparent periodic changes lies in the systematic influence of the sun's heat on the buildings, and that this was in great part removed by a screen erected by Struve on the second year after he began his observations. But, on comparing his own results with those of Peters, made with an entirely different instrument, he is forced to conclude that their agreement is such as to show that the real existence of a variation in the earth's axis is very possible, though he hesitates to say that it is certain or even possible. The caution with which Nyren announces his conclusion is certainly worthy of the scientist, and will doubtless lead others to make further examination of this interesting point. He, himself, and Mr. Wagner have, indeed, already begun such a series of observations with the same fine instrument with which Struve undertook to determine the annual parallax of certain stars. Nyren expresses himself as decidedly as the results of his study allow him to do, to the effect that the parallax can not be deduced from those observations, as all the stars give negative or imaginary values for it, and we can only conclude that the observations are affected by some unknown influence which goes through its period in nearly a year. The main result of Nyren's investigation, namely, for the constant of nutation, the value 9.2365″, is so nearly the same as that of Peters' published in 1842, that it is not likely that the value which is now in use will be discarded, for the present at least.

GREAT NEBULA IN ARGUS.

The interest in the study of nebulæ, which received so strong an impetus by the construction of the great reflectors of Herschel and others, continues to be fostered by the perpetual attention given to those bodies by the possessors of the giant refractors and reflectors of the present day. Perhaps no celestial object, except the sun, has been during the past few years examined with more interest than the great nebula surrounding *Eta Argus.* This nebula was first carefully examined by Sir John Herschel, in 1834 to 1839, when it was quite invisible to the naked eye, and his drawings and descriptions contain our first exact knowledge of this object, which can only be well seen from the extreme southern observatories. No special drawing seems to have been made by other astronomers until 1862, when Mr. Abbott, an amateur residing at Hobart-Town, Tasmania, made drawings, which he has since then frequently verified and repeated; and in 1865 he announced the fact that great changes had taken place and were in progress in this nebula. So unexpected and novel were the ideas thus promulgated that they found very few adherents, the more so as Mr. Abbott was little known, and his telescope was of but moderate power. Indeed, a very unpleasant and uncalled-for feeling arose, as if Mr. Abbott had questioned the accuracy of Herschel's elaborate drawings, which he in nowise did. In the midst of this discussion there arrived at Melbourne the magnificent four-foot reflector that had given such perfect satisfaction in England at its trial, and of whose powers so much was to be expected. The result of the examination of *Eta Argus* was in the highest degree disappointing, which may have been partly owing to a deterioration of the reflecting surface of the great mirror, and probably was also somewhat due to the peculiarities of the atmosphere of Melbourne and to the inexperience of the observers. Indeed, Mr. Abbott, who visited

Melbourne for the special purpose, states that he was much surprised himself on seeing *Eta Argus* in such a small field of view with so large an instrument, whence we infer that it had appeared very different when viewed through his own telescope. The drawings of Lieutenant A. S. Herschel, made at Bangalore in 1868, and the report of Le Sueur, the first observer in charge of the Melbourne telescope, in 1871, seemed to further complicate the question of the reality of a change in the nebula. But the present observer at Melbourne, Mr. M'George, the director, Mr. Ellery, and also the government astronomer of New South Wales, Mr. Russell, have each made drawings of the nebula, and these, with the drawings of Mr. Abbott, made in 1871, fully establish the existence of great changes, as follows: 1. The brightness of the nebula has increased so much that it has become visible to the naked eye. 2. The bright star *Eta Argus* is now thrown upon a darker background, instead of being in the brightest part of the nebula. 3. Numerous stars are now present which were not before visible. 4. The brightness of a number of stars, that were before much fainter than the principal star, has increased.

Mr. Abbott states that in the same field of view with *Eta Argus* there are now twenty-four stars of the sixth, seventh, and eighth magnitudes, and an immense number of fainter ones. The most recent communication by Mr. Abbott on this subject summarizes the results of his observations as follows: In the eye draft of the object *Eta Argus*, February, 1873, the principal stars appear to have retained their relative position as shown in the drawings of last year. The dark spaces are extending and becoming more undefined, gradually filling up with small stars, of which there are now fully half as many more as were shown in last year's drawing.

The whole field of the telescope when directed to *Eta Argus* is studded with stars, from the seventh to the tenth magnitude, too numerous to count. In all probability before long photography will be applied to this and other portions of the dense nebula.—*Monthly Not. Roy. Soc. of Tasmania.*

SCHROETER'S OBSERVATIONS OF MARS.

Terby, in some researches on the physical changes in the planets of the solar system, has come upon a mass of important unpublished observations by the famous Schroeter.

These have long remained in the possession of the family, but the Belgian Academy has now resolved to publish such of these works as have been presented to it, especially a memoir of one thousand pages of descriptive manuscript text, and two hundred and seventeen drawings of the planet Mars, as observed between 1785 and 1803. The value of this work to the present generation of astronomers is very highly estimated. Schroeter was unexcelled in the accuracy of his work, and he has here dealt with all those details of his subject that have for some years past been so attentively studied by those who possess good telescopes. His attention was particularly given to the spots on Mars, both those that served to determine its rotation, and also the bright spots at its poles. Schroeter thought that the black spots belong to the clouds of Mars, which have a less reflecting power than the solid portions of the planet.—*Bull. Acad. Belgique*, 1873, 352.

RECENT OBSERVATIONS ON THE PLANET MARS.

The last volume of the *Annals of the Observatory of Leyden* contains an investigation by Kaiser, the director of that institution (whose recent death we have had occasion to announce), upon the spots of the planet Mars, and the conclusions that may be drawn from their study. Besides his own observations, Kaiser had at his disposal some four hundred and twelve drawings published by previous astronomers since the year 1636. Concerning these latter, Kaiser says that he finds such great discordances between them that one can scarcely believe that they refer to the same body; but while these differences are partly due to the fact that only those portions of the planet which are directly opposite to the observer can be distinctly seen, he attributes them principally to inexperience on the part of the observers, and want of uniformity in their methods of drawing. Perhaps the greatest difference is noticed among the drawings made in 1862 by the most experienced observers furnished with the most powerful telescopes. Of his own drawings, Kaiser publishes twenty-one engravings; and, from very careful comparison with all the previous ones at his disposal, he concludes that the time of rotation of Mars about its axis (which is known to be about once in one day and thirty-seven minutes) can not be determined as accurately as some astronomers have supposed; and that a time must elapse before it will be possible to use the rotation of Mars as a standard by which to judge of the invariability of the motion of the earth—the problem which Sir William Herschel originally attempted to solve.

The white spots near the north and south poles of Mars, which are generally supposed to be accumulated snow, have been subjected to accurate measurements by Kaiser, who thinks that the discrepancies in the conclusions of various observers in different years in regard to them is to be found in the hypothesis that these white regions undergo considerable change of position on the surface of the planet.—*Ann. Leyden Obs.*, vol. iii.

AN INCENDIARY METEORITE.

Apprehensions have frequently been expressed concerning danger to property, and to life and limb, from the fall of a meteorite; but very few well-authenticated instances have hitherto been placed on record as to fires being caused by such bodies. We learn, however, from *Gaea*, that a few moments before the meteoric shower which was so prominent in Northern Germany in May last, two fishermen were passing up the River Trave, who saw a meteor fall and strike against a church tower, and rebound upon an adjacent house. This was accompanied by a loud report which roused the town; and in a few moments afterward fire was observed on the roof of the house, which spread, and destroyed several buildings before it was extinguished.—7 *C*, 1873, VI., 356.

A NEW COMET.

Through the Smithsonian system of international scientific telegrams we have received notice of the discovery of a new comet on the 19th of August by Borelli, the astronomer of the Observatory at Marseilles, France. Several errors seem to have been made in the communication as originally published, which for a few days delayed the astronomers of this country in finding and observing the comet as promptly as was desirable; and it was announced to be impossible to discover any comet in the neighborhood of the position indicated by the figures given in the dispatch of August 19. On the other hand, Professor Hall, at Washington, who makes it his duty to promptly follow up every newly discovered member of our solar system, informs us that a dispatch from Paris dated August 24 has been received, communicating the position of a comet just discovered by the Messrs. Henry, of Paris. This comet was immediately found and accurately observed by Hall; and it is suspected that there was some error in the original communication of Borelli. According to the system now generally adopted by astronomers, a comet is known by the year and the order of discovery. We have, then, the following comet record for 1873. The *first* comet of 1873 is the periodic comet of 1867, the so-called Tempel's comet, and was first seen on its present return by Stephan, of Marseilles, on the 3d of April. The *second* comet of 1873 was discovered on the 3d of July by Tempel, at Milan, whither he had recently been driven by the proscription of the German citizens in France. This discovery was very generally announced throughout the astronomical world; but, for some reason, Borelli seems to have been ignorant of it, and to have independently discovered it on July 30, when he announced it as a new comet. This comet was observed by Professor Hall at 3 A.M., August 25, when it was in right ascension one hour and forty-eight minutes, and declination, south, thirteen degrees and twenty-six minutes. Schulhof, of Vienna, finds that this is a new periodic comet, having a period of about six years. The *third* comet of 1873 is that announced by Borelli on August 19, which, however, can not be found. The *fourth* and last is that telegraphed by Henry, of Paris, August 24, and which, when observed by Hall at Washington, at half-past 3 A.M., August 26, was in right ascension seven hours and forty-one minutes, and declination north fifty-eight degrees and fifty-two minutes. It appears as quite a bright comet when seen through a nine-inch telescope, and is moving rapidly eastward and southward into the head of the constellation of the Lynx.

THE NEW BUILDING OF THE CINCINNATI OBSERVATORY.

A public announcement was not long since made that the plans of the new observatory at Cincinnati had been approved, and were about to be carried into execution. It gives us pleasure to record the rapid progress that has been made in this work, as evinced by the fact that on the 28th of August the corner-stone of the new building now in process of erection on Mount Lookout was laid with becoming ceremonies. The site chosen for the new observatory is about four miles northeast of that on Mount Adams, where the original observatory, founded by Professor O. M. Mitchell, was established. The corner-stone that was laid in 1843 on that elevation by John Quincy Adams has been carefully removed to the new site, and appropriately forms the corner-stone of the new equatorial pier. The observatory has, by means of a tripartite agreement with the city and the heirs of Nicholas Longworth, now passed into the hands of the Cincinnati University. The proceeds, amounting to $50,000, realized on the sale of the property on Mount Adams, have been invested for the support of the art department of the university. The city, however, has pledged itself to maintain the observatory when once established, and the establishment has itself been hastened by the liberality of Mr. John Kilgour, who has given four acres of ground as a site for the new building, and added $10,000 for the latter. The site is admirably adapted for the purpose of the institution. It is one of the highest points in the county, commanding a beautiful and extended view, and it is not likely that the difficulty experienced at the old site from the smoke and vapors of the city will for a long time, if ever, trouble the astronomers on Mount Lookout. The new edifice faces south, having a width of about sixty feet, a depth of ninety feet, and two wings, making the breadth through the wings about one hundred feet. One of the wings will be used for the meridian instruments; and in the centre of the building, on a brick pier thirty-six feet high and seventeen feet in diameter, will rest the big telescope. The building will be two stories high, except in the centre, where the revolving turret of iron for the equatorial will add half a story. The structure is to be of pressed brick, with freestone trimmings.

The exercises connected with the ceremony consisted of an address by Hon. Rufus King, in which he gave a clear and interesting statement of the early history of the observatory, dwelling with peculiar interest upon the fact that "it was the energy of Mitchell, his tireless zeal, his earnestness in the cause he so bravely espoused, that won the first victory for our city and gave us the observatory. That observatory was not only the incipient observatory of the country, but was the electric spark which led to the universal cultivation of astronomy as a science in the United States, and, in time, to the establishment of the noble institutions which crown so many of our highest promontories. The example set by Cincinnati was not without influence in the founding of such observatories as we find now at Washington, Cambridge, Albany, and many other places all over the country." After alluding to the labors of Mitchell, who was not daunted by the unfortunate fire that in the very first year of the existence of the observatory destroyed his previous means of support, and after dwelling upon the practical usefulness of the labors of Professor Abbe, and the new and, as he hoped, firm foundation upon which the future prosperity of the observatory seems now to be assured, he concludes with the expression of his belief, in which, we are sure, all who are conversant with the fact will unite, "that the Cincinnati Observatory is a noble monument to its founders, and a hundred years hence the descendants of the present and former generations will point to it with pride." Judge Hoadley followed Mr. King by a short address, in which he contrasted the labors of the astronomer, gauging the heavens with his telescope, and those of the *Challenger*, now dredging the ocean. The corner-stone was then laid, with an appropriate address by Mayor Johnston, and the assemblage adjourned to a beautiful grove near by.—*Cincinnati Commercial.*

DISTRIBUTION OF THE STARS.

Among the astronomical works executed of late years, and having a bearing on our ideas concerning the construction of the universe, none seem more worthy to rank with the labors of the Herschels and the Struves than *Die Durchmusterung; or, The Marshaling of the Northern Heavens*, by Argelander. This work embraces accurate observations of 324,000 stars, and the preparation of large and elaborate charts, showing graphically the position of these stars. In order to make use of this work in obtaining a general view of the distribution of the stars, Proctor has compiled an equal surface chart on a small scale, showing the number of stars in each square degree; and from a study of this he deduced some interesting views, which were published in the year 1870. Astronomers interested in these studies will be glad to learn that Mr. Proctor has now concluded to publish his chart in the shape of a photograph, eighteen inches in diameter; and by means of which, with the naked eye, one may obtain a highly interesting and correct view of the appearance of the heavens as seen with a small telescope.

SUCCESS OF THE SYSTEM OF CABLE COMMUNICATION OF CELESTIAL PHENOMENA.

The arrangement made by Professor Henry, of the Smithsonian Institution, a few months ago, for the interchange between America and Europe, by Atlantic cable, of important astronomical discoveries and announcements, appears to have borne excellent fruit. One great object of this movement was to enable astronomers in all parts of the world to concentrate attention upon any celestial phenomenon before too great a change of place had occurred, or before the intervention of a long period of moonlight after the first discovery. On the 26th of May last Professor Henry announced a new planet, discovered by Professor Peters, to the Observatory of Paris, among other institutions, and on the following night it was looked for by the director of the Observatory of Marseilles, who at once detected it, and subjected it to a careful criticism. The announcement of three planets has thus far been made from the Smithsonian Institution to Europe; the only return communication being that of a telescopic comet, discovered at Vienna on the 5th of July. On being notified of the fact, Professor Hough, of the Dudley Observatory, at Albany, made search for it, and succeeded in finding the object without any difficulty.

THE DIAMETER OF THE FIXED STARS.

Stephan, of Marseilles, proposes the following method of determining the apparent diameter of the stars. If, through an excellent telescope, a star, whose angular diameter is really nothing, be viewed with a sufficiently high magnifying power, the image is seen to be a bright spot surrounded by the concentric rings of light and shade which are called diffraction rings. Fizeau has shown that these rings, if of extreme faintness and distance from the central spot, can only be formed when the angular diameter of the source of light is nearly insensible; and, following out the suggestion given by Fizeau, Stephan has applied to the Marseilles telescope a diaphragm having two apertures for the observation of the fringes produced by interference. If the star has a certain diameter, the fringes will disappear altogether; and if its diameter is zero, the distances of the fringes will vary with the distances of the two apertures in the diaphragm. The results of Stephan's limited number of measures thus far taken is that Sirius appears to have a measurable diameter. He hopes to continue his observations.—6 *B*, 1873, 1008.

THE NEBULAR THEORY.

Professor Peirce has communicated to the recent meeting of the American Association for the Advancement of Science the result of some of his investigations into the development of the solar system, according to the nebular hypothesis of Laplace. He considers that the actual rotation of the planets on their axes is explained on the supposition that they were formed from rings thrown off from the rotating central body, or sun, in the process of condensation. The inner portion of such a ring, having a less velocity than the outer portion, the axial rotation would necessarily follow the breaking up of the ring. Professor Peirce even is able by mathematical analysis to show that the velocity of the rotation of Jupiter and of Saturn is precisely such as would result from these theoretical mechanical considerations.—*Proc. of the Portland Meeting of the Amer. Assoc. for the Advancement of Science.*

THE STABILITY OF THE SOLAR SYSTEM.

Mr. Stockwell, in a memoir published by the Smithsonian Institution, gives the result of some laborious researches on the secular variations of the planetary orbits. The inequalities in the planetary motions that depend upon the variations of the elements of the elliptic orbits in which they move require an immense number of years for their full development, and are called secular inequalities. The determination of the periodic inequalities has hitherto received more attention than has been bestowed upon the secular inequalities. This is owing in part to the immediate requirements of astronomy, and also in part to the less intricate nature of the problem; but, aside from any considerations connected with the immediate needs of practical astronomy, the study of the secular inequalities is one of the most interesting and important departments of the science, because their indefinite continuance in the same direction would ultimately seriously affect the stability of the planetary system. Lagrange and Laplace have, however, shown that the secular inequalities are themselves periodic, requiring many centuries in which to complete their cycles. The exact computation of these inequalities has been undertaken, both by the former astronomers and by Pontecoulant, and subsequently with greater accuracy by Le Verrier. But Stockwell has approached the problem with the advantage of the most recent discoveries in astronomy and accurate knowledge of the motions of the planets, and has given to the whole work of computation a system such that it is now possible to determine the secular variations of the planetary elements with less labor, perhaps, than would answer for the accurate determination of a comet's orbit, which latter is a matter of perhaps ten hours' computation. Stockwell has computed anew, with the utmost accuracy, the numerical values of the secular changes of the elements of all the known planets. In reference to the earth and its orbit, he says: "The secular motions which take place in the case of the spherical earth are so modified by the actual condition of the terrestrial globe, that changes in the position of the equinox and equator are now produced in a few centuries that would otherwise require a period of many thousand years." This consideration is of much importance in the investigation of the reputed antiquity and chronology of those ancient nations which attained some proficiency in the science of astronomy, and the records of whose astronomical labors are the only remaining monuments of a highly intellectual people, of whose existence every trace has long since passed away.

The grand problem which yet remains to be solved is thus clearly stated by Stockwell: A system of bodies moving in eccentric orbits is manifestly one of stability; on the other hand, a system of bodies moving in circular orbits is one of unstable equilibrium. It would seem, then, that between the two supposed conditions a system might exist which possesses a greater degree of stability than either, the idea is thus suggested of the existence of a system of bodies, such as the planets revolving around the sun, in which the masses of the different bodies are so adjusted to their mean distances as to insure to the system a greater degree of stability than would be possible by any other distribution of masses. The mathematical consideration of the criterion for such a distribution of the masses has not yet been fully developed, and the problem is here introduced for the purpose of calling the attention of mathematicians and astronomers to it.—*Smithsonian Report*, 1871, 272.

THE SPECTRUM OF THE SOLAR ATMOSPHERE.

Rayet has communicated some novel observations made by him on the spectrum of the solar atmosphere. He on the 16th of August made the remarkable and entirely unexpected discovery of the reversion of one only of the two lines that constitute the sodium line D in the solar spectrum. At a proper altitude, one only of these two lines, namely, the less refrangible, seemed bright, and at a proper distance from the solar limb both the lines were reversed—the less refrangible was always far brighter than the other. As yet these two lines of the spectrum have always appeared identical in the laboratory experiments; but it is notable that they are not precisely equal, and that upon the sun the most refrangible is slightly brighter. In considering his observations upon other substances, Rayet considers it probable that there may be a general law applied in a great number of neighboring lines belonging to the same substance. The less refrangible will be those that are most easily reversed.—6 *B*, 1873, 530.

SPORER'S OBSERVATIONS UPON THE SUN.

Sporer has quite recently communicated to the Academy of Sciences in Berlin the result of his recent observations upon the solar spots and protuberances. In the case of many of the protuberances, known as the red flames, it seems to him that they owe their origin to the presence of solar cyclones. Sporer accounts for the presence of protuberances on several successive days in very nearly the same spot by the supposition that volcanic eruptions take place. He divides the protuberances into two classes, those that are of the nature of flames, and which Secchi calls rays, and the proper hydrogen protuberances. In respect to the nature of these latter, Secchi thinks that they have no relation to the spots, while Sporer ascribes to them an intimate connection with spot formations. By connecting his own observations with those of Carrington, Sporer shows that the solar spots are more frequent in the southern than in the northern hemisphere, that they diminish in size and number more rapidly than they increase as they pass from their successive minima and maxima. Sporer also confirms a singular result previously arrived at by Carrington, namely, that the spots at the time of the minimum approach the solar equator, but at other times are more numerous in higher latitudes.—12 *A*, 1873, 391.

ON THE DIAMETER OF THE SUN.

The observations of Rosa on the diameter of the sun, from which Secchi has concluded that this is subject to a periodic variation intimately connected with the protuberances and the spots, has called forth a review of his measurements by Wagner, of the Poulkova Observatory, in which he not only shows the weakness of Secchi's reasoning, but contributes very valuable and important information in regard to the subject, in the shape of a discussion of the observations made by himself with the most refined instruments of modern times. Wagner states as his own conclusions that the precision of the image of the sun, as it appears in the telescope, varies much more than that of the stars, which circumstance evidently depends upon the influence of the hot rays of the sun—for the worst images coincide with the most transparent atmosphere, while slight cloudiness or haziness in general favors the production of sharp definition. Wagner therefore arranges his observations in six groups, varying with the steadiness of the atmosphere. He finds that in general the solar diameter, as measured by him, is greater as the vision becomes poorer. Arranging his observations according to a period of twenty-seven and a half days, which is the time of the rotation of the sun, he finds no trace of a change in the solar diameter. Arranging them in annual groups, however, he finds an annual period, that evidently depends upon the fact that the condition of the atmosphere in the winter time is much less favorable to accurate observations than in the summer time.—*Vierteljahrsschrift der Astronom. Gesellschaft.*

THE CONSTITUTION OF THE SUN.

The discussion as to the nature of the solar spots that has now for over a year occupied the attention of the French Academy of Sciences seems to have consisted chiefly of a series of hypotheses, proposed by Secchi, Vicaire, and others, in opposition to the well-established views of Faye. The latter has, with some success, defended his own views, and shows the weak points or fallacies in the reasoning of other astronomers on this subject. In one of the last communications which we have from Faye, he gives an excellent résumé of the various hypotheses that have from time to time been proposed to account for the phenomena seen upon the sun's surface. He states as follows:

1. They tell us that the sun is a body dark and cold, surrounded by a thin shell of gas, or of certain physical forces developing incessantly light and heat. Gaseous eruptions rise from the solid nucleus and form the spots. This hypothesis has obtained very generally until the last few years, although it seems to be a case of perpetual motion.

2. Others affirm that the sun is an incandescent liquid globe, upon which appear scoriæ like those to be seen in fused metal. It would be difficult to say how any such globe is kept free from being incrusted.

3. Others believe that the sun is a gaseous mass, kept at a temperature of many millions of degrees, and agitated by eruptions more or less volcanic. According to Tacchini, the spots are due directly to these eruptions. According to Secchi, they are due indirectly to depressions. What kind of eruptions can these be arising from the interior of a gaseous mass?

4. Others pretend that, except the temperature, the sun is like the earth; that at least it has an atmosphere like ours, the winds blow as ours do, and the tempests even, and especially the clouds are like ours.

5. Others affirm that the sun has the sensibility and the impressibility of explosive matter to such an extent that the most delicate forces, such as the attraction of the planets

Jupiter, the Earth, and Venus, can produce on its surface the great phenomena that it presents to us.

6. According to Sir John Herschel, the sun is a nucleus, solid and cold, surmounted by many gaseous envelopes: in the exterior envelope, under the influence of trade winds, there form cyclones that penetrate perhaps into the interior envelopes—that is to say, into the photosphere and into the region of the penumbra. By the admission of such impossible hypotheses science is much injured.

7. According to Mayer and Waterston, the sun is a body heated by the incessant collision of aerolites that fall upon its surface. This seems to be the germ of a grand idea, but fettered by the use of hypotheses.

Finally, Mr. Vicaire proposes to consider the sun as a combustible body, that has been burning since a certain epoch in an oxidizing atmosphere.

As for himself, Faye says that he has endeavored to avoid all hypotheses, to simply study the movements of the spots, and establish from them such laws of nature as may result therefrom.—6 *B*, 1873, 301.

THE TEMPERATURE OF THE SUN'S SURFACE.

On this subject Zöllner, some three years ago, published some interesting investigations, in which he sought to determine the minimum limit which we must ascribe to the temperature of the sun. As the result of his very critical calculations, he found, for the temperature of the glowing fluid surface, 13,230 degrees Centigrade. On the other hand, the temperature at a depth, below his surface, of one-fortieth part of the sun's radius, he concluded must be something over 1,000,000 degrees Centigrade. Differing from him, Secchi comes to the result that the temperature of the surface must amount to 5,000,000 degrees or more, and that this is the lowest limit that we can possibly adopt. These two results are so discordant with each other that Zöllner has undertaken, in a second investigation, to arrive at the desired temperature by an entirely different method of reasoning. It is evident that any method for the determination of any physical peculiarity of the sun, based on measurements and principles derived from our experience on the earth, will yield the more probable results in proportion as the number of assumptions are fewer and simpler. Zöllner's new method for the determination of the solar temperature requires only one single theoretical assumption, viz., the law of Mariotte and Gay-Lussac; and but one empirical assumption, viz., the knowledge of the ratio of the densities of the aqueous portion of the atmosphere at two different distances from the solar surface. The spectroscopic study of the solar limb allows us to investigate the so-called chromosphere, which is an important portion of the atmosphere, and to determine the mean altitude of this layer, wherever there are protuberances to disturb the equilibrium. If, then, we were able to determine, even roughly, the ratio of the pressures or of the densities on the upper and lower limits of the chromosphere, we should be in possession of the above-mentioned desired data, by the use of which we should be able to ascertain the mean value of the temperature of the chromosphere. Zöllner, in accordance with these views, shows that it is, in fact, possible to determine approximately the ratio of the pressures at the base and at the upper limit of the chromosphere. According to the observations made by Wüllner, he shows that the change of pressure from 2000 millimeters to one millimeter produces an effect on the spectrum of the hydrogen similar to that change which is observed in the spectrum of the chromosphere when we pass from its lower to its upper limit. The mean height of the chromosphere, on the most quiet portion of the sun's surface, is about ten seconds of an arc. Combining this with the preceding datum of Wüllner, Zöllner says that the absolute temperature of the chromosphere is 61,350 degrees Centigrade. To this result Zöllner attributes, naturally, only very slight weight, except in that it must be considered an approximation sufficiently near to the truth to show that the very high temperature of 5,000,000 advocated by Secchi is entirely out of the question. Secchi had established his very high temperature upon the assumption of the proportionality between the radiation of heat from any body and its absolute temperature. This assumption, however, has already been shown by Zöllner to be quite erroneous; and, lately, Soret has, by some interesting investigations, confirmed the correctness of Zöllner's conclusions. Soret, by means of a very hot flame, brings to a bright glow a plate of zircon, and then determines its radiation of heat with the help of his actinometer, which same instrument he also employed for the measurement of the radiation of heat from the sun. It is known that the temperature of the plate of zircon could not be much higher than 2500°, which is the temperature of the flame in which it was heated; but Soret finds that, if he applies to his observations with the actinometer the principle applied by Secchi, he receives for the resulting temperature of the plate of zircon a value of 46,000°; whence it must be concluded that the law of proportionality between the radiation and the absolute temperature of a body is extremely erroneous—always giving results perhaps twenty times too great.—7 *C*, 1873, 411.

THE SPECTRA OF THE SUN'S LIMB AND CENTRE.

Mr. Hastings, of the Sheffield Scientific School of New Haven, has endeavored to overcome an inconvenience that has hitherto impeded the direct comparison of the spectra of the limb and centre of the sun. He has succeeded in bringing the two spectra side by side in the field of view of his spectroscope, by introducing in front of the slit a small prism with four polished sides. The rays of light from the limb of the sun, after entering this prism, are subject to a total reflection, and while the telescope is directed to the centre of the sun, so that its light falls directly upon the slit of the spectroscope, the rays from the sun's limb, after passing through the four-sided prism, also fall upon the slit, and the observer receives them both simultaneously into his eye. When the instrument is properly directed, and in adjustment, we see a very narrow black line dividing the spectrum longitudinally into two parts of widely different intensity. The fainter part, belonging to the limb of the sun, is marked on its edge by the chromosphere lines. The differences between these two spectra are immediately recognized, and are most pronounced when the sky is the clearest. Since the light from the border of the sun undergoes a general absorption within the solar atmosphere, so that its intensity is reduced to much less than one fourth of that at the centre, we might expect that the lines in the spectrum of the limb would very materially differ from those seen in the spectrum of the centre of the sun. Hastings says that the spectroscopic character is indeed changed very slightly; that it is impossible for him to escape the conviction that the seat of the selective absorption which produces the Frauenhofer lines is below the envelope which exerts the general absorption shown by the diminished brightness of the borders of the solar disk. But the phenomena of the solar faculæ, or bright spots, prove that the exterior envelope is very thin, and rests upon the photosphere, whence Hastings concludes, from both these premises, that the origin of the Frauenhofer lines must be in the photosphere itself, in accordance with Lockyer's views. A further modification of this apparatus has enabled Hastings to bring into the same field of view the spectra of two opposite edges of the sun. The rotation of the sun on its axis was then very clearly demonstrated by its effects on the spectral lines, their relative positions being manifestly displaced by reason of the change in the refrangibility, due to the fact that one limb of the sun was approaching while the other was receding from the observer.—4 *D*, 1873, 369.

THE CONNECTION BETWEEN MAGNETISM, AURORAS, AND SOLAR SPOTS.

Professor Loomis, the well-known meteorologist, has made a careful comparison between the relative extent of solar spots, the diurnal inequality of the magnetic declination, and the number of auroras so far as they have been catalogued from the year 1776 to the year 1872, and his conclusions may be stated as follows:

A diurnal inequality of the magnetic declination, amounting at Prague to about six minutes, is independent of the changes in the sun's surface from year to year. The excess of the diurnal inequality above six minutes, as observed at Prague, is nearly proportional to the amount of spotted surface upon the sun, and may therefore be inferred to be produced by this disturbance of the sun's surface, or both disturbances may be ascribed to a common cause. The correspondence between the auroral curve and the sun's spot curve, though not as close as between the magnetic curve and the sun's spot curve, is certainly quite remarkable. In only two cases is there any sensible difference in the dates of minimum of the two classes of phenomena. There is, however, some disaccordance between the dates of maximum, and such as to suggest that the connection between magnetic and auroral curves is more intimate than between the auroral and the sun's spot curves. The critical periods of the auroral curve occur a little later than those of the sun's spot curve, and the aurora maximum is frequently more prolonged than the sun spot maximum. If we institute a comparison between the auroral and the magnetic curve, we shall find the correspondence to be still more remarkable. The auroral maximum generally occurs a little later than the magnetic maximum, while the time of auroral minimum coincides with and slightly precedes the magnetic minimum. On the whole there seems to be no room for question that the number of auroras seen in the middle latitudes of Europe and America exhibits a true periodicity, following very closely the magnetic periods, but not exactly copying them. If, now, we inquire as to the proper connection between these three classes of phenomena, we can not suppose that the small black spot on the sun exerts any direct influence on the earth's magnetism or electricity, but we must rather conclude that the black spot is the result of a disturbance at the sun's centre, that is accompanied by an emanation of some influence from the sun which is almost immediately felt upon the earth in an unusual disturbance of the earth's magnetism and development of the auroral light. "Appearances," says Professor Loomis, "favor the idea that this emanation consists of a direct flow of electricity from the sun. If we maintain that light and heat are the result of vibrations of a rare ether which fills all space, the analogy between this and electricity would lead us to conclude that this latter is also the result of vibrations in the same medium, or, at least, that it is a force capable of being propagated through the ether, with a velocity similar to that of light." This idea of the nature of electricity has already been developed by other scientists, especially by J. Clerk Maxwell.—4 *D*, 1873, 245.

ON THE CONNECTION BETWEEN AURORAS, SUN SPOTS, AND TERRESTRIAL MAGNETISM.

Dr. H. Fritz has recently published the results of an investigation on the periodicity of the auroras, and his conclusions are not very dissimilar to those subsequently published by Professor Loomis, of Yale College. Fritz says that the polar light is a periodical phenomenon, whose most important period embraces fifty-five years, approximately. Four of these periods, apparently, group themselves together and form a greater period of over two hundred years, while the fifty-five-year period itself is subdivided into five secondary periods of about eleven years each. The fifty-five-year period stands in an intimate relation to the period of the sun's spots, the maxima and the minima of each corresponding exactly; but the principal maxima of the auroras are more decided than those of the sun's spots. The aurora stands in an intimate relation to the terrestrial magnetism and its variations: from observations gathered from the most various regions of the earth, we know that magnetic disturbances and auroras frequently happen at the same time, or follow each other in close connection; but the disturbances of the terrestrial magnetism that accompany the polar lights are not perceptible at all the magnetic stations, and probably auroras sometimes form without being connected with any disturbance of the earth's magnetism. A comparison of the curves representing the changes in the various elements of the earth's magnetism with the auroral curve shows that the maximum of the aurora that occurs daily about ten o'clock in the evening agrees completely with that minimum of the magnetic declination which, like the maximum of the auroras, is delayed the farther north we go. This aurora maximum only coincides with the secondary maximum of magnetic perturbations that is shown at many stations on the globe, because the aurora maximum corresponds in high latitudes with that maximum of the magnetic disturbance that occurs after midnight. The annual periods of terrestrial magnetism and of auroras agree still better, since the separate elements of both agree in their principal features with the equinoxes. Since the secular period of the auroras agrees with the period of the solar spots, and these latter again run parallel to the variation of magnetic declination, therefore it follows that the eleven-year and the greater periods, both for the auroras and the terrestrial magnetism, must agree. The magnetic disturbances, and probably also the secular variations of the earth's magnetism, stand also in intimate relation to the auroras. Dr. Fritz concludes that the entire series of observations that he has discussed justifies us by no means in forming, as yet, any theory upon the nature and cause of the aurora—rather must we still further diligently observe and establish the regularity of the phenomena.—19 *C*, 1873, 234.

THE RED FLAMES OF THE SUN SEEN WITH A COMMON TELESCOPE.

Mr. R. Langdon communicates to *Nature* the result of some observations which are well worthy of being repeated. Very few observers have met with such success in this line as he appears to have had, and his method will place it within the power of the amateur every where, at very little expense, to observe the red protuberances of the sun. Langdon states that he cut out several circular disks of thin brass, blackened on both sides, and, after trying several, found one the right size, such that when inserted in the interior of his telescope at the focus of the object-glass, it very exactly concealed the glowing body of the sun. He expected then, possibly, to be able to view the protuberances on the limb of the sun, and in this he states that he was successful, so that on the 16th of June, 1872, he observed such a protuberance on the southwestern limb of the sun, and on the 20th of September he again saw a red flame. These flames did not appear to be projected against the sky, but upon a very delicate purple background. No colored glass was used in either of these observations, but while adjusting the apparatus a sheet of letter paper was held between the eye and the telescope, which was removed the instant the sun was exactly behind the artificial occulting disk. This method reminds one of a proposition recently made by Professor Abbe to Dr. John W. Draper, of New York, in which it was proposed to place at the solar focus a plate of glass having a central circular aperture equal to the diameter of the solar image: the light and heat of the solar disk passes through the aperture, while by using properly selected chemicals we should be able to directly photograph the solar protuberances without waiting for a total eclipse of the sun.—12 *A*, 1873, 263.

ASTEROID NO. 134.

Professor Henry has received a telegram from Professor Foerster, Director of the Berlin Observatory, announcing the discovery by Dr. Luther, at Dusseldorf, of a planet on the

27th of August. The position of the object was at that time in right ascension 7 minutes, and in declination north 7° 53′, moving toward the south slowly, and of the tenth magnitude. In connection with the discovery of new planets, it may be mentioned that elaborate charts of the heavens, including every star visible with a large telescope, have been prepared by most of the astronomers who are busy in this field of discovery. Specimens of such charts were recently exhibited before the German Astronomical Association by Professor Peters, of Hamilton College, and the desire was expressed that these should be published for the general use of astronomers.

THE ECLIPSES OF JUPITER'S SATELLITES.

The method of determining the longitude at sea by observations of the eclipses of Jupiter's satellites, that was so diligently studied by the great inventor of the telescope, has, as is well known, during the last few years fallen into disrepute, while the advantages of the accurate observation of the moon have justified navigators in generally adopting the method of lunar observations in preference to any other. In order, however, to remove from astronomy the reproach of allowing any phenomenon to take place without being observed, Professor Airy has urged that there should be made more numerous observations upon the satellites of Jupiter at fixed observatories, and with telescopes of various powers, that the mathematical tables representing the motions of these bodies might be perfected. Among the numerous contributions to this subject that have appeared during the past few years, that by Glasenapp, of the observatory at Poulkova, seems to be of much interest. In this communication Glasenapp compares the observations of ten different observers, all stationed at the same place, and observing the same satellite with telescopes of very various optical powers. After a careful discussion of these results, he points out that, although the differences between the individual observers are very considerable, yet the mean of the observations made upon both limbs of the planet accord very well among themselves, whence he concludes that, although in the observation of isolated contacts, the personal equations produced by the differences in the eyes and telescopes may be very considerable, yet their effect will disappear, in great part, on taking the mean of each pair of corresponding contacts. It remains then to determine the coefficients necessary in order to reduce the apparent moment of contact of the limbs of the planets and satellites to the true moment of the contact of the centres of these planets.—*Bull. Imp. Acad. of Sciences, St. Petersburg*, vol. xviii., p. 98.

ON THE EXISTENCE OF A RESISTING MEDIUM IN SPACE.

It is well known that the principal argument in support of the existence of a gaseous medium in space, that offers sensible resistance to the motions of bodies through it, is drawn from the computations of Encke, in reference to the comet commonly known as Encke's comet. The observations of the successive appearances of this comet, at intervals of six years between the dates of 1819 and 1848, were discussed by Encke with an immense outlay of time consumed in the necessary computations; and, after having made allowance for the disturbance of the orbit of the comet by the attractive influences of all the known planets, Encke found himself forced to conclude that the observed appearances could not be reconciled with the present constitution of the solar system, unless there were introduced a hypothesis as to the actual existence of some gas that should retard the motion of the comet around the sun. The only source of error that can possibly be attributed to Encke's computations lies in the intrinsic imperfections of our knowledge of the masses of the planets and of the mathematical formulæ employed by him. In order to remove all doubt as to this question, Dr. Von Asten has undertaken to go over the principal portion of Encke's computations, pursuing, however, an entirely independent method, and introducing the use of mathematical formulæ of a far more perfect nature than those employed by Encke. It is only after Encke's methods of computing the perturbations have been controlled by other methods whose perfection is undoubted that one can decide whether the hypothesis of the opposing medium in space is entirely untenable, or whether it merely needs slight modifications. Dr. Von Asten has, in this revision of Encke's results, happily availed himself of the mathematical memoirs of Gyldén and Hansen. The former astronomer has developed improvements on Hansen's method of computing perturbations, in that he represents the mean anomaly of the disturbed planet by an elliptic integral. By applying Gyldén's and Hansen's methods, Von Asten finds himself justified in the belief that the complete computation of the absolute perturbations of Encke's comet is a labor whose execution lies quite within the limits of possibility. He has himself, in his memoir published recently, gone through with the necessary computations relating to Jupiter's attraction on the comet, and it is to be hoped that competent persons will be found to take up the subject at this point, and carry out the computations relating to the influences of other planets; so that, eventually, the question of the existence of Encke's resisting medium may be definitely settled.—*Untersuchungen Enckeschen Cometen*, *Dr. Von Asten*, *St. Petersburg*, 1872.

ON THE CONSTITUTION OF THE SUN'S CRUST.

Professor C. A. Young has suggested that the solar crust may consist of a more or less continuous sheet of descending rain, not of water, of course, but of the materials whose vapors exist in the solar atmosphere, and whose condensations and combinations are supposed to furnish the solar heat. As this tremendous rain descends, the velocity of the falling drops would be retarded by the resistance of the denser gases underneath, or the drops would coalesce until a continuous sheet would be formed, and these sheets would unite into a sort of bottomless ocean, resting upon the compressed vapors beneath a forest of innumerable ascending jets and bubbles. The thickness of this sheet would depend upon the evaporation at its bottom, and upon the rapidity of its growth at the top, and would probably continually increase at the same slow rate.—12 *A*, 1873, 393.

THE SPECTROSCOPIC METHOD OF OBSERVING THE TRANSIT OF VENUS.

In order to observe the first moment of the contact of the planet Venus with the disk of the sun at the approaching transit of Venus, it is proposed to employ, not only the direct photographic, but also the so-called spectroscopic method. This last method consists in this: Before the apparent contact of the two objects takes place, a spectroscope adjusted to the telescope is so placed that at the point on the solar disk where the contact is expected we shall behold the bright lines of the sun's atmosphere, which extend, as is well known, to a considerable distance from the glowing body of that luminary. It is, therefore, apparent that when the planet approaches the solar disk, it will, first of all, cut off the bright spectroscopic lines representing the solar atmosphere, and in this way will itself, as it were, become visible; whereas otherwise it would be invisible until it had entered upon the bright solar limb. By this means the observer becomes perfectly prepared for the observation of the exact moment of the contact of the dark disk of Venus and the bright disk of the sun. This method has, indeed, been employed in observations of solar eclipses, and with such success that it is known that the moment of contact can thus be observed more exactly than in any other way.

Secchi has announced a modification of this method, and has tested it in the instance of the partial solar eclipse that occurred in Italy on the 26th of May last. His arrangement is as follows: In front of the slit of the ordinary spectroscope, and about one inch distant therefrom, he places a dispersing prism of considerable power. This prism offers, in the plane of the slit, an image of the sun constructed of many-colored rings, like a very impure spectrum. The rays that penetrate from this image through the spectroscope give, in the field of view of the small telescope, a very sharp and clear image of the sun, in which not only the limb, but also the dark and bright spots are clearly seen; in short, one sees the sun as through a colored glass. The chromosphere, seen by a proper arrangement of the apparatus, has a bright line, somewhat distant from the sun's disk, corresponding to the altitude of the chromosphere, and the spectral line that we choose to employ. It follows, therefore, that the opaque planet will cover the chromosphere on the corresponding point in the field of view of the telescope; the chromospheric line will be broken; and the observer thus is forewarned that the planet approaches its contact with the sun. In making his first trial upon the eclipse, Secchi was able to detect the approaching and otherwise invisible moon eleven seconds before its first contact with the sun's limb. In applying the same method to the transit of Venus, on account of the slow motion of the planet, this interval of time will be materially larger. At the end of the eclipse, Secchi was able to follow the moon for twenty-five seconds after the close of the actual eclipse. At the end of forty-eight seconds, he states that there was no longer any trace of the moon—that it had evidently completely passed the chromosphere. It is interesting to compare the result of Secchi's observations, made with the powerful assistance of this method of observation, with those obtained by his two assistants, and it appears that the latter first detected the presence of the moon at the beginning of the eclipse from ten to fifteen seconds after the actual contact as observed by Secchi. On the other hand, Respighi applied to the same eclipse of the sun the ordinary spectroscopic method; that is, without a prism in front of the spectroscope, and without a spectroscopic slit. In this form of the apparatus we see, not the sun's limb, but the chromosphere in the shape of concentric rings; and Respighi had to assume for the moment of contact that in which the colored rings were entirely broken through. His measurements also differ considerably from Secchi's; but it appears that Respighi has observed the first contact twenty-one seconds earlier even than Secchi. It would seem that Respighi's method, however, can not be so exact as that of Secchi, since Respighi does not distinctly see the sun's limb. It is, therefore, apparent that this method suggested by Secchi is a decided improvement upon that which has been employed by several spectroscopists during the past five years.—19 *C*, 1873, 280.

THE HEAT RADIATED FROM THE MOON.

The Earl of Rosse has made an attempt to determine, by accurate observations, the heat that we receive from the moon. For this purpose he employs a very delicate thermo-multiplier in connection with his six-foot reflecting telescope. Observations made during the eclipse of the moon showed that the least heat was received from the moon in the middle of the eclipse, when also the least quantity of light was received, at which time the quantity of heat was only one half of that observed during the full moon. From a long series of observations, corrected for the change in the distance of the moon, Lord Rosse is able to draw a curved line, whose ordinates express the heat, and whose abscissas express the corresponding altitude of the moon above the horizon. By combining these observations again, he derives a table for correcting all his observations for the influence of the absorption of the earth's atmosphere, which table is very nearly identical with that which has been previously obtained by others for allowing for the influence of the earth's atmosphere in absorbing the light of the moon and stars.

The final result of Lord Rosse's investigation is that, as the moon reaches the full, the increase of the heat radiated to the earth is more rapid than at any previous time since the new moon; a result similar to that obtained by Zöllner in studying the brightness of the moon.—*Proc. Roy. Soc., April*, 1873.

THE METEOR OF JUNE 17, 1873.

The brilliant meteor that appeared over Southern Germany and Bohemia on the 17th of June last, has been made the subject of an attempt by Von Niessl to determine the orbit and magnitude of this body. The meteor was seen to break into many pieces, and the sound of the explosion was heard as a fearful noise, while the fragments fell burning to the earth, some of them having been actually secured by the inhabitants, and are described as being of the size of peas, and having something the appearance of sulphur. Von Niessl concludes that the altitude of this body, when it was first seen, was about eight and a half miles above the earth, and when it exploded was about four and one third miles. In attempting to determine what orbit this body must have been describing about the sun before it came into the earth's atmosphere, he assumes that its motion may have been in a hyperbolic orbit, and that it must have passed nearest to the sun in the latter half of July, at which time it was distant from the sun about six tenths of the earth's distance. The diameter of the meteor, whether it were a compact mass or a collection of small masses, is concluded to have been about 1000 feet.—*Astron. Nach.*, 1873, 165.

ON THE ALTITUDE OF SHOOTING-STARS.

Dufour relates a most interesting observation in connection with the shower of shooting-stars on the 27th of November last. He says that during that same evening he was in Switzerland, at Morge. The heavens were entirely covered with an extremely thin cloud, and there could be distinguished with great clearness from his point of view the general outline of the Alps, and even the summit of Mount Blanc, elevated 4800 meters above the sea. He observed that from half-past eight to nine o'clock in the evening, during which he paid especial attention to the matter, he did not see a single shooting-star, and, as others know they were visible in all other portions of Europe, he concludes that there could not have been a single one that penetrated into the atmosphere to a point 4800 meters high. At this altitude and at that time he computes that there must have been 0.55 of the atmosphere above Mount Blanc, and, consequently, the numerous meteors which were at this time shooting through the air had all become extinct after having traversed this same 0.55 of its thickness. In general, Dufour remarks that, in the course of many years, he has never yet observed a single shooting-star below the clouds.—6 *B*, 1873, 497.

RECENTLY DISCOVERED COMETS.

The third comet of 1873 was recently announced as having been discovered by Borelli on the 19th of August. The fourth comet, which has by some been mistakenly assumed to be the same as Borelli's, was discovered by Paul Henry at Paris on the 24th of August. The fifth comet is now announced, and is none other than the periodic comet of Faye, for the discovery of which an ephemeris had been computed by Mr. Plummer. The large disaccordance between Mr. Plummer's ephemeris and the actual position of the comet has somewhat retarded its discovery, but it is now announced as having been found by Mr. Stephan, the director of the observatory at Marseilles. The position of the comet is two hours of right ascension in advance of Plummer's ephemeris. —12 *A*, 1873, 371.

BIELA'S COMET.

In reference to Biela's comet, which was believed to have broken into two portions in the year 1845, and to have subsequently disappeared in a great number of smaller portions, appearing as a shower of meteors in the year 1872, Klinkerfues has published a short study, in which he maintains that the original Biela's comet described a somewhat different orbit from that of the modern comet, especially because of the disturbance experienced by the attraction of the planet Jupiter; but allowing for this disturbance, Klinkerfues concludes that probably the comet which was seen in the year 1162 was identical with it, and was also intimately connected with the shower of meteors known to have been observed in the year 524.—19 *C*, 1873, 214.

THE PRIME VERTICAL TRANSIT INSTRUMENT AT LISBON.

It is well known that the transit instrument, when used in the prime vertical, has in the hands of Struve led to the most accurate possible determinations of the zenith distance of the stars and the constants of stellar aberration, nutation, and parallax. The investigation of parallax is, of all others, the most delicate that engages the attention of the astronomer. It was, therefore, with great interest that Struve gave to the government of Portugal his advice when consulted, in 1861, in regard to the new observatory that was then about to be erected at Lisbon. The geographical position of the Royal Observatory at Tapada was to be such that the bright star Alpha Lyræ must pass near its zenith every day at its transit, and Struve represented the great value that would attach to a thorough investigation of the parallax of this star, to which purpose he knew of no instrument so well adapted as the prime vertical transit. The labor of using this instrument is so considerable, and the advantage of a thorough familiarity with the methods of so expert an observer as Struve was so highly esteemed, that the Portuguese government dispatched to St. Petersburg a young officer of the navy, Lieutenant Oom, whose duty it should be to perfect himself in practical astronomy at the renowned observatory of which Struve was the director. The new observatory at Lisbon contains, besides the prime vertical, also a magnificent equatorial and an excellent meridian circle. While each of these instruments is, in its way, of the most perfect construction, yet especial interest centres in the prime vertical transit. This has been manufactured by the famous artists, the brothers Repsold, of Hamburg, who have introduced into its construction several novel features. Upon a solid pedestal of stone there stands a pier of iron, manufactured at the great establishment of Krupp. On this pier the telescope rests at one end of a horizontal axis, whose opposite end bears a counterpoise of the same weight. The iron pier, with the telescope, admits of being raised a small fraction of an inch, reversed in its position, and set down again, the whole operation employing less than one minute, although the weight to be moved amounts to about 2500 pounds. The length of the telescope is seven and a half feet, and the aperture of the object-glass about seven inches.—*Jornal da Academia, Lisbon.*

STELLAR PHOTOMETRY.

The invention by Dr. Zöllner, in 1862, of his elegant photometer, which is specially designed for the study of the relative brightness of the stars, seems to have given a great impetus to this branch of astronomy. By Zöllner's instrument, the determination of the brightness of a star is made a matter of exact measurement, and leads to more correct results than any other method that has as yet been proposed. With the results attained by himself and his colleague, Engelmann, of Leipsic, our readers are already acquainted. The most recent publication in this field of observation is by Lindemann, who has, by using the instrument that belongs to the Imperial Observatory at Poulkova, sought to determine, in a general way, the relation between the intrinsic brightness of the classes of stars that are usually designated as of the third, fourth, and fifth magnitudes, etc. He has extended his labors even to the faint stars of the ninth magnitude, and has chosen especially such portions of the heavens for the study as afford him groups of stars of the greatest possible variety of magnitudes. Lindemann finds that the comparison of his own work with that of his predecessor in this field, Dr. Rosen, shows such a uniformity in their results as to give great weight to their importance. From 175 observations of bright and faint stars, Lindemann deduces as the most probable value of the coefficient of brightness in passing from one order of magnitudes to the next inferior, the decimal fraction 0.0394. This, therefore, in connection with the results of Rosen, seems to him to justify us in the belief that the mean ratio of the brightness of successive stellar magnitudes, for the stars of Argelander's *Durchmusterung*, can now be considered as quite accurately determined. But, as to the question of the differences that may exist in the special ratios between any two successive orders of magnitudes, he concludes that the observations are, as yet, only sufficient to justify the belief that this ratio is smaller for the stars visible to the naked eye than for telescopic stars.—*Bull. Imp. Acad. of Sciences, St. Petersburg*, vol. xviii., 34.

BIELA'S COMET.

The various hypotheses as to the formation of comets and the groups of meteoroids, with which certain comets are intimately associated, have received somewhat further elucidation from a recent communication of Professor Kirkwood. Two theories have been broached, which respectively require that the different bodies moving together in the orbit of Biela's comet have entered the solar system, either as a single mass, subsequently broken up into portions, or as a group of cometary bodies. The latter hypothesis has been advocated by Kirkwood, who adduces the following facts in its support:

1. There is nothing improbable in supposing that the bodies now known as the Biela comet, or the Biela group of comets, were originally distinct and separate masses while they were moving in straight lines through space, and before their orbits were changed into ellipses, with the sun as a focus.

2. It is improbable that, had they originally been united, they would have escaped observation until the year 1845.

3. It is highly probable that the comet of 1818 is intimately related to that of Biela, and that that of 1772 belongs to the same group, if, indeed, it be not identical with that of 1818, whence it would follow that the Biela group of comets began to separate from each other long before the year 1845, when the first actual observation of their separation was made.

4. It is probable that the comet whose discovery is due to Klinkerfues and Pogson on the 2d of December, 1872, and which has by some been regarded as identical with the long-lost companion of Biela's comet, is, on the other hand, another member of the same family.

5. If we trace back the position of Biela's comet and the planet Jupiter, we shall find that they were in the vicinity of each other in September, 1734. This is the most recent

date previous to 1772 at which they could have been in close proximity; and Kirkwood considers it probable that the members of this cometary cluster were at that time thrown into their present elliptical orbit, and that since then the various members of the group, by collisions with each other, and possibly with meteoric streams, have become gradually separated. By assigning this as the date at which Biela's comet entered the solar system, Kirkwood explains the fact that the meteors, which have been five times observed since 1798, are not recorded to have been observed previous to that date, whereas other systems of meteors connected with other cometary groups may be traced back many centuries. —6 *D*, 1873, 21.

THE DAILY PHOTOGRAPHS OF THE SUN.

Professor Winlock, of Cambridge Observatory, states that by the last year's work he has been able to secure photographs of the sun on at least twenty-five days in each month on the average, being far more successful than the astronomers of London, who have reported an average of eighteen monthly. This striking difference is due to the atmospheric peculiarities of the two cities—though doubtless something is to be argued in favor of the extremely simple apparatus used at the Harvard College Observatory. Professor Winlock estimates that if a similar work were to be undertaken in Washington, there would result, by combining the two series of photographs, a perfect daily series, without any gaps, and one that would contribute much to our knowledge of the cycle of solar-spot changes, which is believed to exert so decided an influence over meteorological phenomena.

FAINT VARIABLE STARS AND ASTEROIDS.

Professor Watson, of Ann Arbor, announces as the result of many years' careful study of the faintest visible stars, in his search for new asteroids, the following important conclusions: 1. The asteroids are not generally to be classed among the faintest telescopic objects, but are much brighter than the faint stars among which they move. 2. The number of asteroids is probably not unlimited, but, on the contrary, comparatively very restricted, and very possibly does not exceed two hundred. 3. The number of variable stars increases with astonishing rapidity among the higher magnitudes.

THE NATURE OF THE RINGS OF SATURN.

M. G. A. Hirn, well known for his investigations into the dynamical theory of heat, has published a mathematical memoir on the rings of Saturn, and discussed the various conditions that have been suggested as possibly contributing to maintain the dynamical stability of that system.

Although M. Hirn's results do not materially differ from those already demonstrated by Peirce and Maxwell, yet we recognize the importance of having this additional and perfectly independent investigation of so difficult a subject.

In a recent popular exposition of this subject, M. Hirn gives the present state of our knowledge as follows: 1. Solid rings can not exceed a certain size without breaking. 2. Solid homogeneous rings are unstable, and must break up into satellites. 3. Non-homogeneous or weighted solid rings are stable, but must have an enormous (imaginary) strength, and therefore can not be permanent. 4. Gaseous or liquid rings can exist; and such was very probably their original condition; but their existence can be only ephemeral, and they must fall toward and join the planets; if Saturn's rings were once fluid, they must long ago have thus disappeared. 5. The rings can only endure as solid fragments of limited size, and separate from each other.—*Bull. Soc. d'Hist. Nat.*, 1872, 448.

THE PLANET VULCAN.

This hypothetical planet, in whose existence many still believe (though we understand the evidence on which Le Verrier sought to establish its existence to be very much shaken), has recently appeared, if we may credit Mr. Cowrie, of Hong-Kong, who thinks he saw it on the occasion of its transiting the sun's disk. Singularly enough, there comes from two good amateur astronomers of the Manchester Philosophical Society a note recalling an observation made by them both on the afternoon of the 12th of March, 1849, when they watched for half an hour the passage of a small black spot across a portion of the sun's disk. The number of observations of this character seem to have slowly increased until, whether or not we believe in Vulcan, we are at least admonished to keep a very sharp watch of the solar orb. It is greatly to be desired that the photographs taken at Greenwich and Cambridge be supplemented by a set taken at Melbourne.—12 *A*, 1873, 475.

WORK AT THE EDINBURGH OBSERVATORY.

The annual report of Professor C. P. Smyth states that the force of the observatory is now concentrated upon a general star catalogue, to include all the determinations of position made at Edinburgh since the establishment of the observatory. In the department of meteorology, there are fifty-five stations from which monthly reports are received. The standard time is sent from the observatory to very many places in Scotland, and in several a noon gun is automatically fired at the exact second. In the city of Edinburgh a large number of clocks are controlled electrically from the central clock at the observatory—a system that has been widely spread over Great Britain and the Continent, and is now in very successful use in Washington, Boston, and Pittsburgh. The effect of the low state of the barometric pressure of the atmosphere upon the rate of the standard clock seems to have given much trouble. Like many of the other observatories of Europe, and even of America, Edinburgh is to have a new and large equatorial telescope; the report states that it is very nearly completed, the main parts being already in position. Singular to state, there appears to be no satisfactory provision made by the government for the proper support of the persons who are to use this instrument, and, in Professor Smyth's own words, "it places us in connection with this new equatorial in a nearly parallel position to that of any unfortunate artillery officer who should have received a big gun, of perhaps the most approved wrought-iron and steel construction in itself, but without means of moving it, without powder and shot, and yet should be expected by the public to be continually firing it with immense success, and at all sorts of objects, throughout the whole year."

B. TERRESTRIAL PHYSICS AND METEOROLOGY.

AMOUNT OF FORCE DERIVED BY THE EARTH FROM THE SUN'S HEAT.

An interesting computation has been made of the amount of force imparted to the earth by the sun's heat. According to the best investigations that have been made, there is received in one minute enough heat to raise the temperature of five and a half cubic miles of water one degree Centigrade. If, now, we compare this with the work done by a given amount of heat, as utilized in a steam-engine, it will be found that the heat sent to the earth in the sun's rays during the space of one minute is able to do as much work as would be done by two thousand steam-engines of one hundred horse-power each, working continuously for the space of four thousand years.

What becomes of this inconceivably great amount of power is worthy of consideration; and we begin to realize the nature of the problems of the future scientists when we reflect that by far the larger part of this heat force expends itself upon the earth in actual work, only a small portion of it being radiated into space. Of course the result accomplished, such as the maintenance of the temperature of the earth, ocean, and atmosphere, the stimulating of animal and vegetable life, etc., etc., must be the equivalent of the power retained by our globe.—*Mitth. naturforsch. Gesellsch., Berne*, 1871, xxxix.

RIVER TEMPERATURES.

The United States Signal Corps has recently extended its series of observations in the form of a daily record of the surface and bottom temperature of the rivers and harbors upon which the several stations are situated. This, while of much interest in a meteorological point of view, is also of practical importance in connection with the subject of introducing useful food fishes into the rivers and lakes of the United States, as lately provided for by Congressional enactment. It is well known that the possibility of introducing salmon into any given stream will depend upon the relationship of its temperature during the summer and autumn to the particular species; some kinds, as the true salmon of the North Atlantic (*Salmo salar*), requiring a summer minimum of at least sixty to sixty-five degrees, while others will bear a higher temperature.

SIGNAL-OFFICE RIVER REPORTS.

The army Signal-office has made preparations for a very great extension of its valuable system of reports of the heights of rivers, particularly of all those opening into the Mississippi. Over twenty-five stations are now established at suitable points on these rivers, especially, of course, on the Ohio, Missouri, and Mississippi. They are provided in some instances with automatic self-recording apparatus, and at all other places the observation of the height of the water is taken eight times daily when floods are apprehended. By this most beautiful system every wave of high water is accurately followed in its course down stream, and the approach of dangerous high floods is easily foretold by the repeated telegraphic reports. The system of river reports, which has been in operation during the past year, has given such universal satisfaction to those navigating the Western waters that the demand for increased facilities can only be met by this new and far more elaborate system of stations.

The universal interest and value of the systematic telegraphic reports of the weather and of the rivers now furnished by the army Weather Bureau show what a power the electric telegraph is destined to become when its ramifications shall be still further extended, and the expense of using it cheapened.

CRUISE OF THE NEW YORK SCHOOL-SHIP MERCURY.

The New York Nautical School-ship *Mercury* has spent the past winter in deep-sea research, as in a previous season, and, as before, has utilized the opportunities presented in the interest of science. Captain Giraud addresses the president of the board of Commissioners of Public Charities and Correction from Rio, under date of January 25, stating some of the points in which he regarded his operations as successful in connection with deep-sea soundings and temperatures. He surveyed a large portion of the so-called "volcanic region" of the Atlantic Ocean, finding the water very deep in that vicinity. Specimens brought up from the bottom appeared to be of undoubted volcanic origin. The Casella-Miller deep-sea thermometer was used on one occasion at a depth of 2040 fathoms, two miles north of the equator, in longitude 22° 16′ west, and indicated a temperature of 35° Fahr., at 1000 fathoms 38°, and at the surface 81°, the air being 80°. During the voyage from the Canary Islands to Rio, the temperature at uniform depths was found to vary only about two degrees.—*New York Herald.*

EARTHQUAKE WAVES.

The self-registering tide gauges of the Coast Survey are doing good work not only in recording tides, but also in catching the fleeting waves produced by earthquakes. One of the first cases of this kind occurred on the Pacific coast in 1854. The great earthquake of Africa, in 1870, produced a wave that traveled in one half of a day to Honolulu; and in one, two, and three days respectively to San Francisco, Melbourne, and Yokohama. It is now proposed to use this simple instrument at a number of points in the Mediterranean Sea as a regular means of recording the frequent earthquakes that occur there, where the systematic daily tides are so slight as to be nearly imperceptible. The annual report of the observatory at Sydney, New South Wales, states that the tide gauge at that port has recorded fewer earthquake waves than that at New Castle (a hundred miles distant), probably owing to the more open harbor of the latter.—*Monthly Notices R. Astronom. Soc., February*, 1873.

RATE OF INCREASE OF HEAT IN PENETRATING THE EARTH.

A new determination of the rate of increase of heat as we descend into the earth has been lately made by Dunker, and the care with which the experiments were conducted gives much value to his results. The observations were made in an artesian well in Sperenberg, Germany, having a depth of about 3900 feet. The well being supplied with water from several springs, it was necessary to avoid the disturbing influence upon the temperature of the circulating water; and, in order best to secure this end, a small hole was bored at the bottom of the larger bore of the well. This smaller hole was about twenty feet deep; the self-recording thermometer was placed in it, and the entrance firmly closed. The average of two determinations made in this way gave, after correcting for all known sources of error, 37.24° Réaumur, or 115.79° Fahrenheit, as the temperature of the strata at the depth of the small hole. The measures at lesser depths were taken with equal care (by effectually stopping, temporarily, the water circulation), and they show that the rate of increase was not uniform, being on the average one degree Centigrade for 27.8 meters of descent, or one degree Fahrenheit for forty-seven feet.—*Natur und Leben, January*, 1873.

DISCORDANCE IN ARCTIC TEMPERATURES.

Mr. Dove has lately laid before the Berlin Academy the result of his investigations of the variability of the temperature of the regions bordering on the arctic zone. He states that as yet we have had opportunities for studying the question only through the observations of the arctic expeditions, and through those made at the few fixed stations in Siberia; but the recent publication of longer series of observations made at stations in Greenland and in Iceland affords new and valuable material, with which he has combined all the temperature observations hitherto published by the Smithsonian Institution, and especially those made by Professor Cleaveland at Brunswick, Maine. Mr. Dove finds an astonishing discordance in abnormal seasons between Greenland and Iceland. For instance, the very cold year 1863 in Greenland had nothing analogous in Iceland; and so, inversely, the cold spring of 1866 in Iceland was accompanied by a warm spring in West Greenland. This strong contrast of the temperature in two countries so near together seems to him to partly account for the very severe storms that have been generally reported from that region, and particularly those noted by Koldewey in his recent expedition.

Mr. Dove then seeks to find something similar in the contrasts of monthly temperatures in the northern portions of the United States; but the result is such that he concludes that "the arctic zone possesses a peculiar meteorological system." He also very distinctly asserts that we can only think of applying corrections to the monthly means of temperatures observed during north polar expeditions and other short periods, in order thus to obtain normal annual means, when we have primarily determined, at least approximately, the form of the isothermal lines for the epoch of the observations.

In connection with the preceding, Mr. Dove has made a study of the cold days of February, the so-called February minimum, for a number of European stations, and has shown that this, in Europe as in America, probably results from a cold polar current of air.—*Monatsberichte, R. Akad. Berlin, September and October*, 1872.

RAIN-FALL IN JERUSALEM.

Dr. James Chaplin, who is at present residing in Jerusalem, corrects a statement that the rain-fall there for 1863–64 amounted to but 8.84 inches, the actual quantity being something over 19 inches. The error arose from the use of an imperfect rain-gauge, and has been corrected from other observations.

In reference to the sirocco, he remarks that this is one of the most frequent evils, being especially prevalent in the month of May, and again in September, October, and November, just before the setting in of the rains. Its peculiarly depressing effect he considers to be due to the entire absence of ozone, the most careful observations, both of dry paper and that which had been moistened, failing to indicate any discoloration of the ozone paper.—*Quarterly Statement, Jan.*, 1873.

RAIN-FALL IN THE UNITED STATES.

The extensive work on the rain-fall in the United States, lately published by the Smithsonian Institution, will be invaluable to engineers and others to whom are referred the great questions of improving the navigation of the rivers of this country. By means of such tables as are given in this volume, a few minutes' computation enables one to determine the area of country that must be drained in order to secure a water supply sufficient for any specified purpose. The engineers of Europe have long been sensible of the great practical value of works of this nature, and we have before us a chart of the rain-fall of Switzerland, showing, by carefully drawn isohyetals, the minutest detail of the annual precipitation (including the melted snow of winter). The construction of this chart, which is probably preliminary to a far more elaborate exhibit, is based on the returns during the six years 1864–1869, from the ninety-seven stations of the Switzerland hydrometric commission of the "Naturforschende" Society. A comparison of the data for some of the Swiss lakes with those for the great lakes of America may prove of interest. Thus we have the annual rain-fall for Lake Geneva, 39.4 inches; for Lake Neufchatel, 37.4; for Lake Zurich, 46.2; for the Boden-See, 43.3 inches. On the other hand, we find from the Smithsonian charts, for Lake Ontario, 32; for Lake Erie, 38; for Lake Huron, 30; Lake Michigan, 30; Lake Superior, 28 inches; and for Salt Lake, Utah, 20 inches.

The ratio of rain-fall to evaporation, and the resulting volume of water flowing into the rivers, are among the most interesting of the questions that come before hydraulic engineers. Mr. Benteli, the author of the Switzerland rain-chart, has studied the subject, and finds that in the area drained by the Aar only eighteen per cent. of the rain-fall is lost by evaporation; the remainder flows into the river past the city of Aarau.

The neighborhood of the Grimsel, and of Mount St. Bernard, is the region of the heaviest rain and snow fall in all Europe, the annual fall being measured as 98.4 inches. The Smithsonian rain-charts give 80 inches for the extreme northwest coast of Washington Territory, and 60 inches for Southern Florida, as the points of heaviest rain-fall within the United States.—*Mitth. naturforsch. Gesellsch.*, *Berne*, 1871, 344.

UNVARYING COURSE OF CIRRUS CLOUDS.

It seems to be generally admitted that there are two cold poles (points of minimum temperature) in the northern hemisphere, one in Asia, and the other in North America, and that from these the trade-winds radiate, regulating, as they veer to one side or the other, the changes of the weather. To complete the statement, attention is called to the fact that it is extremely probable that the high cirrus clouds are unaffected by the variation in course, between northwest and southeast, which the trade-winds experience on the eastern borders of the two great continents, but preserve the normal direction imparted to them by the rotation of the earth—

namely, that of the anti-trades—and, at a great elevation, continue undisturbed from west or west-southwest to east-northeast. Observations are not complete enough to establish the latter proposition, but numerous concordant statements render it so probable that it seems worthy of the attention of local and other observers.

In North America, where the axis around which the wind veers lies decidedly between northwest and southeast, as in Eastern Asia, the fact seems better substantiated than in Europe (can, indeed, be considered as fixed), and the inference is justifiable that the condition on the eastern coast of Asia is similar. Russell verifies by his own observations in Canada, in Washington, the Southern States, and Cuba, the statement of Espy, that in the United States there is an unvarying upper current of air from the west. Blodgett asserts that at Philadelphia, at all seasons, a western current can, not unfrequently, be detected by cirrus clouds. In Northern Asia, even on the east coast, no exact information on this point has been supplied, on account of the neglect to notice particularly cirrus clouds. In interior Asia a few definite observations can be given, and on the east coast of Siberia a few at least not contradictory ones, inasmuch as the existence of cirrus clouds has been noted with varying inferior winds, but without giving their direction. If it should be demonstrated, then, which the writer does not doubt, that the high cirrus clouds, the greatest elevation of which can be placed at 40,000 feet, on the east side of the two cold poles do not take part in the variation of the anti-trades from a west-southwest to southeast direction, but that these elevated masses of ice crystals and flakes continue unaffected in the normal direction imparted by the earth's rotation, the fact will be of the highest importance in giving a more correct exhibition of the total movement of the atmosphere, and lead to the conclusion that the whole depth of the atmosphere does not find the initial and final point of its motion in the region of the greatest cold, but that a very considerable and more elevated portion moves above this, having this point at the geographical pole of the earth. There would be in this a new proof that the whole atmosphere takes part in the circulation between the equator and the poles, and that the cause of the movement is not simply the difference of temperatures, but much more—the centrifugal force of the earth's rotation, in consequence of which there exists at the points of maximum velocity, during the night as well as the day, a continuous upward current, of aspiration, of the trade or polar current drawn to this region, and that this air, with the moisture contained, must again descend. This may only take place in the polar latitudes, toward which it moves, and which it finally reaches in its normal west-southwest direction, also by force of aspiration, as compensation for the air drawn from those regions.—3 *C*, *September* 30, 1872, 949.

INFLUENCE OF FORESTS ON RAIN-FALL.

The question as to the influence exercised upon the amount of rain-fall throughout the year by the presence or absence of forests, is beginning to excite much attention, and numerous communications on the subject make their appearance in the scientific journals. M. Lemoine, in a paper read before the British Association, remarks that the existence of any influence of this kind must be considered extremely doubtful. In the basin of the Seine it has been shown that forests, as compared with soil coated with grass, have no peculiar influence upon the water-courses. The real function of forests, in his opinion, consists in their protection of the soil by preventing the earth from being carried away, and in their retarding the flow of torrent waters. In fact, in the Alps, the presence of forests prevents the formation of torrents, and the replanting of woods extinguishes torrents already existing; although, in many cases, merely turfing the soil produces the same effect.

In illustration of the influence of vegetation in retarding evaporation from the soil, an experiment was adduced which consisted in sinking two cylindrical jars of the same size into the ground to the depth of four inches, leaving them projecting one inch above the surface. One of these was placed in a newly cleared plot, and the other where it was partially but not completely protected by the bushes. The same amount of water was placed in each jar, and at the expiration of five days it was found that the evaporation from the jar in the open grounds had been more than twice that from the one which was covered.—18 *A*, *September* 6, 1872, 637.

DRYING UP OF THE ISLAND OF SANTA CRUZ.

The Bulletin of the Torrey Botanical Club contains a suggestive paragraph in reference to the influence of trees upon rain and atmospheric moisture, as shown by the experience of the island of Santa Cruz in the West Indies. This island is said to have been a garden of freshness, beauty, and fertility twenty years ago; it was covered with woods, trees were every where abundant, and rains were profuse and frequent. The recent visit of a gentleman who had known the island in its palmier days, revealed a lamentable change, one fourth of the island having become an utter desert. The forests and trees had been cut away, rain-falls had ceased, and the process of desiccation, beginning at one end of the island, had advanced gradually and irresistibly upon the land, until for seven miles it had become dry and barren as the sea-shore. Houses and plantations had been abandoned, and the advance of desolation was watched by the people, wholly unable to prevent it, but knowing, almost to a certainty, the time when their own habitations, their gardens and fresh fields, would be a part of the waste. Indeed, the whole island seems doomed to become a desert. This sad result is owing entirely, according to the belief of the inhabitants, to the destruction of the trees upon the island some years ago.—*Bull. Torrey Bot. Club*, 1872, III., 38.

ELECTRIC STORM OF JANUARY 7–8, 1873.

Some interesting electric phenomena were noticed on the occasion of a recent storm in the Northwestern States, and as the extended net-work of telegraph lines affords opportunity for studying similar occurrences whenever they recur, it is to be hoped that attention may be more generally given to the accurate observation of these electric storms. Excepting a notice in the Chicago *Tribune*, the only account that we have of the phenomena is that communicated by Mr. Simmons to the Chicago *Inter-Ocean*, of January 22, from which we make the following summary:

At 2:25 P.M., January 7, while a severe storm was raging in Minnesota, and a high southwest wind, with light snow and very low temperatures, prevailed in Central Iowa, it was noticed at the telegraph offices in the latter district that atmospheric currents were interfering with the working of the telegraph lines. These currents increased in intensity to an almost unprecedented extent, and then died away during the evening.

At 6:45 P. M. these disturbances were noticed at the offices in the Mississippi Valley separating Iowa from Illinois.

At 9:30 P. M. light disturbances were noted at Chicago, and continued at intervals during the night and until the evening of the 8th, when the discharges became very rapid and intense. It was now ascertained that the phenomena had entirely ceased in the Mississippi Valley, and that the region of disturbance was probably central at Chicago and eastward. Here, as before, with two or three exceptions, the effect was confined to wires running due east and west, the exceptions being the north and south lines, on which, however, but little interference was noticed.

Later in the evening of the 8th, the disturbance was felt at Detroit, Michigan, and "every observation confirmed the opinion" that the central path of the storm extended "from Des Moines, Iowa, due eastward to Detroit, Michigan, narrowing its limits north and south as it approached the latter place, after which it rapidly subsided."

It is well known that in all these observations there is generally some doubt as to the interpretation of the observations, owing to our ignorance of the state of insulation, etc., of the telegraph wires. In the present case, however, Mr. Simmons appears to have made accurate observations relative to this point, since he states that while the east and west wires were almost exclusively affected, the known resistance and insulation of these lines, in reference to the propagation of ordinary voltaic electricity, did not in the least assist tc explain the observations. Indeed, he states that the large number of operators and practical telegraph men who witnessed the display quite agree that the effects were entirely different from those experienced during the ordinary auroral storms with which they are familiar.

It is therefore probable that the present is a case of atmospheric electricity as distinguished from that known as ground currents, the latter being connected with auroral displays. While the phenomena of January 7–8 were evidently concomitants of the storm that prevailed from Minnesota to

Lake Huron; and it is perhaps probable that the disturbances of the 8th at Chicago and Detroit were in a measure independent of those observed on the 7th in Iowa.

SIGNAL TELEGRAPHY AND THE HERRING FISHERY.

The business men of Eastport, Maine, have succeeded in having a signal station established at that place for the purpose of obtaining information that will be of great service in connection with the fishing business, which constitutes its chief staple. A very important branch of trade has lately risen there in what are called "frozen herring." These consist of sea-herring (*Clupea elongata*) of the largest size, which have recently been discovered in great abundance within a circle of twenty miles' radius from the village. They are taken in gill-nets and frozen, and in that state shipped fresh to market, where they bring a good price, the value of the fishery up to the middle of January being estimated at twenty or thirty thousand dollars. In this instance it is of importance that a premonition of the weather be obtained as far in advance as possible, since if, during a cold snap, the weather become suddenly warm, it will be an intimation to close up operations, so as not to have a large stock of unsalable fish on hand; while, on the contrary, should cold weather be anticipated after a warm spell during the winter, the fishermen would be on the *qui vive* to make arrangements for taking the earliest advantage of the opportunity. It is also a matter of much moment for such of the boats as start off with their cargoes to market, as well as for those who depend on fishing out at sea on the outside fishing-grounds, to know something of the probabilities for the coming twenty-four or forty-eight hours.

RAIN-GAUGE AT SEA.

The apparatus used for the determination of the amount of rain-fall on land is not adapted for use upon the sea, but an arrangement has recently been devised by which the rain-gauge is hung like a ship's compass in its gimbals: an open mouth is thus always directed toward the sky. In this way it is hoped that much valuable information will be obtained, which will have an important bearing on the discussion of the subject of general climatology. It is probable that hereafter such gauges will constitute a part of the equipment of every vessel fitted out for scientific purposes.—12 *A*, *January* 16, 1873, 202.

DERANGEMENT OF THERMOMETERS IN CARRYING.

It often happens in the transportation of thermometers, especially if the boxes are jarred, that a portion of the mercurial column separates and moves toward the end of the tube. This may generally be reunited with that in the bulb by allowing the thermometer to drop from two to three inches in a vertical position upon a card held in the left hand; or by holding the thermometer in the right hand, and striking the arm (*not* the thermometer) against the palm of the left hand; or, finally, by whirling the thermometer with care, and not too rapidly, by a cord attached to the end. In many cases, however, the detached column of mercury may be very small, perhaps a degree, or even only half a degree, so that the error it occasions may be referred to inaccuracy in fixing the zero point, and in such cases its weight is not sufficient to enable it to overcome the adhesion to the glass. The following method will also meet such cases: Incline the thermometer, with the bulb highest, at an angle of 20° to 40°, and strike the bulb end gently with a flat piece of wood in the direction of the tube. Some of the mercury will pass out, fill the whole tube, and unite with the detached portion. Then slowly and carefully change the inclination of the thermometer until the bulb is so much depressed that the mercury barely begins to move toward it, and, as a rule, the whole united column of mercury will flow toward the bulb. A small bubble of air will generally be present at the point where the separation previously took place, but if the inclination be carefully changed, as above directed, and jarring entirely avoided, it will remain upon the glass, and the previously detached column will readily pass it.—14 *C*, 1872, CCVI., 240.

SIGNAL-SERVICE WEATHER BUREAU.

We notice in the French journals several statements relative to the Army Signal-office that are quite erroneous. They are to the effect that "the Signal-office was created by the late Commander M. F. Maury," and that "the United States government, at the request of Mr. Maury, established the present system of storm signals." While fully recognizing the debt that the world owes to Mr. Maury, it is evident that in the preceding statements a great injustice is done to the men who really built up the present system of weather probabilities. In reference to this system, it is not too much to say that the published reports and other documents show that Mr. Maury has had nothing to do with it. The Army Signal-office is a purely military institution, and it had no existence as such until gradually developed during the late civil war by the exigencies of war and the genius of General Myer. During this period Mr. Maury, as is well known, was one of the most prominent leaders of the Southern cause. Storm warnings did not form a part of the duties of the chief signal officer until the Secretary of War specially intrusted to him the execution of the law passed by Congress in 1870. In the passage of this law Mr. Maury had no part whatever, its framing and advocacy being wholly due to Professor I. A. Lapham and Hon. H. E. Paine, both of Milwaukee, Wisconsin. It is, however, to be remembered that the way had been paved for the success of these gentlemen in their public-spirited enterprise not only by the success of the long-established system of storm signals in Europe, but by the still earlier labors of American meteorologists. It was Redfield who first in America, in 1838, satisfactorily established the law of the progression of storms. Espy, as meteorologist to the Navy, and subsequently to the War Department, showed by his daily weather maps for a number of years that storm prediction was perfectly possible. The Smithsonian Institution had established the first system of telegraphic meteorological reports, and when, after many years, it was discontinued, Professor Abbe revived it at Cincinnati in 1869, and by actual daily predictions (which had not been attempted by the Smithsonian) combined the labors of his predecessors into a successful and practically useful undertaking. He has himself narrated the unsuccessful attempts he made to enlist the co-operation of Chicago and other cities in a national system; but to his correspondent in Milwaukee was reserved the full success of this undertaking. To Professor Lapham must the credit be given of having brought to a most successful conclusion this long line of efforts. The field of

Maury's labors was so exclusively upon the ocean that, were he living, he would be the first to correct the errors that have been circulated in France.

METEOROLOGY IN CANADA.

The meteorological system of the Dominion of Canada is, as most of the citizens of the United States are aware, in a very prosperous condition, and has many features of the weather bureau of our own country. From the second annual report of the superintendent, Professor G. Kingston, of Toronto, we learn that the organization embraced (in January, 1873) one central station, Toronto, seven chief stations, eleven telegraphic reporting stations, and one hundred and twenty-six ordinary stations. Among these last are included thirty-eight light-houses, by the addition of which Professor Kingston has materially added to the value of his net-work of observing stations, which has become one of the best in the world, and is specially valuable in that it supplements the extensive system now under the direction of the War Department. As most of the observers are volunteers, the entire expense to the government of the maintenance of this system (including the hoisting of warning storm signals) amounted to the small sum of eight thousand dollars. Under the heading of "Recent progress and present condition of meteorology in Canada," Professor Kingston says: "Prior to the autumn of 1869 there were but few meteorological observers in the Dominion. . . . Being dissatisfied with a state of affairs so discreditable, . . . I addressed myself by letter and in person to those actually engaged in meteorological observations, and also to others. . . . The result has been a steady increase in the number of observers, and in the exactness and regularity of the observations. From October, 1869, to the spring of 1871 the meteorological work of Canada was carried on by an organization that was strictly voluntary. The work of organizing new stations, and of compiling returns, was gratuitously performed by the director of the Toronto Observatory and his assistants. In the spring of 1871 the Legislature of the Dominion recognized the value of these labors by a grant of $5000 for the promotion of meteorological research, and with a special view of preparing the way for establishing a system of storm signals. . . . I have always entertained the opinion that a system of weather prognostications would have been placed eventually on a firmer footing if its establishment could have been postponed till greater development had been given to the . . . statistical stations. Had it not been for the action of the United States during the last three years, the course just indicated by me would have been the wisest. The fact, however, that the United States have inaugurated a very liberal and extensive scheme, and that the observations taken at upward of sixty stations distributed throughout that country can be placed at the disposal of Canada on the easy condition of paying the cost of the telegrams from Buffalo to Toronto, is a very strong reason why Canada should enter on a work now which in other circumstances would have been better postponed. . . . With respect to the dispatch of warning signals to Canadian ports . . . I have thought it better to make an arrangement with the Signal-office at Washington whereby notices of disturbances which are likely to reach any part of the Dominion are sent to me from Washington.—*2d Report of Professor Kingston.*

METEOROLOGY IN RUSSIA.

The extensive system of meteorological stations that at the earnest representations of Humboldt and others was established throughout the Russian possessions, in the year 1830 and subsequently, after continuing unbroken until 1864, was in that year somewhat affected by the death of Kupffer. His successor, the eminent Kämtz, unfortunately lived but two years—too short a time to effect the many improvements that he had projected. It has thus been left to Wild to thoroughly reorganize this highly important series of stations. The first volume of observations under the new system—that for the year 1870—has but just been received (the delays incident to the publication of such an immense mass of figures are well known to those engaged in similar works). In this, besides the hourly results carefully deduced from the continuous records of the self-registering instruments at St. Petersburg, there are given, both in detail and in monthly means, the observations made during the year at seven stations in Asiatic and thirty-nine stations in European Russia, in addition to those taken by Mr. Fritsche at the observatory in Pekin, China. The introduction gives a very exact account of the reliability of the various different series, which is highly valuable to those who have occasion to use either this or the earlier volumes of observations. The altitudes of the stations must necessarily almost always be determined barometrically, and in this important matter the researches of Hann on decrease of temperature, and the admirable hypsometric tables of Rühlmann, are uniformly used.

INTERNATIONAL WEATHER TELEGRAPHY.

Mr. Allison, the meteorological agent of Nova Scotia, has recently communicated to the Scientific Institute at Halifax the following letter from Mr. Scott, the director of the Meteorological Office at London. Mr. Scott says: "The various nations here are establishing centres of their own. These exchange reports daily, and send extra telegrams to each other whenever a storm is reported. Each office then decides for itself whether or not it will warn its own coast. This is the plan we have introduced, and it is adopted by Holland and Norway; Sweden and Denmark are also about to take it up, and Russia will probably follow suit. The French system of extensive generalization gives a magnificent view of the general condition, but does not enable you to draw conclusions for local storms and weather. It is also perfectly impossible for a distant central station to keep its observers in check. Telegraphic errors are our *bête noir*, and it is expensive work asking for repetitions over long lines; consequently the French reports are seldom if ever corrected before publication, and errors of an inch sometimes appear in their charts, and are never subsequently corrected. The storm signal we use is the drum, and we hang up under it, in a frame, the order to hoist it."—*Proc. Nova Scotia Sci. Inst.*, IV., 165.

METEOROLOGY IN THE ARGENTINE REPUBLIC.

The progress of the science of meteorology has of late years been so decided as to warrant the establishment of the extensive systems of storm warnings that are now in operation in every civilized country of the northern hemisphere from India to America. It is therefore with the greatest pleasure that we chronicle the establishment of a National Meteorological Bureau in the Argentine Republic of South America—one that will, it may be hoped, eventually become a telegraphic storm-warning system. A letter of February 4 from Dr. B. A. Gould, a distinguished American astronomer, and now the director of the observatory at Cordova, gives the following information on this point:

"Here the meteorology and climatology of the vast tract of country from the tropics to Cape Horn, east of the Andes, has remained until this time almost unknown, notwithstanding the singular and very exceptional character of the atmospheric relations. Although reluctant to spare any time from the astronomical investigations which brought me here, I have been so much impressed with the absolute scientific necessity of a series of meteorological observations in the vast territory of the Argentine Republic that I have procured the passage of a law establishing a National Meteorological Bureau, and have assumed the charge of it until it can be properly organized and confided to other hands. Within a few months I hope to have something like fifteen to twenty observers at work, making three observations daily; and in another year I am not without hopes of having double that number engaged in the work, from the slopes of the Andes and the borders of Bolivia down to the confines of Patagonia. The government has assigned $6500 this year for the purchase and transportation of instruments. . . . The weather causes us (astronomers) much trouble. This is the ninth consecutive rainy or overclouded day—not sun, moon, nor star having been visible in all that time. And yet, before selecting Cordova as the site of the observatory, I had been assured that I might count upon 320 clear nights in the year! But 120 would have been nearer the mark."

DOVE ON CLIMATE.

The reliability of the commonly accepted views of Dove as to the possibility of obtaining from a short series of observations the true average climatic conditions, by applying to the given series corrections for non-periodic changes deduced for some neighboring station, has recently been investigated by a study of the observations made at Chiswick and in London since 1826, the material for which has only lately been published. As this is the first attempt to firmly establish the truth of the views Dove has long maintained, it is interesting to fully consider the conclusions which he thus sums up: "From this investigation it results that if in the determination of annual mean temperature and its periodic variations the influence of the local peculiarities of the place of observation can not be recognized, then in the determination of the non-periodic variations of temperature in the neighboring stations its influence will be so unimportant that it can be neglected, presuming throughout that there is no important difference of altitude in the stations.

"In my investigations into non-periodic variations, I have always referred the deviations of individual years to secular mean values derived from a very long series of years, which secular means were determined for the same years for the stations under examination. Since for but too few stations there exist these long series of observations, it was necessary to find a method of deriving secular means for the stations embracing a few years of observation, such as would have been given by a long and simultaneous series. I have, therefore, for the neighboring so-called normal stations, for which I had a long series of observations, computed the means resulting from the use of only the same years as those for which observations at a short-period station were available. The difference between this mean and the secular mean gave a correction to be applied to the mean for the secondary station, in order to obtain for it a number corresponding very nearly to what would have been its secular mean." This process implies the assumption that the non-periodic variations of the two neighboring stations were identical. The present investigation contains a striking confirmation of the correctness of this method of procedure, now so generally applied.

A communication has been made to the Academy dei Lincei, of Rome, by M. Tarry, giving the results of his personal experience and investigations into the connection between the cyclonic storms and the showers of sand that frequently visit Southern Europe.

M. Tarry, after traveling as secretary to the French Meteorological Society into Northern Africa and the Desert of Sahara, and having consulted the files of the *Daily Weather Bulletin* of the Paris Observatory, believes himself to have established the fact that whenever a cyclone passes southward from Europe over the Mediterranean Sea into Africa (as some few of them do every season), it then returns northward or northwestward, and transports the sand which in the desert formed a sand-storm to the southern coasts of Europe as a sand-shower of greater or less duration.

The satisfactory investigation of this subject is much impeded by the absence of barometric observations on the southern shores of the Mediterranean; and to remedy this defect, M. Tarry has recently established new meteorological stations at Mogadore, Morocco; Terceira, Madeira; and even in the interior of the Sahara.

INFLUENCE OF FORESTS ON THE TEMPERATURE OF THE GROUND.

The Bavarian physicist Ebermayer has investigated the influence of forests on the climate of the neighborhood as shown by the numerous observations recorded in that kingdom. Among his conclusions are the following results as to the temperature of the ground, as determined by thermometers sunk to depths of one and six inches, and of one, two, three, and four feet. For the upper layer of earth, within one foot of the surface, the minimum monthly mean temperatures occur both in open and in wooded regions in the month of January; only on the high mountains does the lowest temperature occur in February. The temperature increases from February on, until its maximum in July; at the high stations only does the maximum occur in August. From July or August the temperature decreases to January or February. To the agricultural interests it is especially important to note that the monthly increase of temperature is most rapid in May, and is nearly as great in April; it is least in June and July. Concerning the strata lower than one foot, Ebermayer finds that the monthly increase in temperature is greater in June and July than it is in the upper stratum. The loss of temperature is, in the upper stratum, most rapid in November and October, and least in the coldest weather in January and February. In forest-covered places, the lowest temperature occurs in February, and continues to June, during which interval the ground is cooler than the air; in July and August the ground is somewhat warmer than the air. The greatest difference between the temperature of free and forest land occurs in May, and the least in June. The fluctuations in forest land are less than in open ground. The influence of the forest in preventing the cooling of the ground by the radiation of its heat is most noticeable in October and November, and least in January and February.

METEOROLOGY IN HAVANA.

The recent establishment of a signal station at Havana, Cuba, brings to notice a number of meteorological observations that have been made at the Jesuit College in that city during the past twenty-five years. The regular publication of these observations and the deductions that may be drawn from them lead to the conclusion that science will receive very valuable aid from this station in the West Indies. The prevailing wind in this region never deviates more than a few degrees from the east. The total number of rainy days in the year is on the average one hundred. Numerous coincidences have been observed between magnetic disturbances and local storms or hurricanes, also between the former and auroras, visible perhaps in distant lands. On the other hand, very frequently the records at Havana show remarkable magnetic perturbations that have not been recorded by the photographic apparatus at Greenwich, England. The amplitude of the daily barometric range is least in June and July, and greatest in the winter months. Fourteen years of observations have been insufficient to determine any certain law respecting the years of hurricanes. They are, however, as is well known, far more frequent from July to January than during the other half of the year. A careful investigation of the terrible hurricanes of October, 1870, leads the Rev. R. P. B. Vines to the conclusion that the winds circulating around the centre of the cyclone describe a circle, and the whole cyclone describes a curve on the earth's surface, such as would be given by wrapping a spiral around a parabola, the folds of the spiral being closest at the apex of the curve. The rate at which the vortex of the cyclone of the 7th of October crossed the island of Cuba was only four miles an hour. The second storm, of the 19th of October, began moving at the rate of nine and a half miles, and increased to twenty miles an hour. The discharges of electric fluid were very intense, and at Cardenas an appearance similar to the aurora borealis was visible for ten minutes. The magnetic needles were very much disturbed. The rising of the sea under the centre of the cyclone is attributed by Vines to the low barometer prevailing there, to which also he attributes certain slight shocks of earthquake, due to the violent expansion of gases confined within the cavities that abound in the island.—12 *A*, 1873, 295.

ON THE SOURCE OF ATMOSPHERIC ELECTRICITY.

In a recent number of the journal of the Austrian Meteorological Society, Mühry has contributed somewhat to a better understanding of the obscure subject of atmospheric electricity, by considering it in reference to its geographical distribution. He maintains that the distribution over the earth's surface of the quantity of electricity is in general parallel with the distribution of temperature; it increases and diminishes with the latter, as well in reference to the earth's surface as in reference to the time of the year and the day. The insolation of the earth is to be considered as the source of the atmospheric electricity: its origin lies in the insulating stratum, and it is in this respect to be considered as terrestrial and not celestial. Atmospheric electricity diminishes as we go from the equator to either pole, and it therefore does not depend on precipitation of vapor, but on temperature. Terrestrial magnetism increases in force as we approach the poles. Electricity is strongest in dry, hot deserts. Contrary to the theories of Dellmann and of Peltier, Mühry holds that aqueous vapor is merely the conductor, or rather convector, bearing the electricity into higher regions. He suggests that it is more important to meteorology to observe the quantity than the kind of electricity, and that the simple straw electrometer of Volta will suffice, instead of the more delicate and complicated instruments that have been deemed necessary. The most important problems that are now remaining to be solved are, he thinks, the details of the geographical distribution in reference to latitude, longitude, and dry and moist climates.—*Zeitschrift für Meteorologie, March*, 1873, 129.

THE ADIRONDACK STATE PARK.

The Commissioners of the State Parks of the State of New York were directed at a recent session of the Legislature to inquire into the expediency of vesting in the state the title to the lands forming the Adirondack wilderness, and converting the same into a public park. After a careful consideration of the subject, they report very earnestly in favor of the proposition, their arguments as to its great importance being unanswerable. They show that while the forests may not necessarily increase the amount of rain-fall in the country, they yet equalize the distribution of the water so as to make it more serviceable for the purposes of agriculture, manufactures, and commerce.

The Adirondack region is one particularly important in this respect, being the highest part of Northern New York, the streams of which, starting in the forests, flow to all points of the compass, the most important being the Hudson. The region, it is true, is in many parts very rocky, but these rocks are covered with a dense growth of moss (sometimes to the depth of several feet), and the whole region is heavily timbered, with the exception of the summits of the highest peaks, and the water at the surface is thus held as by a sponge; and hence, however violent the rain-fall, the moisture is given off gradually through springs, so as to be equalized to a great extent throughout the year. Under these circumstances freshets in the mountains are of comparatively rare occurrence, while at the same time the level of the water varies much less than would be the case if the opposite conditions prevailed.

If, now, the timber be cut off and the underbrush removed, the surface will be exposed to the action of the sun, and its moisture rapidly exhaled into the atmosphere, instead of draining off in the form of springs and rivulets. The falling rain, too, and the melting snows of spring, would pass off much more rapidly, producing floods and causing great damage, but soon running off, and in a short time leaving the streams below their natural level.

The amount of wild land in the Adirondack wilderness is estimated at 1,727,000 acres, or about 2703 square miles. The market value of this property is very slight, and in most cases is now represented by the worth of the timber and the chance of getting it to market. The state already owns nearly 400,000 acres, and the remainder can be obtained at a moderate price. It is thought that the mineral wealth of the region, which exists to an enormous extent in the form of iron of the best quality, can be utilized by transportation to points where the smelting can be done by means of coal, thus avoiding the drain of the timber required for charcoal purposes. The country abounds with game, which would be preserved by the conversion of the region into a park, furnishing a source of pleasure and recreation to summer tourists.

The precedent of the general government in establishing the Yosemite Valley as a national reservation, in charge of the State of California, and in establishing the Yellow Stone Park, for the benefit of the whole nation, is urged as an argument in this case. Although the results of the complete deforesting of the Adirondack region, which would ultimately ensue if unprotected, are presented in a very startling manner, there is no flaw to be found in the reasoning; and as one consequence, there is no little reason to anticipate that the reduction of the Hudson to a stream unfit for purposes of steady water communication would follow, while the streams flowing from the Adirondack region would become insignificant, involving serious consequences to the manufactories now located upon them.

In addition to this, as already remarked, would be associated floods of terrific violence, which would carry destruction and devastation before them. Beyond the mere cost of acquiring this property, the expense of keeping it up would be trifling. Wardens to prevent the destruction of the timber, and the improvement or construction of roads at a few points, would be all that would be required. It is suggested, too, that the lease for stated periods of certain favorite localities to parties desirous of forming villas or hunting lodges would form an important source of income, which would probably more than pay the current expenses of maintaining the park.

THE LIMIT OF PERPETUAL SNOW.

The altitude above the sea-level of the limit of perpetual snow has been the subject of some observations and deductions recently presented by Grad to the Paris Academy. He shows that not only the diminution of temperature in the higher strata, but also several other conditions, must conspire to fix this altitude; such as the depth of the annual fall of snow and the dryness of the atmosphere, the direction of the winds, and the amount of the cloudiness. Grad finds the altitude of the lowest limit of permanent snow to be less within the tropics than under the latitudes of twenty to thirty-five degrees, whence again it diminishes to three thousand feet in the latitudes sixty degrees south and sixty-five degrees north. For no known part of the globe does the belt of perpetual snow descend to the level of the sea, nor to within less than a thousand feet of altitude; not even in the region where the average temperature of the cold half of the year is below freezing, as in Greenland and Spitzbergen.

It is only the glaciers that descend to the sea-level in the countries south of forty-five degrees south latitude, and north of sixty degrees north latitude, by reason of the excessive falls of snow accompanying moist winds.—6 *B*, 1873, 780.

POEY'S CLASSIFICATION OF CLOUDS.

Poey has presented his classification of clouds to the Paris Academy of Science for their approval. In doing so he says that the honor of classifying the clouds by their types belongs to the naturalist Lamarck (1801), and especially to the English meteorologist Luke Howard (1802). Later writers, in following the classification of Howard, have made some mistakes, which Poey now proposes to explain. He states that the stratus of Howard is confounded with his mist or hoar-frost, his original description of stratus having been first published in 1803 in *Tilloch's Magazine.* The nimbus, as defined by Kämtz, and after him by all meteorologists, has no actual existence. In the definitions of cumulus, cumulo-stratus, and strato-cumulus there is a great confusion. Having, for good reasons, omitted the stratus, nimbus, and cumulo-stratus of Howard, and the strato-cumulus of Kämtz, Poey preserves only the two types, cirrus and cumulus, and the two derivatives, cirro-stratus and cirro-cumulus, and replaces the four rejected orders of clouds by the following three derivatives: pallio-cirrus, pallio-cumulus, and fracto-cumulus. The pallium is the sheet cloud, of which two strata are generally present during rain, hail, or snow; the upper cloud (the pallium) is electro-negative; the lower (the pallio-cumulus) is electro-positive. The term nimbus indicates the defective nature of our observations. The cumulus is rare in winter, and abundant on hot summer days. It disappears periodically in the dry winter season in the climate of the city of Mexico. The constitution of clouds is intimately dependent on the intensity of the heat, and there are but two fundamental types—the cold cirrus or cirro-stratus, and the warm rain-clouds, the cirro-cumulus or pallium.—6 *B*, 1873, 823.

THE STORMS OF NORTHERN EUROPE.

There has just come to hand a memoir by Hildebrandsson, recently printed, but presented some two years ago to the scientific society of Gothenburg.

The author's work consists in the special study of some severe storms of Northern Europe, and he states that his object has been not to combat any previous theory, but, on the contrary, to give as far as possible, independently of any previously conceived opinion, a contribution from Sweden to the fund of facts upon which every theory ought to be established. The accurate hourly observations made at Upsala have proved of great value to him in his studies.

His conclusions are summed up by himself as follows (and that they are so nearly accordant with the laws of other investigators in America, in Europe, and India, would seem to argue that the same causes operate in the same manner throughout the world to direct the origin and progress of storms): Hildebrandsson says that the study of weather charts shows: 1. Regions exist of high and low barometer, which are surrounded by isobarometric lines of a more or less regular form. 2. The isobars surrounding the areas of maximum barometer are further separated from each other, the winds are feebler and variable, and the sky is generally serene; these are thus the centres of fine, calm weather. 3. On the contrary, around the lowest barometer the isobars are more crowded together (at least on one side), the wind is stronger in proportion as the isobars are nearer, and the direction of the wind is determined at any point by the law of Buys Ballot, so that the air seems to move about the centre of depression in a direction contrary to the movements of the hands of a watch. At the very centre itself is sometimes found a region where the isobars are further separated from each other, and where consequently the winds are feeble. 4. All the centres of depression come from the north. 5. The path of a storm is in general preceded by a cloudy sky and rain or snow; the rear is, on the contrary, less cloudy. 6. An intimate connection exists between the changes of the various meteorological elements during a storm. In the more southern countries various perturbations obscure more or less the relation that in Sweden appears in a striking manner. By studying principally the barometric minima of winter nights, we have almost entirely eliminated these perturbations, and find: 7. That the wind varies with a surprising regularity, so that from it we can fix at any time, by Buys Ballot's law, the direction in which the centre of low barometer is to be found. 8. The nearer the centre passes the place of observation, the greater becomes the velocity of fall and rise of the barometer, and the quicker the wind veers if the centre is to the north, or backs if the centre pass to the south of the station. 9. If a new storm centre approach, the wind changes in the direction called "backing" toward the south when the maximum barometer has passed. 10. The pressure of the air and the temperature change in opposite directions, the daily curves of barometer and thermometer being in fact nearly contrary to each other. 11. The changes in the pressure of the aqueous vapor nearly follow the changes of temperature.

Numerous weather charts are given by Hildebrandsson to illustrate the preceding memoir; and among them are specially interesting the hourly charts for Upsala, on account of the condensed yet very clear view that they afford of the principal features of the weather, the peculiarity consisting in showing by a single dot the wind, weather, and barometer, while another dot shows the temperature and rain.—*Gottenbourg Ken. Soc., December*, 1872, 26.

EASTERLY CURRENT IN ENGLAND.

An attempt was recently made in London, to determine the vexed question of the existence of a persistent current in an easterly direction in the upper strata of the atmosphere. The ascent was made by Mr. Coxwell in his old historic balloon, the *Nassau*, but the result of the experiment, as far as it goes, was unfavorable to the theory, the balloon having steadily moved, when it reached the altitude determined on (10,000 feet), in a nearly southerly direction.

THE FORMATION OF CLOUDS.

Mühry has lately presented, in a very impressive manner, the conclusions deducible from some observations published by Meissner, in 1863, on the formation of vapor vesicles and of clouds. The researches of Meissner were mainly directed to the relations of ozone and antozone, and it was only as one of the incidental results of his work that he announced that, without the presence of oxygen in the air, there could be no clouds. In regard to this important point Meissner's researches have apparently not attracted the attention that is due them, and Mühry urges that meteorologists and physicists are not yet to consider that the question of the existence of vesicles of vapor has been settled in the negative. Basing his conclusions on Meissner's researches, Mühry says that the condensation and precipitation of aqueous vapor would take place immediately, in the form of small drops, if it were not for the presence of oxygen in the air; that this gas itself brings about the transition stage—the vapor vesicle. The experiments of Meissner consisted in confining within the receiver of an air-pump a mixture of aqueous vapor and the gas to be experimented on. By a rapid stroke of the piston the mixture is then quite suddenly expanded, and the cooling due to expansion produces a precipitation of a portion of the inclosed vapor. The faint cloud that is seen by close observation within the receiver continues but a few minutes, and was first observed with special care by Saussure, in 1783. Meissner, however, has shown that when other gases replace the air within the receiver, the condensation in general takes place not in the form of a cloud, but of fine, light drops that fall directly to the bottom, the cloud being produced only when oxygen is present, either pure or mixed with other gases. These experiments have been repeatedly and very carefully made by Meissner with air, nitrogen, hydrogen, carbonic acid gas, and in pure aqueous vapor alone, and in various mixtures of these gases. Meissner further measured the exact degree of expansion needed to produce these vapor clouds, and found that saturated air at 30 inches deposited its vapor when the pressure is suddenly reduced to 21.4 inches; by a second step he passed from saturated air at 21.4 inches to 16.1 inches, when a somewhat fainter cloud was formed; the third cloud was formed on passing from 16.1 to 13.8 inches, the fourth on passing from 13.8 to 10.7 inches, and a fifth on passing from 10.7 to 8.5 inches. These barometric pressures correspond respectively to altitudes above the sea of about 8000, 15,000, 19,000, 23,000, and 27,000 feet, and the clouds successively formed were of diminishing grades of delicacy, those formed in the rarest medium being extremely delicate and evanescent. For all further degrees of expansion Meissner was unable to perceive any cloud vesicles, although minute transparent drops were present. These results would be directly applicable to our atmosphere had Meissner been able to reduce the temperature of his receiver to that experienced in the upper regions of the atmosphere.—*Zeitschrift für Meteorologie, January*, 1873.

THE DANGERS OF LIGHTNING.

In Germany there exist insurance companies providing specially against loss by stroke of lightning, and in the interest of these special care has been taken to preserve the statistics of lightning strokes, the resulting loss, and the effect of lightning-rods. From a recent report we take the following statistics: In the thirty-one years from 1841 to 1871, in Saxony, 2239 cases of damage by lightning were recorded, of which 1293, or 58 per cent., were cases of "hot strokes" (*i. e.*, they set fire to the material), and 946, or 42 per cent., were the so-called "cold strokes." The total damage is estimated at 15,000,000 thalers. In consequence apparently of the increasing number of hard roofs (metallic roofs, slate roofs etc.), the ratio of hot to cold strokes has apparently diminished, and for the seven years, for example, from 1864 to 1871, the ratio is 46½ per cent. of hot strokes to 53½ of cold. Of the strokes falling on dwellings with hard roofs, only 22 per cent. set fire thereto, while of those falling on houses with soft roofs, (wooden roofs, thatched roofs, etc.), 73 per cent. were ignited. The lightning appears, in the instant of striking, to lose remarkably its power of firing the object struck, often leaving a building entirely unhurt when it does not at first meet some combustible substance. The denser the body, and the better it conducts heat, the less is the power of the lightning to fire it; and a stroke falling first on such a body never sets fire to any thing that it may afterward encounter in its path. Thus has it frequently happened that a very inflammable roof has been protected by an iron knob, when, as is frequently the case, this, the highest portion of the building, is first struck.—*Verein sächs Ingen.*, 1872, 8.

BAROMETRIC DETERMINATION OF ALTITUDES.

Monsieur Montigny has laid before the Academy of Sciences of Belgium the results of a series of experiments made on the spire of Antwerp Cathedral, in which he determined barometrically the heights at several points in winds of different directions and velocities. His tables show a difference between the calculated height and the real height, the latter being greater for winds in the eastern semicircle, while the former is greater for westerly winds. In north and south winds, and those closely neighboring, the heights measured both ways closely agreed. The differences between true and barometric altitude increase regularly, according as the observer stands on the east and west or north and south sides of the spire. The height, as measured by the barometer, increases as a rule with the velocity of the wind. No connection was found between barometric height and the inclination of the wind. Observations at Namur and Brussels, compared with those at Antwerp, show a systematic variation like that just described.—12 *B*, 1873, 375.

THE LOCAL DEVIATION OF THE PLUMB-LINE.

Baeyer communicates to the Royal Prussian Academy of Sciences a note with regard to the local deviation of the plumb-line, and its influence upon accurate levelings. Upon the Brocken, the absolute latitude is 10″ greater than that which is computed for the same spot by triangulation, connecting it with the Seeberge. Three miles north of the Brocken, at Hornberg, the observed latitude is 4″ greater than the computed. If, now, we assume that at a greater distance, as, for instance, at Wolfenbuttel, these discrepancies diminish, so that observation and computation agree, then it must follow that between Seeberge and Wolfenbuttel there exists a northerly deviation of the plumb-line; that is to say, a deviation such that the zenith of the plumb-line is north of the normal zenith, and that the northerly deviation greatly increases from the Seeberge to the Brocken, where it reaches a maximum, and then again diminishes until it disappears at Wolfenbuttel.—7 *C*, 1873, 409.

THE EARTHQUAKE OF JUNE 29TH IN NORTHERN ITALY.

Concerning the very serious earthquake that occurred on the 29th of June in the state of Venice, some details have recently been systematically collected by De Fonvielle, who finds that, as near as he can estimate, the centre of the district most severely affected by the shock was in the valley of the Marino, in the province of Bellune, a region frequently affected by previous earthquakes. The shock was felt in Italy, Germany, in the Tyrol, and even in Munich, and was, by coincidence, of course, followed in Germany by a very violent storm, which, in passing over Vienna, tore away the captive balloon exhibited at the Exposition. — 6 *B*, 1873, 66.

THE THEORY OF THE SECULAR VARIATION OF THE LEVEL OF THE OCEAN.

Dr. Schmick has not hesitated for some time past to warmly advocate in the German scientific periodicals the actual existence and periodicity of great changes upon the earth's surface, by which the portions once forming the dry land have become the bottoms of oceans. That such changes have actually taken place, the geological strata have in the hands of the paleontologists long since given satisfactory demonstration, but the periodical nature of these changes has not yet seemed so well established. Whewell, in his essay on the flood, seems to have been the first author of scientific ability who has attacked this problem. He sought to explain the historical tradition of the Flood by the assumption of a great tidal flood caused by the sun and moon, which, however, the Newtonian theory of gravitation, as is now known, demonstrates could not possibly have taken place except in the South Pacific Ocean, and which then would have only appeared as an oscillating flood, and not as a permanent one, enduring for 120 days, as the sacred record describes it. For the solution of this difficulty, some material has recently been offered in the details of the great earthquake wave which, in August, 1868, accompanied the terrible earthquake that destroyed Arica, in Peru. The latter earthquake has been especially studied by Hochstetter, who has collected the material therefor with great patience. The earthquake wave that spread from Peru westward was recorded at Sydney, Australia, by the self-registering tide-gauge, and the record shows that, while during five days the ocean went through its regular changes, there occurred on the 13th of August, in the afternoon, a series of vibrations corresponding to the so-called earthquake wave. Hochstetter and Schmick deduce the following conclusions from their study of the record at Sydney, Australia:

1. In reference to the earthquake itself, that it must have affected a circular region almost entirely under the sea.

2. The lunisolar tidal wave, as well as the sea wave of the earthquake, require twenty hours and thirty-seven minutes in order to pass over the distance from Arica to Sydney, both species of waves having precisely the same velocity.

3. The notion that has previously obtained, viz., that only the southern portion of the great Pacific Ocean is subject to primary waves that spread themselves over the entire earth in two or three days, is quite false.

Having subsequently obtained from Russell, the director of the observatory at Sydney, a complete copy of the record for the entire year 1871, Schmick has been able by the study of this material to establish the following propositions:

1. The tide records agree precisely with the Newtonian theory of gravitation.

2. That the known laws peculiar to harbors, known as the establishment of the port, hold as well for Australia as for Europe.

3. That an observation made by Captain Cook, viz., that on the Australian coasts in the summer time the night tide is the highest, while in winter the day tide is the highest, and which observation has been for a long time doubted, because the opposite rule holds for Europe, is, however, quite correct. The difference between the tides in Europe and those on the Australian coast consists chiefly in the fact that the latter are very much affected by the tide waves reflected back to Australia from the western coast of South America.

4. These reflected tidal waves occupy twenty hours and thirty-four minutes in passing from South America to Sydney.

5. In reference to the assumption that primary waves do exist in the South Pacific Ocean, the annual record gives a brilliant confirmation of that which the earthquake waves had first revealed, viz., that the assumption is thoroughly erroneous.

6. The level of the sea at Sydney stood at the end of the year 1871 one foot six and a half inches higher than at the beginning of the year, and had been gradually increasing during the year to this maximum, with, however, various irregular sinkings in the mean time.

The removal of the water of the ocean from the northern hemisphere to the southern, which is thus demonstrated, is looked upon as a remarkable confirmation of the views of the author, at least in kind if not in degree; and he adduces a calculation showing that the moon, in a period of four years and five months, can draw a stratum of water five inches deep to the northward, and a stratum somewhat deeper than this to the southward. These relations will be reversed at some future time, when the perigee of the moon has a different relation than it at present has to the earth's orbit. A further demonstration of the truthfulness of Hochstetter and Schmick's theory of the periodical variation of the level of the ocean is drawn from the observations made in the North Sea during the past sixty years. It is ordinarily assumed that these observations, which have been already examined by many authors, especially Berghaus and Moberg, show a steady diminution of two feet in a century, and, assuming the variation to be uniform, it would amount to 210 feet in 10,500 years. Of this change one third is attributed by Schmick to the influence of the sun, and the remaining two thirds to that of the moon. In the work before us we do not see any reference by the authors to the known change in the relative position of the land and water caused by the secular cooling of the earth, the effect of which, as recently developed by Mallet, seems to us sufficiently to account for the change observed at Sydney, Australia. There seems but slight reason to attribute it, we think, to a periodic variation in the height of the water of the Southern Pacific Ocean, depending on the position of the moon's perigee and the earth's perihelion.—7 *C*, 1873, 375.

THE FOUCAULT PENDULUM EXPERIMENT.

The general interest which centres in the interesting experiment known as the Foucault pendulum, will cause mathematicians and physicists to notice the short memoir of Hullmann, entitled "A Critical Investigation of the Change of the Plane of Vibration of a Pendulum." In this work the author discovers several inaccuracies in all previous computations on this subject, and suggests in their place a new computation. It is generally understood that, at the pole of the earth, the plane of vibration of a free pendulum remaining constant must make an angle with the movable meridian of the place, which angle, in consequence of the rotation of the earth on its axis, continually increases, until it amounts to 360 degrees at the end of twenty-four hours; that is to say, that after the lapse of one day the plane of vibration returns to its original position. At the equator, the plane of vibration remains always parallel to the meridian; while at all other points of the earth's surface, it makes an angle with the meridian which depends upon the latitude of the place, and at the end of twenty-four hours has not yet amounted to 360 degrees. The author's special object has been to discover when the pendulum will finally return to the original plane. —19 *C*, 1873, 296.

A SCIENTIFIC BALLOON ASCENSION.

A balloon ascension for the purpose of scientific observation was made on the 26th of April last in Paris, in which five gentlemen participated, under the general supervision of Janssen. This is the first ascension made by these gentlemen, and it is to be hoped will be repeated. After considerable training and a careful study of the objects before them, and receiving the suggestions of many experienced physicists, as well as the assistance of the French Society for Aerial Navigation, these gentlemen undertook to study the question of aerostatic triangulation, as well as to make numerous meteorological and physiological and other observations. Some of the instruments which they carried were quite unique in their way, among them a holosteric barometer, rating down as low as six tenths of an inch of atmospheric pressure, and very sensitive and exact—an instrument that had been made for the use of Janssen in his travels in the Himalaya mountains. They had also a bimetallic thermometer, constructed by Jobert, with extreme stability, and yet sufficiently sensitive to indicate very rapid changes in temperature. An instrument of peculiar design, intended to be held in the hand, was also carried, by means of which it was expected to determine the direction and the velocity of the motion of the balloon. Several hundred printed cards were also carried, which were thrown, as occasion demanded, from the balloon, and bore upon their face the request that they should be returned by mail by the finders, who should note upon them the time, the barometric pressure, the wind, etc., etc. Twenty-three of these cards were returned to the voyagers shortly after their landing, and have afforded Messrs. Jobert and Spinelli the means of tracing with great accuracy the profile of the path pursued by the balloon through the air. The balloon voyage began at about eleven o'clock in the morning. The greatest height attained seems to have been about 15,000 feet, and the descent took place about two o'clock in the afternoon, at a point seventy-five miles southeast of the starting place.—6 *B*, 1873, 1473.

A SCIENTIFIC BALLOON VOYAGE.

Professor A. King, the well-known aeronaut of Boston, who last summer constructed one of the largest balloons ever seen in America, for the express purpose of making very high and very long voyages as a means of studying the meteorology of the upper portion of the atmosphere, has lately made an ascension from the city of Buffalo, which promises to be of the greatest interest. Ascending at about three o'clock in the afternoon, the party, consisting of Mr. King, Mr. Holden, of Boston, and four other persons, rose rapidly to a height of about 6000 feet in the course of twenty minutes. The balloon at first moved eastward, and then somewhat south of east. Very severe local storms were apparently prevailing in various directions, and the Weather Bureau had announced that the storm-centre was at that time moving eastward over the upper lake region. The clouds between the balloon and the sun caused such a cooling in the gas of the balloon that the aerial ship was soon found to be rapidly falling, and at a quarter of four the altitude above the earth was but 2300 feet. After remaining at this low level for an hour, a very rapid ascent was secured by throwing out ballast, until a height of 8800 feet was reached shortly before sunset. The last observation of the barometer made by daylight was at half-past six, when the altitude was 3600 feet, and the balloon still traveling in an easterly direction, and from this time until the landing the course was pursued quietly, without any incidents worthy of note. The wind at that time was moving only at the rate of about six miles an hour, and the aeronauts landed near the village of Corning, N. Y., having traveled almost exactly one hundred miles in the course of four hours. A series of observations of the barometer and thermometer were made at regular intervals of two minutes, so long as daylight lasted, by Mr. L. L. Holden, who has accompanied Mr. King on twenty similar excursions, at most of which he has endeavored to assist Mr. King in his attempts to utilize these balloon voyages for the furtherance of meteorology.—*New York Herald, September* 19, 1873.

THE GREAT NOVA SCOTIA STORM.

The terrible destruction of life and property that attended the great storm in Nova Scotia on the 24th and 25th of August has led to a careful examination of the accounts of the weather found in the logs of the various vessels at that time sailing along the eastern shore of the United States, and it seems certain that this storm was a true cyclone of large dimensions, and that its destructive force was experienced, not only in Nova Scotia, but equally so on the ocean during the week previous. The accounts of the weather experienced by the steamer *Hammonia* show that the storm passed from Nova Scotia northeastward toward Iceland, while, on the other hand, the records of the vessels of the United States Atlantic squadron show that the cyclone already existed in all its fury on the 17th and 18th of August, at which time it was passing in a northwesterly direction, about midway between the Bermudas and the West Indies. Reports are continually coming in of vessels lost or disabled on being drawn into the centre of the revolving storm; and it is a remarkable commentary upon the state of the science of navigation that there has as yet been found but one sea captain who, possessed of a knowledge of the nature of these storms as shown in the well-known works of Piddington, Reid, Redfield, and others, and possessed of a trusty barometer, was wise enough to avoid the centre of the storm, and to even make good use of the strong winds on its exterior circumference to waft him more speedily on his journey. It can not be too often repeated that the rules laid down by the students of meteorology are abundantly sufficient to enable any navigator, who has a barometer with him, to avoid exposing in the least his vessel and passengers to the fury of these terrible storms; nor can we too strongly deprecate the conduct of those navigators who, like the captains of the *Hammonia* and *Russia*, intrusted with the responsibility of the care of hundreds of lives, willfully steer their vessels directly through the fiercest of the winds and waves. The portions of the coast of Nova Scotia that could be reached by telegraphy were warned by the Canadian system of storm signals of the approach of the hurricane in sufficient time to effect, probably, a considerable saving of life and property. Unfortunately there is, as yet, no telegraphic communication with the Bermudas, and consequently the approach of the storm was not known for a sufficiently long period in advance to secure the safety of the hundreds of vessels that were wrecked upon that coast.

THE INFLUENCE OF THE MOON ON THE WEATHER.

Dr. Wierzbicki has investigated the peculiarities of the climate at Cracow, Austria, and especially the influence of the moon in bringing about periodic changes. The material at his hand for this investigation consisted of forty-six years' observations conducted upon a uniform style at the observatory in that city. With reference to the moon, he says that the influence of this body on the earth's climate is generally believed in by the common people and the seamen. This belief is very old, and seems to be an inheritance from those times when men believed that the stars and other heavenly bodies exerted an influence on the fate of men and nations. The reality of the influence of the moon on the weather has been disputed by most scientific students, and it has been shown by Bouvard that in France it is scarcely, if, indeed, at all discernible. Wierzbicki has studied the arrangement of the cloudy and the rainy days in comparison with the four quarters of the moon in its regular monthly changes, and has also compared those days with the periods at which the moon is nearest and farthest from the earth. In reference to these phenomena, his conclusions do not differ sensibly from those announced by Bouvard and others, who studied especially the barometric changes or aerial tides. Wierzbicki says that, in consequence of his investigations, he is of the opinion that the suspected influence which the moon might exert upon the weather, if not quite inappreciable, is, at least, so slight that, if it does really exist, it must be entirely concealed in the far more powerful local and cosmic causes that affect the earth, and it merits in ordinary matters of life no consideration whatever. He therefore considers it a waste of time to indulge in any further investigations into the influence of the moon on the weather.—*Jahrbücher of the K. K. Central-Anstalt, Vienna*, 1873.

OCEANIC CURRENTS, THE CLIMATE AND BOTANY OF NORWAY.

Dr. Schübeller has published, as a contribution to the history of the effect of cultivation on Northern Europe, a very valuable essay on the connection between the climate and flora of Norway. He states that the reason why Norway takes the place that it does among the cultivated lands of Europe is found alone in the presence of the Gulf Stream; without the Gulf Stream the greatest part of Scandinavia would be only a second Greenland, covered under snow and glaciers. In treating of the influence and direction of the Gulf Stream, as shown by the drift-wood found on the coasts of Iceland and Norway, Schübeller notices the contents of a note that was found in a flask thrown up on the coast of Findass in September, 1861: this flask was entirely covered with muscle shells and algæ, and had been floating in the sea for twenty-one years, as was shown by the following two notices. First: "August 17, 1840, on board the ship *Adrian*. A terrific gale has damaged the vessel." Second: "August 10, 1848. This bottle was found by the ship *Jenny Lind*, near Brazil. After reading the above note, we return the bottle to the water." It is shown, therefore, that this flask had between the years 1840 and 1848 floated from the North Sea through the British Channel to Brazil, and during the following thirteen years—1848 to 1861—had returned to

Norway, having crossed the Atlantic at least twice. In reference to the rapid growth of plants in the Polar regions during the summer season, Schübeller concludes that this is due not so much to the warmth as to the continuous sunshine that the plants enjoy during the long polar days, in connection with which a most important point is to be remarked, viz., that the change of temperature is during these polar days much slighter than in those regions where day and night alternate. Among the general conclusions given by Schübeller, he states that if in Scandinavia any kind of grain is successively brought from the plains up into the mountainous regions, it becomes accustomed thereto, and not only develops, but develops in shorter time than before, and even at a much lower temperature. When such grains as have been cultivated for many years successively in the mountainous regions are then slowly returned to their mother earth, they at first bear fruit earlier than the same varieties that have remained uninterruptedly cultivated in that place. In this way does grain behave that is slowly transferred from southern to northern regions—the seeds increase in size and weight according as they are removed to the south, and diminish as they are removed to the north. With these phenomena are associated similar changes with reference to the odors and the quantity of sugar contained in the sap.

INFLUENCE OF THE SUN'S SPOTS ON TEMPERATURE AND RAIN.

The relation between the sun's spots and the various changes that take place in the earth's atmosphere has been the subject of a number of essays of late years, of which the last that we had to record was the supposed discovery by Lockyer and Meldrum of a periodicity in the frequency of tornadoes, cyclones, and typhoons, corresponding to the period of the solar spots. The most recent investigation in this field is that of Celoria, who has studied the connection between the solar spots and the mean temperature of the year at Milan, as well as the annual rain-fall. The observation of these two meteorological phenomena began at Milan in the year 1763, since which time they have been continued with sufficient uniformity to allow of an investigation of the kind that Celoria has undertaken, with perhaps as great hopes of success as can be any where expected. The result of Celoria's studies is simply that there is no apparent connection between the Milan observations and the tables of the maxima and minima of the solar spots as given by Wolff. This result is entirely in accordance with that published in 1869 by Abbe, who, having arrived at the same conclusion for the city of Munich, then showed that if, on the other hand, we ascend to the top of the high mountain near Munich, namely, the Hohenpiessenberg, and make use of the long series of observations at that elevated height, we find that we have risen above the local disturbances peculiar to the lower strata of the atmosphere, and are able to perceive distinctly the influence of the solar spots upon terrestrial temperatures. —*Zeitschrift der Oest. Gesell. für Met.*, 182.

PRESTEL ON THE USE OF STORM WARNINGS.

The Leipsic Meteorological Congress having invited an expression of opinion from various meteorologists as to certain questions which it proposed to bring before the general Vienna Congress, Professor Dr. Prestel has responded to this request in a pamphlet of eight pages, in which he fully narrates his own experience in reference to some of the questions proposed for consideration. In regard to the question whether the meteorologists of the various governments of Europe should interchange with each other details, not only of wind, but also of the barometric condition of the atmosphere, he expresses himself as very decidedly of the opinion that the most useful datum consists in the difference between the actual barometric pressure and the normal pressure, which latter is given by taking the average of many years' observations, and he concludes that upon these deviations must be based both the barometric gradient and all the predictions of the weather. The magnitudes of the disturbances in the atmosphere are only indirectly dependent upon the barometric gradient between different places, and he proposes, as the unit of distance for expressing the barometric gradient, the nautical mile, which is in common use among all nations, and sixty of which are equal to one degree of longitude on the equator. With reference to the other atmospherical conditions, especially the temperature and moisture, he decides that here also the deviations of these data from their normal values are the only statistics that should be interchanged between international systems for storm warning. The physical laws, according to which the motions in the atmosphere take place, are at present still too little understood to enable us to determine exactly beforehand the path which any storm that is already known to exist on the earth's surface will subsequently take. The cautious observer notes the barometer, and the thermometer also, the direction and strength of the wind, as well as the appearance of the heavens, the kind of clouds, the direction of their motion, and the condition of the sea, and seeks to determine from these elements whether a storm exist in any direction in his neighborhood. But all these data still leave it uncertain in which direction the storm will move. The observer knows not whether the storm-path will pass over him or to one side of him. The uncertainty is completely removed if the observer knows also the condition of the atmosphere with the same accuracy at a number of points in his neighborhood, and in this respect it is that the telegraphic weather notices become of service; and it is his experience that the dissemination of such knowledge in the seaports along the coast of the Netherlands, as it has taken place now since 1860 under the direction of Buys Ballot, has proved highly useful to the marine service. In the most recent times the warnings of the storms have been graphically exhibited by means of the aeroklinoscope, an instrument whose invention is due to Prestel, and which takes the place of semaphores, or such other signals as have sometimes in Holland been exhibited from light-houses. But the difficulty of perceiving any signal from a distance in the thick weather that precedes a storm has prompted Prestel to invent still another instrument, which he calls the storm-warner, which is sometimes constructed in the form of a diagram that can be laid upon a nautical chart, and, being properly adjusted by the observed wind and barometric gradient, points out at once the direction in which the storm centre lies.—*Ergebnissen der Beobachtungen.*

ON THE DETERMINATION OF THE ALTITUDE OF THE CLOUDS.

Professor Dr. Prestel has proposed a method for determining the altitude of the clouds, in which the electric telegraph plays an important part, the trigonometrical principles involved in the method are such as have been previously frequently applied. Dr. Prestel having stationed himself at one end of a short line of telegraph, and being in convenient communication with his student, Mr. Meyer, at the other end of the line, they observed with the sextant the apparent altitude and azimuth of the lower surfaces of such clouds as they from time to time agreed upon. The observations were, of course, taken at the same moment of time, and, from a number of determinations made during the winter and spring months in the neighborhood of the city of Emden, they found that the heights of the lower surfaces of the cumulous clouds vary from 5000 to 20,000 feet, being lowest when the temperature is low, and highest when the temperature is high. Prestel hopes to continue the observations to a sufficient extent to enable him to determine the average height of the lower surfaces of the clouds at various hours during the day. —*Zeitschrift der Oest. Gesell. für Met.*, 182.

ON THE SEMIDIURNAL VARIATION OF THE BAROMETER.

Broun, the director of the observatory at Makerstoun, has studied the effect of the sun on the daily change in the barometer, as shown by observations made in India. He states that in the pleasant season in Malabar, the diurnal oscillation of the barometer is very large. The air at 6000 feet above the sea is, during many days, of perfect tranquillity. Small clouds form and dissipate in the valleys after rising, and without moving to the one side or the other. In April, when the monsoons begin, the clouds begin to form in great masses on the coast of Malabar. They increase gradually from morning till the afternoon, rising to a height of 4000 or 5000 feet. They neither advance nor increase for some hours, and gradually disappear toward evening. The tranquillity of the air is so great that Broun has, upon the mountain, examined the particles of the clouds with the microscope of the theodolite as they slowly moved in front of the objective. The shell of warm air at the surface of the earth ought to rise until it loses its excessive temperature, and should be replaced by the shell of air immediately in the neighborhood, which should rise in its turn; but there is no ascending current of air of this kind, and the hypothesis which requires the clouds, as well as the diurnal variation of the barometer, to be the result of variations of the temperature, seems to be without foundation. Broun, therefore, states that he has established two facts, which must be known and understood before one can propose any hypothesis which shall explain the daily variation of the barometer. The first relates to the change in the daily variation with the season, and may be stated, in brief, as follows: That the barometric variation during the day-time, in the summer, resembles that which is produced in the night-time in the winter, and *vice versa.* This fact Broun has established for Makerstoun, while Lloyd has equally established it for Dublin, and Quetelet for Brussels. The second fact alluded to by Broun relates to the change of the daily variation with the altitude above the sea. This change seems due to an entirely different cause from the variations of temperature. By comparing a number of stations in India at various heights, varying from the sea level to 6000 feet, it appears that the hourly variation approaches a constant value as we approach regions of constant atmospheric conditions. Up to the height of 6000 feet, the semidiurnal oscillations are proportional to the average pressure. These two facts taken together lead Broun to the belief that the semidiurnal oscillation, and the diminution of its amplitude as we rise in the atmosphere, accord with the hypothesis that both result from a polar attraction of the sun, producing an attraction on one side of the earth and a repulsion on the opposite side.—6 *B*, 1873, 1536.

THE UPPER CURRENTS OF AIR.

The interest excited on all sides by the persistence of Professor Wise and the editors of the *Graphic* in the balloon voyage which came to such an untimely end, has done good service to meteorology, so far as it has called forth an expression of opinion from almost every one whose opinion has been worth having. Among those who have communicated their views to the editors of the *Graphic*, nothing has appeared more decisive of the point, and at the same time more interesting, because of the novelty of the observations, than the communication from Professor H. A. Newton, of Yale College. He writes that he has observed, with great care, the bright trains sometimes left behind in the upper air by the shooting meteors. They afford, as is well known, the only direct means of observing the direction of motion of the upper currents of air. These meteors become visible when they are at an altitude of about seventy miles above the earth's surface, and they disappear, generally, at a height of about forty miles and upward. They become luminous only because of the resistance of the air through which they are passing, with an average velocity of twenty-five miles per second. One of these bodies sometimes leaves behind it a train of luminous matter, which remains visible often only a fraction of a second, but sometimes for minutes; and, in rare cases, for nearly or quite an hour. This train appears in the day-time as a smoky cloud; in the night-time as a bright track. During the first few seconds after it has been formed it looks like a straight line along the track that has been passed over by the meteor; but instantly it begins to broaden, and usually the ends fade out first. In a few seconds more, it is seen to become crooked, and it assumes somewhat the shape of a letter S. The height of these trains averages about fifty miles, and they are usually not more than five or ten miles long. After the ends of the train have faded away, the central portion still remains, having by that time generally assumed the shape of a small round cloud, which drifts slowly away. Professor Newton has observed this drifting very accurately. He states that such clouds as he has watched had apparently a velocity of about one mile a minute; but that he has not been able to detect any law governing the direction of this drifting. It does not appear to have a uniform direction. It is quite as likely to move to the north as to the south, to the east as to the west. In fact, he records that, during the same evening, the different trains that he has observed will drift in different directions, and he thinks it most reasonable to conclude that in the highest regions of the atmosphere there is a complex system of currents and winds, precisely similar to that which exists at the earth's surface.

THE TYPHOONS OF CHINA AND JAPAN.

The importance to navigators of a clear perception of the laws of storms is apparent from a consideration of the experience of the captain of the ship *Argyleshire* during the typhoon of the 11th of September, 1872, in the Japan Sea.

The ship was near the south end of Formosa, and was struck by a typhoon with the wind at the northeast, and the centre bearing apparently east-southeast. The captain, believing the gale to be traveling to the northward, supposed himself to be in the left-hand semicircle, and continued on the port tack, heading to the eastward, as near his course as possible, and evidently had an eye to business, thinking that the centre of the storm would pass to the northward ere he could be near enough to be in any danger, and he apparently desired to approach the centre as near as would be consistent with safety, in order to take advantage of the westerly winds by which he would be able to make good time for Yokohama. This would have been all right had the gale traveled north as he supposed, but the sequel shows that seamen should never form hasty conclusions in cases where deliberation may be employed to advantage. If the captain had hove the ship to at once, and awaited the first change of wind, he would have discovered that the vortex was not traveling north, for, in that case, the wind would have shifted to the north-northeast, or have backed, and not have veered to the right as it actually did. After pressing rapidly on, his falling barometer, the increasing force of the gales of wind, and the shortening of the interval between them, the approach of darker and denser clouds, and the appearance of lightning in great quantities, all told the story of the vortex coming nearer the ship, and the captain evidently suddenly concluded that the gale was not traveling north, but westward, and that he was bound nearly for its centre. During the first twelve hours of the gale the ship had sailed and drifted toward the centre until within eighty-six miles of it, when she was put on the starboard tack. Had the captain done this at the beginning of the gale, she would not have approached the centre within one hundred and fifty miles. There are two essential rules of vast importance to seamen to be remembered in connection with circular gales, and which will always be a safe guide. The first of these is that the wind in the right-hand semicircle always changes to the right of the point from which it blows, and, second, that the wind in the left-hand semicircle always changes to the left of the point from which it blows. Again, in the northern hemisphere, the bearing of the centre of the gale is nearly eight points to the right of the direction of the wind. In the southern hemisphere, the bearing of the centre is nearly eight points to the left of the direction of the wind. Again, in managing the vessel when you find yourself in the right-hand semicircle, heave to on the starboard tack. If in the left-hand semicircle, heave to on the port tack. This is true in both hemispheres. By following this latter rule, it will be seen that a ship laying to in the right-hand semicircle in the northern hemisphere will be on the starboard tack, and heading off from the centre, and in the left-hand semicircle will be on the port tack, and heading toward the centre; also, in the southern hemisphere, a ship laying to in the right-hand semicircle will be on the starboard tack, but heading toward the centre, and when in the left-hand semicircle will be on the port tack, but heading off from the centre.—*Japan Weekly Mail, June*, 1873.

CYCLONES AND WATER-SPOUTS.

A work published during the past year by Dr. Reye, of the University of Strasburg, on the above subject, has attracted, deservedly, very much attention and received very high encomiums. This gentleman has treated the subject, both by an inductive process of reasoning, and also, to a certain extent, has elucidated the more obscure phenomena by a mathematical treatment of the problems relating to the deposition of water from atmospheric vapor. Especially interesting is his study of the storms in the sun's atmosphere, to which he devotes a chapter based upon the spectroscopic observations of solar protuberances. In great part, Reye's work is a review of what has been done by many previous meteorologists in this field of study. He, however, himself merits the thanks of his brother scientists in that he has, with scientific accuracy, co-ordinated the various facts. The cause of the spiral movement, which is proved to exist in the smaller tornadoes as well as in the most extensive storms, is attributed by Reye to the heat, which causes certain portions of the air to expand and to rise, and allows other portions of the neighboring atmosphere to flow forward to fill up the space thus vacated; but since this flow can not take place uniformly from all sides, there begins often from the very commencement an eccentric flow and a feeble spiral movement of the rising air. The air flowing inward, always with increasing accuracy, follows these first spiral curvings, because in their directions the air finds the least opposition to its movement. There can scarcely be any doubt that, in the main, these words of Reye express the exact nature of the currents of air, as, indeed, was long ago mathematically demonstrated by Mr. Ferrel, of Cambridge. In explaining the structure of water-spouts, Reye maintains that in this case we have in the interior of the spout a vertical current of air carrying up the warm and moist air, while from above may possibly flow downward colder air. The suddenness with which the water-spouts are formed in a quiet atmosphere suggests that they must be preceded by an unstable equilibrium of the air, and that, by means of this, a powerful interchange of the strata of air must take place, by which at once the stable equilibrium is brought about. The question under what condition of temperature quiet air can exist in stable equilibrium, Reye answers by a computation, showing that this takes place when the temperature of the air decreases by one degree Centigrade or more for every one hundred meters of elevation. He also demonstrates that moist air rises in the atmosphere much more easily than dry air, since the former rises when the diminution of temperature for one hundred meters amounts to one third of a degree Centigrade. With reference to the progressive motion of cyclones, Reye's theory sheds some light, in that it shows that these must always move toward that side on which for a long time the warmest and moistest air has been rising, on which the thickest clouds have been formed and the most rain has been falling. This agrees completely with observation and the principles announced independently in 1870 by Mohn, and in 1871 by Abbe. With regard to the parabolic form of the paths of the centres of storms, he inclines to think that it is determined by the form of the warm currents in the seas over which the cyclones move.—7 *C*, 1873, 314.

BARBADOES RAIN-FALL AND SUGAR CROP.

Governor Rawson, of Barbadoes, has just published the text of a work on the rain-fall of that island, and an investigation of the connection between the rain-fall and the crops, especially the sugar crop, which is the staple production of Barbadoes. This investigation is quite unique in its way, and is a model of thoroughness and discrimination.

The data at his command consisted of twenty-five years' careful meteorological observations from one hundred and seventy-eight stations. In reference to the agricultural products, the distinguished author makes use of exact statistics derived from the custom-house records, which give minute details, especially with regard to the sugar crop, of which 98 per cent. is exported from Barbadoes. With reference to the table of yearly rain-fall, Governor Rawson shows that the only inference appears to be that there is no connection between the periods of two or more successive wet and dry years; that wet and dry years do, however, alternate with much apparent regularity in sets of three or four wet years and one or two dry years; that, again, there has been no great difference between the average rain-fall in the early and in the latter portions of the period from 1843 to 1872. With reference to the monthly rain-fall, he shows that the six months commencing with December are the driest of the year, and the other six months the wettest; the average rain-fall during the wet months being six and seven-tenths inches, the average of the dry months two and nine-tenths inches. The average rain-fall of any month varies but little from year to year. The heaviest rain-fall that has occurred at any season of the year bears a certain ratio to the average lightest rainfall of the same season of the year, which ratio varies but little from seventy-five per cent.

One of the objects of the report of Governor Rawson is to assist those who are interested in calculating the probable character of coming seasons. He gives tables and formulæ for predicting the probable amount of rain that will fall during any month of any year, basing the calculation upon the average results of the past twenty-five years, the study of which latter shows him that these predicted rain-falls may be expected to be correct in about six cases out of seven. He again shows, with reference to the influence of the moon upon the weather, that the largest number of heavy rains have fallen on the fourth, seventeenth, and twenty-seventh days of the moon's age; but the average rain-fall was small on these days, so that in general the influence of the moon is very slightly, if at all, perceptible. One of his most interesting results consists in showing that the average quantity of rain that fell by day is about three per cent. greater than the quantity that fell by night; while, on the other hand, the *number* of nights on which rain fell was fifty per cent. greater than the number of days on which rain fell. In March more rain falls in the night than in the day; in August more rain falls in the day than in the night. On considering the geographical distribution of his stations, he shows that the higher regions of the island receive more rain than the lower ones, in the proportion of sixty-five to forty-four inches; the former being the average rain-fall of those stations that are one hundred feet above the sea, while the latter figure belongs to the stations less than one hundred feet above the sea. In reference to the distribution of the rain-fall with the seasons, he arrives at the startling conclusion that from February to May the rain-fall in the first ten years was twelve inches, that since that period it has steadily diminished, and is now scarcely six inches.

In studying the effect of the rain-fall upon the sugar crop, Rawson makes a careful analysis of the systematic records of the custom-house, which have been kept continuously since 1806. After allowing for the influence of various political acts, such as the emancipation of 1838, whose influence was felt in agricultural matters until the year 1847, and allowing for the effect of the rapid increase in the use of guano and other foreign fertilizers, which took place between the years 1851 and 1857, he makes the following inferences:

The rain-fall affects in most cases the crop of the following year, but that of the current year only in a slight degree. This results from the fact that the rain-fall of the first six months is less than one third of the whole annual rain-fall. The crop is off the ground before the rains commence which chiefly nourish the young sugar-cane. In almost every case the excess or deficiency of the crop is accompanied by a low rain-fall in the preceding year. The effect of a very small rain-fall is more decided than the effect of a heavy rain-fall. A dry season is likely to injure the crop by one fifth more than a wet season is likely to benefit it. In examining the influence of the rain-fall of each individual month upon the crop of that year, Rawson finds that the chances are on the average about three to one that a wet February, a dry

January, a wet April, or a dry June, will either of them give a bad crop in the harvest of that same year; while the chances are about two to one that a wet August, a dry July, a dry December, a dry September, or a wet October, will be followed, either of them, by a bad crop in the following year.

The influence of these unfavorable circumstances in producing bad crops will amount to about thirteen per cent. of the whole crop.

LIGHTNING AND LIGHTNING-CONDUCTORS.

The new Society of Telegraph Engineers has discussed with much fullness, in several of its public sessions, the subject of lightning and lightning-conductors. Mr. Preece, the secretary of the society, considers the subject as affecting the interest of telegraphy, and also the safety of vessels and houses. The direct effect of lightning on the telegraph wires seems to be not so serious as its indirect effect in inducing ground currents. From a correspondence between Faraday and Latimer Clark, it seems that the long under-ground circuits between London and Manchester suffered considerable derangement from these induced currents. Usually, when lightning strikes telegraph poles, they are completely destroyed, unless the stroke divide itself among several poles. As regards the protection of ships from lightning, Preece conceives that accidents from this cause have almost entirely disappeared. Such vessels as have been damaged are invariably those that have been unprotected. The heavy cost of the system used for ships has probably had a serious influence in checking the employment of a similar system to protect buildings; but Preece endeavors to show that it is possible for a man to render his house absolutely as safe as a ship at an expense which may be considered trifling. A chimney lined with a thick layer of soot, by which a current of heated air is ascending, is an excellent but a dangerous conductor; hence so many indoor accidents. The conditions that determine a perfect lightning-conductor are that it shall expose in some prominent position on a building a metallic point, and that it shall offer from this point to the earth a path of little or no resistance to the passage of the current. Preece contends that, instead of the costly copper rods, the ordinary galvanized iron wire known as No. 4, which is one fourth of an inch in diameter, is amply sufficient for any dwelling-house. His reason for recommending telegraphic wire is based on the experience of the English companies in protecting the poles of their telegraph lines. These are invariably supplied with lightning-conductors of No. 8 wire, running from the upper end of the pole to the ground. No pole so protected has ever been known to suffer from lightning. The precautions necessary in fixing conductors to houses are, First, that the conductor must be solid and continuous. There should be no joint, unless it be a well-soldered one. Chain-link rods, braided rope, tubing, etc., should be avoided. Second, the ground connection must be sound and good. Third, each conductor, if there be more than one, should have a separate ground connection, but they should all be also connected together, and connected with the lead roofing, and all masses of metal in their neighborhood. It is unnecessary to insulate these conductors. There should be no points or acute angles in the conductor—the straighter and more direct its course to the earth the better. It is safest to consider that the area protected by the conductor is equal to its height above the ground.

Besides considering many details in the protection of telegraphic instruments, Preece explains the theory of the action of fine points in dissipating or preventing discharges of lightning. The lightning-conductor should terminate at its upper end in a fine gilded or polished point. When this is properly attended to, a glow or brush of light may be seen at the point when lightning approaches it, but a destructive discharge of electricity can scarcely ever occur. These points are sometimes fused by powerful discharges, and require to be renewed. The ground connection should be with as large a mass of metal as possible, such as the gas or water pipes of a city. If the "ground" is too small, it will be corroded and destroyed by electrolytic action. Lightning-conductors of all kinds require periodical examination. If this is neglected, that which was erected for our protection may become a source of danger.—*Jour. Soc. Telegraph Engineers*, I., 337.

ATMOSPHERIC ELECTRICITY.

The last number of the Transactions of the Academy of Sciences of St. Louis contain the result of the observations on atmospheric electricity made by Dr. Wislizenus during the twelve years from 1861 to 1872. Throughout this series of observations the same apparatus has been used, being constructed on a method adopted by Dellmann; the observations are therefore strictly comparable among themselves, and seem to Dr. Wislizenus to justify certain conclusions, which he announces as follows:

"As an important addition to our knowledge of atmospheric electricity, I consider the discovery of its threefold periodicity—the daily, annual, and secular periods; the daily periods are not so constant that they show themselves every day, but are distinctly perceived when we take the average of a week, a month, or a year. The annual period exhibits itself in a regular increase in the quantity or intensity of electricity during the six colder months of the year, and of a decrease during the warmer months, the extremes being in January and July. The yearly means for the twelve years show that there was a gradual increase from 1861 to 1863; then a decrease for five years, and again an increase for four years up to 1872, seeming thus to establish a cycle of about ten years, similar to that of the magnetic phenomena of the sun's spots." Wislizenus believes in the practical usefulness of electric observations for meteorological predictions, and suggests that the Army Signal Bureau, by means of a dozen stations well selected throughout the United States, might materially improve the accuracy of its storm predictions.—*Trans. St. Louis Acad.*, 172.

ON THE CAUSES WHICH PROVOKE STROKES OF LIGHTNING.

De Fonvielle has presented to the Paris Academy of Sciences a short study on the subject of lightning strokes, in which he maintains that two neighboring conducting bodies react forcibly upon each other when they are found under the influence of a thunder-cloud, and that this reciprocal influence is not the same when the conductors are isolated as it is when they are placed in communication with a common reservoir such as the earth. The author endeavors to explain why conducting objects, isolated from the ground, but placed to the southwest or the northeast of large conducting objects that are in communication with the ground, should be exposed more frequently to lightning strokes. He terminates his communication by the remark that the known modifications in the value of terrestrial magnetism consequent upon the movement of the planets, are analogous to those changes that the thunder-clouds produce upon the electrical condition of points on the earth's surface.—6 *B*, 1873, 1394.

THE ORIGIN OF ATMOSPHERIC ELECTRICITY.

The existence of electricity in the atmosphere, even when no lightning is visible, was first shown in 1752 by Delor. Numerous observations have shown since that day that this electricity is always positive when the heavens are clear, and in general the intensity of the electricity increases with the elevation of the point on which the observer stands—a rule which holds even for observations made in balloons. The annual periodicity of the intensity of the electricity was first demonstrated by Beccaria. The daily periodicity was proved by Schubler. Both of these periods have, apparently, some connection with the vapor in the air. The variation of the intensity of the electricity with the geographical position of the observer is, as yet, but little understood, although the observations seem to indicate that the intensity decreases as we go from the equator toward the poles; at least this may be the case for the lowest strata of the atmosphere. The origin of atmospheric electricity was sought for by Lavoisier and Laplace and Sir Humphrey Davy, who attributed its origin, in great part, to the combustion taking place every where on the earth's surface. Volta and Saussure advocated that it arose from the process of evaporation. Pouillet pointed out the influence of the processes of vegetation, but Reich demonstrated that neither gradual evaporation nor the processes of vegetation develop electricity, and that these processes, therefore, could not be the origin of the atmospheric electricity. Peltier subsequently developed a new theory, according to which our atmosphere of itself possesses no electricity, but that the solid earth is negatively electrified, and, although the quantity be invariable, yet the distribution thereof is not necessarily invariable. It would naturally be greater at the summits of mountains and less in the midst of perfect plains. This theory, although very widely applauded, and in very many respects satisfactory, does not explain the diminution of electricity at the poles as compared with that at the equator. Mühry has, therefore, lately broached a new hypothesis calculated to remove this difficulty. He considers the warming of the earth's surface by the sun as the source of atmospheric electricity; that, therefore, the distribution of the quantity of electricity increases and diminishes with the distribution of temperature, not only from the equator to the poles, but also from hour to hour throughout the day and the year. Mühry gives us, however, no idea as to the method by which the sun's heat is converted into electricity, nor does it seem at all certain that such a hypothesis as he has empirically instituted, however well it may explain certain phenomena, is allowable, unless further data can be adduced than he has given to render it probable. Equally in consonance is it with the present condition of our knowledge to think that, while in reality the intensity of the atmospheric electricity does increase parallel with that of the sun's heat, this fact is due rather to the other parallel circumstance, namely, that the mass of aqueous vapor in the atmosphere increases with the sun's altitude; and, as it rises into the atmosphere, there results, at least in continental climates, in the middle of the day, in the lower part of the earth's atmosphere, a diminution not only of the moisture, but also a diminution of the quantity of electricity. In some such way as this it would follow that the daily variation of the electricity is synchronous with the daily variation in temperature, in moisture, and in barometric pressure. It is very desirable, for the further test of Mühry's hypothesis, that there should be made accurate observations upon this subject on the higher mountain peaks, where the daily change of the electricity as compared with the state of the atmosphere should be more accurately determined.—7 *C*, 1873, 322.

THE HAIR HYGROMETER *versus* THE PSYCHROMETER.

Professor Wolff, of Zurich, in a recent number of the *Meteorology of Switzerland*, has given the results of some studies upon the much-vexed question as to the reliability of the hair hygrometer, as compared with the wet and dry bulb thermometers. His comparative observations extend over one entire year, and he gives the following conclusions:

1. The hair hygrometer, made by Hermann and Pfister, in Berne, gives the humidity, in summer and winter, with all desirable accuracy, and does not deteriorate, with careful handling, in the course of years.

2. The psychrometer, when the temperature is above freezing, may, perhaps, be somewhat more reliable than the hair hygrometer, and is certainly necessary as an occasional control over the latter; but in winter, with the most careful manipulation, this instrument frequently gives too large a value for the relative humidity, and even absurd results, if constant watchfulness is not maintained.

3. The differences between a number of psychrometers, exposed in different positions, are somewhat greater in summer weather than those of hair hygrometers.—*Schweiz. Meteor. Beob.*, VIII., 7.

A NEW BAROMETER.

At a recent meeting of the Association of the Lower Rhine Provinces, Dr. Geissler explained a very delicate barometer newly constructed by him. The details of this apparatus can scarcely be properly understood without personal inspection or proper drawings. It is sufficient to say, however, that it consists in inclosing a certain mass of air in such a way that its volume is not influenced by changes of temperature, but is affected directly by the changes in atmospheric pressure. This new form of barometer is very compact and portable; it can be constructed of various sizes, so that its sensitiveness may be made as great as desirable.—1 *C*, 1873, 128.

DESCRIPTIVE METEOROLOGY.

M. Balard, the director of the National Observatory at Algiers, has presented to the French Academy of Sciences a system of registering the barometer, thermometer, and other meteorological elements, to which he gives the name of descriptive meteorology. The point to which he draws special attention is the manner of representing in a graphic table the hourly quantity of blue sky and of cloudiness. He divides the heavens into ten equal portions, zero representing an entire absence of clouds, and ten a completely cloudy sky. By a system of tints he represents the various classes of clouds, a white tint representing cirrus, a gray tint the cumulus, and a neutral tint the nimbus. It follows from this combination that, by a simple inspection of the tables, one can see how the cloudy periods succeed each other. By comparing these various changes in the appearance of the heavens with the oscillations of the barometer, thermometer, anemometer, etc., one easily comprehends the relations and connections which exist between these various elements. The volume of observations that M. Balard has represented in this descriptive manner embraces the past twelve years, although he states that it is now thirty years since he resolved to accumulate with order and method all the data that could serve as the base of a very extended work which he has undertaken on the movements of the atmosphere.—6 *B*, 1873, 585.

THE METEOROLOGY OF THE DOLDRUMS.

The Meteorological Office at London has just published a long-expected contribution to the meteorology of the Atlantic Ocean. For nearly twenty years the captains of a number of the principal lines that navigate these waters have kept for the office quite accurate and minute notices of the weather, temperature of the sea, currents, etc. These have been plotted by Captain Toynbee upon large charts; and the recent publication to which we allude consists in the reproduction, on a sufficiently large scale, of these charts (one for each month of the year), for that section of the Atlantic Ocean that is bounded by the equator and 10° north latitude, and by the meridians 20° and 30° west. This square has been selected as one through which most vessels pass in crossing the equator, and one which is of great importance in a meteorological point of view.

These charts will be followed by others, giving a complete study of the region of equatorial calms, or "the doldrums." This region consists of a narrow belt, from one to three hundred miles wide, crossing the Atlantic Ocean parallel to the equator, which slowly moves northward in our summer, and southward in our winter, following the changing declination of the sun. The belt of doldrums, therefore, passes twice a year through the square considered in Captain Toynbee's charts—once in its northward and again in its southward journey. The series of monthly charts now issued gives all the information that has been obtained for this section of the ocean, which is graphically shown on the maps, representing by figures and arrows the mean temperature and pressure of the air, and the temperature and currents of the sea for each square of 2°, thus dividing the whole section into twenty-five subdivisions.

In his general conclusions, Captain Toynbee says that he finds that the sun creates a low barometric pressure in the doldrums, and that the area of high pressure in either hemisphere which is most convenient, and has not heated land in the way, supplies the air demanded by the deficiency within the doldrums. These areas of high pressure are shown on Buchan's charts to exist in the North Atlantic Ocean in the summer-time, and in the South Atlantic in the winter-time. We find that during the northern winters and spring more upper clouds are seen moving to the northward, and reversed during the northern summer season. The highest pressure within the squares under consideration takes place in July, and it is after this that the winter hurricanes commence. We have at that time high pressure on the north and south sides of the doldrums.

The barometric gradients are in this section much weaker for a given velocity of the wind than in the neighborhood of the British Islands. The currents of the surface of the ocean, running from the doldrums, flow to the eastward, and not to the southeast or northeast, which is explained by Captain Toynbee as the effect of a secondary action of the Gulf of Guinea. The sea is always warmer by about 1° Fahr. than the air above it—a fact also noticed in the South Atlantic Ocean off the coast of South America.—*Viertelj. d. Astron. Gesells.*, 1873.

THE MOVEMENT OF WAVES IN THE OCEANS AND HARBORS.

A work of great importance, on the movement of the waves of the ocean, has been published in Italy during the year 1872, and is very highly spoken of in the French *Naval Review.* The author, Captain Cialdi, of the Pontifical navy, has favored the world with a careful summary of the principal points of his profound mathematical work of seven hundred octavo pages, the result of twenty-five years' study and practical experience of this subject, from which we make the following extracts: Cialdi has sought, with apparent success, to apply his results, which are indeed generalizations from long experience and accurate observation, to the benefit of harbors and rivers, etc.; in the words of Scott Russell, "to force the waves, those dangerous enemies, to become our sturdy slaves." The practical application of his views is now being carried into execution in the mouth of the Izauro, and he hopes also to improve Port Saïd.

The author gives first a brief but quite thorough review of the works of Italian philosophers, beginning with Leonardo da Vinci, and passes then to English, Spanish, and German writers on this subject. He criticises justly all the numerous analytical works on this branch, because authors have, by the insufficiency of mathematical analysis, been obliged to deny the movement of transportation within a wave, which action is shown by observation to be a highly important component of wave motion; and he finds that this has been properly considered only in the works of Leonardo da Vinci. Cialdi next gives his own studies of the question of the movement of the molecules of undulating waves, and the effect of wind on waves, both in the deep sea and near the shore. In the third section of his work he collects all the measurements that have been made of the dimensions and movements of waves, both on the ocean and in the Mediterranean Sea. He also examines minutely the question of the "breaking" of the waves, and finds that the causes of this phenomenon may lie at a depth of six hundred feet in the deep ocean, and at a depth of one hundred and fifty feet in the Mediterranean. It follows from these considerations that sand is elevated from these same depths by the action of waves during storms. Cialdi then analyzes the details of the destructive work of the wave influence even at great depths, as shown in many permanent sea works, and especially in the breaking up of the frigate *Titus*, sunk near Cape Frio, and likewise in the experience of those using diving-bells, which can not be employed with safety in stormy weather at a less depth than sixty feet. He also examines the subject of waves without an accompanying wind, and the very curious case of waves at a great depth without any visible disturbance at the surface. One of the many points to which he directs attention is the decided development of heat accompanying the undulatory motion of the sea; and, again, he gives the result of his own experiments on the color of the sea, showing that the want of transparency of the water on the Agulhas Bank is due to the disturbance at a depth of two hundred feet caused by the waves of the surface. The fourth section of Cialdi's work deals with the defective methods used in determining the existence of ocean currents, especially the use of the log line and float, and gives with great detail the discussion of the phenomena attending waves of transportation. He concludes that a proper correction for the transportation of the log by the surface action of the waves would cause to disappear from our maps a vast number of the secondary ocean currents that to-day ornament the nautical charts.

Finally, Cialdi examines numerous questions in practical hydraulics; and in the marine constructions that are now going on under his direction, the experienced French engineers who are working with him express themselves as convinced that the solutions he proposes seem to be the only practicable ones that promise to secure a permanent triumph over the obstacles that have hitherto presented themselves in works of this class.

The principle of Leonardo da Vinci, which Cialdi says he has made his motto, is so often neglected by deductive philosophers, while it is so important to the advance of science, that it is worthy of being repeated here. "We ought," he says, "to begin with experience, and by its means discover the truth. This is the motto to be followed in investigating the phenomena of nature." — *Revue Maritime et Coloniale*, 1873, 96.

A NEW DETERMINATION OF THE EARTH'S DENSITY.

The determination of the mean density of the earth has been the subject of several long series of observations since the time of Sir Isaac Newton, among which we may mention Maskelyne's determination by measuring the attraction exerted on a pendulum by the neighboring mountain Schehallien. Maskelyne's computations gave the earth a density four and one-half times that of water. Colonel James has by a similar method deduced 5.316, and Airy finds 6.565. Cavendish, by measuring the attraction of a large mass of lead for a small ball, obtained 5.48; Reich, by a similar method, obtained respectively 5.44, 5.49, 5.58. Baily's result was 5.67, and was obtained by the same method with great care and labor. None of these results seem to be so accurate as that just published by Messrs. Cornu and Bailee, who have also recalculated the observations of their predecessors, and explained away some of their discordances. Their own apparatus was not different in principle from that of Cavendish, Reich, and Baily, but was a great improvement upon these in employing balls of lead instead of quantities of mercury, thus enabling them to reduce the length of the arm of the torsion balance. They also eliminated the influence of any electricity that might be present by constructing the entire apparatus of metal. The method adopted by them of reversing the attraction of the sphere of mercury was peculiarly ingenious and advantageous, and consisted in connecting an empty glass globe on one side of the table with the filled glass globe on the other side by means of a tube through which the mercury could be made to flow easily from one globe to the other, and they also introduced the electro-chronographic method of registration. The result that they announce is for the mean density of the earth either 5.56 or 5.50, the former probably being nearer the truth. They also correct Baily's computations for the attraction of the lever, which he had himself not properly appreciated, and had then deduced from his observations 5.55 as the result of his own experiments. Giving a greater weight to the recent observations of Cornu, we may deduce from these and Baily's results the figure 5.56 as representing very nearly the true mean density of the earth.—6 *B*, 1873, 954.

THE ANTI-GULF-STREAM IN THE WEST INDIES.

In a recent letter of the English consul-general at Havana, attention is called to the remarkable destruction of vessels during the months of September to December, 1872, along the northern coast of Cuba. Although there is a tendency to unduly attribute the loss of vessels to unknown currents and to other mysterious causes, yet the consul-general concludes, from the consistent independent testimony of numerous commanders, that there is every reason to believe that there has existed in most recent times, between the Cuban coast and the main Gulf Stream moving eastward, a counter-current, hitherto but imperfectly recognized, and not mentioned in sailing directions and charts. To the unusual strength of this counter-current he attributes the recent loss of vessels, and suggests that it certainly demands the study of hydrographers. The effect of this anti-Gulf-Stream is to push the axis of the main stream to the north and northwest, closer to the Florida coast. Its existence is explained by the increasing volume of the north branch of the equatorial stream as it flows between the Bahamas and Cuba; the conflict of these two streams explains the very contradictory accounts of various captains and others, who have at different times reported sometimes strong southern and western currents, but ofttimes none at all, or even easterly ones.

COLD CURRENT OFF THE COAST OF BRAZIL.

The recent operations of the *Challenger*, according to the London *Athenæum*, seem to indicate that the inhabitants of the deep water exist without any regard to geographical boundaries, while near the surface the distribution is regulated by the temperature of the sea. A deep-water cold current of only 32.5° Fahr. was discovered running to the northward, along the Brazilian coast. No soundings exceeding 2500 fathoms were obtained north of the equator, between South America and Africa. The *Challenger* sailed for the Cape of Good Hope September 25.—15 *A*, *October* 25, 1873, 531.

"THE WINDS OF THE GLOBE."

The publication of the extensive work, under the above title, that has for the past ten years been in course of preparation by Professor Coffin, will not be delayed by the untimely death of the lamented meteorologist. The preparation of the numerical tables will be completed by the son and successor of Professor Coffin, under the supervision of the secretary of the Smithsonian Institution. The editing of the work will be supervised by Dr. A. Wojeikoff, of St. Petersburg, who will also contribute such portions of the text as may seem to be needed. Dr. Wojeikoff's present visit to this country promises thus to be turned to good advantage, and his extensive acquaintance with the meteorology of the Russian dominions insures that the winds of that country will be very fully represented in the forthcoming work.

STORM CHARTS OF THE ATLANTIC OCEAN.

The Meteorological Office at London has published a series of charts and abstracts of the logs of about thirty vessels, showing the weather prevailing for the eleven days ending February 8, 1870. This is "a first attempt at the style of work which is needed to connect the excellent observations now being taken in America with those of Europe." These charts show that during these eleven days five rotatory storms developed on the American coast, and moved north-eastward to points north of the British Islands, bringing, of course, almost continuous southwest winds and warm weather to the latter.

ON SOLAR SPOTS AND PERIODICAL RAIN-FALL.

The remarkable paper of Mr. Lockyer, in which he announced that the chief feature of the meteorology of the future should be to seek for meteorological cycles, such as the eleven-year sun-spot period, and in which he shows the existence of an eleven-year cycle in the cyclones of the Indian Ocean, has called forth excellent responses from various meteorologists, who are disposed to be more cautious in their reasonings than Mr. Lockyer seems to have been. The eminent Austrian meteorologist, Jelinek, following the laborious methods of the true inductive philosopher, has compared a long series of observations of rain-fall with the corresponding observations of solar spots. His conclusion is that while certain few localities show an agreement between the years of maximum rain-fall and of greatest number of spots, yet the majority do not do so. If, however, each epoch of maximum or of minimum be counted separately, he finds for European stations fifty-two cases favorable and forty-two unfavorable to the hypothesis that there is a connection between the two classes of phenomena. Jelinek concludes, very much as Lockyer and Symons seem to have done, that the southern hemisphere may possibly be specially favorable to the solar-spot influence—a supposition that derives some support from the fact that oceanic surface predominates in that hemisphere, and that it is more directly exposed to the solar rays when the earth is in perihelion.—*Zeitsch. für Meteorologie, March*, 1873.

METEOROLOGY AND BALLOONING.

A short balloon voyage was recently made by the well-known meteorologist Tissandier, who remarks that the most noticeable feature of the ascension, which was made on the 4th of October, is the route followed by the balloon under the influence of two superposed currents. At the moment of the ascension, about noon, the lower current carried the balloon in the direction east-southeast, while, at the altitude of 2100 feet, the upper current carried it toward the northeast. The actual curve described in space was, therefore, of a complicated nature until the balloon had risen into the upper regions of the air. It then took a northeasterly course; but, on beginning to descend, again came at once into the influence of the lower current, and, although it had traveled about sixty miles in the course of two hours, yet it might have been possible to have returned by means of the lower current, directly to the place of starting. At the maximum altitude reached during the ascension, which was about 8000 feet, the balloon was plunged into the midst of a bank of heavy cumulus clouds. These clouds were overshadowed by a still higher stratum of cumulo-nimbus, about 12,000 feet above the earth's surface. Through the apertures in these clouds, blue sky could be perceived beyond, and M. Henry, who accompanied Tissandier, observed that the polarization of the atmosphere in these blue regions was far feebler than at the surface of the earth. As has been so frequently the case in the French ascensions, they have not failed to perceive the shadow of the balloon thrown upon the earth, and frequently surrounded by an immense aureole, or halo, of a yellow color.—6 *B*, 1873, 839.

C. GENERAL PHYSICS.

BECQUEREL'S ELECTRO-CAPILLARY PILE.

At a late meeting of the Paris Academy, Becquerel described a novel galvanic battery, or electro-capillary pile, as he terms it. The action of the porous diaphragms used in many galvanic batteries has been carefully studied by him since his invention thereof in 1829, and he states that in them, as in his new battery, the principle is the same—*i. e.*, the property possessed by liquids adhering to the surface of solids in capillary tubes or spaces of conducting electricity like a metal or solid conductor at the same time that the liquids are decomposed. It results from this that when two solutions of proper chemicals are in contact in a capillary tube, there is produced an electric current along its length in a direction the inverse of what would take place if the space were not capillary.—6 *B*, 1873, 245.

TELEGRAPH LINE TO AUSTRALIA.

It is perhaps not generally realized that Melbourne, Australia, is now in telegraphic communication with London, and, of course, with the rest of the world. The route taken by the Australian portion of the line of telegraph is from Port Darwin, on the northwest coast, overland to Port Augusta, eighteen hundred miles in a south-southeast direction. This long line leads through a hitherto unknown territory, no one having ever passed over the whole route until the construction companies pushed their way ahead, and, of course, every thing needed had to be transported by camels and other teams. Two years were occupied in building the line through this region, and it was finished in October, 1872. From Port Darwin a submarine cable extends to the southeast end of Java, the land lines of the Dutch government connecting this point with Batavia. From the latter city another cable stretches to Singapore, whence again a cable is laid to Madras. These cables are all owned, and were laid, by the Telegraph Construction and Maintenance Company, of England.—*Ocean Highways, January*, 1873.

SPONTANEOUS ELECTRIC CURRENTS.

The studies of Count du Moncel upon the electric currents found on telegraph lines will go far toward explaining the origin of the so-called "ground currents." He states that he finds strong currents on a line of wire having one end hanging free in the air, and that these vary with the moisture and the temperature. He has shown that they are not due to atmospheric electricity, because they never exist when the line is perfectly well insulated; and on such a line only a thunder-storm has any effect. Du Moncel considers the observed electricity to originate in couples formed by the suspended wire on the one hand, and the earth plate on the other, the earth itself and the telegraph poles forming the moist intermediate medium. He explains why the observed currents are, in fine, clear weather, positive during the day and negative during the night, but the reverse in rainy weather; and he elucidates the phenomena observed by Matteucci in a series of very careful experiments made on the plains of Lombardy.—*Telegrapher*, 1873, 49.

A NEW RELATION BETWEEN ELECTRICITY AND HEAT.

Dr. Guthrie, in a paper read before the Royal Society of London, gives the result of his study of a new and possibly important relation between electricity and heat. He finds that when an electrified insulated body is presented to a heated body (especially when the latter is in communication with the earth), the latter has the power of completely discharging the former of its electricity. The discharging power of a heated body diminishes with distance and increases with its temperature, and specially depends upon the heat rays of high intensity. The discharging power of a small white-hot platinum wire exceeds that of a large cannon-ball heated to the temperature of boiling water. This power does not depend upon the temperature of the electrified body. Negative electricity is always discharged more easily than positive, but the difference in this respect diminishes (with certain variations) as the temperature increases. Similar effects are obtained whether we use galvanic or static electricity. As hot iron discharges electricity most easily, so, on the other hand, a ball of white-hot iron refuses to be charged. As the white-hot ball cools it becomes first possible to charge it with negative, and subsequently, as it grows cooler, with positive electricity.—1 *A*, *February*, 1873.

SENSIBILITY OF SELENIUM TO LIGHT.

The electrician of the Telegraph Construction and Maintenance Company calls attention to the extreme sensibility of selenium to the influence of light during the passage of the electric current through it. According to this statement, if an electric current be passed through a bar of selenium in the dark, and the bar then subjected to the light of the sun, or even that of a candle, its conductive power is immediately doubled, the effect ceasing, however, when the light is withdrawn. This result is not all diminished by the intervention of rock-salt or colored glass, and is not due in any degree to heat. It is suggested that this discovery is capable of practical application in connection with photometric measurement. —18 *A*, *February* 21, 1873, 551.

ANALYSIS OF A FLASH OF LIGHTNING.

The duration and complex character of flashes of lightning form the subject of a very interesting and valuable contribution by Professor Rood, of Columbia College. To a certain extent his conclusions had been anticipated in a too little known work of Professor Henry on electricity, and also by other observers; but Professor Rood has, in other respects, penetrated further into the secrets of this phenomenon. By means of a rapidly revolving disk, Rood has shown that "the nature of the lightning discharge is more complicated than has generally been supposed. It is usually, if not always, multiple in character, and the duration of the isolated constituents varies very much, ranging from intervals of time shorter than one thousandth of a second up to others at least as great as one twentieth of a second; and, what is singular, a variety of this kind may sometimes be found in the components of a single flash." The sparks from an ordinary electric machine or Leyden-jar are shown by Rood to be much shorter and far more nearly instantaneous, and he failed in several attempts to artificially reproduce the longer discharges of the lightning flash by passing sparks through watery vapor or spray. According to the analysis by Dr. Vogel of the spectrum of the lightning discharge, quoted by Professor Rood, some flashes give spectra of bright lines on a dark background, while others give bright lines on a less bright continuous spectrum as a background, and, finally, some give a continuous spectrum destitute of lines. Rood thinks it probable that the continuous spectrum corresponds to the prolonged constituents of the flash, and that the normal spectra of bright lines on a dark ground were produced by flashes more nearly instantaneous.—4 *D*, *March*, 1873.

APPARATUS FOR OBSERVING MINUTE INTERVALS OF TIME.

The simple apparatus used by Professor Rood in measuring the duration of a flash of lightning is described by him in a recent communication, and he expresses the hope that others may be induced to make use of something similar, in order to add to our knowledge of this subject. Rood finds it difficult to observe figures painted on a revolving opaque disk, and considers it advisable to use a black or gray opaque disk about four inches in diameter, having an open sector or square hole cut through it. For flashes of medium duration he uses a square of from one quarter to one half inch, and even larger. For examining the multiple character of the flashes, he prefers a long, narrow sector of one or two degrees. For portability, a spring rotation apparatus is used, being so constructed as to admit of giving the disk from twenty to thirty revolutions per second, according to the observer's desire, and an index should show to what extent the clock-work is run down at the moment of the observation of the flash, so that the rate of rotation of the disk can be determined. Besides this portable instrument, another, a fixed one, is described by him as calculated to give admirable results.—4 *D*, *March*, 1873.

NEW DETERMINATION OF THE VELOCITY OF LIGHT.

A new experimental determination of the velocity of light has just been effected by Mr. Cornu, of Paris. The method was that of Fizeau, in which a ray of light is sent to a telescope at a distance of several miles, where it is reflected from a mirror so that it returns directly to the observer. The observer is supplied with a telescope, alongside of which a toothed wheel revolves in such a way that the teeth pass directly across the focus of the telescope. The observer can then see the distant telescope by looking at the teeth of the wheel, which will be close to his eye; and, when the wheel is turned, every time a tooth passes it shuts off both the view of the distant telescope and the passage of the light from the first telescope. A series of flashes are thus sent, which on their return to the observer are either cut off by a tooth of the wheel or admitted between the teeth, according to the movement of the wheel while the light was going and coming.

In Cornu's experiments the second telescope was at a distance of 10,310 meters, or about six miles and a half. By giving the toothed wheel a velocity of 800 turns a second, six teeth would pass the focus of the telescope while the light was going and coming, and the flash would be caught by the seventh tooth. The mean result of more than five hundred trials gave a velocity of 298,400 kilometers, or 185,396 miles, per second—a result only 400 kilometers greater than that of Foucault with the revolving mirror.

Mr. Cornu's paper was referred to the French commission on the transit of Venus, and we hope our American commission may be able to make a similar determination with improved apparatus.

RECENT DISCOVERIES IN ACOUSTICS.

In the March number of the *American Journal of Science*, Dr. A. M. Mayer published his fourth paper of original investigations in acoustics. The first paper of this series describes simple and effective experiments with tuning-forks, showing when a sounding body is *moved* the motion shortens the sonorous waves in those portions of the air toward which the sounding body moves, and lengthens the waves in those portions of the air from which it recedes.

This result, first indicated by Doppler in 1841, Professor Mayer makes evident as follows: If two forks are in unison, and one of them is sounded, while the other, placed at a distance, has touching one of its prongs a suspended ball of varnished cork, then the vibrations of the sounding fork will be communicated through the air to the other fork, and, having been thus set in vibration, it will project from its prong the suspended ball. Now if the prongs of the sounding fork are weighted, its vibrations will be slower, and therefore the waves which it produces in the surrounding air are longer than they were in the first experiment, and not being *in time* with the vibrations of the other fork, the latter is not affected by them, and the cork ball remains at rest. But if we now move the weighted fork *toward* the other with the proper velocity, then these longer waves will be *shortened*, and will equal those given by the stationary fork, which now enters into vibration and projects the cork ball. The same results are obtained when a fork which gives too many vibrations, and therefore wave lengths, is moved away from the stationary fork.

These experiments are easily repeated, and can be shown to a large audience by projecting on a screen by means of a lantern the magnified images of the fork and its suspended ball. The experiments beautifully illustrate the well-known method of determining the motions of the heavenly bodies from an examination of the displacement of the fixed lines in their spectra.

In the second paper, Professor Mayer gives his discovery of a method of detecting the phases of vibration in the air surrounding a sounding body, and thereby measuring *directly in the air* the lengths of its waves, and exploring *the form* of its wave surface. To detect the direction of the swinging particles of air, and to describe around a sounding body the form of its wave surface, at first seems beyond the reach of experiment, and it was first accomplished by the physicist in the following manner: An organ-pipe has a hole cut in its side; this hole is then covered with a delicate membrane; over this membrane is placed a small wooden cup. A gum tube leads into this cup a current of gas, which flows out by another tube, terminated by a small gas jet. When the organ-pipe sounds, this gas flame will jump up and down as the membrane closing the mouth of the cup vibrates outward and inward. If we now view this vibrating flame in a revolving mirror, it will appear as a band of light, with its upper border cut into teeth like those of a mill-saw, each tooth corresponding to an upward jump of the flame, and each space between two contiguous teeth corresponding to a downward jump of the flame. This method of observing the vibrations of air in an organ-pipe is due to König, of Paris.

If we then take a hollow sphere of brass of the proper size, with a circular opening in one side, and with a small tubular opening in the opposite side (known as a Helmholtz resonator), and attach to the latter a gum tube leading to another membrane and box, whose gas jet is placed exactly below the jet of the organ-pipe, and hold the opening of this sphere near the pipe, we will see in the revolving mirror *two* series of serrations, with the teeth of one series exactly over the teeth of the other series. Now if we gradually move the sphere away from the pipe, we will see the serrations corresponding to the vibrating sphere of air gradually slide along those produced by the vibrating air in the organ-pipe; and when we have removed the sphere to such a distance that the serrations again appear exactly over each other, we will have moved the sphere from its first position by *the length of a sonorous wave* corresponding to the note given by the pipe. Furthermore, if when the sphere is placed at any distance from the pipe, so that the serrations of one flame are exactly over those of the other, we move the sphere around the pipe in all directions, so that in every position the serrations remain stationary, then we will have described in space *the wave surface of the vibrating air;* for from all parts of that surface described by the mouth of the sphere we have taken into the sphere the same phases of vibration. Professor Mayer thus found that the wave surface of an open organ-pipe was an ellipsoid, with its foci at the top and bottom of the pipe.

In his third paper, Professor Mayer describes his method of measuring, with precision, the wave lengths of sound traversing tubes filled with air or any gas, and makes an important practical application of this method in an invention which he designates as an "Acoustic Pyrometer," which instrument consists of a coil of tubing formed of a material resisting very high heats, placed in the furnace whose temperature we would measure.

A sound is sent through this tube, and the length of the sonorous wave corresponding to this sound is measured by means of the vibrating flames. These waves will increase in length with the rise of temperature of the air in the tube, and these wave lengths can be determined with such great precision that a temperature of even 2000° Centigrade can be measured accurately to 10°.

The subject of the last paper of Professor Mayer's acoustical researches is "on the experimental determination of the relative intensities of sounds, and on the measurement of the powers of various substances to reflect and to transmit sonorous vibrations." The above measures are also made by means of König's vibrating flames. The following will convey a general idea of the method: Two of Helmholtz's resonators, vibrating to the note given by the two bodies, are placed near the bodies the relative intensities of whose sounds we would estimate. To each of these resonators is attached a gum tube; these tubes lead to a forked tube of metal, at the confluence of whose branches is placed one of König's membranes with its gas jet. One of these gum tubes has a piece cut out of it equal in length to a half-wave of the note given by the two bodies, and this piece is replaced by an equal length of telescoping tube made of one tube of glass sliding inside of another. Both bodies are sounded. The vibrations proceeding from them impinge on the open mouths of the resonators, and the impulses of the vibrating air in these resonators are sent through the gum tubes to the membrane. Now by drawing out or pushing in the telescope tube, vibrations in opposite directions are caused to reach the membrane, and then, *if the intensities* of these vibrations are equal, the membrane must necessarily remain at rest, and the flame, viewed in the revolving mirror, will appear as a band of light with a smooth unruffled top border. The distances of the resonators from the sources of sound are now measured, and the ratio of the squares of the distances will give the relative intensities of the two sounds.

After Professor Mayer had succeeded in measuring the intensities of the vibrations of the air at certain distances from the sounding bodies, he measured the powers of various substances to transmit, absorb, and to reflect sonorous vibrations. To accomplish this, he placed one of the sounding bodies in the focus of a parabolic reflector, and brought the two resonators at such distances from their sounding bodies that the intensities of the pulses traversing their respective tubes were equal. He then placed in front of, but not too near, the mouth of the resonator, in front of the reflector, the plane surface of the substance whose transmitting and reflecting powers he would determine. Serrations now appeared in the flame, because part of the force of the pulses which previously sounded the resonator are now reflected from the interposed substance. The resonator which has not the reflecting surface in front of it is now gradually drawn away from its sounding body, and at each successive point of remove the pulses propagated through the two resonator tubes are brought to opposition of phase on reaching the membrane by means of the glass telescoping tube. Equality of impulses having been obtained, we measure the distance of the resonator which has not the reflecting substance in front of it from the origin of its sounding body, and this measure, together with the known previous distance of this resonator, when equality was attained before the interposition of the reflecting surface, gives the data for the computation of the intensity of the *transmitted* vibration. This number subtracted from the measure of the intensity when the substance was not before the resonator, taken as unity, gives the reflecting power of the substance plus its absorbing power.

REMARKABLE ELECTRICAL PROPERTY OF GLYCERINE.

Professor Waltenhofen finds that when a card is coated with glycerine on one side, and points connected with conductors leading to the coatings of a Leyden jar, or the terminals of a Ruhmkorff coil, are placed in contact with opposite sides, but not exactly opposite each other, the positive in contact with the coated side, the perforation by the discharge will invariably be opposite the positive point, instead of the negative, as in Lullin's experiment.—14 *C*, CCVII., 1873, 305.

THE ELECTRIC PHENOMENA OF CRYSTALS.

The electrical phenomena developed in many crystals by heating or cooling them has not been thoroughly pursued since the early days of David Brewster until the recent investigations of Hankel, of Leipsic. The elaborate researches of this eminent physicist have opened up new views of the subject, and will undoubtedly contribute to place upon a more correct basis our knowledge of the relations between heat, electricity, and crystalline structure. Hankel has stated some of his conclusions very nearly as follows: "Up to the time of my researches on the thermo-electric peculiarities of topaz, we knew only of the electric phenomena of crystals having electrically polar axes—that is, of those of which one end showed positive, the other negative electricity; and this seemed to be a physical necessity, so that it was concluded that there existed the possibility of thermo-electric excitation if the crystal was hemimorphous, and if pieces of crystals showed a thermo-electric tension it was concluded that the perfect crystal would be hemimorphous. My studies upon many varieties of crystals show that this idea is wholly unfounded, and rather is it true that the thermo-electric excitation is a general property of all crystals, at least those in which other properties render it not impossible, and that, if the tension were not too feeble to be measured by our instruments, it would always be discovered."

The observations of the distribution of electricity, both in the perfect and in the broken crystals, force us to modify our former views as to the nature of crystals in general. Until now, certainly all mineralogists and physicists have assumed that, if a crystal be broken or cloven, then all physical peculiarities, except the exterior form, are to be found in the separate pieces as in the original crystal, and that, therefore, the pieces are, in these respects, similar to each other; and, indeed, the optical and thermal properties do not allow us to detect any differences in this respect. On the other hand, the thermo-electric phenomena show that this view can not be maintained intact. We must now consider the crystal as a complete individual in itself, in which, as in the organic individual, the respective parts do not resemble each other or the whole, though the exterior form of the parts and the whole may be perfectly similar.—*Sachsc. Gesellschaft*, 1872.

THE DISSIPATION OF ELECTRICITY IN GASES.

In a memoir by Boboulieff, in the journal of the Russian Physical and Chemical Societies, the author has ably discussed the question of the gradual dissipation of the electricity with which any insulated conductor may be charged. After giving in some detail the conflicting results arrived at by the most eminent experimenters, such as Coulomb, Matteuci, Dellmann, Charault, Warburg, Riess, Biot, and others, as to the dependence of the slow dispersion upon moisture, pressure, temperature, the nature of the gas, etc., Boboulieff then follows out the indications given by the modern dynamical theory of the constitution of gases. He shows that if electrical dissipation be due, as is commonly thought, to the successive transfer of minute quantities of electricity from the isolated body to the atoms of the surrounding gas, then the laws followed by this phenomenon may be deduced from the general principles established by Maxwell and Clausius in their works on the constitution of gases, and that, according to these, we ought to have the following general laws: 1. The coefficient of dissipation is inversely proportional to the square root of the absolute temperature of the gas. 2. It is proportional to the pressure of the gas. 3. It depends on the nature of the gas. 4. The dissipation must follow Coulomb's law, which is based upon observation, and requires that the logarithm of the quantity of the electric charge must diminish proportionally to the time. This last theoretical result, supported as it is by the observations of Coulomb and others, needs no further consideration; but, in support of the first three deductions, the author submits a number of special experiments and observations made by himself on air and hydrogen. The apparatus employed by him consisted essentially of a bell-glass filled with gas at any desired tension, and within which were two light gilded balls—one fixed, the other movable. The latter was suspended from one end of a light horizontal bar, to which was fastened a magnetic needle, and all of which hung by a single fibre of silk. The gilded balls, being equally charged, repelled each other to such a distance that the repulsive force was balanced by the magnetic movement of the needle. The latter afforded the convenient means of determining at any time the extent to which the balls had lost their electric charges. Rejecting all the observations in which a small error in observation could entail an appreciable effect upon the resulting coefficient of dissipation, and confining himself to the most accurate results, Boboulieff finds (1) that the dissipation in air diminishes with the diminution of pressure, and (2) that the dissipation in hydrogen is less than in the air at the same pressure. In some of these experiments the charge of the two gilded balls was maintained for eight or ten days, during which interval observations were regularly made upon them.—*Journal of the Physical and Chemical Society*, 1873, 36.

A NEW SPECTROSCOPE-MICROMETER.

Professor Rood, of New York, has devised a very convenient eye-piece micrometer for use in spectroscopic measurements. A thin, smooth, semicircular plate of silver is blackened by smoking it, the soot being attached by subsequent flowing with weak spirit varnish. On this dead black surface, and perpendicular to its diametrical edge, lines 0.25 millimeter apart are ruled with a dividing engine, the numbers being afterward added. The opaque plate, thus prepared, is placed in the interior of a negative, or, preferably, in front of a positive eye-piece, so that it is in focus, and occupies nearly half the field. A lateral opening in the eye-piece, somewhat nearer the eye, admits the light necessary for illuminating the ruled lines. In general the diffused light of the room is sufficient for this purpose; but, if not, a distant lamp conveniently placed accomplishes the same purpose. In this way a set of bright lines is seen in the field of view, more or less bright as the lateral opening is more or less shaded, which may be used with great satisfaction in fixing the position of lines in spectra given either by prisms or ruled plates.—4 *D*, *July*, 1873, 44.

A NEW DOUBLE-IMAGE MICROMETER.

A proposition has been made to the Paris Academy of Science by a M. Noel, describing a proposed new form for the double-image micrometer, which seems to have some advantages over the divided object-glass and the divided ocular. Noel places within and near to the principal focus of the telescope a plane mirror, so adjusted that the image of the object to be measured is formed at the side of the tube. The mirror, however, is not of one piece, but is divided into two separate halves; the optical axis of the telescope and the line of bisection are in the same plane, and perpendicular to this plane is an axis about which either (or one) of the mirrors may be revolved. The two images of the object, as formed by the respective plane mirrors, may now be separated as in the double-image micrometer, the degree of their separation being equal to the angle included between the two planes. The advantages of Noel's construction are (1) that the micrometer screw is replaced by the divided circle, and (2) that the value of a division of the divided circle may be easily altered at will, and allows of attaining very great precision with comparatively little labor.—6 *B*, *January*, 1873, 750.

THE NATURE OF SUNLIGHT.

Dr. Draper, of New York, has lately published a summary of the views respecting the activity of the rays of the sun that have long been held by him, and which are now probably almost universally accepted by scientific men, although the elementary text-books on this subject have not yet been divested of the somewhat inaccurate expressions of thirty years ago, which latter also continue to be used by photographers and most practical men.

According to Dr. Draper, the calorific, luminous, and chemical effects produced by the solar rays are not so many distinct forces or emanations coexisting in a beam of light, which can be dispersed by a prism, according to a fixed law, over the length of the spectrum; but are, on the contrary, only the various effects of one and the same force acting under different conditions and upon different substances. He maintains (1) that the chemical action is not limited to the more refrangible rays, but is equally distributed over the luminous and the calorific portions of the spectrum; (2) that the ray effective in producing chemical or molecular changes in any special substance is determined by the absorptive power of that substance; (3) that there is also no special localization of the visual or the thermal effects.

In the case of the silver iodide so generally used by photographers, Draper shows that the more refrangible rays produce an effect contrary to that produced by the less refrangible. In the case of the bitumens and resins, he shows that a properly prepared film of these is as sensitive to either the ultra red or the ultra violet rays as the silver iodide is to the latter rays only.

In the highly important case of the development of the carbonic acid gas found in the atmosphere by the action of sunlight on plants, he shows that this is accomplished by the action of the rays between the orange and the green bands of the spectrum, the maximum effect being in the yellow. The vegetable colors and the colors of flowers are shown to be dependent each upon the chemical action of a corresponding specific ray or rays. The union of chlorine and hydrogen goes on under the influence of every ray of the spectrum, but with greatest rapidity in the violet. The effects of light on chlorophyl show that the vegetable colors are destroyed by rays complementary to those that have produced them.

The second of the above propositions is supported by the observations on the decomposition of the silver iodide, in relation to which Dr. Draper develops a fact of much interest to photographers, *i. e.*, that the ordinary collodion film absorbs only about one fourth of the whole actinic effect of the rays falling upon it; the rest passes through and is lost. Could the film be made to absorb the whole, its sensitiveness would be correspondingly increased.

The second proposition is especially supported by the direct experiments with chlorine and hydrogen. The solar rays having passed through a layer of chlorine, are unable to cause the combination of a mixture of hydrogen and chlorine on which they are allowed to fall; without the intercepting layer of chlorine, the solar rays cause the immediate combination of the two gases. Further experiments with absorbing media show that the more refrangible rays are the ones effective in causing the union of chlorine and hydrogen, and that, furthermore, the rays that are specially effective are those corresponding to the bands common to the spectra of the two gases. The process of union begins after the lapse of a certain time, during which the rays entering the mixture have been acting upon it to prepare it for the subsequent union. The actual union is a progressive phenomenon, the rapidity of which increases with the intensity and quantity of light.

The action of light on the chlorine compounds of silver is precisely similar to that on the compounds with hydrogen; and "there is to practical photographers an advantage, both as respects time and correctness in light and shade gained by submitting a sensitive surface to a brief exposure in a dim light, so as to pass it through its preliminary stage."

PROTECTION OF SHIPS' COMPASSES.

The possibility of protecting ships' compasses from the disturbing effects of the varying action of the iron of the vessel has led several eminent electricians to devise means to secure this result more or less perfectly, and the latest suggestion is that of Mr. Gloesvenor, member of the Royal Academy of Brussels, who proposes to place the standard compass on a prolongation of the bowsprit of the vessel, in this way securing the advantage of having all the disturbing iron on one side of the needle, and placed symmetrically with reference to it. The necessary length of the prolongation Gloesvenor finds by experiment to be twenty-five or thirty feet. To read the compass conveniently, he puts a mirror above it, in which a person standing on the deck may read the needle or compass card. A small fixed telescope facilitates the accurate observation.—*Bull. Acad. Belgique*, 1873, 357.

PERIPOLAR MAGNETO-ELECTRIC INDUCTION.

Since the discovery of magneto-electric induction by Faraday, the experiments on the subject have been varied in many ways. One class of these is well explained, viz., the effects of induction in a closed circuit when the distance of some portion of it from a magnetic pole is changed, or the magnetic intensity itself changed. Another series of induction phenomena—those in which a conductor moves in a field of magnetic force without in the least changing its distance from the magnetic poles—of which an example is found in the rotation of a metal disk about a central magnetic axis, has lately been made the subject of some excellent experiments by Le Roux. The author judged that the previous experiments on this class of phenomena have been on too small a scale to yield reliable results, and he succeeded in obtaining a rotating disk whose electric phenomena became visible as sparks, the current being nearly as strong as that of one cell of a galvanic battery, and whose strength could therefore be studied by the electroscope rather than by the galvanometer. The disk used in these experiments was of fine copper, six inches in diameter and the twentieth of an inch thick, and it made sometimes a hundred and eighty revolutions per second about its axis. At the extremities of one of the diameters of the disk were placed respectively the north and south poles of powerful electro-magnets.

The magnetic currents induced in the copper disk while it rotates flow from the central axis to the circumference of the disk, or radially, so soon as a thick wire is applied to complete the circuit between circumference and centre. Until this connection is made, the rotating disk experiences no opposing force except friction. As soon, however, as the connecting arc of wire is applied, the rapid development of the electrical sparks shows that the power applied to turn the disk is being converted into electricity, and the power thus consumed must be supplied by increasing the force that turns the disk. By connecting the centre of the disk with the earth, and its circumference with one plate of a condensation electroscope, Le Roux has succeeded in showing that an electric tension exists in the disk even when the connecting arc is not present, thus settling one of the most delicate of the doubtful points in the study of induced electricity. The phenomena of peripolar induction, as Le Roux denominates those we have been describing, have a direct and important application to terrestrial magnetism.—19 *C*, 1873, 102.

BECQUEREL ON THE NATURE OF ELECTRICITY.

Becquerel, as the conclusion of long research on the electrical forces, says that "in the present state of our knowledge of physics and chemistry, it is scarcely possible to attribute to chemical affinities an electric rather than a calorific origin. What, then, is their origin? Time will answer. They are connected probably with universal ether. Let us study all the causes that exert an influence upon these affinities. This is the only way to effect the removal of the veil that covers this mystery."—6 *B*, 1873, 851.

ON THE NATURE OF THE ELECTRIC SPARK.

Casin has studied the nature of the electric spark given off by the Ruhmkorff induction coil, and he finds that in general these sparks are complicated, although appearing to the naked eye single and instantaneous. By examining such sparks by means of a rapidly revolving perforated disk, he finds that when the electrodes are small platinum bulbs, distant from each other only a small fraction of a millimeter, the discharge consists of hundreds of successive small sparks. When, however, the distance is five or six millimeters, and the electric batteries are not too strong, but one bright spark is seen, so that generally, as the distance of the electrodes decreases, the number of successive sparks increases.—6 *B*, 1873, 876.

IRRADIATION.

Le Roux states, as the results of his study of the optical phenomena of irradiation, that these belong especially to the field of indistinct vision, and that irradiation increases in proportion to the distance of the image on the optic nerve from the *fovea centralis.* For this latter portion of the retina the phenomena do not exist; for it there is no other irradiation than that which results from the want of acuteness of vision, and for the whole field of view irradiation is still a question of acuteness of vision, and is explained physiologically by the progressive spacing of the sensitive elements of the retina in proportion to their distance from the *fovea centralis*, the place of their maximum concentration. The production of obscure ligaments between opaque contours is not a phenomenon of irradiation, for then it would be a negative irradiation, which means nothing; it is, he thinks, a phenomenon of imperfect accommodation, and is produced in contemplating objects with the naked eye as well as with telescopes; but one can make it disappear, or else exaggerate it, by causing the accommodation to vary. Among other interesting phenomena, Le Roux has observed an obscure ligament, isolated from each of its contours by luminous bands.—6 *B*, 1873, 960.

POLARIZATION OF LIGHT BY REFLECTION.

When a ray of polarized light is reflected from a surface of glass, the two principal components of the reflected ray experience no sensible difference of phase, except when the angle of incidence is in the neighborhood of the angle of maximum polarization. At this point, within a comparatively limited angular extent, there is established a rapidly increasing difference of phase which soon becomes equal to a half-wave length, when it remains constant, as the angle of incidence increases up to the normal value of the polarizing angle. If, now, the reflection takes place from a metallic surface, the difference of phase, instead of changing so abruptly, is produced in a uniformly continuous manner, in proportion as the angle of incidence varies. The above propositions, long since established, have now been connected together by a very curious observation of M. Mascart. He has shown that if a thin film of silver be deposited on a glass surface, this metallic film will, if of extreme thinness, give to the reflected light somewhat of the character of light reflected from a metallic surface; while, if the thickness of the film be comparatively great, the properties of the reflected light become simply those due to metallic reflection. The special interest of the measures which M. Mascart has published lies in the fact that by three different methods of measuring these films he has arrived at results confirming each other, and showing that films of silver, whose thickness is but one two-hundredth part of the length of a wave of light, exert an appreciable influence on the phase of the light that is reflected from it, and that a film one quarter of a wave length in thickness gives almost pure metallic reflection. The influence of the slightest deposit of oil, or any change in the condition of the reflecting surface, is, of course, immediately perceptible in these experiments.—6 *B*, 1873, 868.

LISSAJOUS' PHONOPTOMETER.

Lissajous describes an extremely convenient method of studying the small movements, either periodic or continuous, of any body, at greater or less distances. His microscope, having a vibrating object-glass, was described in 1857; but he has now generalized the principle of the instrument, and by putting the ocular, or the front lens of the ocular, into vibration, he has much extended the usefulness of his invention. The vibration of the lens is brought about by attaching it to a vibrating sounding body. He has applied the phonoptometer to the study of bells and the qualities of their sounds, to the vibrations in the interior of a stove, to the movement of reed pipes, and to the velocity of projectiles.—6 *B*, 1873, 878.

THE MOST TRUSTWORTHY PYROMETER.

The great advantages which those enjoy who pursue their studies in the schools and universities of Germany are specially perceived when we examine the theses of the graduating classes and of their instructors, which are frequently published in connection with annual programmes of lectures. The last programme of the Technological School at Chemnitz contains a most exhaustive investigation, both experimental and theoretical, into the various methods of measuring very high temperatures, by Professor Weinhold, with the assistance of Dr. Schreiber, who was a student at the time the observations were made. The methods considered in the course of this investigation included the following:

First, the expansion of volume; second, the variation, in pressure, of inclosed gases, or the two forms of the air thermometer; third, the warming of a cold mass of any substance by heat, or the calorimetric methods; fourth, the melting of hard bodies; fifth, the conduction and radiation of heat; sixth, the change in the velocity of sound; seventh, the effect of heat on optical phenomena; eighth, the dissociation of chemical compounds; ninth, the development of electricity by the thermo-electric method; tenth, the change of the coefficient of electric conductivity.

Some of these, indeed, needed but a few passing remarks to dispose of their claims to accuracy. Of them all, the first method, that of the air thermometer, although most difficult of application, is theoretically adapted to give standard results; and the object of the author has been to ascertain whether some other method can not be found that, in comparison with this, shall be sufficiently accurate and much more convenient. After detailing the various precautions taken to prepare an air thermometer whose results should be of the highest attainable reliability, the author explains that the construction of the apparatus which he employed was, with some modifications, the same as that used by Regnault, Magnus, etc., and consists in measuring the pressure of a definite mass of air whose volume is kept approximately constant. The determination of the boiling-point of pure zinc, at 1035° Centigrade (1895° Fahr.), he considers to be the most accurate that has yet been made, and with as perfect a standard as this Professor Weinhold then proceeds to compare the various pyrometers of Gauntlets, Bock, and Oechsle, and shows them to be quite unreliable within the demands of modern science, even for temperatures of 500° and less. He next investigates the expansion of metals and hard bodies, as glass, porcelain, quartz, etc., and shows that all these bodies have such irregularities in their rates of expansion as to be practically worthless. The specific heat of a body at low temperature is not the same as that at a higher temperature;

and the imperfection of our knowledge of the rate at which specific heat changes leads Weinhold, before investigating the value of the calorimetric pyrometers, to first study the change of specific heat at temperatures of 900°, and less, for platinum and for iron. The latter proves to be far the better of the two metals for the purpose in view, and the errors of the result are not too large to forbid the use of iron in the calorimetric method. The specific heat of platinum varies, with curious irregularities; while for iron the changes are apparently very regular. The very promising method of Lamy, or the dissociation thermometer, does not give satisfactory results, though the author proposes to continue his researches in this direction. Finally, Weinhold tests the Siemens' pyrometer, whose principle of action is the measure of the increase in the resistance offered by a heated wire to the passage of a galvanic current. The instrument employed by him had been constructed for use in temperatures of less than 500°, and for such was found perfectly trustworthy. For temperatures up to 1000° its error was small and nearly constant, so that this method was decided to be the best of all that were examined. Weinhold thus sums up his results, which are of interest to all engaged in those manufactures requiring the use of high temperatures:

First. Of all the pyrometers that are sold ready for immediate use, the Siemens' only is to be recommended.

Second. The calorimetric method, used in a proper way, can serve as a pyrometer.—*Programme tech. Schule, Chemnitz.*

TENSION OF VAPORS FROM SOLIDS AND LIQUIDS.

A result of much practical interest in the study of the theory of hygrometry has been announced by Montier, who establishes the interesting point that any body emits a vapor having a tension depending not only on the temperature, but also on the physical condition of the body; for instance, the vapor of water at 32°, and of ice at 32° Fahr. The demonstration of this principle involves the truth of the dynamical theory of heat, which seems to establish the fact that if a body can exist at the same temperature, yet in two different states, characterized by a difference in the respective coefficient of specific heat, then the vapors emitted by the body in these two states possess in general different physical properties.—6 *B*, 1873, 1080.

RECENT RESEARCHES IN HYDRAULICS.

The laws of the motion of water, whether in rivers or seas, have been very successfully studied by Boussinesq, who has presented a profound memoir on his subject to the Paris Academy. In giving a general review of his studies we may say that Boussinesq, having shown that the formulæ and the methods employed by engineers strictly refer to the motion of water in straight channels, then proposes, as his problem, to examine, in detail, the effects of friction, eddies, and curves in rivers or pipes. He shows how the value of the coefficient of the flow of water depends on these disturbing elements, as also on the internal friction between contiguous atoms of the flowing water. Boussinesq then considers the problems of water flowing with variable motion, in the solution of which he attains much more generality than any previous author, in that he attacks the problem, by making use not of the principle of living force, but by the consideration of the theorems of quantity of motion. In the further study of the flow of water in rivers, he finds that when the uniform regimen begins to be established, after a rise, the surface of the fluid is affected by a series of transverse undulations having the same dimensions in the direction of the current as the rapidly decreasing height of the water. Passing, then, to the movement of waves in a river, either up or down the current, Boussinesq shows the effect on these of eddies and frictions, and deduces a formula such that if these disturbances be neglected, it is reduced to that of Lagrange and Scott Russell, which has been employed for a long time, although known to be imperfect. After this nearer approximation to the actual problems of nature, the author finally examines the effect of the curving of what he had hitherto supposed to be a straight channel. Other questions, as to the phenomena of initial waves, etc., are successfully treated. —6 *B*, 1873, 943.

CHLORINE ACTIVE IN THE DARK.

Melsens has observed that porous varieties of carbon (coke, for example) will, after purification, absorb nearly their own weight of chlorine gas, if only the temperature be kept from rising. If, now, a current of hydrogen gas, thoroughly dried, be passed over the coke thus charged with chlorine, even in absolute darkness, it will combine with the chlorine, and form hydrochloric acid gas. Using an amount of the carbon weighing fifty grammes, the temperature lowered twenty degrees. Here, then, was an actual combustion of hydrogen by chlorine taking place in the dark, without heat, and actually producing cold. This cold, however, is due to the absorption of heat by the condensed chlorine, which resumes the gaseous state.—6 *B*, 1872, 92.

RECENT OBSERVATIONS ON SHIPS' MAGNETISM.

In 1865, Professor William Harkness, of the United States Naval Observatory, was ordered to the iron-clad *Monadnoc*, for the purpose of making observations on the action of her compasses during the cruise that she was about to undertake from Philadelphia to San Francisco, by the way of the Strait of Magellan. The observations made by Professor Harkness are of a novel character in the history of American naval science, although it is well known that in England the subject of ships' magnetism, and its effect on the compasses of the vessels, has attracted a great deal of attention for the past twenty years, and, in the hands of scientific men, especially of Airy, has led to a fair understanding of the whole question. We believe, however, that Professor Harkness' results have a special interest as being the first, and, perhaps, the only ones, that have as yet been attained on vessels of the double-turreted Monitor type. The conclusions to which he has arrived may be briefly stated as follows: The deviations of seven compasses were observed and compared with the theory at ten different places, so situated as to afford very great changes in the terrestrial magnetic elements. For all these compasses the coefficients depending upon the hard and soft iron have been so far separated from each other as to render it possible to predict the deviations in any part of the world, and for the Admiralty standard compass, as well as for the azimuth compass of the *Monadnoc*, every one of the coefficients in Poisson's general equations has been determined separately, with a considerable degree of accuracy. The agreement between the theoretical and observed variations of these compasses is sufficiently exact for the purposes of navigation, but is not entirely satisfactory in a scientific point of view. It is questionable whether the theory really represents the semicircular as well as it does the quadrantal deviation, and to settle this point there is great need of more observations. The so-called permanent and sub-permanent magnetism of the ship were undergoing a constant and rapid change during the progress of its voyage, such a change as would correspond to a transfer of magnetism from aft forward, and to a rotation from right to left in the direction of the force. The ratio of the hard to the soft iron force was slowly varying at each compass, and for the different compasses it ranged between four and sixty-seven. There were compasses on board at which the attraction of the hard and soft iron forces coincided, from which it follows that in no case was the ratio of the hard to the soft iron force the same in the coefficient "B" (of Poisson's notation) as it was in the coefficient "C." So far as can be judged from the observations discussed in this report, in the case of a vessel "swung" for the first time, it is impossible to make any reliable estimate of the ratio of the hard to the soft iron force in the coefficients "B" and "C," and, therefore, it is also impossible to make any reliable estimates of the changes that the deviations of the compasses will undergo on a change of magnetic latitude.—*Harkness' Observations on Terrestrial Magnetism, Washington*, 1873. (*Smithsonian Contributions.*)

THE BEST CONDITIONS FOR ELECTRO-MAGNETS.

Du Moncel has communicated to the French Academy the results of his study upon the problem, What are the dimensions to be given to the electro-magnet, and the dimensions of the wire to be employed in the coil, in order to attain the best possible conditions, the resistance of the circuit and the force of the battery being given? He has,

1. Established the principle that a given helix produces its maximum effect when its own resistance (x) is greater than that of the remainder of the galvanic circuit in the ratio of 1 to $1+x$.

2. That, for the same diameter of the coil, the helix which gives the best results is that whose thread has a size and a length such that its resistance is equal to that of the exterior circuit.

3. That the thickness of the magnetic helix should be equal to the diameter of the magnetic bars that it incloses.

4. That the length of the magnetic helix should be equal to the diameter of the bars multiplied by eleven, and practically by twelve, because of the thickness of the insulating wire.—6 *B*, 1873, 348.

THE ROTATION OF THE PLANE OF POLARIZATION UNDER MAGNETIC INFLUENCES.

Since Faraday made the discovery that the plane of a polarized ray of light can be changed by the influence of magnetism, physicists have frequently made this the subject of their investigations. It has been established that the ratio of the change to the intensity of the magnetic current depends upon the nature of the substance, upon the degree of concentration of the solutions (in case such are experimented upon), and upon the temperature of the body under observation. Quite recently, Bichat has laid before the scientific world a very extended experimental investigation upon this whole subject, in which, besides confirming many previous results, he establishes some new and important facts, which may be summed up as follows:

Transparent bodies, whether they are in a solid condition or dissolved in liquids, are still subject to the magnetic influence. The power of this magnetic influence diminishes as the temperature rises, and it entirely disappears when the body is converted into vapor. For instance, notwithstanding he applied the most powerful means, Bichat was unable to find the least trace of a change in the plane of polarization when the ray of light passed through the vapor of the chloride of tin.—19 *C*, 1873, 281.

THE TEMPER OF STEEL AND ITS MAGNETIC POWER.

Jamin has made an excellent study of the magnetic power of various kinds of steel, as well as of that which has been tempered to a greater or less degree. He measures the power of his magnet by the weight that it will support, using, of course, magnets of the same size, and exposing the same surface to their armatures. He finds that soft iron does not retain its magnetism so long as tempered iron, while, on the other hand, those kinds of steel which have but little carbon have but little magnetic tenacity, while those that have a medium amount of carbon become elastic and resist the attempt to magnetize them. The soft steel is, of all other substances, that which takes up the greatest temporary magnetism. The tempered steel receives far less, but holds it more energetically. By the coefficient of polarity, Jamin means the ratio between the force of attraction shown by the magnet and its length or mass. He finds this coefficient to vary remarkably with the temper and annealing of the steel; so that, in almost every case, the steel that has been tempered by heating it up to a cherry red has about thirty per cent. greater capacity for magnetism than that which has been heated up to the second blue tint. The rule, however, holds only for the English steel. That which comes from certain steel works in France follows a directly contrary rule, inasmuch as in these cases the steels that have been highly tempered have a greater capacity for magnetism than those tempered at low heat.—6 *B*, 1873, 90.

TERRESTRIAL MAGNETISM AND BAROMETRIC FLUCTUATIONS.

Mr. J. A. Broun has advanced the theory that there is a connection between barometric variations and those of terrestrial magnetism. He first endeavors to show that great barometric depressions are produced, simultaneously, in various parts of the equatorial seas; that they have a period of twenty-six days, and are due to a direct action of the sun; that there is also a periodical maximum of the magnetic force, following two and a half days after the barometric maximum. Broun then proceeds to compare the records at two antipodal stations, and shows that the respective barometric variations follow similar laws, so that the maxima occur on the same day at both stations in twenty-six-day cycles, of which fourteen make one mean solar year. The amplitude of the barometric oscillation is one fourth of an inch. These results are based upon the published hourly observations at Makerstoun and Hobart-Town in 1844 and 1845, as made in accordance with the system of investigation into terrestrial magnetism pursued by the British government in those years. Mr. Broun finds his conclusions also verified by a study of the observations at Greenwich Observatory during the past twenty years.—6 *B*, 1873, 695.

ON ELECTRIC CONDENSATION.

Neyreneuf has investigated the subject of condensation of electricity by the use of the so-called condensers of various kinds. He concludes: 1. That the constancy of the charge of an electrophorous ordinarily depends upon the imperfection of contact. 2. That the employment of a proof plane is thoroughly defective in any quantitative research, and even in any qualitative research into the electric state of an isolated lamina. 3. That the employment of the gold-leaf electroscope demands the greatest precautions, because of the variable condition that is always produced in consequence of the action as an electrophorous of the isolating lamina. 4. That an electrophorous used under the most favorable conditions theoretically, will not give any result, because of the antagonism of its spontaneous discharge, and that obtained by the ordinary working of the apparatus.—6 *B*, 1873, 202.

THE EFFECT OF LIGHT ON THE PASSAGE OF AN ELECTRIC CURRENT.

Mr. Willoughby Smith, a well-known electrician of England, has made some observations on the remarkable property of the metal selenium, which have been repeated by others with, however, variable success. Mr. Smith states that, being desirous of obtaining a convenient source of electric resistance, he was induced to experiment with bars of selenium, whose diameter was about the twenty-fifth part of an inch, and length half an inch; each bar was sealed in a glass tube, and its ends connected with platinum wire. Noticing great discrepancies in his results, he found on investigation that the resistance of these small bars altered materially according to the intensity of the light that so shined upon them. When the bars were fixed in a box with a sliding cover, so as to exclude all light, their resistance was at its highest, and remained so constantly; but immediately upon removing the cover of the box, the resistance diminished from 15 to 100 per cent., according to the intensity of the light falling upon the bar. Merely intercepting the light from an ordinary gas-burner, several feet from the bar, increased the resistance from 15 to 20 per cent. If the light was intercepted by rock-salt, or clear glass, the resistance varied according to the amount of light passing through the substances. When a strong light from the ignition of magnesium was made about nine inches above the surface of a basin of water, at the bottom of which a selenium bar was placed, the resistance of the latter immediately fell more than 70 per cent., but returned so soon as the light was extinguished.—4 *D*, 1873, 301.

EFFICIENCY OF DIFFERENT ELECTRICAL MACHINES.

Mascart has presented the results of some comparisons made by him as to the efficiency of the different styles of electrical machines, in comparison with the work done in turning them. The efficiency of a machine is defined by, 1, the difference of electric potential that it is capable of establishing between two conductors; 2, the quantity of electricity it can deliver in a given time. For the Ramsden plate machine the efficiency is proportional to the diameter of the plate: the cylinder machine of Nairne is but one half so powerful. The Holz induction machine, having two movable plates, rotating in the same direction, exceeds all the friction machines. The electricity furnished by the Ruhmkorff induction coil of large size, however, exceeds the Holz machine in the ratio of one hundred and thirty to eighty-six. One spark from the inductive coil, the electrodes being twenty centimeters apart, contains about the same quantity of electricity as is given by one turn of the handle of the Holz machine; at the usual rate of operation of the Ruhmkorff apparatus, which is six sparks per second for strong discharges, it becomes equal to three Holz machines.—6 *B*, 1873, 1014.

THE EFFECT OF GALVANIC CURRENTS ON THE LENGTH AND ELASTICITY OF A METALLIC CONDUCTOR.

It is known that any wire which conducts a galvanic current is somewhat heated up thereby, and in consequence changes its elasticity and its length. Streintz has undertaken to investigate whether a wire that is heated up to the same temperature by external means, and without conducting electricity, experiences the same change in its length and elasticity as do those wires through which a galvanic current is passed. Previous investigators, especially Wertheim and Edlund, have with reference to this question arrived at opposite conclusions. Streintz's conclusions are that the elasticity of a conducting wire is not affected when an electric current is passing through it, except to an extent corresponding to the temperature of the wire; that, however, on the other hand, the length of a conducting wire is changed to a considerable extent more than is due to the temperature, so that it expands in its length from 15 to 25 per cent. more than is due to the temperature to which it is heated by a passing current.

The experiments were made upon brass, copper, soft and hard steel, all the other metals giving results coinciding with the previously stated law. The expansion in length of the hard steel was not greater than might possibly have been due to errors of observation. From certain conclusions, Streintz conceives that the heat excited by the galvanic current is polarized, a conclusion to which Villari was led by a very different process of reasoning. It is notable that the expansion due to galvanism seems to have no relation to the modulus of elasticity.—19 *C*, 1873, 219.

THE POWER OF SMALL TELESCOPES.

De Abbadie gives some interesting details as to the degree of minute visibility that can be attained by the use of small astronomical telescopes. He says that Kitchner, in 1815, with a Ramsden telescope of $2\frac{3}{10}$ inches' aperture, and a magnifying power of seventy times, saw the companion star to Polaris. A short time before the death of Dawes, that eminent English observer published, at the request of De Abbadie, some of his own results. He says that a telescope of 1.6 inches' aperture easily showed the companion of Polaris, and did so even after its aperture had been reduced to 1.4 inches, provided the heavens were particularly favorable to this class of observations. De Abbadie's own experiments in this direction were made with a telescope of 1.8 inches' aperture, manufactured by Dallmeyer, of London. With a magnifying power of thirty, this telescope shows the companion of Polaris; and with a magnifying power of seventy-eight times, and a very steady atmosphere, he separates the northern pair of the star Epsilon Lyræ. The previous observations were made with English telescopes; but he says that this perfection in the construction of small telescopes is not unknown to the French artists. He quotes a glass manufactured by Bardon, whose aperture is 1.6 inches, which, with a magnifying power of sixty times, shows the companion to Polaris. De Abbadie calls attention to this matter in order to indicate to astronomical amateurs what degree of visibility can be attained with small instruments, and especially since it shows that in a telescope the perfection of the workmanship of the lenses is of more importance than their great dimensions.—6 *B*, 1873, 92.

SPECTRA OF SIMPLE AND COMPOUND BODIES.

Lockyer, in a recent letter on the subject of spectral analysis, states that he has studied various series of salts: First, those series in which the atomic weights vary; second, those in which the associated elements vary; and among his conclusions we note the following:

1. In compounds of lead, the diminution of the spectral rays, both in length and number, coincides with the increase of the atomic weight of the non-metallic element in the compounds under consideration. In compounds of barium with fluorine, he finds that its spectra are far simpler than those of lead. So also with strontium and magnesium, and their compounds of fluorine, there are, as in the case of barium, only four lines in their spectra. He thinks that this anomaly is due to the excessively refractory nature of these fluorids, preventing them from volatilizing so readily as do the compounds of lead. The compounds of sodium with chlorine and fluorine and iodine have given results quite opposite to those given by the compounds of lead; that is to say, the iodine, etc., produce metallic spectra very complete. Lockyer has also discussed the difference between the spectra produced by a flame and those given when we make use of the electric spark, and he finds the differences are such as are probably due only to the difference in the intensity of the heat and light. He has also investigated the spectra of the above-mentioned chemical compounds when heated in hydrogen as well as in atmospheric air, and concludes that a compound body has a spectrum as well defined as that of a simple body; but that, while the spectrum of this latter consists of lines whose number and thickness augment with the molecular density, the spectrum of a compound body, on the other

hand, consists principally of bands. In both cases the simplest spectra correspond to the least density, and the complex spectra, as well as the continuous spectrum, correspond to the condition of greatest density.

2. The heat necessary in order to act upon a compound body so as to render its spectrum visible, decomposes it by reason of its volatility. The number of true metallic rays that appear augment, therefore, in proportion to the dissociation, and, in proportion as the metallic rays increase in number, the bands diminish. Applying these considerations to the spectrum of the sun and the stars, Lockyer concludes that the general appearance of the solar spectrum shows that in all probability it is not a compound of the spectra of compound bodies. The spectra of the stars, as drawn by Secchi, prove, in Lockyer's opinion, the certainty of the existence of composite vapors in the atmosphere of some of the stars, and one can suppose that the changing appearances of a variable star are due to the state of unstable equilibrium in the temperature of this star, which would produce at one time a great absorption of compound molecules or of metalloids, at another time a feeble absorption of elementary molecules.—6 *B*, 1873, 1400.

DIFFRACTION GRATINGS.

Professor C. A. Young, of Dartmouth College, has suggested that the gratings made by ruling fine lines at equal distances on a plate of glass may advantageously replace the prisms of the spectroscope designed for the observation of the solar prominences through the Frauenhofer line C. Mr. Rutherford has recently furnished Professor Young with such a ruled surface of glass, the lines of which are at such an interval that six thousand four hundred and eighty of them are contained within the space of one inch. Substituting this for the prism of the common spectroscope, Young obtains a spectrum of the first order, and in which the D lines are about twice as widely separated as by the original instrument; in the neighborhood of the C line, the dispersion is nearly four times as great. On applying the new instrument to his equatorial telescope, he finds that he can easily see the bright lines of the solar chromosphere; and on opening the slit of the spectroscope, he perceives the outline of the chromosphere, and the forms of the prominences quite as well as with the instruments ordinarily applied to that class of observations. He finds the diffraction gratings much easier and lighter managed than the train of prisms, and anticipates that for a certain class of observations they will supersede them.—4 *D*, 1873, 473.

THE MECHANICAL COMBINATION OF COLORS.

Mr. F. J. Smith has designed a very convenient and elegant instrument to illustrate the phenomena of combination of colors. The instrument is designed to show the color that results from a mixture of all or any of the colors of the spectrum given by any. It consists essentially in a disk which can be caused to revolve very rapidly; at the centre of the disk is fixed a small plain mirror at an angle of forty-five degrees to the axis of revolution. In front of the mirror is placed a prism, while in front of the prism, and like it attached to the disk, there are placed slides, which can be changed so as to cut off any part of the rays of light. A ray of light is admitted through a small slit attached to the mirror, in such a way that the light, moving along the axis of revolution, passes first of all through the slit, then impinges upon the mirror, and is reflected at right angles to the axis; then, passing through the prism and the slides, it falls upon a fixed screen which entirely surrounds the movable disk; the disk being set in revolution, a colored band falls upon the screen, and moves around it as the disk revolves. When a certain velocity is arrived at, the colors combine, so that, looking upon the screen, we see the light which originally entered at the slit, and of the same color, unless any portions of this light are cut off by the slides when the revolving color is seen upon the screen.—12 *A*, 1873, 262.

THE SOLAR HEAT REFLECTED FROM LAKE GENEVA.

Dufour has, by means of hollow, blackened bulbs with a central thermometer, investigated the comparative amount of heat received from the direct rays of the sun, and that received from those rays that are reflected from the surface of the water of Lake Geneva. Simultaneous observation was also made of the atmospheric temperature, and the whole series of observations were repeated at five different stations.

He concludes that the highest proportion of heat reflected from the lake was about seven tenths of the incident heat, which amount is reflected when the solar rays make an angle of about four degrees with the surface of the water. When the sun is thirty degrees above the water, the proportion of heat reflected is inappreciable. The proportion of heat reflected is almost without exception greater as the lake is calmer. The rays that after reflection strike upon the adjacent shores of the lake have a decided influence in stimulating vegetable growth. This action of reflected heat has no probable connection with the absence of salt in the water, and the same or very similar effects will no doubt be observed from the surface of the ocean. This reflected heat is not without its influence on favorably situated plains, and ought to affect favorably the development of their vegetation. The loss of heat passing out of the atmosphere into the celestial spaces should by these experiments be considerable, and especially in the southern half of the hemisphere, where the oceanic areas are wider than in the northern hemisphere.—4 *D*, 1872, 218.

A NEW METHOD OF ANALYSIS OF COMPOSITE SOUNDS.

At the recent meeting of the National Academy of Sciences, Professor Alfred M. Mayer read a paper entitled "A New Method of Analysis of Composite Sounds." This analysis is interesting, not alone by reason of its delicacy and perfection, but also on account of its being a complete experimental confirmation of Fourier's celebrated theorem, as applied by Ohm in his propositions relating to the nature of a simple sound, and to the ear's analysis of a composite sound into its simple sonorous elements. The discoveries of Professor Mayer led him directly into experimental researches on the organs of hearing of different animals, and to the new and curious discovery that the fibrils of the antennæ of certain insects vibrate in sympathy to the notes which these same insects emit, thus affording the only *proof* ever given that the antennæ must be the organs of hearing.

The theorem of Fourier is the expression of a mathematical possibility, and shows that if we represent any composite sound by a periodic curve, then such curve can always be reproduced by compounding harmonic curves (often infinite in number) having the same axis as the given curve, and the lengths of whose recurrent periods are 1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, etc., of the length of the given curve.

The above theorem is the statement of a mathematical possibility, and it does not necessarily follow that it can be immediately translated into the language of dynamics without experimental confirmation; for, as Helmholtz remarks, "That mode of decomposition of vibratory forms, such as the theorem of Fourier describes and renders possible—is it only a mathematical fiction, admirable because it renders computation facile, but not corresponding necessarily to any thing in reality? Why consider the pendulous vibration as the inevitable element of all vibratory motion? We can imagine a whole divided in a multitude of different ways: in a calculation we may find it convenient to replace the number 12 by 8+4, in order to bring 8 into view; but it does not follow that 12 should be always and necessarily considered as the sum of 8+4. In other cases it may be more advantageous to consider the number as the sum of 7+5.

"The mathematical possibility, established by Fourier, of decomposing any sonorous motion into simple vibrations, can not authorize us to conclude that this is the only admissible mode of decomposition, if we can not prove that it has a signification essentially real. The fact that the ear effects that decomposition, induces one, nevertheless, to believe that this analysis has a signification independent of all hypothesis in the exterior world. This opinion is also confirmed precisely by the fact stated above, that this mode of decomposition is more advantageous than any other in mathematical researches. For the methods of demonstration which agree with the intimate nature of things are naturally those which lead to theoretic results the most convenient and the most clear."

But although Helmholtz thus states the importance of an experimental confirmation of this theorem, yet he did not attempt to test its truth by a course of rigorous experiments. This Professor Mayer has succeeded in doing by the aid of his new method of sonorous analysis.

It is well known that if a surface advance regularly under a point of a body having a pendulous vibration in a plane parallel to the surface, this point will describe on the surface a sinusoidal, or, as it is now more generally called, a harmonic curve. Ohm states that such a vibration, and only such, can produce on the ear the sensation of a simple sound—in other words, of a sound which has one and only one pitch. But the point of the sonorous body—whether it be a point of a membrane, of the drum of the ear, of the end of a vibrating rod, or of the air itself—may be actuated by a motion which, when it is caused to describe itself on the above-mentioned surface, may depart greatly in its form from the simple harmonic curve. Yet in this case, according to Ohm, the ear will act on this composite motion as the analysis of the mathematician can act on its corresponding curve, and will decompose it into the simple harmonic vibrations which compose it. Therefore the ear will, in this case, perceive several sounds, each having one definite pitch, and with the proper degree of attention can take cognizance of any one of them, to the exclusion, more or less, of all of the other components.

But if Ohm's proposition be true, then there must be a reason for it in the very dynamic constitution of the ear. This Helmholtz saw, and the discovery of the 3000 chords of Corti in the cochlea and of Schultze's bristles in the ampulæ led him to suppose that these bodies effected the analysis of the sound by vibrating sympathetically with its simple components. Thus he founded his theory of audition, which at once led him to his physiological theory of music as contained in his renowned work, "*Die Lehre von den Tonempfindungen*," in which he reveals the hidden causes of musical harmony, which had remained for 2000 years a secret and a problem to the mind of man. But many difficulties present themselves when we would bring to the test of experiment the propositions of Ohm and Helmholtz's ingenious hypothesis of audition. First, the complex sound on which we would experiment emanates from a multitude of vibrating points, and the points of the resultant wave surface differ in their amplitudes of vibration, while points equally removed from the geometric centre of the wave differ in their phases of vibration, so that when such a wave falls at an angle on sympathetically vibrating bodies which present any surface, the effects produced are the results of extremely complex motions. The mind sees at once the difference between this complex conception and Ohm's simple statement of his application of Fourier's theorem. The only experiment, indeed, which Helmholtz adduces in support of his acoustical applications of Fourier's theorem is precisely in the condition of the relations we have just described, viz., that in which the chords of a piano are caused to vibrate sympathetically to the elements which may exist in the note we sing over the strings of the instrument.

As the mathematician in his analysis decomposes seriatim every point of the recurring curve into its elements, so the physicist, in confirming the theorem of Fourier, should decompose into its elementary harmonic vibrations the sonorous motions which such curve represents and, indeed, reproduces when it is drawn under a slit in a piece of paper which exposes only a point of the curve at once. To do this it is required that only one vibrating point of the body should be experimented on, and that the composite vibratory motion of this point should be conveyed along lines to bodies vibrating sympathetically to the elements of the composite vibration, and that these sympathetically vibrating bodies should be capable alone of giving simple or pendulous vibrations.

To render assurance doubly sure, Professor Mayer, having found two fibrils of the antennæ of a mosquito which vibrated powerfully to two different notes, measured these fibrils very accurately under the microscope. He then constructed some fibrils out of pine wood, which, though two or three feet long and of the thickness of small picture-cord, had exactly the same proportion of length to thickness as the fibrils of the antennæ of the mosquito. He found that these slender pine rods or fibrils had to each other the same ratio of vibration as the fibrils of the mosquito.

These experiments were also extended in a direction which added new facts to the physiology of the senses. If a sonorous impulse strike a fibre so that the direction of the impulse is in the direction of the fibre, then the fibre remains stationary. But if the direction of the sound is at right angles to the fibre, the fibre vibrates with its maximum intensity. Thus, when a sound strikes the fibrils of an insect, those on one antennæ are vibrated more powerfully than the fibrils on the other, and the insect naturally turns in the direction of that antennæ which is most strongly shaken. The fibrils on the other antennæ are now shaken with more and more intensity, until, having turned his body so that both antennæ vibrate with equal intensity, he has placed the axis of his body in the direction of the sound. Experiments under the microscope show that the mosquito can thus detect to within five degrees the position of the sonorous centre.

To accomplish the above would be to arrive at a new method of analysis of sounds, and to give a complete experimental confirmation of Fourier's theorem. This Professor Mayer has succeeded in doing, as follows: A membrane is placed near the sonorous body. Attached to a point of this membrane are several fibres from a silk-worm cocoon. Each of these leads to a tuning-fork. Now, it is known that a tuning-fork can only give a simple sound, that is, a sound having only one pitch. Hence, if any of the sounds which are given by these forks exist in the sounds given by the sonorous body, the forks giving these sounds, and only these, will vibrate. Professor Mayer showed this by placing on the prongs of the forks small pieces of wax. This system of analysis is found to be so delicate that if the fork is thrown out of tune by the weight of the piece of wax, so that it will give one beat in eight seconds with the sound which it had before it was loaded, it will thus detect this difference in the pitch. According to Weber, of Germany, the most accomplished musical ear can detect a difference of pitch in two notes whose ratio of vibration is as 1000 to 1001; but by this method a difference of pitch can be detected in two notes where the ratio of vibration is 4000 to 4001.

Professor Mayer then gave an account of experiments by which he has partly succeeded in measuring the relative intensity of sounds by the quantity of heat that sounds give when the bodies producing them are caused to send their vibrations into India rubber. The rubber is in the form of a very thin sheet, stretched between the prongs of a fork, and inclosed on the sides by a thermo-battery. Professor Mayer is still conducting researches in this direction. Unless we can measure the intensity of sounds, there is no science of acoustics. Last year Professor Mayer made an initial step in that direction, by measuring with great accuracy the relative intensity of sounds of the same pitch. But to measure the relative intensity of sounds of a different pitch is a much more difficult matter, and has not yet been accomplished. Professor Mayer, however, hopes to succeed in this by converting a certain known fraction of a sonorous vibration into heat.

Professor Mayer now exhibited to the Academy the resultant curve produced by combining the first six harmonics of a musical note. This curve was then drawn on a circular disk of glass by removing from its blackened surface the continuous line of the curve, which returned on itself. This curve was now placed in front of a lantern, and the image of the line was projected on a screen. A slit in a piece of cardboard having been placed in front of the curve, and in the direction of a radius of the disk, and the disk being revolved, caused the spot of light on the screen to vibrate like the drum of the ear when it listens to a musical note. This experiment, from its novelty and interest, elicited great applause.

Professor Mayer then proceeded to give an account, illustrated by experiment, of what he supposes to be the organ of hearing in insects. Placing a male mosquito under the microscope, and sounding various notes of tuning-forks in the range of the sounds given by the female mosquito, the various fibres of the antennæ of the male mosquito vibrated sympathetically to these various sounds. The longest fibres vibrated sympathetically to the grave notes, and the short fibres vibrated sympathetically to the higher notes. The fact that the nocturnal insects have highly organized antennæ, while the diurnal ones have not, and also the fact that the anatomy of these parts of insects shows a highly developed nervous organization, leads to the highly probable inference that Professor Mayer has here given facts which form the first sure basis of reasoning in reference to the nature of the auditory apparatus of insects.—*N. Y. Tribune Extra, No.* 10.

A SYSTEM OF OPTICAL TELEGRAPHY.

During the siege of Paris by the German armies, a Commission was nominated by the Governor to decide upon the problem of optical telegraphy. The proceedings of this Commission were, of course, not published so long as the public safety demanded secrecy; but there was deposited with the Secretary of the Academy of Sciences a sealed package, containing a short exposition of the experiments and results obtained during the war. The recent publication of a memoir by an Italian on this same subject has led the members of the French Commission to state that the Italian method of observation and their results, as announced by them, offer a very complete analogy with those of the French Commission; and, in order to secure priority, the latter body has made public some of their results. The sealed packet was, therefore, opened by the Secretary of the Academy of Sciences on the 7th of July, 1873, and from its contents we make the following abstract:

The apparatus used by the French Commission consisted of two telescopes, one at each station, the stations being generally, of course, upon mountain-tops or other prominent points. The telescopes were pointed directly upon each other, so that a light placed at the focus of one was seen by an observer at the eye-piece of the other. The brightness of the image perceived by the observer would, of course, depend on the intensity of the original light, the distance between the telescopes, the apertures of the telescopes, and the state of the atmosphere. Numerous experiments were made in September, October, and November, 1870, in order to determine the best conditions of construction and establishment of the apparatus. The signals were made simply by displaying and concealing the light, a conventional alphabet being employed, probably not dissimilar to that known as the Morse alphabet employed by telegraphers. The rapidity with which signals were exchanged appears to have coincided very nearly with the rapidity attained in ordinary telegraphy. The maximum distance between which signals were successfully exchanged appears to have amounted to thirteen miles. The Commission also undertook to put Paris in communication with the provinces by sending up two of its members in a balloon, in order, if possible, to communicate their conventional system of optical signals to those dwelling beyond the lines of investment. The two members who undertook this matter established themselves at Bordeaux, where they formed a school of optical telegraphy, and were able to introduce the use of non-achromatic telescopes of a very large size, a step that was very advantageous in the matter of economy. The first communication between Paris and the country beyond through the medium of these two branches of the Commission took place in January, 1871. Experiments were also continued subsequently to the conclusion of the armistice, and the details so perfected that at night-time the signals, as they were then made, were read with the naked eye at a distance of twenty-three miles, and the practical utility of the method thus completely demonstrated.—6 *B*, 1873, 36.

HARMONIC ECHOES.

Lord Rayleigh communicates the explanation of certain interesting echoes, which he calls harmonic echoes, a name given to it by Dr. Brewer. On the river Nahe, not far from Coblentz, is an echo which makes thirteen repetitions at certain intervals. Sometimes the echo seems to approach the listener, sometimes to be retreating from him; sometimes distinct, sometimes feeble; at one time it is heard to the right, at another to the left. The special peculiarity of it consists in that the sound heard is at times in unison with the direct sound, and at others it is a third, fifth, or tenth of the fundamental sound. Similar echoes, but perhaps more musical, are found at Paisley, Scotland, and at the Lake of Killarney, in Ireland. The latter is celebrated in that it returns in response to any simple air played on a bugle a very excellent repetition of it, having a pitch corresponding to the second harmonic. An echo near Glasgow returns any note that may be played a third lower, and after a few minutes' pause a second repetition is heard still lower than the former, and after a similar pause the same notes are repeated a third time in a still lower and feebler tone. Rayleigh, while hesitating to believe that these descriptions are not somewhat exaggerated, thinks that they have a basis of truth, and has himself observed the sound of a woman's voice echoed from a plantation of fir-trees, but with the pitch raised an octave. The explanation which he gives of these interesting phenomena presumes that the echo is returned to the hearer, not from a plain surface, but from a broken surface, or a group of small obstacles, from the surface of each of which a small wave of sound is reflected back to the observer. This diffused sound he considers would necessarily contain the higher elements, that is, the notes of higher pitch, in excessive proportion, and, consequently, the direct wave, being shorn of these higher elements, will appear duller than the original sound. If, for example, a plain wall were covered with small projections, there would be a diffused echo due to the projections, and an ordinary echo obeying the law of reflection. In the latter echo, the original will be faithfully reproduced. In the diffused echo the higher elements, or the waves of higher pitch, will preponderate, and according to the relative strength of the diffused and the regular echo will be the impression made upon the ear of the hearer.—12 *A*, 1873, 300.

HINRICHS' THEORY OF MOLECULES.

Hinrichs, of Iowa, has, in his "Molecular Mechanics," given the physical properties of bodies as a function of the atomic weight, and the moment of inertia of the molecules, and he has recently sought to determine, experimentally and quantitatively, the existence of these physical properties. He communicates his result to the Paris Academy of Sciences as follows: According to his theory, the specific heat, the specific volumes of the temperatures of boiling and fusing, are all definite and simple functions of the moment of inertia of the molecules; and, by a process of computation which he develops at length for the case of a certain class of hydrocarbons, he arrives at the conclusion that the maximum value of the moment of inertia of a molecule of these bodies is 81.5 units of an empirical scale adopted by him.—6 *B*, 1873, 1592.

THE DIALYSIS OF VEGETABLE CUTICLES.

According to Barthelemy, the cuticle of a vegetable is a natural colloidal film, through which carbonic acid gas is absorbed into the plant by a process similar to that first observed by Graham, and called by him the phenomenon of dialysis. The experiments of Professor Graham were made upon thin solutions of various substances, almost exclusively of vegetable origin, and also on easily soluble substances, to which he gave the name of crystalloid. Thus, for instance, gruel or broth, containing a very little arsenic dissolved in it and submitted to dialysis, gives up the whole of its arsenic to the pure water on the opposite side of the dividing film separating the gruel from the pure water. The film probably acts upon different substances with different degrees of intensity, depending upon their relative chemical natures, and in the experiment with gruel, and, in fact, in most chemical analyses by this process, parchment paper is found to be a most effective substance. Barthelemy maintains that the cuticle of most vegetable substances, and especially of leaves, is particularly energetic in facilitating the transmission of carbonic gas. From a number of experiments made by him, he has shown that a given quantity of this gas is diffused through a film formed from a portion of the leaf of a Begonia in one hour's time, while the same quantity of nitrogen required fourteen hours, and oxygen required six hours' time; that is to say that the natural colloidal vegetable surfaces have for carbonic acid a diffusable power thirteen or fourteen times greater than that which they have for nitrogen, and six times greater than they have for oxygen.—6 *B*, 1873, 428.

THE RELATION BETWEEN THE PHENOMENA OF ELECTRICITY AND CAPILLARITY.

When a globule of mercury is placed in a vase of glass, and surrounded by sulphuric acid, it contracts itself and becomes more convex. When we put it in metallic communication with an iron or copper point, which also touches the acid, there is produced an electric current which polarizes the surface of the mercury. Experiments show that the contraction of the surface is due to a change in its capillary constant. This constant is the electro motive force of the polarization, they being functions of each other.

Reciprocally, an extension of the surface produces, by purely mechanical action, a polarity, the same as that made by the electric current.

Lippman, to whom we owe the preceding novel remarks, bases on these phenomena the idea of a machine which shall transform the current of a galvanic battery into mechanical work. Two masses of mercury, covered by the acidulated water, served alternately as the negative electrode to the current from one element of a Daniell's battery. The motions of the expanding and contracting mercury act upon small tubes to which their motion is communicated.—6 *B*, 1873, 1408.

THE DYNAMICAL THEORY OF GASES.

Maxwell writes that he has recently been revising the theory of gases, founded on the assumption of the collisions of elastic spheres; using, however, the methods of his paper published in 1866, rather than those of his first paper, published in 1860, which latter are more difficult of application, and which he thinks led him into some confusion in treating of the diffusion of gases. He finds evidence of considerable importance in favor of his present hypothesis, namely, that published in 1866, in the result of the experimental investigations of Loschmidt, who has made a number of determinations of the interdiffusion of gases in the cases of hydrogen, oxygen, carbonic oxide, and carbonic acid, to which we have alluded in a previous communication. Proof of a higher order, however, is furnished by a comparison between the results of experiments of entirely different kinds; as, for instance, the coefficients of diffusion and those of viscosity. He compares the results of some computations based on the experimental investigations of Loschmidt, Meyer, and himself, and he finds a certain agreement—such that the ratio of the above-mentioned coefficients agrees within the limits of the possible errors of the determinations. In the theory of the constitution of gases propounded by himself, an important part is played by a quantity called *the mean length of the uninterrupted path of a molecule*, or, more concisely, *the mean path.* He calculates the value of this mean path, in hydrogen, at the temperature zero degrees Centigrade, and barometric pressure 760 millimeters, to be 965 millionths of a millimeter, and for carbonic acid gas 430 of the same units. In the case of hydrogen, the wave length of the ray of light called the F ray is five times as great as the above-given mean path of the molecule. He then proceeds to enter upon a more hazardous question, namely, the actual size of the molecule; and making use of such approximate data as are at present only available for this computation, he finds for the diameter of the molecule of hydrogen about six millionths of a millimeter, and for the molecule of carbonic acid about nine such units.—12 *A*, 1873, 300.

DIFFUSION OF CARBONIC ACID.

It has generally been supposed that in an inclosure, protected against the wind, a layer of carbonic acid gas will remain for a long time, with a layer of atmospheric air above it, without any considerable mixture of the two gases taking place; this being based upon the hypothesis that two fluids, of different specific gravity, will long remain separate if kept still. On this account it is often maintained that the carbonic acid gas of an occupied room is in largest percentage near the floor, and that in sleeping at a point somewhat above this the accumulations of the gas will be comparatively innocuous.

Dr. Pettenkofer, however, has recently substantiated the assertions of previous writers, as to the inaccuracy of such views, by a series of experiments made at Marionbad, where a spring throwing off carbonic acid gas very rapidly has a small wooden house built over it, and into which the gas, containing at least 70 per cent. of carbonic acid, is continually discharging. He finds, as the result of continued and careful investigations under these circumstances, that carbonic acid gas is diffused into the atmosphere with the utmost rapidity; so much so, indeed, that at a distance of only an inch above the water surface, more than two volumes of the atmospheric air were already mixed with the gas of the spring; and that, still higher, the diffusion is so complete that the air is quite respirable.—18 *A*, *May* 30, 1873, 262.

THE FLOW OF WATER IN RIVERS AND CANALS.

We have already given in some detail the valuable theoretical results attained by Cialdi in studying the various important problems of hydraulics. In the practical labor of measuring exactly the currents in rivers, a decided improvement appears to have been made by D. F. Henry, chief engineer of the water-works in Detroit, in the invention and application of his telegraphic current meter. By the invention of this instrument, and especially by the extended series of experimental determinations made with it, he has contributed materially toward an advance of the science of hydraulics.

The principal application of his current meter thus far made consists in the measurement of the currents of the St. Clair River, both on the surface of the water and at depths successively increasing to forty-five feet. Henry concludes that in large rivers we may consider the surface velocity in a calm time to be nearly the same as the maximum velocity, while in narrow canals, with vertical sides, it may be considerably less. The velocity at various depths, according to Henry, may be represented by the ordinates of an ellipse, whose abscissas represent the depths below the surface. In order to obtain the velocity of any cross section of the stream, Henry maintains that the mean velocity observed at six tenths of the depth, especially when the observations are made at a number of stations in a line crossing the stream, is decidedly better than the mean velocity deduced from mid-depth observations.—4 *D*, 1873, 155.

A NEW EXPLANATION OF RUPERT'S DROPS.

The bursting produced in Rupert's drops the moment that the thin end is broken off has been hitherto attributed to a state of forced dilatation of the interior.

These drops, as is well known, are generally made by dropping melted glass into a basin of cold water, and it is supposed that the exterior surface being suddenly chilled, confines the interior portions in a condition such that the least disturbance of the equilibrium of the outer surface allows the interior to suddenly expand, thereby causing the whole piece of glass to fly into numerous fragments. De Luynes has quite carefully investigated this subject of the breaking of the Rupert's drops, and, in order to cause them to break without applying to them from the exterior any additional mechanical force, he suspends such a drop by a thread over a platinum vessel containing fluohydric acid. On allowing the fine extremity of the glass to dip into the liquid, he finds that he can always dissolve the whole of the thin end without destroying the drop. But when the acid touches the origin of the neck, that is, its point of divergence, the equilibrium is always broken, and the drop then separates into a great number of fragments, but in most instances without explosion. On the other hand, if he dip the large end of the drop into the acid, keeping the origin of the neck and the whole of the thin end out of the liquid, the drop may be completely dissolved without rupture.

These experiments prove that the stability of the drop depends on the existence of the origin of its neck. If, again, we cut through the drop by a saw, the explosion always takes place as soon as a little more than half the thickness of the glass has been cut away. Again, if the drops are encased in plaster of Paris, covering a little more than half of their thickness, and the thin end be left protruding, the moment that the neck is reached by the fluohydric acid, and the drop is disaggregated with or without explosion, the fragments will be found to remain very nearly in their place, and grouped into a series of conic assemblages, encased one within the other, and having their summits toward the thin end. If, on the other hand, instead of using fluohydric acid, we saw into the big end, after the explosion takes place the small conical arrangement is perceived, but the summit of the cone is in an opposite direction. And, again, if the drop is sawed in the middle, we have on each side of the incision opposite conical arrangements. Similar phenomena are presented by thin glass tubes, which are chilled by cooling in the air at the moment of their fabrication.

De Luynes also confirms the results attained by Dufour concerning the heat disengaged during the explosion of the Rupert's drops. He even finds that occasionally a specimen presents itself, such that on squeezing it between the finger and thumb a considerable disengagement of heat is produced. The explanation of all these phenomena, De Luynes thinks, does not require that we assume the glass drops, when entire, to be held in a condition other than that which arises from unequal expansion, resulting from the difference in the cooling of the interior and exterior portions of the Rupert's drop. He considers the drop as formed by the superposition of layers of glass unequally chilled and expanded, yet cemented, as it were, to one another. The exterior layers, because of the resistance of the interior ones, can only yield to this force of elasticity when through any cause whatever the interior layers of the drop are at the same moment set free to return to their normal state of expansion. Owing to the form of the drop, it is apparent that all these layers meet together at the origin of the neck, so that, on destroying this, the common point of resistance vanishes.—4 *D*, 1873, 232.

THE ATOMIC THEORY OF PROFESSOR CHALLIS.

The various forms in which the atomic theory is developed by all the different authors who have made this the subject of mathematical or experimental investigation, have appeared unsatisfactory to Professor Challis, who has, in a recent work of considerable mathematical ability, developed his own views of the theory of action at a distance. He regards the material universe as "a vast and wonderful mechanism, of which not the least wonderful thing is its being so constructed that we can understand it." The world, according to Professor Challis, is made up of atoms and ether. The atoms are spheres unalterable in magnitude and endowed with inertia, but with no other property whatever. The ether is a perfect fluid, endued with inertia, and exerting a pressure proportionate to its density. It is continuous, and, therefore, does not consist of atoms, and fills up all the interstices of the atoms. The two constituents of the universe, therefore, are atoms, which we can picture in our minds as so many marbles; and the ether, which behaves exactly as air would do, if Boyle's (or Mariotte's) law were strictly accurate, if its temperature were invariable, and if it were destitute of viscosity, and if gravity did not act upon it. Professor Challis sets before him "the task of explaining all actions between bodies or parts of bodies, whether in apparent contact or at stellar distances, by the motion of this all-embracing ether, and the pressure thence resulting. The hypothesis with which we thus start," says *Nature*, "is certainly not embarrassed with any indefinite or ill-defined conceptions of the properties of the elements of matter." Without going through the mathematical solutions given by Challis in the work referred to, we may merely indicate the nature of the problems that he undertakes to solve. He introduces the Newtonian law of attraction, varying inversely as the square of the distance, as a consequence of the periodic motion of the particles of ether, but is not able to deduce the numerical value of the influence exerted by the particles of ether upon the atoms of which matter is constituted. Having, however, by the vibrations of the etherial particles, set in motion the atoms of matter, he shows that attractions and repulsions will result. Besides the waves of ether, the author contemplates streams, spiral and otherwise, and, through these, accounts for electric, magnetic, and galvanic phenomena. The work under consideration, considering it as a theory explaining the nature of the force of gravitation, is to be compared only with that put forth by Le Sage, and known as the dynamical theory, the defects of which have, during the past two years, been exposed by Sir William Thomson. On either theory, it would seem as if the universe needed the application of some exterior power in order to maintain the existing state of things. —12 *A*, 1873, 279.

THE DYNAMICAL THEORY OF GASES.

The following remarks from Stefan's memoir on the conduction of heat by gases are worthy of being reproduced, and will show the rapid progress recently made of the dynamical theory of gases.

Stefan says, "The dynamical theory of the constitution of gases explains the pressure as the effect of the impulse of rapidly moving particles." From the known pressure and density, Clausius has deduced one of the constants that characterize the nature of every gas, viz., the velocity of the progressive motion of the gaseous molecules. By the same theory, Maxwell has explained the internal friction of gases as the effect of the exchange of velocities between the molecules moving at different rates in different strata. From the observations of Graham on endosmose, from the pendulum experiments of O. L. Meyer, and from the value of the internal friction as deduced by Maxwell, the latter has arrived at a second constant peculiar to the nature of the gas, viz., the number of impacts that take place between the molecules of the gas in a unit of time, and the mean length of the path pursued by a molecule between two successive impacts. From the same theory, however, it follows that, by means of the two constants thus found, there may also be determined the velocity of diffusion and the coefficient of conduction of heat. A series of determinations of the velocity of diffusion has been made by Von Loschmidt for various combinations of gases, and Stefan finds that, by the use of the above-mentioned previously known constants peculiar to each gas, we could have predicted the results of Loschmidt's observations. On the other hand, the conductivity for heat has been already computed in advance by Maxwell and Clausius from theoretical considerations. Therefore, for the more complete establishment of the dynamical theory of gases, it is of the greatest importance to have an experimental determination of this same quantity. After giving an account of the numerous difficulties that had hitherto prevented the accurate determination of the quantities in question, and the methods by which he had been in the highest degree successful, Stefan says, "The results so obtained are now in a truly unexpected agreement with the values predicted by Maxwell." The conducting power of air is found to be to that of copper as 1 is to 20,000, and to iron as 1 is to 3400. The predicted law that the conductivity of air should be independent of its density is also experimentally demonstrated in a most irrefragable manner. The conducting power of hydrogen is seven times greater than that of air, precisely as Maxwell had predicted. But few of the theories of the physical sciences can point to a more brilliant confirmation of predictions than this, and the dynamical theory of gases must now be considered as one of the best established of modern physics.—*Sitzungsber. Acad., Vienna*, 1872, 45.

THE MECHANICAL PRINCIPLES OF FLYING.

L'Aéronaut, a journal devoted to the interests of aerial navigation, contains a valuable contribution to our knowledge of the mechanical principles of the flight of birds, in an article by M. A. Penaud. The elaborate experiments of Thibault on the resistances opposed by the air to motions of thin plates of metal form the basis of the mathematical studies of Penaud, as well as of those by Louvrié, published in 1868. Thibault's experiments showed that in moving a plane square surface the resistance normal to the surface remains very nearly constant so long as the angle between the normal and the direction of motion (the angle of incidence) is included between 90° and 45°; it then diminishes progressively to 20°, from which point up to 0° of incidence it is sensibly proportional to the sine of the angle. M. Penaud now demonstrates, first, that a bird sailing in the air falls as slowly as possible when he employs for his horizontal movement one fourth of the work of the fall; second, a bird in sailing with a uniform movement clears a given space with the least possible fall when the work of suspension is sensibly equal to the work of translation: the plane of the wings then bisects the angle formed by the horizon and the direction of movement, and the latter angle is itself a minimum.

From these principles (which apply to birds, and not necessarily to insects) Penaud deduces most of the known characteristics of the flight of birds. For insects, as well as for fishes, the modes of propulsion involve quite different principles of mechanics.—*L'Aéronaut, January*, 1873.

THE SILENT DISSIPATION OF ELECTRICITY.

This subject, on which such diverse opinions are maintained in the various treatises on electricity, has been investigated with great care by Boboulieff, of St. Petersburg. He states as the result of most critical study of the theory of gases, and after prolonged and delicate experiments on dry air and on dry hydrogen gas, that (1) the dissipation of electricity in the air, and in all gases, diminishes with the diminution of the pressure, and that (2) the dissipation in hydrogen is smaller than in the air at the same pressure. These conclusions seem to confirm the dynamical theory of gases as propounded by Maxwell and others, and to agree with the results of a portion of the earlier experiments, especially with Coulomb and Warburg.—*Jour. Russ. Chem. and Phys. Soc.*, 1873.

EDLUND'S THEORY OF ELECTRICITY.

The electrical theory of Professor Edlund, of Stockholm, which was first published in 1870 (in Swedish), has now been translated into French, and seems destined to have a wide circulation. The ease with which it can be submitted to mathematical treatment, and the success that has attended attempts to explain by it some of the more complicated electrical phenomena, even in all their details, gives it a very great value, as, in itself, a convenient means of research; probably, however, we still have to look beyond the theories of Franklin, Thomson, Maxwell, Edlund, etc., for the true physical nature of that which we call electricity. According to Edlund, no hypothesis is necessary other than that already so well established—*i.e.*, the existence of an extremely elastic and subtle ether—a gas diffused throughout all space. The properties of this ether are those that have already explained the nature of light and heat—*e.g.*, it permeates all transparent bodies as well as the most perfect vacuum, and may exist in all opaque bodies, though in the latter brought under peculiar influences, such that it can no longer transmit light, though it may both heat and electricity. The atoms of ether repel each other, as do those of ponderable gases. The ether atoms within the mass of a good conductor of electricity move more easily than within a poor conductor. The mechanical action of the ether of one body upon that of another constitutes the phenomena of electricity; and thus, by Edlund's theory, is all reduced to not very complicated questions of mechanics. A body is said to be charged with positive electricity when it contains more than its normal quantity of ether. The galvanic current consists in the transportation of ether from one point to another in the circuit. By the mathematical development of these simple propositions, to which he adds the principle that is not very generally entertained in works on mechanics, but which he deems axiomatic—*i. e.*, that "every thing that occurs in nature demands an interval of time, no matter how short"—Edlund endeavors to account satisfactorily for the fundamental phenomena of electricity.—*Ann. Chim. et Phys.*, 1873.

SECULAR MAGNETIC VARIATION IN NEW YORK.

The recent annual report of the State Geologist of New Jersey, Professor G. H. Cook, gives some interesting particulars of the history and establishment of the boundary-line between New York and New Jersey. This boundary is an artificial line marked out by stone monuments set up at each mile of the distance from the Hudson River, and continuing forty-eight miles in a northwest direction. It was established in 1773 and 1774, and at that time the magnetic bearing of the line was N. 54° 40′ W. Professor Cook justly urges the importance of re-establishing the broken monuments, and of determining the present magnetic bearing of the whole line.

INTENSITY OF THE FRAUNHOFER LINES.

The number and length of the lines given in the spectra of metallic vapors being dependent upon the density of this vapor, only the longest lines remain visible when the vapor is rarefied. Lockyer has recently made the important discovery that the lines which are reversed in the solar spectrum are, without exception, the longest lines observed in the spectra of the corresponding element. Since, therefore, the very few zinc and aluminium lines visible in the solar spectrum are the longest lines observed in the spectrum of their vapors, the presence of these metals in the sun may be regarded as established.—6 *B*, LXXV., 1816.

MENDING A BROKEN OBJECT-GLASS.

It is not generally the case that astronomers attempt nowadays to do delicate work with poor instruments, and we should have thought that probably no living astronomer would trouble himself to make a broken object-glass serviceable to science. The recent experience of Dr. Gould, in Cordova, is quite remarkable in this respect. A letter received from him not long ago announced that the large objective sent him for use in stellar photography was found, on arrival, to be broken into small pieces. The glass had been made by Mr. Rutherford, of New York, for this particular class of work, and there was but one similar to it in the world. The disappointment of those who had hoped that celestial photography would become an important department of astronomical work in the southern hemisphere is now happily relieved by the announcement of Dr. Gould that he has so far succeeded in patching together the pieces of the broken objective as to afford reasonably distinct photographic images, and that he believes the instrument will yet prove serviceable. The difficulty of replacing this glass by an entirely new one was such as to quite justify the labor that Dr. Gould has apparently bestowed upon his delicate task. The photographic glass that he has now at his disposal has an aperture of about sixteen inches, and a focal length of as many feet.

ACTINIC POWER OF LIGHT.

In confirmation of the views lately and very clearly set forth by Professor Draper, must be noted the recent report of a committee of the German Photographic Society on a method of shortening the time necessary for the exposure of the sensitive photographic plate by a previous or a subsequent exposure to diffused light. The experiments made by this committee show that the time may be reduced by one half, and that the slower the action of the extraneous light, the better the result. The colored glasses of Gaensli were found to give excellent results. These glasses, although they cut off the blue and violet rays, yet allow a light to pass whose strongest actinic power is in the green rays. The committee emphatically state that "there is *no* non-actinic light," only a difference in the rapidity of action, in which latter the violet and the blue have the superiority.—*Vienna Phot. Correspondenz, November*, 1873.

ACOUSTICS OF LARGE ROOMS.

A recent study of this subject has been made by Orth, according to the method of graphic construction as detailed in the treatise of Langhaus, the law of reflection of sound and that of intensity, as affected by varying distance, being mainly involved. The former consideration is easily introduced in graphic constructions; the latter necessitates calculations based upon the length of the path of the sound waves. By the employment of 0.01 of a square meter at a distance of ten meters from the origin of sound, as a unit of intensity, Orth was also able to accomplish a graphic representation of intensity. The effect of intersecting waves upon each other he did not regard as demanding practical consideration; but, on the other hand, the diffusion of sound by reflection from rough surfaces proved to be of great importance, as furnishing, in some cases, the readiest remedy for acoustic annoyances. The only source of acoustical defects in a hall to be considered, according to these investigations, is the reflection of sound waves in such a way that they strike upon the ear of the hearer within a certain interval after the direct waves, and are recognized as an echo or resonance. For graphic determinations this interval of time is converted into difference between the lengths of the paths of the direct and reflected rays from the origin of sound, and the question of practical acoustics rests essentially on a knowledge of the limits within which this difference exerts a disturbing influence. The observations of Orth, which differ from those of Langhaus, show that a difference of from sixteen and a half to twenty-three feet not only causes no disturbance, but under some circumstances may produce favorable reinforcement of the direct by the reflected sound, and that with diminished intensity the difference may be somewhat greater, but under no circumstances should it exceed thirty-three feet. On the other hand, the intensity at a difference of 196 to 230 feet may be regarded as too small to be noticed. From a discussion of the acoustic conditions of churches, in this way, he concludes, first, that the ceilings, which in theatres help the effect in the upper tiers, in churches are too high for this, and may produce resonance or echo, and that it is therefore necessary to diffuse the sound reflected from them; and he gives the results of a comparison of different forms of ceilings obtained by graphic construction; second, that the walls require to be not less carefully investigated, since defects are often attributable to walls rather than ceilings; and since they can not always be conformed to acoustical demands, the most practical question is frequently how to render the reflected rays without effect by suitable management of the surface; third, that surface and material, partially touched upon before, need scientific investigation to complete our knowledge in regard to the part they play; fourth, that sounding-boards, generally constructed empirically, ought to be regulated in size and form by suitable construction in each case, and that the material should be carefully selected.—*Technische Blätter*, III., 1872, 187.

VIBRATION OF CORDS.

M. Gripon has investigated the vibration of cords and rods in resisting media, and his results, as communicated to the society at Lille, are as follows: He noticed at first that a cord attached at one end to a vibrating diapason not only vibrated in unison with it, but in certain cases the division of the cord into nodes presented a peculiar character in that the number of nodes became less than it should be, and the cord, divided into equal sections, seemed to vibrate as if its extremities were fixed, and gave forth sounds of lower pitch than those of the diapason. Duhamel had shown that the latter mode of vibration is due to the initial state of the cord, and is not permanent, but is soon destroyed by extraneous resistances. Gripon finds that the second movement is as necessary as the first, and under proper conditions quite as permanent; and he concludes, from numerous experiments on cords, ribbons, etc., by varying their size, length, density, shape, and tension, that a diapason may generate in any attached cord vibrations of any other pitch whatever lower than its own, a condition which had been thought impossible by Duhamel and philosophers generally. Gripon finds the explanation of the phenomenon in the resistance of the air, and his observations were made on cords vibrating in water, alcohol, oils, and other fluids. He makes the nodal part of the vibrating cord very prettily visible by connecting the cord with the negative end of a galvanic battery, the positive end being a platinum point, movable in the water in a direction parallel to the different parts of the vibrating cord. The cord is thus covered with attached bubbles of hydrogen gas, and these are detached from it only at the points where the vibrations are decided, while the nodal points are marked by the remaining attached bubbles of gas. The distances between the nodal points indicate the pitch of the vibrating cords. Gripon finds that the ratio of the distances for the same cord or spring, when vibrating in the air or in a fluid, varies with the motion of the cord, its density, the density of the liquid, and its viscosity; and it is the same for oil, which is lighter than water, and for gum-water, which is denser. It is greater for oil than for a mixture of oil and alcohol, having the same density. It is greater for water and sulphuric acid than in sulphide of carbon, of the same density. A very curious and striking experiment is pointed out by Gripon as a result of this investigation, and one that will probably be hereafter often repeated in the physical lecture-room. It is known that if we put some olive-oil in a proper mixture of alcohol and water, the oil takes a spherical form, and floats in equilibrium in the interior of the mass. Now pass through the centre of such a sphere a fine thread of copper, fixed to the diapason, and when the latter is made to vibrate we shall see the globe of oil revolve about its axis, and flatten by reason of its rotation, provided that the globule is not at a nodal point. Thus the cord is seen to have such a movement that each of its points describes a small elliptical or circular curve. The flattening of the sphere realizes the well-known experiment of Plateau. The experiment is more difficult with spheres of sulphide of carbon floating in a mixture of water and sulphuric acid, because the sulphide does not adhere to the copper thread, and thus escapes the vibration.—*Mem. Soc. Lille*, 1872, 241.

D. CHEMISTRY AND METALLURGY.

CHEMICAL COMPOSITION OF DEAD-SEA WATER.

In addition to the long-known buoyancy of the water of the Dea Sea, owing to its saline contents, its other peculiarities are an excessive bitterness, from which the mouth can not readily be freed, and a peculiar greasiness, readily observed upon passing the hand through it. Bathing in it produces an unpleasant itching and prickling over the whole body, even after thorough rubbing, which can only be allayed by a bath in the purer water of the Jordan. Prolonged and frequent contact with the water even causes pustules upon the skin. Its fatal effect upon all organic life is generally known, destroying immediately, as it does, even such animals as have been accustomed to strong salt-water, although fish exist in considerable numbers in its tributaries. This effect is attributed in part to the saline matter contained in it, amounting to as much as twenty-eight per cent., and in part to the quantity of bromine in the water. It was shown by Schneider that small fish were seen in a tributary of the Dead Sea up to a point where the density was 1.115, and it was his impression that chloride of magnesium was the chief cause of the fatal quality of the water. The chemical composition varies with the season, amount of rain-fall, etc.; and, according to Terreil, the density upon the surface varied between 1.021 and 1.164, and increased to 1.256 at a depth of 984 feet. Chemical analysis showed that the relative quantities of the ingredients varied with the depth; the percentage of bromine, for example, rising from 0.167 per thousand at the surface to 0.709 per thousand at the depth of 984 feet, an unusual amount, and one that might be of importance in the production of bromine. Iodine and phosphorus seemed to be entirely wanting, and the absence of the latter, Lartet insisted, would in part account for the absence of animal life. In failing to discover silver in it, Malaguti afforded additional evidence of a want of connection between this and the seas nearest to it. The conclusion, from chemical analysis as well as a number of geological indications, is that the saline matter in the Dead Sea is due to mineral springs which formerly existed in great numbers in and adjoining its basin, and are still present to a small extent.—2 *C*, *August*, 1872, 170.

OCCURRENCE OF GOLD IN SEA-WATER.

Sonstadt, in an article upon the presence of gold in sea-water, communicated to the *Chemical News*, remarks that the amount is less than one grain to the ton, and that the proportion is too small to permit the separation or even detection by the ordinary tests. He therefore proceeds to give the various methods by which the presence of the metal was determined by him.—1 *A*, *October* 4, 1872, 160.

REDUCING POWER OF NASCENT HYDROGEN.

Active reducing properties are generally attributed to hydrogen liberated from palladium, which may have absorbed it as the negative pole of an electrical circuit. Graham cites, as remarkable evidences of this, the conversion of ferri-cyanide of potassium into ferro-cyanide, and of sesqui-salts of iron into proto-salts. Professor Böttger states, however, as the result of his investigations, that palladium and some other metals, as thallium, magnesium, and arsenic, possess of themselves such power, without previous absorption of hydrogen, when placed in solutions of certain salts, especially of ferri-cyanide of potassium and of sesqui-chloride of iron. He suggests, as an experiment corroborative of the above, the placing of a clean piece of palladium foil in one half per cent. solution of ferri-cyanide of potassium, and after the lapse of ten minutes testing the solution with a sesqui-salt of iron for ferro-cyanide.—15 *C*, XVIII., 273.

FICHTELITE.

Professor Mallet, of the University of Virginia, has lately examined certain colorless crystalline crusts found in the cracks between the annual rings of growth of a log of long-leafed pine (*Pinus australis*), and has come to the conclusion that in all respects they are identical with the *Fichtelite*, a hydrocarbon hitherto only known in a fossil state.—21 *A*, *December*, 1872, 1083.

DISCOVERY OF THALLENE AND OTHER SOLID HYDROCARBONS.

Professor Henry Morton, in a communication to the *American Chemist,* calls attention to a solid hydrocarbon lately discovered by him, and which he names *Thallene.* In the previous investigations of certain tarry matters left in the bottom of the still in distilling petroleum for the manufacture of illuminating oils, he also succeeded in extracting a solid crystalline body of a yellow-green color, and of remarkable fluorescence, which he described under the name of *Viridin.* This was very remarkable for the peculiar spectrum which its fluorescent light yielded, resembling in a striking manner that of anthracene, although the crystalline form, solubilities, and fusing points of the two bodies were decidedly unlike. He subsequently succeeded in separating another species from viridin besides the thallene in question. The paper referred to contains a very copious account, accompanied by diagrams of the peculiar phenomena of these chemical novelties.—*American Chemist, November,* 1872, 162.

EXPLOSIVE ANTIMONY.

Antimony is precipitated from its solution in hydrochloric acid on copper foil attached to the negative pole of a battery (the positive being platinum foil) as a brittle, lustrous film, which, after being washed with distilled water, scales off on bending the copper foil, and by friction or percussion can be made to explode, with the evolution of light and heat, on account of its sudden passage from the ductile, homogeneous, amorphous condition to the crystalline.—8 *C, November* 7, 1872, 367.

ACTION OF COLD CHARCOAL ON CHLORINE.

According to Melsens, certain kinds of charcoal absorb great quantities of chlorine even in the cold, one variety taking up nearly its own weight. Charcoal thus charged, when placed in contact with dry hydrogen in the dark, forms hydrochloric acid, the combination being attended by a fall of temperature. In contact with water, both hydrochloric acid and carbonic acid are formed. No trace was found of the oxygen acids of chlorine, or of organic acids, among the products of this action.—13 *A, February* 15, 1873, 70.

ACTION OF AMORPHOUS RED PHOSPHORUS.

According to Testini, amorphous red phosphorus, under the influence of solar heat in a barometric vacuum, has the peculiarity, like porous charcoal, of absorbing various substances without acting chemically upon them. Thus rosaniline, iodine, and sulphur are all absorbed to a sensible degree by the phosphorus, and may be subsequently reclaimed by proper methods.—3 *B, June*, 1872, 309.

ACTION OF OZONE ON VULCANIZED RUBBER.

Mr. Wright, in the *American Journal of Science*, refers to the action of ozone upon vulcanized rubber, his attention having been called to it by the fact that the ebonite insulators of Holtz's electro-machine became unusually hygroscopic soon after the instrument had been used, with the attendant production of ozone—to such an extent, indeed, that the liquid sometimes trickled down in drops. Examination showed that this contained a considerable amount of free sulphuric acid, which was supposed to result from the action of ozone upon the sulphur of the India-rubber.—21 *A, December*, 1872, 1073.

LIQUID CARBONIC ACID.

In the description by Thilorier of the properties of liquid carbonic acid, the conditions under which the experiments were performed are not given. The following are the principal results of an investigation, made by Cailletet, of the behavior of liquid carbonic acid at ordinary temperatures. The liquid is colorless, and very mobile; it is a non-conductor of electricity, and the current from three Bunsen cells will not pass through a film 0.002 of an inch thick. The sparks of an induction coil pass through without decomposing it, and are white and brilliant. The number obtained, in numerous experiments, for the coefficient of compressibility of the liquid was not constant, doubtless by reason of the unavoidable presence of non-condensable gases. Contrary to expectation, from its analogy to water, it does not dissolve common salt, sulphate of soda, nor chloride of calcium, and in contact with carbonate of potash it forms bicarbonate, which remains undissolved in the unabsorbed liquid. Carbonate of lime, as calc-spar or dried chalk, is not attacked by it even after contact for an hour, and with a pressure varied between 20 and 40 atmospheres. Sulphur and phosphorus are insoluble in it, while iodine dissolves sparingly, imparting a pale violet tint. Water dissolves but little of it, the excess of the liquid acid floating upon the solution. Petroleum dissolves five-sixths' volumes of the liquid, the first portions producing a marked striated appearance, as seen in mixing liquids of different densities. With a small quantity of petroleum, saturation soon takes place, and the excess of acid floats on the top, with the surface of separation sharply defined. On diminishing the pressure, the carbonic acid becomes gaseous with violent rapidity; and it is only after it has all passed off, and the pressure has been considerably diminished, that the petroleum gives up the dissolved acid. Bisulphide of carbon mixes with it sparingly. Sulphuric ether absorbs large quantities, perhaps in all proportions. At 20 atmospheres, far below the point at which liquefaction begins, the gas entirely disappears, and during solution the striated appearance may be noticed. Unctuous oils dissolve sparingly in it. Tallow, under these circumstances, becomes white upon the surface, and loses its oily portions. Stearin and paraffine are insoluble in it. Soda-amalgam had no reducing effect, and metallic sodium, after contact of more than an hour, was simply coated with a film of bicarbonate. The oxidation in the case was, however, due to the presence of a small quantity of moisture, and not to the decomposition of the carbonic acid.—19 *C, January* 25, 1873, 37.

SOLIDIFICATION OF NITROUS OXIDE.

In a paper read by Mr. Wills before the Chemical Society of London, an account is given of the process and apparatus necessary to obtain nitrous oxide in a solid state by the evaporation of the liquid. In this he states that, although the apparatus which he described was generally the most convenient, the liquid nitrous oxide will quickly become solidified if a rapid current of air be passed through it. Unlike carbonic acid, the liquefied gas can be readily preserved for some length of time in an open vessel, provided it be kept still. Liquid carbonic acid becomes solid as soon as it escapes from the vessel containing it, since the vapor tension of the carbonic snow at the time of its formation is much above the atmospheric pressure, while the vapor tension of the solid nitrous oxide is less than one atmosphere.—1 *A, February* 28, 1873, 103.

ACTION OF SILICATE OF SODA ON FERMENTATION.

According to MM. Rabuteau and Papillon, silicate of soda has a very decided chemical action in checking alcoholic fermentation, in this respect being somewhat similar to borax, although much more energetic. A small quantity of the silicate will entirely arrest the fermentation of wine, as also of milk.—3 *B, October* 10, 1872, 222.

CONTROVERSY BETWEEN PASTEUR AND FRÉMY.

M. Frémy, the well-known opponent of the theoretical views of Pasteur in regard to fermentation, etc., claims to have produced alcoholic, lactic, and butyric fermentation, and to have caused fermentation in the heart of organic cells, in the absence and without the possible access of atmospheric germs. He also claims to be able to show that alcoholic, lactic, and butyric fermentation are not derived from germs, and transformed one into the other, or produced with the same organisms and the same fermentable liquors.

Pasteur promptly responds to this, by saying that the germ of the yeast from grapes is the *Mycoderma vini;* that grape yeast differs from beer yeast, properly so called, in the fact that it has not a single cell of the beer yeast; that grape yeast is identical with beer yeast of low fermentation; and that the *Mycoderma vini* is one of the germs most common in the air, particularly in the summer; although it appears to have two modes of life. In mother liquors, it seizes the oxygen of the air, and makes it serve for its nutrition, and delivers it in the state of carbonic acid; in ferments, it develops itself free from air, and becomes alcoholic and grape yeast.—3 *A, October* 5, 1872, 281.

ALCOHOLIC FERMENTATION.

Schnetzler informs us that alcoholic fermentation, with the evolution of gas, is caused by living cells of the fungus known as *Saccharomyces*, present in the ferment, and that there are cases in which other species of fungi, as *Mucor*, *Aspergillus*, and *Penicillium*, present in the same liquid, produce the fermentation without evolution of gas.—25 *C, March*, 1873, 183.

ALCOHOLS FROM FLINT AND QUARTZ.

A lecture has recently been given by Professor J. Emerson Reynolds before the Royal Institution of Great Britain upon the above subject. Taking the word "alcohol" in its ordinary and popular sense, it might seem that, if this be true, the very rocks under our feet are likely to be turned into exhilarating beverages. But the word "alcohol" can not be so defined. It is a *generic* term in organic chemistry, certainly quite as much so as the word "acid." One of the chief distinguishing features of our modern chemistry is that substances are no longer named because of their common and obvious properties—a method which in the case of the acids has been, and still is, productive of great evil—but on account of the peculiar chemical constitution they possess, in virtue of which they undergo certain chemical transformations with facility. The name "alcohol," for example, is applied to those carbon compounds which readily yield compound ethers by the action of acids, the facility of doing this resulting from the peculiar arrangement of their atoms. But such a definition includes many substances not ordinarily regarded as alcoholic. For instance, glycerine, all the sugars, and even beeswax. Professor Reynolds' interesting discourse, therefore, has reference to the fact that as silicon (of which flints and quartz are the oxide) is analogous to carbon, bodies having the constitution of alcohols may be formed in which silicon partially replaces the carbon. He has brought together the results of all the researches which have been made on the subject, principally by Friedel, of Paris, in connection with Crafts, of Boston, and Ladenburg, of Heidelberg, and has added some observations of his own. The facts are that we are now acquainted with a chloroform in which silicon replaces carbon entirely, and with silico-heptyl and silico-nonyl alcohols, in which the carbon is thus partially replaced. Evidence of the existence of silico-propyl, silico-amyl, and silico-hexyl alcohols has also been obtained. Certain more complex alcohols, as well as ethers and acids, containing silicon, have been prepared, and Dr. Reynolds now announces that he has prepared the silicon analogue of cyanogen. The entire results of these researches, therefore, sustain the prevision of theory in making the carbon and the silicon atom chemically identical in combining power, each being equal to four hydrogen atoms. The question which still remains to be solved is whether that property, at present peculiar to carbon, by which it is able to combine with itself, and thus to form a nucleus containing from two to thirty carbon atoms —a property which more than any other so admirably fits it for its uses in organic nature—is possessed by silicon. At present no group of more than two similar atoms united to each other is known to exist in any compound with which chemistry is acquainted, if the groups which carbon forms be excepted.—1 *A*, 1873, 237.

THE CHEMICAL FORCE OF THE SOLAR RAYS.

The chemical force in the rays of the sun has been studied from a new point of view by Marchand, who has communicated numerous interesting results to the Paris Academy of Sciences. Marchand's method differs from that adopted by Bunsen and Roscoe in that he measures the effect of the sunlight on a solution of perchloride of iron and of oxalic acid, and not on a mixture of chloride and hydrogen. He estimates the chemical effect as one quite independent of the heating effect, but does not seem to have arrived at the advanced views indicated by the studies of Professor Draper, of New York, in whose opinion the solar rays are not a complicated mixture of caloric, luminous, and actinic rays, but a simple phenomenon whose results are tripartite, according to the nature of the body on which they act. Marchand has for four years continued the daily use of his photometric liquid, and submits conclusions interesting to both chemists and physicists. He finds that his liquid is acted on specially by the rays between Fraunhofer's F and G lines; he gives the law according to which the thickness of the atmosphere diminishes the effect of the sun in decomposing the liquid and liberating carbonic acid gas; he finds that the chemically active rays are not affected by atmospheric currents, and therefore the chemical climate is a different one from the thermal climate. The total daily photochemical force is, according to Marchand, greater at the pole than at the equator at the time of the solstice. The earth's atmosphere, in so far as it can affect the rays F and G, is between seventy and seventy-five miles high. The rays of whose chemical force Marchand's actinometer gives an indication have but one seventh the force of the heat rays that accompany them, and are 16,127 times less active than the chemical rays measured by Bunsen and Roscoe. Marchand computes that the chemical force received from the sun by the earth, each minute, suffices to transform into carbonic acid nearly forty millions of tons of carbon, and that the continuance of this chemical action for a whole year would consume a stratum of coal covering the entire surface of our globe to the depth of about one inch.—6 *B*, 1873, 760.

SEPARATION OF DIGESTIVE FERMENTS.

The interesting discovery has been made by Paschutin that the ferments present in the intestinal juice of dogs, which act on cane-sugar and starch, as well as the three ferments in the pancreatic juice, can be separated by filtration through porous porcelain cells. The filtration is difficult with an aqueous extract of the pancreatic juice, but succeeds much better with extracts made with concentrated solutions of salts; and it further appears that solutions of different salts extract the ferments in different proportions; some, in fact, taking one ferment, and that more completely than water. Thus, the ferment which acts on albumen is extracted almost pure by Rochelle salt, hyposulphite of soda, nitrate of ammonia, etc.; that acting on starch, by arseniate of potash, etc.; that acting on fat, by antimoniate of potash, bicarbonate of soda, etc.; and Paschutin concludes that the use of concentrated solutions of salts will likewise facilitate the separation of the ferments of the intestinal juice.—18 *C, April* 9, 1873, 237.

LIQUEFACTION OF GASES.

Melsens has lately made some interesting experiments on the liquefaction of certain gases. It is well known that charcoal can absorb its own weight of chlorine. Charcoal thus saturated is placed in a siphon-shaped tube, hermetically sealed. The long arm of the tube, containing the charcoal, is then dipped in boiling water, while the short arm is immersed in a freezing mixture. The heat sets free some chlorine in the gaseous state, and by the pressure thus produced the gas is condensed as a liquid in the short arm of the tube. Several cubic centimeters of the gas may thus be liquefied and shown in the lecture-room. Melsens also succeeded in condensing to liquids, in the same manner, ammonia, sulphurous acid, hydrobromic acid, sulphureted hydrogen, ethyl chloride, and cyanogen. The same investigator has also studied the thermal effects due to the absorption of various liquids by charcoal. Five or ten grammes of charcoal were treated with from seven to nine times as much bromine, and the absorption of the latter developed an increase of temperature of over 30° Centigrade.—6 *B*, 1873, 671.

POSITION OF INDIUM IN THE CHEMICAL SYSTEM.

The proper classification of the metals is a matter of great importance to chemists. Indium has hitherto held a doubtful position, but at last seems to be definitely placed. Following Bunsen, who put the metal among those forming sesquioxides—namely, iron, aluminum, etc.—Roessler has succeeded in obtaining a true *indium-alum*, perfectly analogous to the well-known iron-aluminum and chromium-alums, crystallizing in the same octahedral form, and having a similar formula.—*Bull. Chem. Soc.*, *September* 20, 1873.

COPPER IN THE GREEN FEATHERS OF THE PARROT.

The presence of copper in the red coloring matter of the feathers of an African bird known as the *Musophaga*, or Touraco, has long been known, and Mr. Sidney Lupton, in a communication to the *Chemical News*, states that the green feathers of the Australian love-parrot (*Melopsittacus undulatus*) also contain this metal. He had frequently observed these parrots pecking at the brass mountings of their cages or in their rooms, and was told that in Australia they abound chiefly in the districts where copper is to be met with. In his experiments he collected a quantity of the feathers, burned them, and extracted the residual ash with nitric acid. On adding a solution of ferrocyanide of potassium to the filtrate, a distinct precipitate of the color of copper ferrocyanide was formed. Mr. Lupton suggests that a green pigment, of which copper is a constituent element, analogous to Mr. Church's turacine, may be extracted from these green feathers, and also that the green of feathers generally may be due to some similar coloring matter.—1 *A*, *October* 24, 212.

MANUFACTURE OF IRON IN INDIA.

The researches of Mr. Vincent Day show that as early as the third or fourth century, and down to the fourteenth, malleable iron was produced in immense quantities in India, and at so cheap a rate as to be used as building material for public monuments and sacred edifices, and that its manufacture became extinct and the art lost long before European occupation of India.—1 *A*, *October* 24, 212.

ACTION OF THE PHOSPHORUS IN COAL.

Analyses of different coals invariably show the presence of phosphorus in such quantities as may not be disregarded in the production of iron to be used in manufacturing steel, since it is known that all the phosphorus in the charge of a blast-furnace passes into the iron. It is suggested that the well-known efficacy of coal ashes with certain soils may not simply be due to mechanical action, but in part also to the presence of phosphates and other constituents.

SOLVENT POWER OF LIQUID CARBON DIOXIDE.

The remarkable solvent power of the sulphide of carbon suggests that the liquefied oxide may be equally active, and experiments upon this question have been made by Cailletet in a special apparatus designed for the purpose. It consists of a steel tube containing mercury, connected by means of a copper tube with a steel cylinder containing water. By a powerful screw acting on the surface of the water a pressure of 900 atmospheres can be obtained in the steel tube of mercury. In this mercury is plunged a sort of enlarged thermometer tube of glass, the bulb of which is open below, and the tube of which, made very thick, serves to hold the substances to be acted upon. The dry gas is placed in the glass vessel, and on applying pressure it condenses to a liquid, and collects in the stem. It is a colorless, mobile liquid, and is a non-conductor of electricity. An induction spark in it gives a brilliant white light, but causes no decomposition. It does not dissolve sodium chloride, sodium sulphate, calcium chloride, calcium carbonate, sulphur, phosphorus, stearine, nor paraffine. Normal sodium carbonate becomes bicarbonate. Iodine dissolves sparingly, giving a purple solution. Liquid fats are slightly dissolved. Water dissolves only traces of the liquefied oxide, but it is more soluble in carbon disulphide and in petroleum naphtha. Ether dissolves it freely. Sodium does not appear to exert any reducing effect upon it, though a film forms on its surface. Its coefficient of compressibility could not be determined.—6 *B*, LXXV., 1271.

COPPER IN TURACINE.

Mr. J. J. Monteiro has lately obtained a large number of feathers of the Touraco (*Musophaga*), and placed them in the hands of an English chemist for investigation, who reports that, from three hundred feathers, he obtained 1.045 grammes of turacine, which yielded between seven and eight per cent. of metallic copper. The touracos, according to Monteiro, are common on the coast of Africa, from five to fifteen degrees south latitude; and over the whole country, for a considerable distance inland, copper is found in the form of malachite, or green carbonate of copper; the green specks of this material being noticed almost every where. Mr. Monteiro is not certain whether copper occurs to the same extent on the west coast of Sierra Leone, Senegal, etc., where the birds are also abundant; but there is no doubt that throughout the whole region of the west coast, which he has visited, and where the birds are plenty, copper is also disseminated very extensively.

Professor Church has suggested that copper may enter into the system as an article of their food; but, at any rate, Mr. Monteiro thinks it probable that the birds are attracted by the bright green of the malachite, and that they swallow small particles of it with the gravel which, in common with all birds, they consume with their food.

We have already referred to the occurrence of copper in the green feathers of the little Australian love parrot, and to the alleged fact that it is found almost exclusively in a copper-producing region. It will be an interesting problem now to determine whether Australian parrots and the touracos are entirely confined to copper-producing countries, and whether the green plumage of parrots, and of birds generally, is at all connected with their co-existence in the region of copper-bearing rocks.—1 *A*, *October* 17, 201.

E. MINERALOGY AND GEOLOGY.

DISCOVERY OF TIN IN AUSTRALIA.

One of the most important discoveries in Economic Geology made during the past year is that of tin in Australia. Tin has been met with heretofore in Australia, but the recent discoveries indicate far richer deposits than any before known there. The district in which the metal was found is along the valley of the MacIntyre River, on the high plateau of the Australian Alps. The ore occurs, as usual, in granite, and so disseminated as to form a kind of stockwork. The overlying surface deposits contain large quantities of oxide of tin, and it is probable that a very large amount of ore will be obtained from the diggings or washings. In a series of trials recently made, twenty pounds of detritus were found to yield from three ounces to two pounds of ore. The tin-bearing belt is known to have more than 150 miles of linear extent, so that these new mines may in time become quite as productive as those of Banca or Cornwall.

LOCALITY OF THE MATERIAL OF CHINESE PORCELAIN.

The locality of the material employed in China for nearly three thousand years in the manufacture of porcelain has been found by Richthofen to occur east of Lake Poyan, in the direction of Hongtchow. It is a stone of the hardness of feldspar, of green color and jaspery appearance, stratified between clay-slate. It is converted into a fine powder by pounding, the finer portions being repeatedly separated and moulded into small bricks. The Chinese recognize two sorts of the crushed material, almost identical in appearance. The region abounds in most luxuriant vegetation, including azaleas, rhododendrons, etc.—8 *C*, *January* 23, 1873, 30.

SUPPLY OF NITRE IN SOUTH AMERICA.

According to the Abbé Moigno, there is, in a single district of South America of about 483 square miles, a quantity of soda equal to 63,000,000 tons, an amount sufficient, at the present rate of consumption, for 1393 years; and still larger quantities of this salt are found at the foot of the Cordilleras. —1 *A*, *August* 30, 1872, 107.

PITCHBLENDE IN COLORADO.

Professor Hill announces to the American *Journal of Science* the discovery of pitchblende in large quantity near Central City, Colorado. Several tons of the ore, containing fifty per cent. of uranium oxide, have already been shipped to England. It has, so far, brought a price of one dollar per pound. Another mine in the vicinity has also produced considerable quantities of a tellurium ore, containing gold and silver, and also a small percentage of lead.—4 *D*, *May*, 1873, 386.

DOLOMITES OF THE UNITED STATES.

Dr. Feuchtwanger communicates to the *Engineering and Mining Journal* a paper upon dolomites in the United States, and calls attention to their very great value in the arts. Chemically considered, these rocks are composed of carbonate of lime and carbonate of magnesia, and are not to be confounded with magnesite, which consists only of magnesia. The American dolomites are used largely in architecture, the favorite white marble of Vermont being composed of it. The Rosenthal cement is said to owe its powerful hydraulic properties to the mixture of clay with the dolomitic material.—*Engineering and Mining Journal*, *December* 17, 1872, 72.

SEEBACHITE, A NEW MINERAL.

A new mineral, called *seebachite*, from the basalt of Richmond, near Melbourne, has lately been described by Bauer. It is closely related to Herschelite in crystallographic character, but differs in having a considerable percentage of lime.

TAMMITE, A NEW MINERAL.

Mr. Hugo Tamm has recently described what he considers a new mineral of much interest, under the name of *Crookesite.* The substance, as obtained, was too small to admit of a satisfactory analysis, but it has been determined to contain about 88 per cent. of tungsten, 5.6 of iron, and 0.15 of manganese. Mr. Crookes, who has already been honored by having a mineral named for him, suggests that this be called *Tam-*

mite as soon as the remaining ingredients are ascertained.—16 *A*, *October*, 1872, 521.

MANGANOPHYLL, A NEW MICA.

Igelström has described a new species of mica from the iron and manganese mine of Pajsberg, Sweden, under the name of manganophyll. This contains 21.4 per cent. of protoxide of manganese, and is consequently the richest manganese mica hitherto known. It is suggested that it is very closely allied to alurgite, and that the two species may be possibly identical. It possesses a color varying from bronze to copper red, and appears to crystallize in the hexagonal system.—16 *A*, *October*, 1872, 521.

KRYOKONITE, A GLACIER DEPOSIT.

Under the name of Kryokonite, Professor Nordenskjöld introduces to notice a peculiar deposit in the form of a gray powder, often agglomerated into small globular masses, which occurs at the bottom of holes in the ice of Greenland. The origin of this ice-dust is enigmatical, and the discoverer seems undetermined as to whether it is of meteoric origin, or comes from the basalt region near the coast, or from the supposed volcanic tracts in the interior of Greenland.—16 *A*, *October*, 1872, 521.

ZEUNERITE, A NEW MINERAL.

Among the minerals recently worked out at Schneeburg, in Saxony, Professor Weisbach, of Freiburg, has found what he considers to be a new species, and has called it *Zeunerite.* This is an arsenite resembling copper uranite in its grass-green color and its crystalline form, but differs in the fact that it is an arsenite instead of a phosphate.—16 *A*, *October*, 1872, 521.

SYNGENITE, A NEW MINERAL.

A new mineral has been lately described by Professor Zepharovich, from the potash beds of the salt mines of Kalusz, in Galicia. This, which has been named Syngenite, occurs in cubes of sylvine, in colorless, pellucid crystals, somewhat resembling selenite. It is very closely allied to polyhalite.—13 *A*, *October* 15, 1872, 391.

MAXITE, A NEW LEAD ORE.

A new lead ore, lately discovered in Sardinia by Max Brown, is said to consist of a hydrated sulphato-carbonate of lead—a compound entirely novel in the mineral kingdom. The new ore is to be called Maxite, as the name Brownite had already been appropriated.—16 *A*, *October*, 1872, 521.

THE CRUST OF METEORIC STONES.

Simultaneous but entirely independent investigations by Professor Reinsch, of Tübingen, and Meunier, of Paris, led them to the conclusion that the black crust of gray meteoric stones is not the result of fusion during their passage through the atmosphere. The Krähenberg meteorite was examined by Professor Reinsch, and his results communicated at the German Scientific Association during its recent meeting at Leipsic. Microscopic examination of thin sections of the crust showed that it was composed of two entirely distinct portions. The external, highly porous layer, filled with channels and cavities, seldom contains metallic iron, magnetic pyrites, or other minerals; while the interior, highly lustrous, compact layer, decidedly distinct from the gray granular mass of the stone, often incloses metallic iron and magnetic pyrites. In rare cases particles and laminæ of metallic iron penetrate both layers, and are slightly changed by oxidation as far as they extend into the outer layer. The ground mass of the stone consists of particles, more or less spherical, of a light or dark gray material (silicate of magnesia), in which metallic iron, magnetic pyrites, and different silicate minerals (the latter without distinct crystals) are imbedded without any recognizable order. The globules generally are made up of several minerals; but even when they contain only one they exhibit under the microscope small inclosed masses of magnetic pyrites, either in isolated aggregations or filling vein-like fissures. When simple in structure, they are perfectly spherical; but when more complex, less spherical; and in the latter case the different substances are not arranged according to their specific gravities. The iron and magnetic pyrites, when both are present, are generally found in the external, seldom in the central parts. Professor Reinsch therefore concludes that these meteoric stones could not have been at a red heat, even for a short time, in an atmosphere containing oxygen, as the magnetic pyrites would have been converted into ferrosoferric oxide, and, in contact with metallic iron, into a lower sulphide; and that the crust can not consist of the fused mineral ingredients, since, at the temperature of fusion of silicates, the magnetic pyrites in contact with metallic iron would have suffered change. The incomplete crystallization of the mineral ingredients, and the deviation of the globules from the spherical form, in cases of complex composition, indicate that they assumed the solid form suddenly, without time for the arrangement of the substances according to their specific gravities.

Meunier communicated the results of his investigations of the meteoric stone of Pultusk to the Paris Academy in August. Exhaustive qualitative examination of several parts of the crust, differing in appearance, agreed in revealing the presence of olivine, augite, and a black decomposable coloring matter. The specific gravity was precisely the same as of the interior portions. Upon microscopic examination, the crust, like the mass it covered, appeared crystalline instead of vitrified. At a few points there were exceedingly delicate glassy fibres, which seemed to form a net-work, sometimes amounting to a continuous layer. These had certainly been fused, but were of uncommon fineness, and, as well as the external layer, were entirely colorless and amorphous. Any term applied to this coating that implies its fusion must, therefore, be a misnomer. At the first glance it presents in some places a blistered and slaggy appearance, but closer observation shows that it is only wrinkled like the surface of fracture of the gray portions; and the enlargements on the surface at certain points, attributed to the accumulation of melted matter, prove to be due to the accidental shape of the stone at those points, for a section perpendicular to their surface shows the dark crust to be no thicker here than elsewhere. The splintery appearance of the surface, which in many cases suggests scorification, results from the sudden cooling which the warm surface experiences on contact with terrestrial bodies. Attempts to imitate the black crust confirm the conclusion that it does not result from fusion. A splinter of the gray material before the blow-pipe gives, in general, nothing similar to the black crust, but by oxidation becomes more or less ochre brown, and fuses with difficulty to a brown glass on its thin edges. A very small splinter in the reducing flame acquires at first a dark color, and then fuses to an almost colorless glass, dotted with dark spots. This experiment shows the phases in the change of the surface of the stone from its normal to a vitrified condition. Heating, as usual in experiments on metamorphism, also indicates that the crust is simply a metamorphosed, not a fused, mass. The thinness and regularity of the crust are explained as doubtless being due to the exceedingly low temperature of the stones at the moment they strike the earth's atmosphere. To this same excessive cold must be ascribed the cohesion of the carbonaceous meteorites which penetrate the earth, or rebound from it at their fall, while, under ordinary circumstances, they fall to pieces under the least blow.

Perhaps a study of the metamorphosis of meteorites will reveal an approximate measure of the temperature of the interplanetary space, in regard to which there are such contradictory estimates; and the thickness of the metamorphosed crust, which is independent of the size of the stone, may possibly, by means of a few readily suggested experiments, give us an indication of the internal temperature of the stones when suddenly exposed to the effects of heat, from which the temperature of the regions whence they came may be derived.

The form of the meteorites, and especially the evident contrast between the front and back parts, are generally construed as arguments in favor of the action of fusion in the formation of the crust; but the facts already given completely contradict the opinion that the matter has been melted away from the blunt edges, as the temperature necessarily implied would have left its impress in the mass of the stone, while many decidedly rounded meteorites have remained perfectly white—for example, that of New Concord, in May, 1860. This rounding of the front face seems due to erosion by the air, as truly as that of rocks to erosion of water. The furrows and folds are the result of sculpturing, and the crust is produced in the bared portions in proportion as the heat penetrates. According to this view, many meteorites manifest a striking general resemblance to some Scandinavian islands, scraped out by glaciers on the north, while they have been protected on the south.—19 *C, October* 26, 1872, 352.

BLACK INCRUSTATION OF GRAY METEORITES.

According to Meunier, the black incrustation or coating with which gray meteorites are almost always clothed is due principally, if not entirely, to the mechanical action of the weather upon the body during its passage through the earth's atmosphere. This movement, upon the one hand, produces a sort of varnish or false enamel upon the exterior of the mass, and, upon the other, a development of heat which causes the black coloration—the phenomenal fusion being only secondary in importance. Meunier has found similar black crusts upon rocks that were evidently non-meteoric, and which he ascribed to the same cause, namely, mechanical atmospheric agency — the difference being that the crust is somewhat thicker than is generally found upon meteoric stones: in one case the friction of the air being very energetic and of short duration, while in the other the reverse takes place.—21 *A*, *February*, 1873, 14.

ANTIQUITY OF THE GUADALOUPE BONE BRECCIA.

In a communication by Hamy upon the age of the so-called anthropolites of Guadaloupe (or, in other words, certain human bones found imbedded in calcareous rock in that island), we are informed that an antique object resembling a frog in shape was found in connection with the bones, by which we are entitled to assign to them a comparatively modern origin, as being of the Carib race, and belonging to a people who occupied the West Indies at the time of their first discovery by Europeans, and afterward.—3 *B*, *February* 20, 1873, 837.

REMNANT OF THE ICE PERIOD IN SCOTLAND.

Dr. Buchanan White believes he has found a remnant of the ice time in Scotland. It consists in a small moth, *Zygaca exulans*, which is entirely unknown upon the British Isles, but of frequent occurrence in the Alps and in Scandinavia. This induces Dr. White to consider it a trace of the ice time, while others think it doubtful.—7 *C*, VIII., 512.

ACTUAL GLACIERS IN THE MERCED GROUP.

Mr. John Muir, in the *Overland Monthly*, announces the existence of actual glaciers in the Merced group of California mountains, and remarks that the snow banks of Mounts Lyell and M'Clure, of the Yosemite region, are true glaciers, as shown by the forward movement of stakes planted by him across the bank. The central stakes were found to move forty inches in forty-six days, while the surroundings exhibit all the peculiarities of glaciers in the form of moraines, etc. The Mount M'Clure glacier is about half a mile in length, and of the same breadth in the broadest part, and the Mount Lyell glacier is about a mile long.—4 *D*, *January*, 1873, 69.

FLORA OF THE PLIOCENE OF CENTRAL FRANCE.

M. De Saporta has presented to the Academy of Sciences of Paris a very interesting communication upon the remains of plants and their foliage found buried under the eruptive ashes of an ancient volcano at Cantal, in France, during the pliocene epoch. According to Mr. Rames, who has made a special study of the geology of Cantal, the country had but a slight undulation down to the miocene period, its surface then being covered with lakes. At this epoch occurred the first basaltic eruptions, which are covered by the upper miocene, with its remains of *Amphicyon*, *Machairodus*, *Mastodon angustidens*, *Dinotherium giganteum*, *Hipparion*, etc.

Subsequently to this the relief of the land became more decided, and a soil was developed along the flanks of the new volcano, in which, during a long period of repose, the vegetation referred to in the communication was established. Afterward, however, a violent eruption occurred, accompanied by a shower of ashes mixed with water, and followed by avalanches of mud, which buried or destroyed the forests, and covered up the leaves which littered the soil, the trunks of the trees themselves sometimes being left erect, and sometimes prostrated.

It is thought that careful study of this fossil flora will throw light not only upon the contemporaneous vegetation during the epoch in question in different parts of the world, but also upon the mode of the origin of the species belonging to the present period. A striking fact is the collocation in these deposits of forms now belonging to the Canary Islands and the Mediterranean, side by side with those of Central Europe, the Caucasus, and North America. Species yet existing in Central Europe are also found but little changed, and associated with others which have become exotics.—1 *B*, *February* 3, 1873, 290.

ROCKY MOUNTAIN FOSSIL.

Professor Meek announces the existence of primordial species among the fossils collected by Dr. Hayden, in 1872, from near Gallatin City, Montana—a very important geological fact. He has also found carboniferous fossils in various localities. Some of these are from the "divide" between Ross's Fork and Lincoln Valley, Montana, embracing many of the same species as occur in the noted Spurgeon Hill locality, in Indiana, of the age of the St. Louis limestone.

COAL IN PERU.

Much gratification is felt in Peru at the discovery of a new coal deposit near Pisco, which is said to be one of the best and richest on the Pacific coast, and the locomotives on the Ica and Pisco Railway are using it with great success. The mine is situated close to the sea, and near a perfectly safe harbor, and the coal is said to be finer in quality than any in Chili, and of great extent, and, if so, must prove to be of very great economical value.—*Panama Star and Herald, May* 9, 1873.

GEOLOGICAL AGE OF WYOMING COAL.

Among other communications to the Dubuque meeting of the American Association was one by Professor Cope upon the geological age of the coal of Wyoming. The professor was engaged during the whole of last summer in making explorations into the paleontology of the Rocky Mountains, in connection with Dr. Hayden's expedition, and as the result of his inquiries he comes to the conclusion that the great coal area of Wyoming lies within the limits of the cretaceous formation. It is surrounded to the west and south, and perhaps to the north, with eocene tertiary beds, and the appearance of the country indicates that a smaller lapse of time than is usual has separated the periods of their deposit. He states that no cretaceous types of vertebrates have yet been found in any of these tertiaries. The principal ground upon which the professor bases his decision is the discovery, at Black Buttes, of part of the skeleton of a dinosaurian, a portion of which had been previously procured by Professor F. B. Meek and Mr. Henry Bannister. This he names *Agathaumas sylvestris*.—5 *D*, *November*, 1872, 669.

UPPER COAL MEASURES WEST OF THE ALLEGHANIES.

In a recent paper on the "Upper Coal Measures west of the Alleghanies" (or the group of strata including the Pittsburgh coal and the beds above it), Professor J. J. Stevenson holds that during their period the general condition was one of subsidence, interrupted by longer or shorter intervals of repose. During subsidence the great marsh, now appearing as the Pittsburgh coal-bed, crept up the shore; but in each of the longer intervals of repose it pushed out, seaward, upon the advancing land of the eastern shore of the inland sea, and thus gave rise to the successive beds above it. The Appalachian coal-field and that of Indiana and Illinois were probably never united, and the bituminous trough of the former west of the Alleghanies did not owe its basin shape primarily to the action of forces concerned in producing the Alleghany Mountains.

NON-OCCURRENCE OF THE DIAMOND IN XANTHOPHYLLITE.

An alleged discovery, some time ago, by Mr. Jeremejew, of minute diamonds in xanthophyllite excited much interest as to the question of the true matrix of this gem; but the result of recent investigations by Dr. Knop, of Carlsruhe, shows that the so-called crystals are merely angular cavities, shaped like diamonds, it is true, but entirely destitute of any substance whatever. Nor is it probable that they ever contained diamonds, since minute sections of xanthophyllite, freshly prepared, and magnified fifteen hundred diameters, appear to be perfectly free from cavities; but after treating them with sulphuric acid they made their appearance in numbers, precisely similar to those referred to. In other experiments, fine plates of xanthophyllite were examined under a microscope, in all directions, without revealing any peculiarity; but on touching them with a few drops of concentrated sulphuric acid, and heating them until white fumes appeared, the cavities manifested themselves. It is thought, therefore, that this phenomenon is due entirely to the corrosive action of acid on the mineral.—15 *A*, *April*, 1873, 265.

NATURE OF LOESS.

In an inaugural address by Jentzsch, discussing the "quaternary strata in the vicinity of Dresden, and the formation of loess in general," he concludes, from careful examination of and experiments with loess, that all its essential characteristics are simply consequences of the degree of comminution, and are sufficient to separate it geologically from loam and clay. Its particles are chiefly from about 0.0008 to 0.0016 of an inch in diameter, and those of plastic clay and loam about 0.00024 to 0.0004 of an inch. The cohesion of the loess is consequently less than that of clay, and it falls to pieces in water on this account, as well as because the angle of friction is lessened by water. Absence of stratification is explained as resulting from the obliteration of sharply defined margins of the earlier deposits by this effect of water; and strata are consequently only recognizable when the layers are in different states of comminution. The properties, as well as the location and contents, indicate that it is a fluviatile deposit in overflowed portions of valleys.—19 *C, January* 25, 1873, 130.

VOLCANIC ERUPTIONS IN ICELAND.

The past winter was very mild in the southern portion of Iceland, but quite severe in the northern. In the middle of January an eruption of the volcanoes in the great Yokul Mountains, in the southeast corner of the island, took place, which continued with unusual violence for about a week, and then suddenly ceased. Since then no fire has been noticed. Large quantities of ashes have fallen on different localities, but it is believed that the deep bed of snow protected the pasture lands from destruction. Volcanic eruptions took place at the same time in Chili.—1 *C*, 1873, 128.

THE TOURMALINE.

A work has just been published on the tourmaline by Dr. Hamlin, of Maine, so well known as a specialist on the subject of gems, and as having one of the finest private collections in the United States. He makes special reference to the beautiful and matchless crystals found in the State of Maine, and gives four very fine illustrations in color by Prang. He also claims the tourmaline to be the most interesting of all the gems, when we come to consider the beauty and diversity of its color, the complexity of its composition, and the wonders of its physical properties. When the mineral equals the blue and red sapphire, the emerald, or the topaz in color, he considers it equal in value to either of the above gems, and this view is supported by the eminent Professor Beudant, of Paris.

GEOLOGICAL SURVEY OF CANADA FOR 1871–72.

Professor Selwyn, director of the Geological Survey of Canada, has just published a report of the progress of that useful work during the year 1871–72. This is largely occupied by an account of a geological reconnoissance in British Columbia made by direction of the Canadian government. The expedition was well provided with scientific assistants, and accompanied by a photographer, and in the preliminary report embraced in the present volume will be found some interesting details. Special attention was paid to the gold deposits, as also to the coal-beds, both on the main-land and on Vancouver Island.

The survey has experienced a severe loss in the removal of Professor T. Sterry Hunt, one of the earliest and most efficient members, to Boston, where he has taken charge of the chair formerly held by Professor William B. Rogers in the Institute of Technology.

THIRD AND FOURTH ANNUAL REPORT OF THE GEOLOGICAL SURVEY OF INDIANA FOR 1871, 1872.

The third and fourth annual report of the Geological Survey of the State of Indiana for the years 1871 and 1872 has just been published by Professor E. T. Cox, State Geologist, and, like its predecessors, consists of a neat, compact volume, with an accompanying atlas of geological maps. The report opens with a general statement on the part of the director of the more interesting features of the geology of the entire state, especially as to the location and working of coal veins. This interest is of great importance in Indiana; and its rapid extension within a few years past, according to Professor Cox, may be traced largely to the discoveries and suggestions of the State Survey.

Reports of detailed explorations of several counties, as made by Professor Cox or his assistants, are given in the volume, followed by a preliminary examination of other portions of the state. Mr. Charles Boerner furnishes a paper on the meteorology of Switzerland County, Indiana, in which the peculiar features of its climatology are well expressed in a series of tables. The volume concludes by a paper upon the manufacture of specular iron, prepared by Mr. Hugh Hartmann, with special reference to the introduction of new and improved processes in working up the ores of the state.

REPORT FOR 1872 ON THE GEOLOGY OF NEW JERSEY.

Professor Cook, State Geologist of New Jersey, has just presented his annual report for the year 1872, which contains an account of the progress of the work done during the past year, and refers to the labors of Professor John C. Smock in the iron-ore region, of Mr. Bogardus in analyzing soils, etc., and of Professor Bowser in surveying several iron mines. Professor Cook himself has been chiefly occupied in furnishing information as to various new products of the state. He has also been engaged in determining questions connected with certain drainage projects, which had been under the charge of the Geological Survey.

Among other points brought forward by Professor Cook is a suggestion as to a new survey of the boundary between New Jersey and New York, the original monuments having in great part got out of place or been removed, and consequently much uncertainty is now existing as to the precise line of partition between the two states.

The discovery of a valuable mine of mica in Warren County is recorded, from which plates of the mineral over a foot in diameter can be readily obtained.

FOURTH ANNUAL REPORT OF MINING STATISTICS FOR 1872.

The Fourth Annual Report, for 1872, of Professor R. W. Raymond, United States Commissioner of Mining Statistics, has just been published by Congress, in a volume of about 560 pages. This contains the usual valuable summary of the condition of the mining industry in the states and territories of the far West, and an account of improved metallurgical processes in the way of lead ores, the amalgamation of gold and silver ores, the treatment of native silver ores in Chihuahua, the metallurgical value of the lignites of the far West, and the metallurgy of native sulphur.

To this is added the consideration of the mining laws, the wire rope in transportation, etc., closing with an appendix upon the bullion product. This, for all the states and territories west of Missouri, and exclusive of New Mexico, amounts, according to Professor Raymond, to $58,284,029. The report, like its predecessors, contains a vast amount of statistical and other information, and will doubtless be eagerly sought for by those interested in mines and mining.

GEOLOGICAL SURVEY OF OHIO.

The Legislature of Ohio, as was hoped, provided at its last session for the continuance of the geological survey of the state, having appropriated the following sums for the purpose: For salaries of geological corps and chemist, from June 1, 1873, to January 1, 1874, at which time the survey must close, $3500, with the condition that no part of the salary of any member of the corps shall be paid until the manuscript of his report is in the hands of the printer, ready to be set up. The other appropriations are $2400 for salaries of assistant geologists during the same period, $1150 for traveling expenses, $1000 for paleontological work, $300 for chemicals, $1000 for zoological and botanical catalogues, and $6000 for printing sixteen thousand additional maps of group sections for the geological report.

All the apparatus, implements, and mathematical instruments used by the survey on the completion of the reports are to be delivered to the trustees of the Ohio Agricultural College for its use and benefit. Additional appropriations for the survey are $2333 33 for salaries of officers, $1370 84 for salaries of assistant geologists, $660 for contingent expenses, $500 for paleontological work, making a total appropriated at this session for this purpose of $14,214 17; this exclusive of $6000 for sixteen thousand maps of group sections, and the cost of engraving, composition, press-work, paper, and binding, and the general illustrations.

For the advancement of agriculture, $3000 are appropriated for the use of the State Board, and $152 for fitting up and painting rooms for geological specimens, $500 to the president of the Ohio Agricultural Society, and $400 for the purchase of carpets for the two rooms used by the Agricultural Board. —*List of Laws.*

FINAL REPORT OF THE GEOLOGICAL SURVEY OF OHIO.

The first volume of the final report of the Geological Survey of the State of Ohio has lately made its appearance in the form of a handsome octavo volume of nearly seven hundred pages, and an atlas of plates. This is devoted to an account of the geology of the state, and will be followed in a few weeks by another volume upon its paleontology. Four other volumes of a smaller size are to appear hereafter, together with a general geological map. Of these, one on general geology and one on economical geology will be completed and ready for the printer in January next. A third volume, on agricultural zoology and botany, and a fourth, embracing the remainder of the paleontology, will complete the series.

From a history of the geological survey of Ohio, by Professor Newberry, the present State Geologist, we learn that as long ago as 1836 a committee was appointed to ascertain and report to the Legislature the best method of obtaining a complete geological survey of the state, and an estimate of the probable cost of the same. That committee consisted of Dr. S. P. Hildreth, Dr. John Locke, Professor J. H. Riddle, and Mr. I. A. Lapham. These gentlemen submitted to the Legislature of 1836–37 the plan of a general geological survey, upon which action was immediately taken, and a bill was passed on the 27th of March, 1837, appointing a corps of geologists, and appropriating $12,000 for the prosecution of the work.

Professor W. W. Mather was placed in charge of this survey, with Dr. S. P. Hildreth, Dr. John Locke, Professor J. P. Kirtland, J. W. Foster, Charles Whittlesey, and C. Briggs, Jun., as assistants.

The first report of their labors was presented and published in 1837, and a second in the year following. The financial panic of 1837 and the consequent paralysis in business interfered with labor in this direction, and the survey was interrupted. Enough had been done, however, to show the great economical importance of such labors, and to warrant the hope that before long they would be resumed. This was prevented by various causes: the first being the defalcation of the State Treasurer, by which half a million of dollars were lost; second, the expenditures for a new State-house; and, finally, the war of the rebellion. The idea was not lost sight of, however, and in 1869 an act was passed, authorizing the renewal of the work, and providing for the appointment of officers for the survey, of whom Professor J. S. Newberry was the chief geologist, and E. B. Andrews, Edward Orton, and John H. Klippart, assistant geologists, together with several others, whose services were required but a short portion of the year.

The chemical work was intrusted to Professor Wormley, of Columbus, one of the best analytical chemists in the country. The work began in June, 1869, and has been prosecuted with the utmost diligence ever since, annual reports of progress being made from year to year, each filling an entire volume, and supplying copious notes in regard to the general and economical geology of the state. The limitation of time for the work made by the Legislature having been reached, the publication of the general results has commenced with the volume first referred to.

It will of course be sufficiently understood that so vast a state as Ohio, with its immense resources and extended areas of coal, iron, stone, and other economical products, can not be thoroughly explored in any thing like the time that has been devoted to the purpose; but it is probable that, the broader features having been thus sketched out, the details can be filled in from time to time. It is very much to be hoped, however, that the Legislature will authorize a renewal of the work, so as to give as complete an exposition as possible of the subject, as they will thus be doing what will redound not only to their own reputation, but to the best material interests of the commonwealth.

The appropriations made by the state in 1869 were on quite a liberal scale, although the salaries allowed to the chief officers were very inadequate, bearing but a slight proportion to the value of the service rendered. The chief geologist received \$3000, of which a large portion was paid by him to an assistant, not otherwise provided for, as compensation for such time as was devoted to his other duties. Three assistants received \$1800 each, and for chemicals and local assistants \$5500 were appropriated, making an aggregate of

$13,900. In 1870 an appropriation of $18,000 was made, and in 1871 one of $21,000. The appropriations for subsequent years have been already mentioned in our pages.

The cost of the survey to the state has been somewhat unnecessarily increased by the publication of an excessive number of copies of the report; as, while the chief geologist estimated that 5000 copies would be sufficient for the needs of the state, and to supply outside institutions and individuals, 20,000 were actually printed; this involving not merely a great expense for press-work and paper, but also for the numerous plates accompanying the reports. The responsibility of this excessive number, however, rests upon the Legislature, and not on the geological corps.

Still the resources of the state are sufficiently ample to meet such expenditures, while the increased number will insure the supply to very many more intelligent recipients. It is to be hoped, however, that the appropriations for the continuation of the remaining volumes of the report will not in any way be interfered with by the excess of the first order.

Professor Newberry renders proper acknowledgments to various persons, both savants and others, who have aided him in his work.

The volume, which constitutes "Part One" of the report, contains a valuable sketch of the physical geography of Ohio, with a statement of its geological relation to the Silurian and Devonian system, and also an account of the geology of Cuyahoga and Summit counties, all by the chief geologist, and constituting about one third of the volume. Professor E. B. Andrews follows with a history of Gallia, Meigs, Athens, Morgan, and Muskingum counties; Mr. Edward Orton, with that of the Cincinnati group—Hamilton, Clermont, and Clarke counties; the remaining counties being reported upon by Mr. M. C. Read, Mr. G. K. Gilbert, and Mr. N. H. Winchell.

CALIFORNIA PETROLEUM.

Professor Peckham has recently communicated an elaborate paper to the *American Chemist* upon the asphaltum of California, in which he takes occasion to refute the idea that the California bitumen deposits in any respect represent the oil springs of the East. He remarks that bitumen occurs there of every variety, from green petroleum, of the consistence of olive-oil, to solid asphaltum, heavier than water. Of this there are millions of tons, some of it pure, but mostly mixed with earthy or organic matter. He, however, is decided in his conviction that there is not a particle of asphalt, nor any other natural bituminous product in that region—that is, a residuum from the evaporation of petroleum—but that it is essentially a product of oxidation.

If the former view were the correct one, then there would be every warrant for incurring even very great expense in boring so as to reach the unaltered soil; but that the contrary is the case is shown by the fact that maltha or tar of varying density has been obtained at from ten to four hundred and sixty feet from the surface—a depth too great to admit the slightest action of the sun's rays. Nor is he satisfied that the evaporation is due to the action of subterranean heat, since, where such action was most apparent, in the vicinity of a certain spring, the petroleum was least dense and most slightly altered.

The only natural springs of petroleum that Mr. Peckham has seen in California are the Cañada Laga and the Pico springs. But, wherever examined, he was satisfied that the change from petroleum to maltha was due to the action of atmospheric oxygen, either direct or transmitted by rain-water.

Contrary to the experience with the Pennsylvania petroleums, he has never been able to find in those of California a particle of either the crude materials nor any substance distilled from them that contained a trace of paraffine or any other solid matter. For this and other reasons he is decidedly of the opinion that the California hydrocarbons are of very little value as regards their products of distillation, and that the difficulty of mining them, even for such purposes as they might be adapted to, is such as to render them of comparatively little commercial value, except in a few cases.

INDUSTRIAL EMPLOYMENT OF NATURAL GASES.

It is interesting to note the fact that an extended industrial employment is made, in many regions of the country, of the inflammable gases which here and there, especially throughout the oil-producing regions, issue from the earth in immense volumes. Professor J. S. Newberry, who has had opportunity of thoroughly acquainting himself with the matter, has quite recently devoted an article to the statistics of this interesting subject. From this the information is obtained that the town of Fredonia, New York, has been for more than forty years partially lighted by gas which issues from the earth near that place. The gas which issues from the salt wells of the Kanawha Valley has been long utilized to supply the heat employed in the evaporation of the brine. It is noteworthy that, in many localities where its occurrence had formerly been looked upon as inconvenient and even objectionable, its value as a heating or lighting object is now properly appreciated, and that in several instances borings have been instituted with the especial object of obtaining it. Many other instances of the present or prospective utilization of these natural gas springs are named in the article in question. Of these, it is of interest to note the occurrence of a gas well at West Bloomfield, New York, which delivers, according to Professor Henry Wurtz' estimate, some fifteen cubit feet per second, and which it is proposed to conduct to the city of Rochester, some twenty miles distant, for the purpose of utilizing it for industrial purposes.

METEORIC DUST IN SNOW.

A communication was lately made to the Paris Academy of Sciences by Professor Nordenskjöld upon the occurrence of a carbonaceous powder mingled with fine particles of metallic iron, which he has observed in the snow of various regions of Northern Europe, and more recently at Mossel Bay, in Spitzbergen. In December of 1871 an unusually heavy fall of snow took place at Stockholm, and, to his surprise, he observed that the snow which fell toward the end of the storm was blackened as with soot, and when examined was found to consist of the above-mentioned substance.

Thinking it possible that this might have resulted from the smoke of some factory or burning forest, the Professor requested his brother, who was living in the interior of Finland, to examine into the subject, and he also succeeded in obtaining a similar substance. Still more remarkable, however, was his detection of it in Spitzbergen, where human agencies could not by any possibility be taken into the account; and he is therefore of the opinion that it must be meteoric in its origin, and suggests that further observations be prosecuted by the systematic examination of both snow and rain at different seasons of the year in different parts of the globe.—6 *B*, *August* 18, 1873, 463.

LESQUEREUX ON THE FOSSIL PLANTS OF THE NORTHERN HEMISPHERE.

An important component of Professor Hayden's report upon the geology of various parts of the West consists of memoirs on the fossil plants, by Professor Leo Lesquereux, well known as among the most accomplished and thorough specialists in that branch of paleontology. The following are among the conclusions arrived at by him, and indicate among other points that the flora of the tertiary period of Europe stands in close relationship to that of America, and is probably derivable from it; and that, while in Europe and Arctic America it has been materially changed, many of the original features are retained at the present time in the temperate portions of the North American continent. The summary of his views is as follows: 1. The tertiary flora of North America is by its types intimately related to the cretaceous flora of the same country. 2. All the essential types of our present arborescent flora are already marked in the cretaceous of our continent, and become more distinct and more numerous in the tertiary; therefore the origin of our actual flora is, like its facies, truly North American. 3. Some types of the North American tertiary and cretaceous flora appear in the same formations of Greenland, Spitzbergen, and Iceland; the derivation of these types is therefore apparently from the arctic regions. 4. The relation of the North American tertiary flora with that of the same formation of Europe is marked only for North American types, but does not exist at all for those which are not represented in the living flora of this continent; therefore the European tertiary flora partly originated from North American types either directly from our continent, or derived from the arctic regions. 5. The relation of the tertiary flora of Greenland and Spitzbergen with ours indicates, at the tertiary and cretaceous epochs, land connection of the northern islands with our continent. 6. The species of plants common to the cretaceous and tertiary formation of the arctic regions and of our continent indicate in the mean temperature influencing geographical distribution of vegetation a difference in +, equal to about 5° of latitude for the tertiary and cretaceous epochs. 7. The same kind of observations on the geographical distribution of vegetable species shows, at the tertiary and cretaceous times, a difference of temperature, according to latitude, analogous to what is indicated at our time by the characters of the Northern and Southern vegetation.—13 *A, October* 1, 375.

IRON BEDS IN AUSTRALIA.

Among recent discoveries of valuable minerals in Australia is that of iron, in the form of magnetic iron, and brown hematite at Wallerawang, Victoria, in close proximity to limestone, fire-clay, coal, and a railway station.—3 *A, October* 18, 1873, 484.

BORINGS IN THE SUB-WEALDEN OF ENGLAND.

For some time past an important enterprise has been carried on in the interest of geological science in the formation known as sub-Wealden, the object being to determine the existence of coal at any depth, so as to reach the paleozoic rocks. The borings commenced about 250 feet down in the known Purbeck beds, and on the 1st of September they had reached a depth of 294 feet. The bore was at first nine inches in diameter, and cuts only on the outer edge, leaving a core, which is frequently extracted by the tube. It is proposed to prosecute this boring to the depth of 2000 feet if necessary. —18 *A, October* 3, 1873, 61.

RUSSIAN MINERAL PHOSPHATES.

From the translation of an article in the *Journal of Practical Agriculture,* we are informed of the recent development of vast beds of phosphate of lime that have of late years attracted attention in Central Russia. The geologists who explored that country in the first half of the present century remarked the presence of an uncrystallized stone which some of their most eminent men called a ferruginous mineral. It was only in 1858 that the first analysis of it was made by Professor Chodnef, at St. Petersburg, who showed that it contained a very large per cent. of phosphate of lime and magnesia. In 1866, Professor Engelhart, of St. Petersburg, officially explored these deposits, and added greatly to our present knowledge of their extent and character. The beds of the rock in question are found below the white chalk and above the green sand, and nodules of the phosphate are found on the surface of the soil in many other places. The extent of country covered by the principal phosphatic zone is not less than twenty million hectares, and it is thought not to be an exaggeration to say that Central Russia rests upon enough phosphate of lime to supply all Europe. Around the boundary of the cretaceous basin of this country the phosphate beds appear to be at or near the surface, but in the central regions they dip to a depth too great to permit their being worked economically. The results of the chemical examinations of this remarkable rock show that the average quantity of phosphoric acid is about 20 per cent., varying from 12 to 33 per cent., while the proportion of lime varies from 18 to 50 per cent. These great deposits were hardly discovered when their development commenced. At present there are two establishments for this purpose in the government of Kursk and one at Riga; this last receives the raw material from Smolensk, reduces it to powder, and sells a considerable quantity to the landowners of the Baltic provinces. The quality of the article is excellent; and if means can be found to reduce the price, not only will the sale be more rapid, but the profits greater. In Russia, it is remarked that, notwithstanding the value of these phosphates and the importance of manure to the Russian farms, the agriculturists have scarcely begun to profit by them; the rural inhabitants are slow to adopt mineral manures, accustomed as they have been for ages to the use of farm manure alone.—*Monthly Agricultural Report*, p. 23.

F. GEOGRAPHY.

LIFE IN THE MEDITERRANEAN.

In carefully discussing the observations made in the Mediterranean in 1871 on the *Shearwater*, Dr. Carpenter finds his former inferences—that the excess of carbonic acid and diminution of oxygen in these waters is incompatible with the full development of animal life—verified by the facts, this being mainly in consequence of the want of proper circulation, induced by the occurrence of a bar at the Straits of Gibraltar. He thinks that nearly the whole available oxygen has been converted into carbonic acid, so that, while the proportion of oxygen to carbonic acid is never less than one third in the open sea, it is here no more than one twelfth—a difference sufficient to account for the paucity of animal life on the deep bottom of the Mediterranean.

The dredgings carried on between Sicily and the coast of Africa furthermore showed that below a depth of 150 fathoms animal life was very scanty, and Dr. Carpenter is inclined to believe that in the Mediterranean the existence of animal life in any abundance at a greater depth than 200 fathoms will be found quite exceptional, in this respect presenting a striking contrast to the great variety of organisms found in the eastern and northern Atlantic at depths between 500 and 1200 fathoms.—13 *A*, *January* 15, 1872, 32.

UNEXPLORED REGIONS OF THE WORLD.

According to a writer in *The Academy*, there are four vast areas which have never been traversed by civilized man, and which, among them, constitute about one seventeenth of the whole area of the globe. Of these the greatest is the antarctic region, the extent of which is about seventy-five times that of Great Britain. The second lies about the north pole; the third is in Central Africa; and the fourth in Western Australia. The south polar region referred to is almost conterminous with the antarctic circle, to which the nearest approach was made by Ross in February, 1842, in latitude 78° 10′, south of New Zealand. The nearest approach to the centre of the region at the north pole was by Parry, in latitude 81° 45′, north of Spitzbergen, in July, 1827.

The unexplored African area (which promises most interesting results, from its variety of animal and vegetable life, and its peculiarities in an ethnological point of view) reaches on the west very closely to the coast, and it is only near the equator that it has been driven inland, at the extremities of Du Chaillu's journeys of 1865 and 1866, and by the high point of the Ogowaï River reached by Walker in the last-mentioned year. The settled parts of the coast-land of Angola give the boundary on the southwest. If the Livingstone Congo expedition under Lieutenant Grandy be successful, it will penetrate to the very heart of this unknown space; and it is hoped that this, together with the German Congo expedition, will secure important results. The preparations for the latter are well advanced, and it is stated that Dr. Finsch, the eminent ornithologist connected with the Bremen Museum, will accompany the party in the capacity of zoologist.

In Australia the great unknown desert region lies to the west of the track explored from south to north by Stuart in 1861, and which now forms the line of telegraphic communication across that continent. The areas of these unknown regions of the globe are estimated, approximately, at about 11,600,000 square miles.—13 *A*, *February* 15, 1873, 69.

ENLARGEMENT OF COAST-LAND BY MARINE VEGETATION.

The influence of gregarious marine plants in changing the form and increasing the extent of coast, which is visible in the islands of the Indian Ocean, is especially noticeable on the east coast of Sumatra, on account of the adaptation of the shore in its shape and nature to the propagation and growth of Rhizophoreæ (the mangroves), as well as by reason of the luxurious growth of vegetation in those regions. The whole coast for miles into the interior presents an unbroken, uninhabitable green flat, and the increase in depth of the water is very gradual, as is usual on the coasts of Indian islands but little above the sea-level. The gradual transition from sea to land is very manifest. The earliest evidence of land is the appearance, especially at high tide, of scattered tips of the lower orders of marine plants, projecting above the water like blades of grass in flooded meadow-land. These belong, for the most part, to the Rhizophoreæ, more particularly the genera Rhizophora, Kandelia, Brugniera, and Ceriops, so remarkable for their form and mode of growth. Their favorite habitat is a marshy shore, free from surf, and not flooded at high tide. They are shrubs rather than trees, from five to twenty-five feet high. The seed germinates while attached to the branch, and only separates when the rootlets have penetrated the slimy soil, and the young plant has strength enough to withstand the action of the sea. The stock does not enter the earth, but rather rests upon a mass of roots, spreading out as they approach the ground, and with their ends fixed in it. During flood tide the tips of the plants only may be visible, but the retiring tide displays the stems and interlacing roots, the latter crowded with mollusks, crustaceans, and fish, left in the slime upon them. This accumulation becomes higher and firmer, and finally, as coast-land, is better adapted to resist the action of the sea than if the plants had rooted in the soil. With the Rhizophoreæ are found species of similar families; for example: of Ægicerus, Climatandra, and Avicennia. As the sea recedes, and these plants are no longer moistened, even at high tide, they die out, and are succeeded by others of different mode of growth. —3 *C, December* 23, 1872, 1246.

EXPLORATIONS IN THE ADRIATIC IN 1870.

Oscar Schmidt, the well-known writer upon the sponges, gives an interesting account of an exploration made by him in 1870 for the purpose of determining the natural history and physics of the Adriatic. His researches were prosecuted on board the *Trieste*, a war vessel belonging to the Austrian navy; and the results were of much interest and scientific value. Dr. Schmidt used two forms of dredges—one of the ordinary rectangular pattern, and the other with triangular frames. The triangular dredges had three instead of two bows for the ring to the rope, two of them being fastened together, while the other was joined to them by a somewhat thinner piece of rope, so that, in case of being hung, the fastening would give way and allow the dredge to be hauled up by one side. This form of dredge was found perfectly available down to a depth of 630 fathoms, especially when leaden weights of eighty pounds were attached in the angles.

The dredge rope used was about the thickness of a man's thumb.

As far as temperatures were concerned, that of the deepest part of the gulf, with a surface temperature of $72\frac{1}{2}°$ Fahr., was not below 59° to 50° Fahr. Very little was observed in the way of currents, especially below one or two hundred fathoms. The deep waters of the Adriatic were found to be very poor in the higher forms of life, mainly, perhaps, in consequence of the absence of such currents as affect the deeper portions of the sea.

One of the most important results of the researches on board the *Trieste* was the discovery of *Bathybius* mud at a depth of from fifty fathoms downward. This was detected by its yellowish-gray color and its characteristic greasy nature, and in this were found a great variety of foraminifera, but almost nothing of the higher forms of life.

Dr. Schmidt was enabled, in consequence of his researches, to determine many interesting facts in regard to *Bathybius* and its associates, and to fix with greater precision than before their true nature. Among other results of his observations he was led to the conclusion that the coccoliths are independent living creatures, and not related at all to *Bathybius*, excepting in the way of association. A second organism, which he calls *Rhabdolithus*, was met with, very closely resembling the coccoliths, and which tends to prove more satisfactorily the distinction between *Bathybius* and the coccoliths. The origin and significance of these objects are still far from being explained, but he is not willing to admit that the *Bathybius* protoplasm is the residue of other low organized creatures. Nor is it *protiston* or *moneron*, in the common acceptation of those terms, according to which all these simplest organisms have a limitation in space and a development. A living creature of unlimited extension is so contrary to our present notions of life and organization that our conceptions and ideas must first adapt themselves to it.—10 *A*, *November*, 1872, 359.

EXPLORATIONS IN THE GULF OF ST. LAWRENCE IN 1872.

The results of the explorations in the Gulf of St. Lawrence, prosecuted during the months of July and August, 1872, by Messrs. Whiteaves and Bulger, have just been published, in the form of an official report to the Minister of Marine and Fisheries. This was the second enterprise of Mr. Whiteaves, and was arranged to complete the labor of 1871. The area examined extended from a little above Cape Rozier to the Magdalen Islands. A depth of water somewhat over 200 fathoms was found near the centre of the mouth of the St. Lawrence, between Cape Rozier and the southwest point of Anticosti; the greatest depth actually met with was 313 fathoms, about half-way between the east point of Anticosti and the Bird Rocks.

The work was prosecuted on board the government schooner *Stella Maris*, which, being a sailing-vessel, was not so conveniently adapted for this purpose as a steamer would have been. In spite of the difficulties in the way, however, large collections were made, embracing several species new to science. The bottom temperature was generally ascertained by bringing up the mud and sand and immersing the bulb of the thermometer in it. In this way a record of 32° Fahr. was obtained at a depth of sixty fathoms, about five and a quarter miles to the east-south-east of Bonaventure Island. The mud elsewhere usually indicated about 37° or 38° Fahr., while in the central channel between Anticosti and a part of the Gaspé peninsula the indications were from 40° to 45° Fahr.

Among the novelties discovered was a sponge belonging to a genus but lately indicated in the *Depths of the Sea*. About thirty-five species of corallines were obtained, large numbers of them being new. Numerous fine specimens of *Virgularia*, of the species collected last summer, were procured, the same kind having been found by Dr. Packard on the George's Banks. Several species of sea-anemones were secured in addition to those of last year's collection. Two undescribed specimens of a coral (both dead) were also gathered at a considerable distance from each other. The relations of these new species are rather to the tropical forms than to those which we already know on the coast of the North Atlantic, and it is suggested that possibly they may have been thrown overboard with ballast. Against this, however, is adduced the fact of the novelty of the form, and the absolute identity of two diminutive objects obtained one hundred miles apart.—*Montreal Gazette, April* 12, 1873.

FAUNA OF THE ST. GEORGE'S BANK AND ADJACENT WATERS.

Professor Verrill, in discussing the collections made by the parties of the United States Commissioner of Fish and Fisheries upon the Coast Survey steamer *Bache* during her cruise off the coast of New England in the summer of 1872, sums up by stating that they represent six distinct faunas and subfaunas, as follows:

First, the surface fauna outside of the Banks, and, at certain times, even extending over their outer slopes. This is essentially the same as the fauna prevailing over the entire surface of the central parts of the Atlantic Ocean, and shows very clearly the direct effects of the Gulf Stream.

Second, the surface fauna inside of the Banks, which is decidedly northern in character, very similar to that of the Bay of Fundy. The contrast between the two shows that the Gulf Stream is almost entirely turned aside by the Banks, and has comparatively little effect upon the fauna of the region between them and the coast.

Third, the fauna of the St. George's Bank itself. This is decidedly boreal in character, and essentially identical with that of the Bay of Fundy at corresponding depths, on similar bottoms, and in regions swept by strong currents. The fauna of the southwestern part, however, is less boreal than that of the northeastern.

Fourth, the fauna of the Le Have Banks, and off Halifax. This, even at the moderate depth of twenty fathoms, is decidedly more arctic in character than that of the George's or the Bay of Fundy at similar or even greater depths.

Fifth, between the George's and Le Have Banks and the coast there is a great region of cold and comparatively deep water—in places more than 100 fathoms in depth—with a bottom of mud and fine sand, and communicating with the great ocean-basin by a channel between the George's and Le Have Banks, which is comparatively narrow and, in some places, at least 150 fathoms deep. This partially inclosed region has, physically and zoologically, the essential features of a gulf, and may be called the George's Gulf. The deeper waters of the Bay of Fundy are directly continuous with those of this area. The fauna of this gulf and of its outlet is peculiarly rich in species new to our coast, and nearly identical with that of the deeper waters of the Gulf of St. Lawrence, and agrees very closely with that found on muddy bottoms, and at similar depths, on the coasts of Greenland, Finmark, and Norway. He also presents additional generalizations as follows:

Sixth, the deepest dredging, in 430 fathoms, was outside of the George's Banks, on the slope of the actual continental border, and within the limits of the true Atlantic "basin." The fauna there is especially rich and varied, decidedly northern in character, and agrees closely with that of similar localities and depths on the European side. The animals were mostly such as inhabit bottoms swept by strong currents in the Bay of Fundy.

Seventh, every where over the Banks, and especially on the southern slopes, the difference between the bottom and surface temperature amounts to from 15° to 20°, or even more; the surface temperature being usually from 60° to 72°. The temperature of the air was very near that of the water, generally one or two degrees higher.

Eighth, no such contrast of temperature was found inside of the Banks in the George's Gulf or the Bay of Fundy; the difference seldom being more than ten degrees, and often, especially in the Bay of Fundy, less than five. The surface temperature at corresponding dates in the Bay of Fundy was 48° to 53°, showing an average difference of about 20° for the surface temperature in the two regions, while the average bottom temperatures do not appear to differ materially.

Ninth, the high surface temperature of the Banks is evidently due chiefly to the direct influence of the Gulf Stream.

Tenth, the very low surface temperature of the Bay of Fundy is largely due to its *geographical position*, and the *absence* of any appreciable influence from the Gulf Stream, but is no doubt intensified by the powerful tides, which are constantly mixing the cold bottom water with that of the surface.

The facts hitherto observed do not seem to warrant the assumption that an "arctic current," properly so called, as distinguished from the tidal currents, enters the George's Gulf or the Bay of Fundy. The action of the tidal currents in bringing up the cold bottom waters of the ocean is perhaps a cause sufficient to produce most of the coldness of the water in this region.—4 *D*, 1873, 98.

PRIORITY OF DISCOVERY OF KING CARL LAND.

Professor Mohn insists upon the claim of the Norwegians to the discovery, in 1872, of the island to the east of Spitzbergen, called by them King Carl Land, after King Carl XV. of Norway and Sweden. English writers, however, insist that this is the same as the Wiche Land discovered by Edge in 1617. This is disputed by Petermann, on the ground that the position given to Wiche Land on the map is considerably south of King Carl Land, and in a region where there is nothing but water.—12 *A*, *March* 27, 1873, 413.

REPORT OF THE GERMAN NORTH POLAR EXPEDITION.

The first section of the first volume of the long-promised report on the German north polar expedition of 1869 and 1870, commanded by Captain Koldeway, has just been published under the auspices of the Bremen Association for Polar Investigation. This contains a portion of the history of the expedition, the scientific results being kept for the second volume, which is shortly to appear. A full account of the preparatory steps in reference to the expedition, the internal fitting up and arrangement of the vessel, together with a list of all stores and supplies, are embraced in the report, as also the detailed instructions prepared by Dr. Petermann for the conduct of the survey.

It will be remembered that there were two vessels engaged in the work — the *Germania*, a steamer, and the *Hansa*, a sailing-vessel—which kept together for a part of the time, and then separated, taking different directions. The story of the *Hansa* and her unlucky voyage is then told—first, her freezing up in the ice, and her adventures during the winter; then the breaking up of the ice, the wreck of the vessel, and the drift of the crew for 800 miles on the floating ice-cake, which, continually diminishing in size, constantly contracted their quarters, finally splitting in two directly under their feet; then the leaving of this friendly refuge by taking to their boats, and their ultimately landing upon the island of Illuidleck on the 4th of June; next, their journey thence to Frederickstahl, where their greatest troubles ended; and from this point, after various stoppages, they were finally enabled to embark for Copenhagen.

This part of the narrative, admirably told, concludes with an account of the original discovery of East Greenland, and the successive voyages of exploration and discovery by which additional information was obtained. The volume is accompanied by a general chart of the eastern coast of Greenland, giving the results of all the expeditions, and ending with this voyage, of which the volume is a narrative.

FICTITIOUS ACCOUNT OF PAVY'S EXPLORATIONS.

Several of the newspapers have recently published, with little or no word of comment, and some with expressions of astonishment, an account of the Pavy expedition, and its supposed discoveries in Wrangell's Land. According to this announcement, the ship *Cadmus* had arrived in San Francisco with a dispatch from Mr. Pavy, and bringing the news that this gentleman, with several associate professors, had safely landed on Wrangell's Land, and, among other wonderful discoveries, had found the remains of immense herds of fossil elephants. Living arctic animals were also encountered in great abundance, together with myriads of birds. Mr. Pavy was preparing to winter at the 75th degree of north latitude, in the valley of the great river of the polar continent, and he felt certain of arriving, the beginning of next season, at a polar sea of moderate temperature, and of afterward reaching the Atlantic through Melville Strait. It is quite sufficient, in answer to this assertion, to say that, according to the best information, Mr. Pavy, although having occupied the current journals for a year or two with an account of his preparations, has not yet actually left San Francisco. The names of the gentlemen mentioned as his companions are, it is said, those of persons in San Francisco who gave him a dinner in that city many months ago in anticipation of his speedy departure.

SOUTH POLAR EXPLORATION.

Dr. Neumayer continues to call the attention of the public, especially that of Austria, to the importance of an exploration toward the south pole, which, in his opinion, promises results far more interesting than those upon the opposite end of the globe. He suggests that a wooden sailing-vessel of about 300 tons, with an auxiliary screw, thoroughly strengthened at the bow, will be required for such an expedition, and that it should be equipped with all the most improved apparatus for ocean research. Starting at the Cape of Good Hope about the beginning of the year (or antarctic midsummer), he thinks that the various groups of islands visited by Cooper and Ross should be touched at. A dépôt should be established at the Macdonald Islands, which reach to 53° 5′ south latitude, where a stock of coal should be left by means of a transport. An astronomical observatory should also be built, and a party of observation kept there for a considerable time. From this haven the vessel could move in various directions, continually prosecuting its special work. In December the attempt should be made to cross the south polar circle, to force through the girdle of pack-ice, and begin the research proper. If possible, a harbor for spending the winter inside the polar circle should be made on Kemp's or Enderby Land; and, at any rate, a small party might be left there, properly provided to resist the atmospheric influences. In the following December the vessel should again proceed to the south, take up the observers on Kemp's Land, and continue researches until the end of the favorable season requires a return to the Macdonald Islands; and after the conclusion of the work the party should sail for Melbourne. Should the Macdonald Islands prove unsuitable to a long stay, then Christmas Haven, in Kerguelen's Land (48° 41′ south latitude, 69° 3′ east longitude), might be chosen for the purpose. In this case, as, indeed, in the other alternative, observations on the transit of Venus might at the proper time be included in the labors of the party.—12 *A, December* 26, 1872, 140.

REPORT ON THE YELLOWSTONE PARK.

The first report (for 1872) of Governor N. P. Langford, superintendent of the Yellowstone National Park, has just made its appearance, and contains an account of what has been done during the year to protect and preserve this interesting region for the benefit of future visitors. We are informed that new natural wonders are continually discovered, and that the number of geysers, hot springs, etc., is almost count-less. The Park was visited during 1872, in connection with the expedition of Professor Hayden, and new routes determined, by which access will be much easier than heretofore. At present the only mode of approach is by means of saddle and pack trains, and Governor Langford suggests the propriety of constructing several wagon-roads for the convenience of the public. One of these roads should start from a point about fifty miles above the junction of Henry's Fork with the Snake River, and extend eighty miles to the north. This will pass over or through the main range of the Rocky Mountains, either by the Henry or the Targee Pass. Another practicable road would commence at the same point on Henry's Fork and follow up the Middle Fork. This route would be shorter than the other, and lead more directly to the Geyser Basin and Yellowstone Lake, the distance between the two being about twenty miles. In the Park a road should be built from Gardiner's River Springs across the Lower Geyser Basin, the distance being forty miles. The opening of these roads would insure the early erection of large and commodious public-houses at Monmouth Springs, Yellowstone Falls, Yellowstone Lake, and the Upper and Lower Geyser Basins.

When these improvements are made it is thought that extensive settlements will spring up in that region, supported in part by the travel of tourists, and partly by the exportation of lumber made from valuable timber in the district. We are informed that there is no land in the Park suitable for agricultural purposes, although enough grass can always be found to feed the horses of tourists. No mines appear to have been detected, nor is there any prospect of them. It is recommended that, for purposes of police regulation, the Park be attached to Gallatin County, Montana; as, although more closely connected with Wyoming, access to the Park is considered impossible by way of that territory. — *Senate Ex. Doc., No.* 35.

EXPLORATIONS OF LIEUTENANT WHEELER IN 1871.

The preliminary report of the explorations and surveys during the year 1871, in Nevada and Arizona, conducted by Lieut. George M. Wheeler, of the engineer corps, has lately been published in quarto form by the government printer.

It contains an account of the plan of the survey, as initiated by Lieutenant Wheeler in 1870, and which he has successfully continued during the year 1872. The work accomplished during 1871 embraces, among other results, the mapping out of various mining districts, and the determination of the areas, direction, and condition of the lodes. The topographical features of the great Colorado plateau have been developed over the region extending from St. George, in Utah, to the White Mountains, near the border line of Arizona and New Mexico, and much information has been gathered as to the geology of this plateau, and of numerous inclosed and interior basins in Nevada. The exploration of the Colorado has determined the absolute limit beyond which a party of examination will not be likely to ascend that river. It has been ascertained that a railroad can cross the Colorado and the mouth of the Virgin River, that it can be carried by easy grades, and that the Colorado can be crossed by a north and south line near the foot of the Grand Cañon; and also that this route may be made available for mails to the northern part of Arizona.—*Report.*

THE OWL-FACED MINERVA.

Dr. Schliemann, a savant at present engaged in exploring what he supposed to be the site of ancient Troy, has written to Professor North, of Hamilton College, according to the *College Courant*, in reference to the characters given by the ancients to Minerva. He has reason to believe that up to a certain period of history this goddess was actually represented with the face of an owl, but that with the advance of civilization she received a human face, and her owl's head was transformed into a separate bird.—*College Courant, February* 8, 1873.

TRAVELS OF PALLADIUS IN CHINA.

The Archimandrite Palladius, who has already sent many interesting facts relative to the geography and internal condition of the Chinese Empire to the Geographical Society of St. Petersburg, has lately forwarded to it a collection of ancient Chinese, Japanese, and Corean coins, as well as a copy of an inscription of a tumular stone which he found near Tourdane, in the southern part of the Oussouri country. Some of these coins, according to Palladius, belong to a period 175 B.C.—*Proc. Geog. Soc. St. Petersburg, November* 1, 1872.

DRIFT-WOOD IN NOVA ZEMBLA.

A paper in Petermann's *Mittheilungen* upon the drift-wood found in Nova Zembla has at present a special interest in connection with the discovery of fragments of a similar character by the crew of the *Polaris* in Polaris and Newman bays. The Nova Zembla specimens consisted mainly of willow of various thicknesses. There were also, however, pieces of beech nearly a foot in diameter, several species of pine, among these *P. sylvestris*, an *Abies*, etc. It is thought that a large portion of this material must have been derived from the Petschora, Obi, and Yenesei rivers, and that none of it could have been derived from the current of the Gulf Stream.—17 *C, May*, 1873, 189.

BRITISH SURVEYS IN PALESTINE.

A recent report on the part of the British surveys in Palestine states that the country is divided naturally into four parallel strips—the coast plain, the hill country, the Jordan Valley, and the eastern plateau. The hills are broad-backed, without marked grandeur in their physical features; but here and there rounded summits rise above the general level of the range. Of these, Hebron is 2840 feet above the sea; the Mount of Olives, 2665; Mount Ebel, 3029; and Jebel Jermah, 4000. On the east the hills descend rapidly to the Jordan, and are furrowed and cleft by deep, wide torrent beds. The Jordan Valley runs nearly parallel to the coast from the base of Mount Hermon to the Dead Sea, which occupies the deepest portion. The Jordan is the great river of the country, which, from the Sea of Galilee to the Dead Sea, has a tortuous course for sixty-six miles, wholly below the level of the Mediterranean.—6 *A, July*, 1873.

ARCTIC COMMITTEE IN GREAT BRITAIN.

A committee has lately been appointed by the Royal Society to prepare a report upon the scientific objects of an arctic expedition, consisting of George Busk, Esq., vice-president of the Royal Society, Dr. Carpenter, president of the British Association, Mr. Joseph Prestwitch, General R. Strachey, Dr. Allman, James Ferguson, Esq., and John Evans, Esq. The arctic committee of the Royal Geographical Society includes Admirals Sir George Back, Collinson, Ommanney, Sir Leopold M'Clintock, and Sherard Osborne; Dr. J. D. Hooker, Mr. Findlay, and Mr. Clements Markham. The joint labors of these committees, it is expected, will soon be completed.—6 *A*, *July*, 1873, 169.

THE PROPER GATE-WAY TO THE POLE.

The problem as to the proper gate-way to the north pole has acquired additional interest since the late news from the *Polaris;* and it is gratifying to know that the approval by the United States authorities of the Smith's Sound route for Captain Hall's exploration is fully indorsed by the best English geographers. In a communication by Captain Sherard Osborne before the Royal Geographical Society of London, on the 20th of April last, it was remarked that at only two points has it been found practicable to penetrate to the arctic seas as far as the eightieth degree of north latitude—the one by way of Spitzbergen, and the other by way of Baffin's Bay, the two being about ninety degrees apart. The route by way of Spitzbergen has never been followed beyond eighty-two and a half degrees, from which point an impenetrable sea of ice was seen extending toward the north, with indications of land running east and west beyond Spitzbergen. Here the southward motion of the ice-fields, on which Parry traveled in 1828, carried him back as fast during the night as he advanced during the day. This, in Captain Osborne's opinion, must be a standing difficulty in the way of any explorer, and he is satisfied that the Baffin's Bay route, and especially that by Smith's Sound, is the one that must be relied upon for any future advance toward the pole, especially as by this route (in the same parallel as that of the Spitzbergen pathway) land was seen extending northward instead of from east to west, and with indications of open water, and the probability of much less trouble from ice drift.—6 *A*, *May*, 1873, 82.

DR. HAYDEN'S SURVEYS.

One of the special results of the United States geological and geographical survey of the Territories, in charge of Professor F. V. Hayden, during the past summer (and of which Mr. James T. Gardner is the geographer), has been the discovery that Colorado Territory is the centre of the greatest elevation of the Rocky Mountain chain. In Central Colorado the chain proper is about 120 miles broad, made up of three lofty parallel ranges, running nearly north-northwest, and flanked from the west by great plateaus and groups of peaks. Between the ranges lie the great elevated basins known as "parks." The front range, which rises abruptly from the plains, is seen from Denver in a grand panorama 120 miles long. From its snowy serrated crest rise many peaks between 13,000 and 14,000 feet high. These are Long's, Gray's, and Pike's peaks, Mount Torrey, Mount Rosa, and Mount Evans.

On the west side of the parks is the Park Range, whose highest group is at Mount Lincoln, this and Quandary Peak each rising to about 14,000 feet. Mount Lincoln forms the base of all the hypsometric works of the Hayden survey on the high peaks. Denver has already been connected with the sea by two lines run with the spirit-level.

During the past summer the Denver, South Park, and Pacific Railway Company completed their line of levels from Denver to Fairplay, and, at the instance of Dr. Hayden, continued the survey to the top of Mount Lincoln, where a permanent meteorological station had been established, under the care of Captain Bruce, the owner of the remarkable mines situated on the summit of the mountain.

The heights of all the culminating peaks have been determined barometrically by reference to this peak, and we are promised that the results shall surpass in accuracy any of the high mountain measurements yet made in this country. The survey has also established a permanent meteorological station at Fairplay, 10,000 feet above the sea, and another at Cañon City, about 6000 feet. These stations are all connected by a spirit-level line, and the comparison of their observations will be of remarkable interest.

The National Range lies east of the Park Range, and is separated from it by the Arkansas Valley. For the grandeur of its form and the height of its peaks this is one of the most striking ranges on the continent. At its northern end is the Mount of the Holy Cross, a peak about 13,000 feet high.

The eastern front is a precipice of 3000 feet in height, on the dark front of which gleams a brilliant white cross of snow, so large and perfect that at the distance of fifty miles it is quite conspicuous.

South of the Holy Cross the whole range is elevated 13,000 feet, towering like a buttressed wall above the Arkansas Valley. At quite regular intervals rise the culminating peaks, ten of these being from 14,000 to 14,400 feet high.

West of the National Range rises the great group of Elk Mountains, five of whose peaks are 14,000 feet high. These are the White House, Capitol, Castle Peak, Maroon Mountain, and one unnamed. So far as known, there are in the district explored the past season by the survey seventy-two peaks, ranging from 14,000 to 14,200 feet in height. Mount Lincoln stands near the centre of the mass, and from its summit may be counted more than two hundred peaks not less than 13,000 feet high.

ASCENT OF MOUNT MEIGGS.

According to the Panama *Star and Herald*, the Fourth of July was marked in Peru by the ascent, on the part of a number of American gentlemen, of the highest peak of the Peruvian Andes. For some time past a party of American engineers has been engaged in cutting through the Summit or Galera tunnel, on the Oroya Railway, at the station near the town of Galera, which is perhaps the highest settlement in the world, and under which the tunnel is being pierced. This village is situated ninety-four miles from Lima, on the west slope of the Andes, and is 15,581 feet above the level of the sea. Quite a large party on this occasion made the ascent, and planted upon it the flags of the United States and of Peru, the flag-staffs being of iron, which will probably retain their places for a reasonable length of time.

The altitude as determined by the boiling-point of water, corrected by the barometer, was 17,751 feet; by the thermometer, it was a few feet less; but from actual levels and triangulation it was fixed at 17,574, showing a remarkable agreement between the indications of the portable thermometrical apparatus and the more accurate indications of the level.

At two o'clock P.M. the thermometer indicated 36° above zero, Fahr., and the barometer an atmospheric pressure of eight pounds to the square inch.

Important additions to meteorological science are expected from the records taken in Galera, under the direction of Dr. E. L. Bissell and Mr. H. B. Tobias, correspondents of the Smithsonian Institution.—*Panama Star and Herald, August* 5, 1873.

BERNSTEIN'S TRAVELS IN THE MOLUCCAS.

A valuable contribution has lately appeared in Petermann's *Mittheilungen* in the form of a report of Dr. Bernstein's journeys in the Moluccas, which region he visited, under the auspices of the government of the Netherlands, for the purpose of making zoological collections for the National Museum at Leyden. Starting in 1861, he was engaged for about three years, during which he visited Halmahera Batchan and Waigou, to the northwest of New Guinea. A second engagement, also of three years, was entered into by him, during which he visited New Guinea, but, becoming broken down by the climate, he was obliged to return. The zoological collections made by Dr. Bernstein have been very rich, and have added much to our knowledge of the fauna of the region referred to. These consisted largely of birds, but embraced also many other objects of natural history.

SIBERIAN EXPLORATIONS OF THE GEOGRAPHICAL SOCIETY OF ST. PETERSBURG.

The Geographical Society of St. Petersburg has lately undertaken a new exploration of Russian territory in addition to those already carried on under its auspices. For this purpose the sections of mathematical and physical geography presented to the councils of the Society in October last a programme of an expedition having for its object a geographical and geological expedition to the Olenek and the Lower Tunguska. It is proposed to intrust the direction of the expedition to Mr. Tchékanoosky, the programme having been drawn up by Mr. T. Schmidt, who is already favorably known in connection with similar enterprises.

The plan consists in a minute exploration of the area between the lower affluents of the Yenisei and the Lena, embracing the basin of the River Olenek, which represents an important deficiency in the known portion of Eastern Siberia. Two years will be occupied in the exploration. During the first the expedition will descend the Lower Tunguska, and will reach Irkutsk by the Yenisei. During the second year it expects to reach the sources of the Olenek by sledges, to descend that river to its mouth, and then cross over to the Lena, and return by this river to Irkutsk.—*Proceedings, December* 13, 1872.

BLUE COLOR OF THE SKY.

The cause of the blue color of certain lakes, especially that of Geneva, is maintained by some to be due to the occurrence of finely dissolved or very minutely divided gelatinous silica; and M. Colas now maintains that the blue color of the sky is produced by the same substance, kept in suspension in the air on account of its great lightness.—5 *A*, *July*, 1873, 327.

MEYER'S EXPLORATIONS IN NEW GUINEA.

Dr. A. B. Meyer has recently returned to Vienna from his expedition to New Guinea, having landed there at MacCleur's Inlet, on the west coast, and crossed the main-land to the Bay of Geelvink. In addition to numerous specimens of nearly all the known species of the birds of paradise, he thinks he has obtained one that is new to science.—12 *A*, *October* 16, 1873, 535.

NEWS FROM DR. NACHTIGAL.

Information from Dr. Nachtigal, dated February, 1872, and just received in Germany, gives some statements in regard to discoveries made in the countries lying to the northeast of Lake Tchad, in Central North Africa. The principal result of his inquiries is that the Bahr-el-Gazal, heretofore believed to flow into Lake Tchad, really flows out of that lake northeast for about 300 miles. A range of mountains, extending for a distance of over 800 miles, was also discovered, one of the passes of which is at least 7878 feet above the level of the sea. At the date of the letter Dr. Nachtigal was about starting toward Bagimri, to the southeast of Lake Tchad.—12 *A*, *May* 2, 1873, 75.

RECENT EXPLORATIONS IN AUSTRALIA.

We find in *Ocean Highways* a sketch of certain explorations in Australia in 1872, organized by Baron F. von Müller, of Melbourne, and commanded by Mr. Ernest Giles. The result of their labors has been to fill in much topographical detail between 129° and 134° east longitude and 23° and 25° south latitude.—6 *A*, *June*, 1873, 132.

ON ASCERTAINING A SHIP'S PLACE AT SEA.

Professor Rogers, of Harvard College Observatory, has undertaken the interesting problem of determining accurately the average number of miles that a ship may be out of her reckoning. He states that, in the case of British vessels, there is a continual increase in the proportion of wrecks; thus those in 1858 were thirty-eight per cent. more than in 1848; in 1868, they were forty-four per cent. more than in 1858. For 1869, we have a decrease in the number of vessels of four per cent., and an increase in the number of wrecks of twenty-one per cent. The confidence in reckoning by astronomical observations had increased the danger from this source. Professor Rogers says that wrecks are caused—

1. By causes beyond control.
2. In order to obtain insurance.
3. From unknown deviations of the magnetic compass.
4. By errors of astronomical observation.

He concludes that seventy per cent. of wrecks might have been prevented by due precautions. The number of insured vessels that are wrecked is 3.3 times as great as the number of uninsured vessels. He shows that from the errors in the rates of the chronometers, an error of position of 3.6 miles must be expected; that an error of 11.5 miles is not improbable, and that an error of 21 miles may occasionally occur. All of this computation assumes that the navigator has an average chronometer. In these instruments, as is well known, the most important source of error is found in the varying temperature. Professor Rogers concludes that the navigator who assumes that he can get the place of a ship certainly within five miles, or, probably, within fifteen, exhibits an over confidence which may lead to his ruin. In this connection it is well to recall the great labors of Mr. Hartnup, of Liverpool, who has devoted many years to the investigation of the rates of ship chronometers, especially of those that sail from Liverpool. At the observatory in that city, he has established the means for conveniently testing the rates of these instruments at the temperatures of 55, 70, and 85 degrees of Fahrenheit. He finds, as the result of the examinations of more than 1000 chronometers, that there is a definite temperature peculiar to each instrument, in which it goes faster than in any other temperature, and, as the number of degrees above or below this temperature increases, the chronometer loses in a rapidly increasing ratio. For any chronometer which has been allowed to remain at the Liverpool Observatory for a period of five weeks, there is issued a certificate of test, containing the necessary data for calculating the correction due to imperfect thermal adjustment. The establishment of a similar chronometer observatory at the port of New York would certainly be a great boon to navigation.

SIXTH ANNUAL REPORT OF DR. HAYDEN'S EXPLORATIONS.

The sixth annual report, by Professor Hayden, of the United Geological Survey of the Territories, has just been published by the government office, and embraces a statement of the progress of explorations in 1872 in portions of Idaho, Montana, and Utah, and constitutes a volume of 871 pages, contains twelve lithographic maps, and a number of wood-cuts. Part I. embraces the reports upon the physical features of the country, by Professor Hayden, M. P. Langford, Dr. Peale, F. H. Bradley, and Cyrus Thomas, that of the last-mentioned author having reference to the physical geography and agricultural resources of Minnesota, Dakota, and Nebraska; Part II. contains articles on paleontology and geology, by Lesquereaux, Meek, Hayden, and Thomas; Part III. is devoted to zoology and botany; and Part IV. to astronomical observations and altitudes. The whole work is of a substantial and important character, filled with scientific essays and announcements of great value.

REPORT OF MAJOR J. W. BARLOW.

The Secretary of War has communicated to Congress the report of Major J. W. Barlow, United States Army, who accompanied a surveying party of the North Pacific Railroad, in 1872, down the Yellowstone River and back to Fort Ellis. The surveying party consisted of about twenty men, under the command of Mr. Haydon, chief engineer, and the escort, commanded by Major E. M. Baker, embraced about 375 men, making the whole number about 400. The expedition started on the 26th of July, and proceeded through Bozeman's Pass to the Yellowstone Valley, being harassed at almost every foot of the way by the Indians, whose hostility to the enterprise of the construction of the Northern Pacific Railroad is such that, according to General Sherman's indorsement, at least two full regiments of cavalry and as many of infantry will be necessary in future to guard and protect the working parties on the railroad.—*Senate Ex. Doc., No.* 16, *Forty-second Cong., Third Session.*

THE FRENCH ARC OF THE MERIDIAN.

The French geodesists of the Topographical Corps of the army have recently successfully completed the direct junction of the triangulation of Spain with that of Algiers. This has been accomplished by Captain Perrier, who has been able to perceive distinctly from the two high stations in Algiers the two corresponding ones in Spain, although they are distant from each other 200 miles in a direct line. The measurements of the bearings of these stations from each other have been conducted with great accuracy. It is very rare that such distant stations can be used in geodetic operations, and the present triangles are said to be the largest that have ever been used in accurate measurements. By the success of the work of Captain Perrier, the famous meridian of Paris has now become a continuously measured arc of over thirty degrees, stretching from the Shetland Islands on the north to Algiers on the south, and its farther continuation southward is evidently only a question of time and money.

TRANSFER OF SAND FROM AFRICA TO ITALY BY THE SIROCCO.

As in previous years, Italian meteorologists announce the occurrence of a shower of sand in considerable quantity in the southern part of Italy, consisting in all probability of matter transported by the south winds, or the sirocco, from the African deserts. In one instance, which took place on the 18th of March, the wind having been blowing for some time from the south or southeast with great violence, and while the barometer descended rapidly, the thermometer indicated a temperature of 59° Fahr., with a suffocating atmosphere. From the study of the record it was found that a cyclone made its appearance on the 10th and 11th of March in the northwest of Europe, in the latitude of the Hebrides. On the following day it extended toward Italy, passing by on the 13th, and thence moving toward Africa. On the 16th and 17th, the return cyclone was apparent on the northern shores of Africa, extending toward the north, and reaching Italy on the 18th, carrying on its flanks, as usual, the sands of the desert. The high temperature accompanying this cyclone melted a great quantity of snow in the mountains, which caused an inundation of the River Po.—1 *B*, *April* 20, 1873, 38.

TRAVELS OF ABBÉ DAVID IN CHINA.

At a recent meeting of the Geographical Society of Paris, a communication was presented containing an account of the travels of the Abbé David in Central China, in continuation of those which have resulted in adding so greatly to our knowledge of the natural history of that country. The abbé left Pekin on the 2d of October, 1872, passing in a southwesterly direction, and moving off the ordinarily traveled routes, with the object of better studying the geological condition of the country. His course was interrupted on the frontiers of Tse-tchuen and Kansu, having been refused permission to enter the latter province on account of the rebellion prevailing therein.

The abbé discovered three coal deposits to the north of Mount Tsin-lin, and visited another in a different locality. At a later date, in descending the Han-kian, his vessel was wrecked, and he lost the greater part of his collections, including numerous species of vertebrates, and probably many novelties. This mishap discouraged him to such an extent that he decided to return almost immediately to France.—3 *B*, *September* 5, 1873, 624.

DETERMINATION OF THE TRUE MOUNT SINAI.

Dr. Beke still continues his efforts to secure a fund for determining the position of the true Mount Sinai, which he thinks is not any where within the peninsula between the gulfs of Suez and Akaba, but in the Arabian Desert, east of the head of the latter gulf. The whole amount needed for the purpose is £500 sterling, and a considerable portion of this has been already contributed, or promised on condition of the completion of the whole.—13 *A*, *October* 1, 1873, 380.

SOUNDING-LINES OF THE CHALLENGER EXPEDITION.

As a matter of interest in relation to deep-sea explorations, we learn that the sounding-lines used by the *Challenger* have proved to be extremely efficient—indeed, far superior to those previously employed for the purpose. These are composed of the best Italian hemp, which, when made up, has but few protruding ends of fibres, and these are well rubbed down with bees-wax and sweet-oil in equal proportions. The advantage of this preparation may be seen from the fact that there is a difference of seventeen to twenty per cent. in the time of going down in favor of those which are so treated.

The number of threads also is somewhat greater. Thus the ordinary deep-sea line heretofore used by the London Admiralty has about eighteen threads, and weighs twenty-three pounds fourteen ounces to the hundred fathoms, with a circumference of 1.065 of an inch, the breaking strain being 630 pounds. The new line has twenty-seven threads, with a weight of eighteen pounds nine ounces per hundred fathoms, with a circumference of one inch, and a breaking strain, when wet, of 1559 pounds. The new medium line of eighteen threads weighs twelve pounds eight ounces to the hundred fathoms, with a circumference of 0.8 of an inch, and has a breaking strain, when wet, of 1211 pounds.

The new cod line, weighing six pounds four ounces per hundred fathoms, has a breaking strain of 777 pounds instead of 252 pounds, as in the ordinary line. Thus with a decrease of fifteen per cent. in weight of material used, an increase of strength has been gained of between 100 and 200 per cent. —6 *A*, *October* 1873, 271.

CANADIAN EXPLORATIONS.

In noticing the great activity of the United States, in the last few years, in the exploration of the regions of the West and Northwest, we must not forget that Canada has been occupied in a similar manner in reference to her own Western territory. Several important geological and geographical surveys have been instituted, in addition to the great general geological survey that has been in progress for many years, the reports of which have proved of such standard value. During the past season Mr. Selwyn, director of the geological survey, and Mr. R. Bell, have been engaged in the regions watered by the North Saskatchewan, while Mr. Richardson has been on the other side of the Rocky Mountains, in British Columbia. Mr. G. M. Dawson, geologist of the Boundary Commission, has just completed a survey of the Lake of the Woods and its neighborhood, and during the season many collections have been made in the country west of Pembina, which, although not equal in value to those of Dr. Coues in the same field, will yet prove of much importance.—12 *A*, *October* 16, 1873, 513.

FINAL REPORTS OF DR. HAYDEN'S EXPLORATIONS.

During the many years in which Professor Hayden has been engaged in prosecuting the geological and geographical survey of the Territories, an annual report of greater or less magnitude has attested the industry of himself and associates, and the value and character of his investigations. He has now commenced the publication of the general results of his labors in systematic form (somewhat upon the plan of the Smithsonian contributions to knowledge), and to occupy five stout quarto volumes. These will constitute a library of reference for the physical and natural history of the great West, and, as such, promise to occupy a high place in the scientific literature of the day.

Of this series of reports the first published is that by Dr. Cyrus Thomas, upon the *Acrididæ*, a group of insects, embracing what are called grasshoppers in the United States and locusts in the Old World, and including some of the most destructive insect pests known. Of these he enumerates about one hundred and twenty species. The types have all been placed in the United States Agricultural Department for permanent preservation. The work forms a large quarto of about two hundred and fifty pages, constituting the first part of a volume to be devoted exclusively to an account of the recent zoology of the West.

BRAZILIAN COAST PILOT.

Among the more important of the numerous current publications of the Hydrographical Office, under Commodore Wyman, is the first volume of a "Coast Pilot" of the coast of Brazil, prepared by Lieutenant Gorringe, and covering the region from Cape Orange to Rio Janeiro, forming a volume of nearly four hundred pages, in which the peculiarities of that portion of the coast are detailed with great minuteness, and accompanied by numerous profile sketches of the shores as observable from the vessel at sea.

Another report of a very practical bearing is the result of the observations made by the United States steamer *Narragansett* during a cruise between Honolulu and Sydney, conducted between the 6th of July and the 7th of September, 1872. The points visited were Christmas Island, the Gilbert group, Mulgrave Islands, the Disappointment and Duff Islands, and the Vanikoro Islands.

EXPLORATIONS OF ALBERTIS IN NEW GUINEA.

Among the most successful of recent explorations in Australasia is that of Señor L. A. D'Albertis in the interior of New Guinea. From an account lately published in the Sydney *Herald*, and quoted in *Nature*, we learn that, during a period of twelve months' residence, he obtained a very large number of specimens of rare birds of paradise, and other objects, including mammals, insects, etc. Of the mammals there are one or two new to science, and possibly one new bird of paradise.—12 *A*, *October* 16, 1873, 501.

THE HISTORY OF THE POLARIS.

No more remarkable story of seafaring life is on record than that furnished by the history of the American North Polar Expedition on the *Polaris*, under command of the late Captain C. F. Hall.

It is well known that an appropriation of fifty thousand dollars was made by Congress for the purpose of fitting out an expedition for research to the North Pole, the Navy Department being directed to furnish a suitable vessel, with supplies for the same, and that Captain Hall—well known from previous visits to the arctic regions—was placed in command by the President.

The vessel was properly prepared for her journey at the Navy Yard in Washington, and proceeded first to New York. The party consisted of Captain C. F. Hall, in command; Captain Buddington, ice-master; Captain Tyson, sailing-master; and H. Chester, as first mate. The scientific corps was composed of Dr. Emil Bessels, as chief; Mr. R. W. Bryan, as astronomer; Mr. Frederick Meyer, as meteorologist; and several assistants, together with a crew; and the Esquimaux Joe and Hannah, and their adopted child, who had been with Captain Hall in previous expeditions in the North.

The vessel left the Navy Yard on the 20th of June, and proceeded by way of New London to St. John's, Newfoundland, and thence to Disco, which point they reached on the 17th of August. The frigate *Congress* was sent as far as Disco for the purpose of carrying coal and other supplies, which were needed in greater quantity than could be taken directly by the *Polaris*. Parting company at that point, the *Polaris* proceeded to Upernavik, where she took on board another Esquimau family, consisting of Hans Christian, his wife and three children, and then continued on her northward voyage.

On reaching Tessuisac a supply of dogs was obtained; and, leaving this point on the 24th, they encountered very little interruption on their northward course until they reached latitude 82° 16′, the northernmost point ever attained by any vessel.

It soon became necessary to go into winter-quarters, and the vessel was finally anchored in Thank God Harbor protected by the Providence Iceberg, on the east side of Polrais Bay, in latitude 81° 38′ N., longitude 61° 44′ W.; the landing taking place on the 3d of September, 1871.

On the 10th of October Captain Hall left the *Polaris* for a sledge journey to the north, and returning after an absence of two weeks, on the 24th of October he was taken ill shortly after going on board, of paralysis of the left side of the body, and died on the 8th of November.

During the winter scientific observations were kept up, and early in the following spring several efforts were made, both by sledges and by boats, to prosecute explorations farther to the north. This, however, was found impracticable; and, the vessel having suffered severely by the ice, it was considered prudent to return homeward, Captain Buddington being in command of the vessel, in accordance with the instructions of the Secretary of the Navy. They left Polaris Bay on the 12th of August, 1872, and, after various adventures, were beset by ice on the 15th of October; and, being pressed between the cakes of ice, the danger of being crushed was so imminent that they immediately began to throw provisions and supplies upon the large cake to which the vessel had been attached, a portion of the crew being occupied in transferring the articles thrown out farther from the side of the vessel, to a proper distance from it, when, a gale coming on, the *Polaris* was torn from her fastenings and driven to the northward, leaving nineteen persons on the ice, comprising Captain Tyson, Mr. Meyer, both parties of Esquimaux, and certain members of the crew.

The *Polaris* experienced very severe injury on this occasion, and before a junction could be made between the separated parties, the ice-floe broke away with its nineteen human beings, when there commenced the most remarkable drift on record, lasting from the 16th of October, 1872, till the 1st of April, 1873, and extending over a distance of nearly fifteen hundred miles. Strange to say, no loss of life was experienced during this winter voyage upon the ice, and comparatively little discomfort, although, of course, great privations and hardships were encountered.

Fortunately, by the time they reached the coast of Labrador, they were met by the Newfoundland sealing steamer *Tigress*, by which they were rescued and carried to St. John's, and thence brought to Washington in the United States steamer *Frolic*, dispatched by the Secretary of the Navy for that purpose, on board of which they were taken on the 27th of May, reaching Washington on the 5th of June, a little less than two years from the time of their departure.

On arriving in Washington, a commission of inquiry into the experiences of the *Polaris*, and the causes which led to the separation of the party on the ice-floe, was instituted by the Secretary of the Navy, consisting of himself, Commodore William A. Reynolds, of the Bureau of Equipment and Repairs; Captain H. W. Howgate, of the Signal Corps; and Professor Baird, of the Smithsonian Institution.

In addition to this, it was thought expedient, in the event of the ultimate loss of the *Polaris* and those remaining on board, to secure from the rescued party as much information respecting the geography, physics, and natural history of the North as could be obtained. The result of this investigation was published in June last by the Secretary.

In view of the disabled condition of the *Polaris*, and the loss of so large a portion of her crew, the Secretary of the Navy, with the consent of the President, determined to send out a relief expedition, and accordingly purchased the *Tigress*, a vessel admirably fitted for ice navigation, and ordered her from St. John's to New York.

At the same time the *Juniata* was ordered to proceed to the coast of Greenland, and facilitate the movements of the *Tigress* by carrying coal and other supplies, for which the latter had not sufficient capacity, and to prosecute the search herself as far as was prudent for a vessel not built expressly for arctic navigation.

Commander D. L. Braine was assigned to the command of the *Juniata*, and Commander James A. Greer to that of the *Tigress*, which was ordered to make her way, if necessary, by every means possible, and in the face of every danger, to the spot where the *Polaris* was last seen; while Commander Braine was directed not to expose his vessel to any danger, but to aid in every possible way the special object of the *Tigress*.

The *Juniata* left New York on the 24th of June, and after certain alterations at St. John's, fitting her better for her voyage, she left for the North, and reached Fiskenaes, in Greenland, on the 14th of July. Continuing along the coast to the north, she arrived at Disco on the 21st of July, and at Upernavik on the 31st. From this place the steam-launch, *Little Juniata*, under command of Lieutenant George W. De Long, sailed on the 2d of August for Cape York in search of the *Polaris* and her crew, supplied with provisions for sixty days, and with coal for fifteen; and after performing one of the most extraordinary voyages on record, she returned on the 12th of August. At midnight of the same day she reached Tessuisak, where she communicated with the *Tigress*.

The *Tigress* sailed from New York on the 14th of July, and touched at St. John's, arriving at Godhaven on the 6th of August, and at Upernavik on the 10th. After receiving supplies of skins, coal, etc., from the *Juniata*, she proceeded northward the same day, and on the 14th of August discovered the camp which the *Polaris* people had occupied the previous winter, which was about sixty miles north of Northumberland Island, or of the place where the party rescued from the ice in the spring had been separated from the *Polaris.*

Here information was obtained from the natives of the departure in June of Captain Buddington and his party, and of the sinking shortly after of the *Polaris.* Such of the papers and instruments of the *Polaris* as were worth removing were brought away by the *Tigress*, which returned to Godhaven on the 25th of August. After being again coaled by the *Juniata*, the search was resumed by running over to the west coast, thence southward to the entrance of Cumberland Sound, and back to the coast of Greenland, in the vicinity of Ivigtut and Fiskenaes, searching in Davis Strait as long as her coal lasted, and then going to St. John's, where she arrived on the 16th of October, and learned of the rescue and arrival in Scotland of the *Polaris* party. Leaving St. John's on the 19th of October, she reached New York November 9th.

After the separation of the two portions of the original *Polaris* party, as already stated, the vessel proved to have received very serious injuries on the night of the 15th of October, when the separation took place, and it was with difficulty that she could be kept afloat, and was finally beached the following afternoon. As already stated, this took place at Littleton Island, considerably to the north of the point previously supposed to be its location. A look-out was kept for the missing men, but without any signs presenting themselves; and winter-quarters were established on shore by means of plank removed from the vessel, to which camp were taken all the valuable articles of equipment. This was in latitude 78° 23′, a locality which had been previously visited by Kane and Hayes.

A party of friendly Esquimaux rendered great service at that time and through the winter. Early in the spring two boats were built, under the direction of Mr. Chester, upon which the party embarked on the 3d of June, and on the 23d they were picked up, south of Cape York, by the *Ravenscraig*, a whaling vessel, which transferred them to other ves-

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sels by which they were taken to Dundee, whence they proceeded to Washington.

No complete account has yet been published of the scientific results of the expedition, although we are assured that, disastrous as was its termination, a great deal of important information has been added to our knowledge of the arctic regions. All branches of science received a satisfactory degree of elucidation; and, although in consequence of the loss of some of the records, the results in all departments can not be given with equal fullness, it is certain that no previous expedition has done more to make known the physical and natural history of the regions adjacent to the North Pole.

As already remarked, the latitude of 82° 16′ is by far the highest ever reached by any vessel; and the specimens of botany, zoology, and geology brought in and now deposited in the Smithsonian Institution represent a higher latitude than that of any previous collection.

EXPLORATIONS BY LACAZE-DUTHIERS ON THE COAST OF ALGIERS IN 1873.

Among the more important explorations into the natural history of the deep seas, prosecuted during the year 1873, we may mention that of M. Lacaze-Duthiers, an eminent French naturalist, and editor of a leading zoological journal. His work was prosecuted on board the *Narval*, a government vessel engaged in the hydrographic survey of the coast of Algeria.

The special object in view on the part of Lacaze-Duthiers was the studying anew of the coral banks which he had explored in 1860–61 and 1862. Accompanied by M. Velan, a young geologist of the Sorbonne, he embarked on the first of May, and for five months they were engaged in carrying on their investigations. Numerous soundings were made from Gibraltar to Cape Negro, in Tunis, and important results secured.

Although the English explorations of the same region, under the direction of Dr. William B. Carpenter, had been almost entirely barren, so much so, indeed, as to induce a generalization as to the extreme scantiness of the fauna of the south coast of the Mediterranean, the present exploration obtained very large collections; among them, numerous novelties both of genera and species, of which a full account is promised hereafter.

Satisfactory as the results were here, other localities, believed to be still more rich, could not be explored for want of time, but will probably be investigated another season.

In the communication to the Academy of Sciences, in which these facts are presented, the author takes occasion to suggest some new considerations in reference to the developments of polyps and their calcareous abode, differing considerably from the views of previous writers on the same subject. —6 *B*, *November* 24, 1201.

THE CRUISE OF THE CHALLENGER IN 1873.

In the department of deep-sea operations, by far the most prominent series is that undertaken by the party on board the *Challenger*, a screw steamer of 400 horse-power, and 2300 tons, under command of Captain Nares, and fitted out by the British Admiralty with every appliance that could be devised for the accomplishment of the object in view.

The scientific staff of the expedition consists of Professor Wyville Thomson, as director, and J. J. Wilde, as private secretary. Mr. J. J. Buchanan performs the duties of chemist; Dr. von Willemoes-Suhm and Mr. John Murray are the zoologists; Mr. Moseley has charge of the botany, and there is also an experienced photographer.

The vessel left Portsmouth on the 21st of December, 1872, in a severe storm, and the first week of the voyage was very uncomfortable to all on board. She reached Lisbon on the 3d of January, where she was detained by stormy weather, and thence proceeded to Gibraltar, and entered the Mediterranean on the 26th of January, where observations of the magnetic dip and deviation were prosecuted.

Returning to Gibraltar, the *Challenger* proceeded to Madeira by a somewhat circuitous route, for the purpose of making some soundings for a cable, and found a depth of 2500 fathoms, with muddy bottom, about seventy miles from Cape Vincent. On the 3d of February the expedition reached Madeira, and proceeded to Teneriffe; leaving on the 14th, to execute a section of soundings across the Atlantic to Sombrero, a small island of the West Indies. On the 26th of

February the deepest water on that section was found in longitude 35° 11′, in the tropics, namely, 3150 fathoms. Scarcely a trace of organic matter was brought up by the dredge.

On the 14th of March Sombrero was reached, and two days after the *Challenger* anchored in St. Thomas' harbor, having made twenty-two soundings, thirteen casts of the dredge, and twelve series of temperature-observations between Teneriffe and that point. On the 24th of March the *Challenger* left St. Thomas, on the third stretch of her voyage, toward Bermuda, during which passage a sounding of 3875 fathoms was successfully accomplished, and she reached Bermuda on the 4th of April. In addition to numerous observations on the physics of the sea, an immense amount of new material was secured, bearing on its animal life; remarkable forms of fishes, crustaceans, etc., were secured, some of which have been published in detail in the columns of *Nature* and other scientific journals.

A special feature in the natural-history work of the *Challenger* consisted in the successful use of the beam trawl, one of fifteen-feet beam having been tried at a depth of 2125 fathoms, bringing up some most astonishing results. An accumulator of fifty-five strands of rubber was found necessary to preserve the trawl and the dredge from the strain caused by the current and the motion of the sea.

The *Challenger* left Bermuda on the 21st, and made an examination of a shoal, which was found to be connected with the main reefs of the island. On the 24th, about forty-five miles to the west of Bermuda, soundings were found, in 2650 fathoms, of gray ooze, and several temperatures were obtained at various intervals between the surface and the bottom. Under-currents were ascertained as tending east, that at the surface being at the rate of 0.24 of a mile per hour; 0.46 at 50 fathoms; and then diminishing to the depth of 500 fathoms, where the drift was 0.06 of a mile per hour; and at 600 fathoms it was not appreciable.

In another locality, in a series of experiments made a few days later, the current was found to be north by west at the rate of 0.75 of a mile per hour at the surface, and 0.6 at 200 fathoms. Captain Davis, from whose article in *Ocean Highways* we borrow much of our account, thinks that the problem of sub-currents will be very difficult to solve, and that it will be some time before sufficient observations can be made to determine their character. There is much difficulty in making them, since, however small the line which connects the under-current drag with the float, it must be acted on in some measure by the currents between the two.

By the 1st of May the steamer reached the middle of the Gulf Stream, where the temperature at the surface of the water was found to be 75°. On this occasion a very strong current was appreciable, setting to the east-northeast, and it was impossible with a line of 2600 fathoms to reach the bottom. By experiments with the current drag it was found that at 400 fathoms there was no indication of any current. The influence of the Gulf Stream seemed to be expended at the depth of 100 fathoms, the water there becoming rapidly colder. There the stream was about sixty miles wide; but the rapid part of the current proved to be only on its western edge, and did not exceed a breadth of fifteen miles, the rate of the current being three and a half to four miles per hour. The temperature of this portion of the stream exceeded that elsewhere by 3°.

On this part of its course the steamer went within 120 miles of Long Island, and then headed for Halifax, finding bottom southward of the Banks in 1200 to 1300 fathoms, from which depth it rapidly shoaled toward the land.

The *Challenger* reached Halifax on the 9th of May, and, after refitting, left on the 19th. On the 21st of May a sounding was made of 1250 fathoms, and here numerous marine animals were brought up by the trawl and dredge. On the 22d a sounding was taken close to the position of Hope Bank, and a depth was found of 2020 fathoms. On the 23d, in latitude 39° 40′ north, and longitude 63° 20′ west, a tide ripple was passed, and a difference of 4° in temperature was found between the two sides, the colder water being on the southward side. The Gulf Stream was now entered, and a sounding taken of 2000 fathoms, muddy sand. Serial temperatures were obtained, when the warm water was found to extend only 50 fathoms down. On the 26th of May soundings were obtained in 2670 fathoms, and seven deep-sea thermometers were lost. The trawl, at the same depth, brought up a quantity of star-fishes and echini.

On the 28th, sixty miles north of Bermuda, 2500 fathoms were obtained, the surface currents setting at 60° east, half a mile an hour. The current drag was again used, but no current was appreciable at 500 fathoms. The vessel then proceeded to Bermuda, and left a second time on the 13th of June for the Azores. On the 16th, at 2575 fathoms, reddish ooze was found; and again on the 17th, at 2850 fathoms. From this point for over 15° in longitude there was very little variation in depth. On the 30th the *Challenger* reached Fayal, and then passed to San Miguel. On the 9th of July she started for Madeira, which was reached on the 16th. She then proceeded toward the Cape Verde Islands, leaving on the 27th of July. Between Madeira and Palma 2400 fathoms were obtained, and between Palma and the westernmost of the Cape Verde Islands 2000 to 2400 fathoms, the deepest water being nearer the latter.

On the 2d of August the *Challenger* left Cape Verde Islands for Bahia, with a view of making her fourth section across the Atlantic; but as the rainy season had arrived, considerable discomfort was experienced. She reached Bahia, however, on the 15th of September, and after a short stay off the Coast of Brazil, she left on the 25th for the Cape of Good Hope.

The latest advices from South Africa report her arrival there after a successful voyage from Bahia. She stopped at the island of Tristan d'Acunha, where two Germans were found, who had been there for several years, and who very gladly embraced the opportunity of leaving the island.

EXPLORATIONS OF W. H. DALL IN THE ALEUTIAN ISLANDS.

The explorations in the region of the Aleutians, commenced by the United States Coast Survey, in charge of Mr. Dall, in 1871, have been continued during the present year with much success. In the spring a schooner, named the *Yukon*, was fitted out for his survey, and was found to answer her purpose very satisfactorily. Mr. Dall left San Francisco on the 2d of April, reaching Unalashka on the 20th of May, and returned on the 6th of November. The field of labor embraced in the survey consisted in determinations of the hydrography, the coast-line, the magnetic variation, and other physical phenomena, together with such observations in natural history and ethnology as the more important interests of the survey would warrant.

All the important harbors were visited, and the latitude, longitude, and magnetic variation of each determined, one line extending from Attu, on the west, through the Aleutian Islands to the Shumagins, on the east. The magnetic variation was found to be 2° 30′ less easterly than it was when the last previous observations were taken, some twenty or thirty years ago; in some instances the difference amounted to 6°. In one case the positions were more than twelve miles out on the charts.

Deep-sea soundings were taken at intervals north of the islands, developing a very unexpected depth of water west of the Unalashka, in one instance 1100 fathoms being reached without touching the bottom within less than twenty miles from the shore. The southwest termination of the shallow plateau of Behring Sea was determined to be at the northwest end of Unalashka, where the bottom suddenly drops from 60 to over 800 fathoms. The soundings put an entirely new complexion on the western part of Behring Sea, and justify the suggestion advanced in 1869 that there is a deep-sea valley in that part of this sea. At a depth of 800 fathoms the deposition of globigerina ooze, or recent chalk, was found going on, as it is in the North Atlantic.

Temperature and current observations were constantly made, which confirm the deductions from the observations in 1871 and 1872. No well-defined or constant current exists in the east or middle portions of Behring Sea. The tides are every where compound and irregular, and always rise from the east toward the west, pouring in with the flood into Behring Sea, while there is but little efflux with the ebb. All the harbors were examined for a place suitable for landing the telegraph cable, but only one was found which offered the required facilities. This was on the island of Great Kyska, and was thoroughly sounded and surveyed. A new and very good anchorage was found on the island of Adakh. Nearly all the prominent peaks on the various islands were measured. Particular attention was given to the volcanic island of Bogosloff. This was found to be much farther north and east than it has been placed on the charts; and 800 fathoms of water were found on the line of the supposed reef, which is laid down on the charts as extending from Bogosloff to Umnak. No such reef exists.

The groups of the Davidoff Islands and Four Craters were found to be very erroneously delineated on all maps.

Incidentally, collections of natural history of considerable interest were obtained, illustrating the geographical distribution of the fauna and flora, which, so far from exhibiting any admixture of Asiatic forms, except one or two sporadic species, grew more and more meagre and arctic in character as the western end of the chain was approached, and the fauna of Attu was found to be purely arctic, so far as the invertebrates are concerned.

Particular attention was also given to remains of prehistoric man; and thirty-six crania, and more than two hundred bone and stone implements, besides several hundred wood carvings, were obtained from ancient village sites, burial places, and caves. The Amaknak and Unga caves, explored last year, were this year thoroughly emptied of their contents, and every thing of value carried away.

A cyclone, which reached the Shumagins in four days from latitude 45° N., wrecked the trading schooner *William Ireland* on the rocky coast of Unga, the passengers and crew being brought back to civilization by the *Yukon.*

Mr. Dall states that during the past winter of 1872–3, although one of the coldest recorded, the thermometer of Unalashka did not fall below +10° Fahr., but that the season of spring was fully a month behind the usual time, and that even as late as the 20th of May the field-ice in the Behring Sea entirely surrounded the fur-seal islands, and reached within one hundred and thirty miles of Unalashka, a state of things unparalleled since 1851.

Among other incidents of the passage to the North, Dall reports that about the 17th of May the waters to the south of Unalashka were found to be swarming with the eggs of cod-fish, floating like little pearls, about six inches below the surface of the water.

DR. HAYDEN'S GEOLOGICAL EXPLORATIONS IN 1873.

The labors of Professor Hayden, of the United States Geological Survey of the Territories, and his party, have been prosecuted during the year 1873, and the field work brought to a satisfactory conclusion for the season. The Scientific Corps of the Survey now consists of the geologist in charge and his staff of three assistants; several eminent paleontologists, a botanist, a zoologist, a photographer, and an artist; a geographer and his staff of three topographers, three assistant topographers, a meteorologist and draughtsman, and a quartermaster and his assistant. There are also a few young men attached as general assistants. The field of operations, in accordance with the plan presented to Congress for the season of 1873, comprised the Territory of Colorado, and that part of Utah lying east of Green River, bounded on the north by the belt of the 40th parallel survey. The triangulations formed part of the same system carried across the Sierra Nevada. The whole map work of the survey is to be based upon a trigonometrical survey connected with measured bases; several of the geodetic stations having been determined astronomically by the United States Coast Survey. The area marked out for examination at the commencement of the season was divided into three districts. The detailed survey of each was intrusted to separate parties, embracing an assistant geologist, topographer, and assistant, and one naturalist. The primary triangulation was carried on with an eight-inch theodolite from the loftiest peaks, thus connecting the whole area to be examined by a net-work of accurate triangles. During the past season Mr. George W. Dean, assistant in charge of longitude determination of the United States Coast Survey, spent three months in Colorado, directing the work of establishing observations at the principal points along the east base of the Rocky Mountains.

The first of these was at Denver; the second at Colorado Springs, at the foot of Pike's Peak; the third near the Raton Mountains, on the southern boundary of Colorado. Sherman, nine miles north of the northern boundary of Colorado, was located by the United Coast Survey last year. These four Coast Survey observations at Sherman, Denver, Colorado Springs, and Trinidad, at which the triangulations of the survey connect, are nearly in the same meridian, and from sixty to one hundred and twenty miles apart in latitude. The longitudes were determined telegraphically, and the latitude by the well-known zenith telescope method. Upon this meridianal astronomical base, 290 miles long, established by the

United States Coast Survey, rest the primary triangulations conducted by Mr. J. T. Gardner, geographer of the Survey, who, with the assistance of Mr. A. D. Wilson, has already carried through from the Pacific coast a system of primary triangles 800 miles long. The triangulation of Colorado connects at four points with this transcontinental belt, but rests on bases of its own. The first is near Denver, measured with great accuracy on the Kansas Pacific Railroad track. It is six miles long. Signals 30 feet high were erected on the plains, by which the triangulation was expanded to the mountains, 20 miles distant. The work was extended 120 miles west, 100 miles north, and 120 miles south, to base No. 2, situated in San Luis valley, 140 miles northwest of Denver. This triangulation is checked by the Fort Steele base of the fortieth parallel survey. These triangles vary from 40 to 80 miles on a side, and are arranged in parallelograms on the plan of the United States Coast Survey.

The organization of the field work began at Denver early in May; and as soon as the weather would permit, three parties were thoroughly equipped and dispatched to their respective fields of labor. Each party consisted of two topographers, a geologist, two packers, and a cook; with one or two additional assistants. The three divisions were called, the Middle Park Division, the South Park Division, and the San Luis Division, and each party had assigned to it an area of about 7000 square miles.

Mr. Jackson, the official photographer of the Survey, operated with an independent party, and secured nearly three hundred negatives of scenery, one hundred of them forming various panoramic views from the summits of the highest peaks. He generally made from four to six pictures, 11 × 14, to sweep the horizon. All the most important peaks of the Wasatch Range, Elk Mountain, and the Colorado Range opposite Denver are represented; one panoramic view includes the entire front range from Long's Peak to Pike's Peak, a distance of over one hundred miles. His views from the summit of Mount Lincoln extend over a radius of fifty miles, including a great number of peaks rising above 14,000 feet.

Numerous smaller parties have been operating in various parts of the West under the auspices of the Survey, with great success. Professor Cope explored a new bone-bed in Colorado, that yielded more than one hundred species of vertebrate remains, upward of seventy of them new to science.

Professors Leidy, Porter, and Lesquereux were also successful, and will contribute much new and valuable matter in their respective branches to the Seventh Annual Report.

Mr. Holmes, the artist of the Survey, made detailed panoramic views from every peak visited, bringing out in a remarkably clear manner all the peculiar mountain forms as well as the geological structure.

The results of the explorations under Dr. Hayden in 1873 will constitute the Seventh Annual Report, to appear early in 1874.

The following is a list of members of the survey prosecuted by Dr. Hayden during 1873:

F. V. Hayden, United States geologist, in charge; James T. Gardner, geographer; James Stevenson, quartermaster and chief executive officer; W. H. Jackson, photographer; W. H. Holmes, artist; Joseph H. Batty, ornithologist; Lieutenant W. M. Carpenter, U. S. A., entomologist; J. M. Coulter, botanist.

First Division.—A. R. Marvine, assistant geologist and director; G. R. Bechler, topographer; S. B. Ladd, assistant topographer.

Second Division.—Henry Gannett, topographer and director; H. W. Stukle, assistant topographer; Dr. A. C. Peale, first assistant geologist; W. R. Taggart, second assistant geologist.

Third Division.—A. D. Wilson, topographer and director; George B. Chittenden, assistant topographer; Dr. F. M. Endlich, assistant geologist; Franklin Rhoda, computor.

E. T. Luce, W. S. Holman, C. T. Noonan, S. H. Nealy, Seward Cole, S. C. Jones, general assistants.

LIEUTENANT WHEELER'S EXPLORATIONS IN 1873.

Among the various government explorations prosecuted during the year 1873, one of the most prominent is that under the charge of Lieutenant George M. Wheeler, of the United States Engineers, the object of which is a thorough examination and determination of the physical and natural history of the regions west of the one hundredth meridian. At the very foundation of the plans of this survey is a series of stations for the purpose of fixing with precision the latitude and longitude of certain positions, as well as the geographical features, to serve as points of reference for the more detailed work of a perfect astronomical and geodetic triangulation.

The stations adopted during the present year were one at the Mormon Observatory, at Great Salt Lake City, under the charge of Mr. J. H. Clark; one at Georgetown, Colorado, under F. Kampf, and another on Green River Crossing, Wyoming, under Mr. William W. Marryatt. Professor Safford also had charge of one at Santa Fé, New Mexico, while Professor H. B. Herr, in addition to his duty of superintending the construction of the permanent Army Observatory at Ogden, Utah, was charged with that of conducting the observations and signals necessary for the determination of the longitude of this point, in reference to Salt Lake City, Utah, and the Lake Survey Observatory at Detroit, Michigan. The Ogden Observatory, consisting of a substantial brick building upon a stone foundation, with three observing rooms, is said to be nearly completed, and is to be fitted up with suitable apparatus, to serve as the connecting station for the points in the area between the forty-ninth and thirty-second parallels of latitude, and the great eastern divide and the Sierra Nevada in longitude.

With the aid of the observers at the stations just mentioned, and of local surveys conducted in connection with them, the data for an accurate determination of the astronomical co-ordinates of the following positions have been obtained: Georgetown, Hughes, Colorado Springs, Lebanon, and Trinidad, in Colorado; Ogden, Utah; Green River, Wyoming; Winnemucca and Virginia City, Nevada; Bozeman, near Fort Ellis, in Montana; and Santa Fé and Fort Union, in New Mexico.

These stations for astronomical observation, whether permanent or transient, constitute the first division of Lieutenant Wheeler's survey.

The second is that of the moving field parties, these being charged with the determinations in regard to the topography of the country, its geology and natural history, its meteorology and other features. This field work was prosecuted from three initial points: namely, Salt Lake City; Denver, Colorado; and Santa Fé, New Mexico. The Salt Lake City party was in charge of Lieutenant R. L. Hoxie, of the Engineers, and took the field about the 20th of May. The Colorado party was under the command of Lieutenant William L. Marshall, of the Engineers, and was occupied in ascertaining the general profile of the continental divide, from the latitude of Denver, Colorado, to that of Fort Wingate, New Mexico, and extending laterally, so as to embrace a rectangular area limited on the east by the meridian of 105° 30′, and on the west by that of 107°; on the north by the latitude of Denver, and on the south by the southern boundary of Colorado.

The Santa Fé division, which was under the immediate command of Lieutenant Wheeler himself, was massed at that place about the 10th of June, for the purpose of connecting the survey with areas previously explored in Northern and Eastern Arizona in 1871, and carrying it eastward as far as the Rio Grande, in order to complete the atlas sheets of the proposed great topographical atlas of the Western territory. By this branch of the expedition a belt of triangulation was carried on to the western boundary of New Mexico, which was completed on the 1st of August; thence, to the southward, three parties were started in nearly parallel lines to the southern limit. A sub-topographical party was detailed from this part of the survey about August 1st, connecting north and eastward, with a view of discovering a route connecting the head of the San Luis valley, Colorado, with Fort Wingate, New Mexico, or some point to be determined in that vicinity, from which Northern and Eastern Arizona might be reached by shorter routes.

In addition to the officers of the army already mentioned in connection with this survey, are First Lieutenant Samuel E. Tillman; Second Lieutenant Andrew H. Russell, Third Cavalry; and Second Lieutenant L. H. Walker, Fifteenth Infantry.

The astronomers have already been mentioned.

The topographers are, Louis Nell, chief of triangulation; B. J. Ainsworth, sub-assistant; Gilbert Thompson and John J. Young, chief topographers; E. J. Sommer and Max Schmidt, assistant topographers.

The meteorological observers are T. O. Brown, William Summers, M. M. Magnet, and C. D. Gedney.

The several branches of the Survey were accompanied by geologists and naturalists, as follows: G. K. Gilbert, chief geologist; Professor J. J. Stevenson, geologist; E. E. Howell, assistant geologist; and Dr. Oscar Loew, mineralogist and collector. The naturalists were Dr. J. T. Rothrock, acting assistant surgeon, Dr. C. G. Newberry, H.W. Henshaw, John Wolf, and John M. Keasby; T. H. O'Sullivan, photographer; and A. A. Wyant, artist.

Other persons who rendered more or less service during the survey are Mr. Francis Klett, G. M. Lockwood, and William D. Wheeler.

It is proper to state that Lieutenant Wheeler has kept up a full working corps in the office at Washington, for the purpose of completing the maps and reducing the observations made during the previous season; and it is proposed to increase this to an extent sufficient to keep pace with the progress of the survey, year by year. The area traversed by the various parties during the season is estimated at about 50,000 square miles.

In addition to reports to Congress of current operations, Lieutenant Wheeler proposes to publish the final results of the survey in six quarto volumes, with the necessary illustrations, and two atlases of maps. The first of these will be a general volume; the second, an astronomical; the third, a meteorological; the fourth, a geological; the fifth, a paleontological; and the sixth, a natural-history volume. Of these volumes, one, two, and four are promised at an early date; as also a certain number of the finished sheets of the topographical atlas.

EXPLORATIONS OF CAPTAIN WILLIAM A. JONES.

The expedition under Captain William A. Jones, which was sent out in June last by General Ord, for the purpose of exploring the head waters of several rivers having their rise in the northwest corner of Wyoming Territory, returned recently, after a successful season.

The party, accompanied by Dr. C. C. Parry, as botanist and meteorologist, and Professor Theodore B. Comstock, geologist, started from Omaha on the 2d of June, proceeding first to Fort Bridger. From this point it traveled northeast to Camp Stambaugh; thence northwest along the base of the Wind River Mountains to Camp Brown, on the Little Wind River; thence across the Wind River valley, over the Owl Creek Mountains, and across the valley of Owl Creek above the junction of the forks. They then proceeded to Gray Bull River; thence passing through Stinking-water valley, they came to an eminence which was ascended to the source of the Yellowstone Lake; and crossing through a narrow pass, they descended to the opposite side of the lake, then down the Yellowstone River to the bridge, crossing which they moved up the river to the Falls, and thence westward over the divide to the east fork of Madison River. From this point they journeyed through the lower and upper basins of Fire-Hole River, and crossing the divide at the southwest extremity, and ascending its shore until they reached the Upper Yellowstone River, they passed on upward to the "Two Ocean Water." This is a mountain stream which flows down into a little valley, where it splits into two rivulets, one of which, by way of the Snake and Columbia rivers, empties into the Pacific Ocean, and the other, through the Yellowstone and Missouri, finds its way to the Gulf of Mexico.

Descending for a short time one of the tributaries of the Snake River, the expedition found an easy pass to the head waters of Wind River, down which they passed, returning to Camp Brown to disband.

A report by Professor Comstock, in the *Journal of Science* for December, gives an interesting statement of the general features of the geology of the country, to which we refer our readers.—4 *D*, *December*, 1873, 426.

INTEROCEANIC CANAL EXPLORATIONS BY THE UNITED STATES NAVY.

The expeditions organized under authority of Congress for the survey of the Darien and Nicaragua routes, with a view of constructing an interoceanic canal, have completed their duties, and their reports have been already submitted to the Navy Department, apparently making up the data for the proper consideration of the subject of a ship canal between the Atlantic and Pacific oceans.

The Darien survey was directed more particularly toward the region of the Napipi, and for the purpose of settling how far the surveys to the south could be profitably carried on in the valley of the Atrato. Commander Selfridge, who was assigned to this duty, entered on his labors in January last, with the co-operation of the *Tuscarora*, under Commander Belknap. The route selected by Commander Selfridge includes one hundred miles of river navigation of the Atrato, found to be capable of navigation by the largest ocean steamers. Between the Atrato and the Pacific, a canal or artificial cut is required, twenty-eight miles in length, twenty-two miles of which passes through a plain, with a gradual rise of ninety feet. The remaining six miles will require a moderate open cut, and three miles of tunneling. The work is estimated to cost from fifty to sixty millions of dollars, and to be capable of completion within ten years. A survey of the Atrato has shown that the head of ship navigation was reached but a short distance above the line selected for the canal, with this favorable indication as to the difficulties of the work, that the region is believed to be quite as healthy as any that has been examined.

The Nicaraguaian survey was placed in charge of Commander E. P. Lull, who was absent from December, 1872, until July, 1873. This officer reports a practicable route for an interoceanic ship canal, having Lake Nicaragua as its summit level. A canal about sixteen miles in length will connect the lake with the Pacific; and its heaviest work will be an excavation of 7½ miles, of 54 feet in depth. For the rest of the distance an embankment will have to be built. Ten locks and one tide lock will be required between the lake and the sea. There will be fifty-six miles of lake navigation, and slack-water navigation is proposed in the San Juan from its head to the mouth of the San Carlos. Four dams will be required to improve the river. The total length of the canal will be 67¾ miles, of which about 47 miles are in excavation and embankment. The mouth of the San Juan River has been filled very much by the silt from the San Carlos and other tributaries. If, however, these branches are made to empty into the Colorado mouth, it is expected that the channel can be opened and kept clear.

Lake Nicaragua is believed to be amply sufficient to furnish all the water necessary for this canal. No statement of the exact estimate of expenses by this route has been given.

NATURAL-HISTORY EXPLORATIONS OF THE NORTHERN BOUNDARY SURVEY.

Dr. Elliott Coues, the naturalist of the Northern Boundary Survey, under Mr. Archibald Campbell, lately returned, bringing large collections in various departments of zoology, promising to be of much interest when elaborated. The expedition took the field the 1st of June, at Pembina, Dakota, where Dr. Coues spent six weeks collecting. The wooded river bottom afforded excellent field for work, yielding a great variety of objects, the season, too, being most favorable for operations, especially regarding the breeding of birds. The fauna here was found to be essentially eastern, containing but a very slight admixture of western or middle province forms, such as *Sturnella neglecta*, *Spizella pallida*, and *Scolecophagus cyanocephalus.* Proceeding westward about the 15th of July, Dr. Coues encountered the peculiar western prairie fauna immediately after crossing the Pembina Mountains, a low range about thirty miles west of the Red River. Here the most abundant and characteristic birds were *Centronyx bairdii*, *Anthus spraguei*, and *Plectrophanes ornatus;* the two first usually accounted very rare, as is the *Coturniculus lecontii*, also obtained. The prairie for some distance is only broken by Turtle Mountain, a large isolated elevation, some thirty miles long, lying on the 49th parallel, some five hundred feet above the surrounding country. This altitude, joined with the latitude, occasioned the presence and breeding of various ducks and waders, which mostly go farther north for the purpose. Some distance beyond, the Souris, or Mouse River, twice crosses the parallel of 49°, running past the line southerly toward the Missouri; but suddenly making a large horse-shoe bend, being deflected to the north again, away from the Coteau de Missouri. This stream again afforded an excellent collecting-ground. In September the expedition reached a point about three hundred miles west of Pembina, and returned in October by way of the Missouri River, striking that river at Fort Stevenson. Although working nearly single-handed, Dr. Coues had in every other respect excellent opportunity for making extensive collections and observations, every practicable facility being extended to him, both by the commissioner, Mr.

Campbell, and by Major W. J. Twining, the chief astronomer of the Survey. He secured several thousand insects, and other alcoholic collections, over a thousand skins of mammals and birds, many nests and eggs, an herbarium, and numerous miscellaneous objects. The continuance of the survey next year will probably enable him to extend his observations to the Rocky Mountains, along the same line, and more interesting results may be anticipated, owing to the less well-known nature of the remaining portion of the survey.

EXPLORATIONS OF PROFESSOR POWELL.

The explorations of the valley of the Colorado River of the West have been continued during the past year by Professor Powell.

A topographical party in charge of Professor Thompson remained in the field during the winter of 1872–3, and Professor Powell returned to it in April. The system of triangulation, previously begun to the north of the Grand Cañon of the Colorado, has been extended so as to include all the country drained by the Rio Virgen, Kanab, Tapete, Paria, Escalanti, and Dirty Devil rivers, and the head waters of the Sevier, and an extensive district of country to the east of the Colorado River and to the south of the Grand Cañon.

Based on this triangulation, an elaborate topographical map has been made of the above-mentioned country. This map presents some curious features, as the region of country delineated is unique. Instead of presenting a series of plains, with hills and mountains rising therefrom, it delineates a series of mesas and plateaus, separated by lines of cliffs, and rising one above another in such a manner as to present the appearance of irregular geographical terraces on a vast scale. Through these table-lands are excavated deep water-courses known as cañons, so that sunken, rather than raised features must be represented; hence it is not so much an orographic map as a chart of profoundly eroded water-ways.

While the astronomical and topographical work necessary to the production of this map has been carried on by Professor Thompson and his assistants, Professor Powell has been engaged in the geological examination of the district, especially in tracing a great system of faults and folds which extend through this country, and a vast number of extinct volcanoes that seem to be connected with the fissures of these faults.

The labyrinth of cañons with which this country is beset, and the long lines of cliffs, which are escarpments of rocks hundreds or thousands of feet in height, and scores or hundreds of miles in length, have been explored and examined, and the geological and meteorological conditions under which they were formed have been the subject of much study.

All the cañons seem to be gorges of erosion. The escarpments are of two classes: those having an easterly and westerly trend are formed by erosion; the northerly and southerly escarpments mark the lines of faults, and are formed by the throw of the formations leaving mural escarpments remaining in place.

During the summer, attention has been given to the Indians inhabiting the valley of the Colorado, and other tribes allied to them in language. For this purpose more than fifty such tribes in the country to the west-northwest and southwest have been visited. A number of vocabularies, embracing several hundred words each, have been made among the Indians known as Utes, Pai-Utes, Shoshonees, Bannocks, Pa-vi-ó-tsos, Chem′-a-hue-vis, etc., and the grammatical structure of their language has been studied to some extent.

The mythology of these people has not been neglected, and interesting additions have been made to the collection of Indian tales and legends concerning the origin of things and the doings of their gods.

Their poetry, too, has furnished a theme for study, and the Professor has now a collection of more than a hundred songs or short poems.

It is curious to notice that while their mythology is occupied with relating the conflicts, wiles, deceptions, and magical deeds of these strange personages, their poetry is chiefly devoted to the beauties and wonders of Nature. They sing of a cloud as a crown of feathers on the brow of a mountain; of a rainbow as made of eagles' tears; and of an earthquake as a mountain trembling with pain.

In their folk-lore they tell of the Spirits of the mountains, who ride mountain-sheep among the crags; of Rock-wanderers, who travel unseen over the deserts of naked stone; of the Spirits of springs, who dwell in the depths of the earth, and who come out at night to sit on the margin of the water and sing doleful songs; and of a great variety of other strange and ghostly personages, and they have a host of stories concerning these weird people, many of which have been carefully gathered up.

It is found that their political organization has a territorial basis. All of the region of country between the Rocky Mountains and the Sierra Nevada, south of Middle Oregon, has been divided or parceled out, and to each district of country some small tribe belongs, taking the name of the land. Wishing to discover with what tribe or political organization an Indian is connected, it is necessary to ask him, "What is the name of your land?" or, "How are you land-named?" Sometimes two or more of these land organizations are united into a confederacy; but this is not very permanent, and is of little force unless strengthened by necessities for defense against a common enemy. The most fundamental, and the universal political organization, is that depending on a division of the land. As all of these tribes call themselves severally by the names of the districts of country which they occupy, such as affiliate socially and speak the same or nearly the same dialects, know each other by the same names; but tribes more remote, either in territory or language, call each other by terms which are descriptive of some peculiarity of the people — some habit, perchance. Thus the Indians whom we know as Utes call other Indians, whom we know as Western Shoshonees, by the name of Ta-sau-wi-his, or White Knives, and the Arapahoe Indians they call Sa-ri′-ta-kais, or Dog Eaters.

A careful study has been made of their rude industries, their clothing and ornaments worn anterior to the advent of the white man, their bows and arrows, war clubs, spears, nets, snares, hooks, and other devices for catching animals and fish, their primitive methods of cultivating the soil, and a great variety of seed, some of which they cultivate, others which they gather as they grow wild on the plains.

Their burial rites and marriage customs, and many other facts to illustrate their mental habits and their social and physical condition, have been noted, so that the forthcoming report on these explorations will treat at length of the Indians of the valley of the Colorado.

YELLOWSTONE EXPEDITION.

Among the more prominent expeditions in the summer of 1873 was that fitted out by the War Department to protect the surveying and working parties engaged in locating the line of the Northern Pacific Railroad, from the Missouri River westward to the Yellowstone and beyond. This escort was composed of ten companies of cavalry, in command of Colonel Custer, Seventh Cavalry; a battalion of four companies of the Seventeenth Infantry, under command of Major Crofton; a battalion of five companies of the Twenty-second Infantry, under command of Captain J. C. Dickey; and a battalion of the Eighth and Ninth Infantry, under command of Lieutenant Colonel Bradley, of the Ninth Infantry. All were under command of Colonel D. S. Stanley, of the Twenty-second Infantry, with the following staff—namely, H. H. Ketchum, Adjutant Twenty-second Infantry, acting assistant adjutant-general; P. H. Ray, Second Lieutenant Eighth Infantry, chief commissary of the expedition; Captain Edward Baker, Assistant Quartermaster United States Army, chief quartermaster; Assistant Surgeon J. P. Kimball, chief medical officer; Lieutenant James H. Jones, acting aid-de-camp. The total force of the expedition was about 1900 men, with 250 wagons.

In view of the unexplored nature of the region to be traversed, the Secretary of War, with his customary liberality, authorized the appointment by the Engineer Bureau of a certain number of scientific gentlemen to make the proper explorations in the department of natural history during the march; and for this purpose Mr. J. A. Allen was commissioned as zoologist and naturalist in chief; Mr. C. Bennett as assistant naturalist, Dr. L. R. Nettre as geologist and mineralogist, Mr. Edward Konopicky as artist, and Mr. Pywell as photographer; the reporter of the New York *Tribune*, Mr. S. J. Barrows, serving as volunteer botanist.

The expedition left Fort Rice by land, while a steamer was sent by way of the Missouri and the Yellowstone to the mouth of Powder River, as a relief.

The surveying party of the Railroad was composed of General Thomas L. Rosser, chief engineer; A. O. Eckelson, first assistant: Montgomery Meigs, chief of the transit party;

H. W. Reed, assistant; T. Winston and H. Stevens, level party; topographer, A. O. Donnah; assistant, A. L. Berry.

After varying experiences, the expedition returned, having accomplished, in a measure, its object; and a detailed account of what was done in the line of topography, geography, and of protection to the railroad, has been published by the Secretary of War in his annual report.

The naturalists of the expedition have also returned from the field with rich collections.

RECENT EXPLORATIONS IN SPITZBERGEN.

Among the explorations of the arctic regions during the year 1873, we find mention in Petermann's *Mittheilungen* of an expedition to Spitzbergen, in July and August, by Dr. Richard von Drasche. The voyage was made on the schooner *Polar Star*, Captain Simonsen, of twenty-one tons' burden, and provided with an iron sheathing to prevent injury from the ice. He left Tromsö on the 30th of June, and on the 9th of July, in latitude 75° 2′, met with the first drift-ice, the temperature being 33.50° Fahr. On the 10th he reached the southern point of West Spitzbergen, and there became beset, and was obliged to change his course. He finally arrived in Bell Sound on the 16th of July. Here they met Professor Nordenskjöld, who had made a boat expedition, while his vessel, the *Polhem*, attempted to penetrate to the north again.

In Magdalena Bay they encountered Captain Johannesen, who had just returned from Jan Mayen's Land, and reported an unbroken sheet of ice from Jan Mayen as far as Amsterdam Island. They landed upon Prince Charles Foreland Island, and thence made a boat excursion to Amsterdam Island. Along the whole eastern coast of Amsterdam Island they found large masses of erratic blocks of granite, syenite, and primitive slates, which do not occur *in situ* in Spitzbergen. Von Drasche concludes that the interior of West Spitzbergen is composed of rocks of Plutonic and primitive slate formations, differing from those on the coast. On the 14th of August the party started on their return to Norway, and arrived at Hamerfest on the 27th.

G. GENERAL NATURAL HISTORY AND ZOOLOGY.

EFFECTS OF SEASONS ON THE DISTRIBUTION OF ANIMALS AND PLANTS.

As a modern illustration of what may have produced some of the earlier changes in the distribution of organic forms, animal and vegetable, Professor Shaler makes a communication to *The American Naturalist* upon the effects of extraordinary seasons in the distribution of animals and plants. Speaking of the winter of 1871–72, he remarks that it was one of the driest on record in New England, the rain-fall not only being much less than usual, but also coming in such a fashion as to leave the ground very dry during the winter. The snow-fall was slight, and did not lie well upon the ground, so that great portions of the surface were quite unprotected. Under these circumstances the long-continued and steady cold froze the earth to a great depth, the freezing extending as much as five feet below the surface in some places, and being sufficient throughout the whole of New England to involve the roots of the vegetation and the forests. The effects observed were in all probability due not only to the intensity of the cold, but to a presumed deficiency of sap in the plants in connection with the low temperature; the roots remaining for some time in contact with relatively dry earth, as the frosts left them, causing a shock too great for their vitality to withstand.

The tree which suffered most was the arbor-vitæ (*Thuja occidentalis*), more than half of these having died, and the rest being in a critical condition. The red cedar was likewise a great sufferer, as also the yellow and white pines; indeed, all the coniferæ in New England have been injured to a greater or less degree. The greatest damage was experienced in sandy soils.

The only change in animal life noticed by Professor Shaler is the comparative scarcity of snakes, which he considers to be a very decided feature. An interesting point in this connection is the question as to what would have been the effect of carrying the action of the climate a little farther; since, small as the destruction of forest trees is, it will doubtless add seven per cent. to the deciduous trees of New England, and remove an equal number of conifers. The latter appear to be the relics of an old time, and not suited to a successful warfare with the younger and more elastic trees, such as the oaks, beeches, etc. If the shock of the last season had been sufficient to kill off the whole of our pines, a complete change would have taken place in our forests, the vacant places being occupied by deciduous species. This would affect the character of the undergrowth very materially, as well as that of the insect life, and, consequently, that of the birds, and mammals. Furthermore, the climate might have been influenced in some measure, for a pine forest retains the snow better than one which loses its leaves in winter, and thus tends to secure a more equable temperature in its neighborhood.

Thus, according to the author, an accidental drouth might bring about a change in the vital conditions on the surface of the land as great as those which, when recorded in strata, we accept as indicating distinct geological formations.—5 *D*, *November*, 1872, 673.

THE OLDEST ZOOLOGICAL MUSEUM IN AMERICA.

It may not be generally known that perhaps the oldest collection of specimens of natural history now extant in the United States constitutes a portion of the present cabinet of Princeton College, New Jersey. It was first brought together by Monsieur Delacoste, a French collector and naturalist, who flourished in New York at the beginning of the present century, and who published in 1804 a catalogue of his curiosities (chiefly collected in Guiana), filling a pamphlet of about ninety pages.

The plan of Delacoste for keeping up his museum was to secure a certain number of annual subscribers, who were to constitute a society for the promotion of the science of natural history. The enterprise was supported by names then very prominent in New York, such as De Witt Clinton, Aaron Burr, Thomas Cooper, Dr. David Hosack, Charles Wilkes, Wright Post, and other parties. The collection embraced about 260 species of birds, 63 of quadrupeds (which included both mammals and turtles), over 50 of fishes, and other objects in proportion. We learn that this collection is still preserved, for the greater part in good condition, at Princeton.

The establishment of the Delacoste collection does not antedate that of Peale in Philadelphia; but that long since disappeared, partly by the scattering of the material collected, and partly from its destruction by fire.

CINCINNATI ACCLIMATIZATION SOCIETY.

A very deserving institution has recently been established in Cincinnati, under the title of the Cincinnati Acclimatization Society, its object being to effect the introduction of such foreign birds as are worthy of note for their song or their services to the farmer and horticulturist. The society announces that during the present spring it expended $5000 in introducing fifteen additional species of birds, and that it has already successfully accomplished the acclimatization of the European sky-lark, which is stated to be now a prominent feature of the summer landscape in the vicinity of Cincinnati. Among the species which it is proposed to introduce is the European titmouse, considered abroad as one of the most successful foes of insects injurious to vegetation.

"REVISION OF THE ECHINI," BY ALEXANDER AGASSIZ.

It is well known that the Museum of Comparative Zoology, of Cambridge, in addition to the bulletin of its proceedings, issues a series of "Illustrated Catalogues," in small folio form. In this several valuable papers have already appeared; but by far the finest and most important is one just out of press entitled *A Revision of the Echini*, by Alexander Agassiz. This embraces an exhaustive account of the bibliography of the subject, as well as its synonymy, followed by detailed descriptions of the genera and species, both as regards the external form and internal anatomy. It is illustrated by forty-nine plates, of which seven represent the geographical distribution of the various groups of *Echini*, the remainder being devoted to representations of the species. A very important experiment has been made in this work as to the availability of different methods of photographic printing for natural-history work, and, we may indeed say, with complete success. About one third of the illustrations of species are crayon drawings on stone, one third are Albert-types, prepared under the direction of Mr. E. Bierstadt, of New York, and the remainder are Woodbury-types, executed by Mr. John Carbutt, of Philadelphia. Nothing can exceed the perfection of finish and detail of the plates prepared by both these methods, and we are sure the work will mark an era in the history of scientific publications. The expense of even an approximation to the accuracy of these figures, on stone or metal, would have been enormous.

Mr. Agassiz has embraced the occasion of a recent extended visit to Europe to examine all the type specimens of the various museums in that country. It is, however, a fact, well illustrating the comparative richness of the Cambridge Museum, that, with only four or five exceptions, it contains every species described during the last forty years.

OPENING OF THE "ANDERSON SCHOOL OF NATURAL HISTORY."

At noon of July 8, 1873, Professor Agassiz formally opened the Anderson School of Natural History on Penikese Island, thus bringing to a practical beginning the great idea of a summer school of natural science as first suggested by Professor Shaler. Our readers are sufficiently familiar with the details of the circumstances which led to the establishment of this magnificent educational enterprise—first, the donation by Mr. John Anderson, of New York, of Penikese Island, one of the Elizabeth group, situated at the entrance of Buzzard's Bay, and valued at $100,000; then his endowment of it in the sum of $50,000 to meet the current expenses; and subsequently the presentation to the professor by Mr. Galloupe, of Swampscot, of a yacht worth $20,000, for use in deep-sea dredgings and other explorations in connection with the school.

In a circular Professor Agassiz gives notice to the public that the island affords no accommodations to strangers, and that no guests can be received excepting those who have been accepted as members of the school. The limit of fifty has long since been made up, one third of them being ladies, while more than a hundred have been rejected in consequence of the limitation. A caterer has been engaged, who will provide for the table, and keep the rooms in order. There is to be no charge whatever for tuition, and as the dormitories have been built at the expense of the fund, no rent will be charged beyond a percentage of the value of the bedroom furniture. The board is to be charged at cost. Should any persons desire to make collections of specimens to carry away with them, cans and alcohol will be furnished at cost to those who are not already provided.

THE BRIGHTON AQUARIUM.

The Brighton Aquarium, under the management, since Mr. Lord's death, of Mr. W. Saville Kent, late of the British Museum, continues to be highly successful. Among the most recent additions are several octopus and dogfish, a pair of porpoises, and other strange inhabitants of the deep; and the number of visitors is great beyond expectation. A similar undertaking has been proposed on the east coast, at Lowestoft, in Suffolk.

THE ZOOLOGICAL GARDENS OF LONDON.

A few months ago a "revised list of the vertebrated animals now or lately living in the gardens of the Zoological Society of London" was published by Dr. Sclater, the eminent secretary of the society, and our readers may be interested to learn of the magnitude of the collections catalogued. The list fills a volume of over 400 pages, embracing nearly 498 species of mammals and 1044 of birds, many of the rare species being represented by a number of individuals. In addition there were also numerous cold-blood vertebrated animals, the true reptiles amounting to 181 species, the batrachians to 35, and the fishes to 68 species. Among the more interesting animals were 93 different kinds of monkeys, including the chimpanzee, orang, and four species of gibbon, the aard-wolf (*Proteles*) of South Africa, the panda (*Ælurus fulgens*) of Nepaul, two species of aard-vark, or ant-bear (*Orycteropus*), and 39 species of marsupials. Among the birds are 61 species of parrots, 79 species of pigeons, 124 gallinaceous birds, and 79 species of ducks, geese, and swans; and more especially attention may be called to the fact that in the gardens there were no less than 11 species of struthious birds, of which three were rheas, or South American ostriches, and four cassowaries. This collection is without a peer any where, and of course in this country there is no collection that is worthy to be mentioned in comparison. But as the gardens realize a very large income to the society ($100,000 in 1871), it is to be hoped that an incentive may be offered to establish such an institution in the United States, and thereby give our naturalists the same facilities for scientific investigation as are to be enjoyed in London.

THE GODEFFROY MUSEUM, AT HAMBURG.

A work entitled *Journal des Museum Godeffroy*, a quarto, of which the first part has just appeared, is intended to illustrate the discoveries of the Brothers Godeffroy, of Hamburg. These gentlemen have undertaken the collection of objects of natural history on a large scale for commercial purposes, and have already secured an immense amount of material, especially from the islands of the Pacific. A series of these is preserved in the Godeffroy Museum, and duplicates are disposed of on reasonable terms to public museums. The collection is under the direction of Dr. J. D. E. Schmeltz, Jun., who is said to be an excellent naturalist, and capable of managing the interest of what promises to be a very extensive establishment.

NUTRITION OF VIBRIOS.

During an investigation into the natural history of vibrios, Grimm has been enabled to discover no organ for ingestion of alimentary substances, and he thinks they must be supplied with nourishment through endosmose. He has observed numbers of them about certain organic substances, part of which they absorb, including any coloring matter, which appears in the interior of the animal. The gelatinous envelope in which they are often found inclosed is thought to be not a foreign substance, but a product from the vibrios themselves. Grimm thinks that vibrios have the power of voluntary movement, and that they possess several modes of progression.—18 *A*, *February* 21, 1873, 551.

GAY'S HISTORY OF CHILI.

At the meeting of the Academy of Sciences of Paris for April 21, Mr. Claude Gay presented the thirtieth and concluding volume of his great work upon the natural, physical, and political history of Chili. As long ago as 1828 Mr. Gay left Paris for South America, and arrived in Chili at the end of 1829, by way of Brazil and Buenos Ayres, with the intention of devoting himself to the study of the botany of that country, which at that time was very little known, few plants having been collected. Encouraged by the generous support of the Chilian government, Mr. Gay undertook to prepare a series of manuals—first on natural history, and ultimately on the geography, geology, and political history of the country. This idea was steadily kept in mind by him; and, with the assistance of specialists in various branches, he has finally completed his work of thirty stout octavo volumes of text, with two folios of illustrations, embracing 333 plates. The work was executed in Paris under his direction, but printed in the Spanish language.—6 *B*, *April* 29, 1873, 985.

MICROSCOPIC LIFE.

Professor Ehrenberg has lately presented to the Academy of Sciences of Berlin a compendium of the researches in which he has been engaged for many years past in reference to the microscopical life of the deep seas, the first report having been presented in 1836 to the Academy, and supplemented from time to time by additional communications. He acknowledges very thankfully the assistance rendered by persons of all nations, and especially in reference to the deposits of California and elsewhere in North America. Some of the richest material at his command was taken from the sea at a depth of 20,000 feet. The total number of distinct species determined by him in his various investigations amounts to 1435, while he has fragments of 172 others, not accurately definable, but certainly additional, making a sum of 1607 species. He takes the occasion to contest the existence of such bodies as the coccoliths, *Bathybius*, *Eozoon canadense*, etc. The paper concludes with a description of 299 new and additional species of infusoria from various parts of the world.—*K. Akad. Wis. Berlin; Monatsbericht*, *April* 25, 1873, 251.

FORMATION OF PIGMENTS BY BACTERIA.

A thorough study of the bacteria has been made by J. Schroeter, and more especially of the conditions affecting the formation of different pigments, and the behavior of the coloring matter of these with reagents. As the coloring matters can be extracted by alcohol, their tinctures were employed for testing their chemical and physical properties. The observation of Erdman, that they differed from all other vegetable coloring matter, and possessed decided similarity to aniline colors, was confirmed. Besides the well-known red (of "reddened bread"), orange, yellow, green, blue, violet, and brown pigments were obtained and investigated; and it was found that even by our present optical aids the organisms concerned in the formation of different pigments could often be recognized as distinct, and that peculiar colors can indeed be produced by several distinguishable organisms, and that these pigments deport themselves differently toward established reagents. The conclusion, therefore, does not seem unwarranted that each decided pigment is the product of a specific organism; and, since the operation seems decidedly analogous to the formation of alcohol by yeast fungus, and of lactic acid by other bacteria, it might be termed pigment fermentation. The formation of coloring matter by bacteria is not more remarkable than that by higher organisms, while it may be assumed that the conditions are much less complicated, so that study of the bacteria may in time lead to some insight into the more important formation of pigments of higher organisms.—19 *C*, *February* 1, 1873, 42.

SMITH'S MONOGRAPH OF THE DIATOMS.

The April number of *The Lens*, the organ of the State Microscopical Society of Illinois, contains the first part of a monograph of the diatoms, by Professor Hamilton L. Smith, of Geneva, who has long been engaged in investigations of this group of objects, and contemplates the publication of an elaborate work, to which the papers of *The Lens* are introductory. The present memoir is accompanied by several plates, illustrating a large number of species, among them a few that are new to science.

CARBOLIC SOLUTION FOR ANATOMICAL PREPARATIONS.

According to Bufaline, an application of camphor and carbolic acid furnishes an excellent preservative for anatomical preparations. The mixture of the two articles forms an oily and compact substance, which is to be dissolved in a sufficient quantity of petroleum, colored with cinnabar. The best proportions are seventy parts of carbolic acid and camphor and 200 of petroleum. The subject may be injected with this liquid or immersed in it, the preparations always remaining soft and flexible if brought into tepid water. The compound has no action whatever upon the injecting or dissecting apparatus.—13 *C*, *August* 1, 1873, 1030.

PRESERVATION OF FLESHY FUNGI.

The preparation and preservation of the fleshy fungi have long been difficult problems to the botanist, various methods being adopted toward these ends with more or less success. They will keep very well, of course, in alcohol; but this is a troublesome and expensive method, and only suited to large museums. In consequence of their juiciness, and possibly of the amount of nitrogen which they contain, they are very subject to decomposition, and are attacked with great readiness by insects. The usual method of preparing them is to subject them to poisonous metallic solutions, but even this does not appear to be sufficient.

A recently devised mode of treatment, which promises more success than its predecessors, consists in coating them with a thin layer of collodion, thus investing them with an exosmotic membrane. This allows the moisture to exhale uniformly, and the plant to dry gradually, the shape, color, and texture being but little affected. The destructive agency of the oxygen of the air is also excluded, and most insects are unable to penetrate the collodion skin, or to introduce their eggs or larvæ beneath it.—1 *A*, XXIV., 383.

EXCRETION OF CARBONIC ACID FROM THE SKIN.

Careful observations have been made by Dr. Aubert in reference to the amount of carbonic acid excreted by the skin in man. For this purpose the subject was placed in a close box accurately adapted to the neck, and having tubes connected with it for the entrance and exit of the air, the tubes being, of course, again connected with apparatus for the analysis of the air, thus containing the products of the cutaneous respiration. The general result arrived at was that, in the course of twenty-four hours, the maximum amount of carbonic acid exhaled was about 97 grains, and the minimum about $35\frac{1}{2}$, thus making a mean of 59.7 grains of carbonic acid as eliminated from the whole surface of the body below the neck. This, of course, is independent of the quantity exhaled from the lungs. Making proper allowance for the head, in addition, the entire quantity may be reckoned at about 60 grains per diem. During the same time, however, the quantity thrown out by the lungs amounted to 13,500 grains; so that the percentage exhaled by the skin is very trifling. The quantity of acid eliminated increased with the increase of the temperature to which the subject was exposed.—13 *A*, *January* 1, 1873, 12.

RESULT OF SUPPRESSING EXCRETIONS OF THE SKIN.

Experiments have been tried by Socoloff as to the effect of suppressing the excretions of the skin, by shaving rabbits and painting the skin over with some material impervious to the passage of vapor. It was found that this always, sooner or later, produced fatal results, the animals a few hours before death exhibiting intermittent cramps and convulsions, while the temperature in the rectum fell to a considerable extent. Even wrapping the animal in cotton failed to produce any material increase of the temperature of the intestines or to delay death. The inhalation of oxygen was equally powerless in preserving life. Ulcers, arising from deep-seated extravasations, were found in the stomach. Albumen made its appearance in the urine shortly after the animal had been varnished. Whatever the substance used for coating the animal, whether simply a gelatine, gum, or regular varnish, inflammation of the kidneys was the result, sometimes accompanied by enlargement of the cell elements, and sometimes by their fatty degeneration.—13 *A*, *March* 1, 1873, 93.

EFFECT OF HEAT ON THE TEMPERATURE OF ANIMALS.

An investigation of the effect of a high temperature upon animals has lately been published by Professor Rosenthal, of Erlangen. As the result, he found that if rabbits be introduced into inclosures the atmosphere of which is 52° to 90° Fahr., the temperature of the animal under treatment does not vary, excepting for some slight transitory oscillations between 79° and 90°. From 90° to 97°, the temperature of the animal rises to 106° or 107°, and then is stationary; the animal becomes prostrated, and pants for breath, with its limbs stretched out and wide-spread, the pulsations of the heart very frequent, and the cutaneous vessels much dilated.

With an external temperature of 97° to 104°, the temperature of the animal rises rapidly to 112° or 113°; the phenomena already referred to are more decided, the pupil of the eye is dilated, the muscles are relaxed, and death intervenes in a very short time.

On removing the animal in season, and exposing it to the ordinary heat of the apartment, its temperature falls to 97° or below, and remains low for several days. When it has come back to its average temperature, however, the experiment may be repeated upon the animal, which will be found to resist these agencies much better than before. It is true that it loses much water, but in dry air, as well as in that saturated with moisture, the animal becomes heated much less than when first exposed to the action of a high temperature. At the same time, however, it shows signs of indisposition, loses its appetite, and becomes sluggish, producing less caloric than in a state of health.—8 *B, December* 21, 1872, 592.

INOCULATING HEALTHY ANIMALS WITH TUBERCULOUS MATTER.

From a series of experiments by Chauveau upon the possibility of transmitting pulmonary diseases to healthy animals, he concludes that with cows, lambs, horses, etc., the only thing that will reproduce tuberculosis is the granulation, or the cheesy tuberculous substance from the human being affected with phthisis. The other products of lung decomposition only develop a transitory inflammation of the spot affected; but when the tuberculous products themselves are introduced, the point of contact soon exhibits an inflamed tissue, and still later there is a generalization of the tuberculous modules in the lungs and in other organs.—8 *B, March* 15, 1873, 880.

"SEA-SERPENT" IN THE BAY OF PANAMA.

The Panama *Star and Herald* of February 16 contains an account of a marine animal, resembling in many respects the celebrated "sea-serpent" of the Northern Atlantic, which was seen from the deck of the steamer *Guayaquil* a few days before, when off the Pearl Islands, in the Bay of Panama. Its head was like that of a sea-horse (*Hippocampus*), and its length, estimated from the undulations of its body as they appeared above the water, was about twenty-five feet. A large sting-ray fish was seen in its company. The *Guayaquil* is a vessel belonging to the Pacific Steam Navigation Company, plying between Guayaquil and Panama.—*Panama Star and Herald, February* 16, 1873.

EFFECT OF VIOLET LIGHT ON SILK-WORMS.

It was noticed by Professor Guarinoni that while 50 per cent. of the silk-worms exposed to white light died of disease, scarcely 10 per cent. of those exposed to violet light died, although all other conditions were the same. He intends prosecuting experiments in the coming year to determine whether this is simply accidental.—28 *C, October*, 1872, 207.

SCOPE OF THE BRITISH ANTHROPOLOGICAL INSTITUTE.

As an illustration of what is meant by anthropology, in its widest sense, we give the classification of the subject as adopted by the Anthropological Institute of Great Britain and Ireland. Subjects coming under the following heads are considered as proper for the inquiry of the society: 1. The physical history of man and the human race. 2. Psychology. 3. Comparative philology. 4. Priscan archæology: *a.* Prehistoric; *b.* Protohistoric. 5. Descriptive ethnography, comprising the reports of travelers and explorers on the physical characters, derivation and relation, manners, customs, religion, language, etc., of various races and nations. 6. Comparative ethnography. 7. The relations between civilized man and aboriginal savage peoples. In this programme it will be seen that any subject properly coming under the cognizance of the anthropologist may find a place.—12 *A, February* 20, 1873, 310.

ASSYRIAN TRADITION OF THE DELUGE.

Much interest has been excited in England by a record of the deluge, which Mr. G. Smith, of the British Museum, has lately deciphered from the Assyrian mounds. The cuneiform characters recently found, and translated by him, give a long and full account of the deluge. The record contains a version or tradition of this event which existed in the early Chaldean period of the city of Erech (one of the cities of Nimrod), now represented by the ruins of Warka. In this newly discovered inscription the account of the deluge is put, as a narrative, in the mouth of Xisuthurus, or Noah. He relates the wickedness of the world, the command to build the ark, its building, the filling of it, the deluge, the resting of the ark on a mountain, the sending out of birds, and other matters.

The narrative has a closer resemblance to the account transmitted by the Greeks from Berosus, the Chaldean historian, than to the Biblical history; but it does not differ materially from either, the principal differences being as to the duration of the deluge, the name of the mountain on which the ark rested, the sending out of the birds, etc. The cuneiform account is much longer and fuller than that of Berosus, and has several details omitted both by the Bible and the Chaldean historian.

This inscription opens up many questions of which we knew nothing previously, and it is connected with a number of the details of Chaldean history, which will be both interesting and important. This is the first time any inscription has been found with an account of an event mentioned in Genesis.—3 *A*, *November* 23, 1872, 448.

ORIGIN OF THE MAORIS.

According to Mr. Thomson, the Maoris (or the aboriginal population of New Zealand) were derived from Southern India, at a time when the peninsula as well as the Indian Archipelago was peopled by negroes. In his opinion, a stream of emigration extended from the peninsula in both an eastern and western direction. Its movement eastward can be traced readily as far as the Moluccas, the race being modified in color, but not in language, by the incursions of the Mangians and Anamese. With the Moluccas as a basis, a stream of the mixed races flowed eastward from island to island over Polynesia, one branch finding its way to New Zealand by the way of Tongataboo.—13 *A*, *Nov.* 1, 1872, 413.

ANTIQUITIES OF THE SCYTHIA OF HERODOTUS.

The Imperial Archæological Commission of St. Petersburg has lately published a second livraison of its magnificent work upon the antiquities of the Scythia of Herodotus. This embraces a large number of figures of prehistoric instruments obtained in the mounds and other localities in the steppes of the Black Sea.

RESULTS OF THE BRUSSELS ARCHÆOLOGICAL CONVENTION.

According to Quatrefages, the principal scientific result of the recent national congress of archæologists and anthropologists, held at Brussels during the past summer, was the determination of the existence of a population in Belgium during the quaternary period, and of the extent of its culture and mode of life, proving, also, the existence of a trade with foreign countries; and, likewise, that among the people of the present day there are elements handed down from the oldest times, even from the most ancient stone period.—30 *C*, *December*, 1872, 94.

PRESERVATION OF BRITISH PREHISTORIC MONUMENTS.

An important movement has just been made in Great Britain, looking toward the assumption, on the part of the government, of the care of the numerous monuments of prehistoric times found in different parts of the British Islands, and variously known as cromlechs, dolmens, earth-works, mounds, cairns, etc. Some of these (Stonehenge, for instance) are celebrated the world over on account of their magnitude and general interest, while numerous others of greater or less importance have a local history and consideration. It has been a source of much regret that these objects have been disappearing with great rapidity, the stone being broken up for building purposes, and the earth-works razed by the operations of the farmer and otherwise.

As the only means of preventing these injuries, Sir John Lubbock has introduced a bill into the present Parliament, with a fair prospect of its becoming a law. It is proposed to place the monuments referred to in charge of a body of Commissioners, who are, for the principal part, high public functionaries, and three of them to be named by the Crown. They are to have charge of certain monuments specified, but with the provision that others not indicated may, with the permission of the Treasury, be brought under their control. When that has been done, any injury or damage to the monuments will be treated as malicious injury, and become penal, unless the written permission of the Commissioners has been obtained, or they have declined to purchase either the monument itself or a power to restrain the owner or occupier of it from injuring it during a certain period of years.

The Commissioners are empowered to purchase the freehold or other estate in any monument, and rights of way for the public to it, as well as to exercise the power of restraint from injury. The amount of compensation to be awarded, under either head, is to be determined under an existing act of Parliament, but the money for the same must be appropriated directly from the Treasury.

When will any such steps be taken by the general government of the United States for the preservation of the many ancient mounds, earth-works, and other prehistoric antiquities of the United States?—12 *A, February* 20, 1873, 297.

PREHISTORIC REMAINS IN ICELAND.

Dr. Robert, of Paris, calls attention to the fact of the existence in Iceland of chipped flint in considerable variety, and of prehistoric age, or decidedly anterior to the discovery of the island in 861 by the pirate Nadodd.—3 *B, May* 8, 1873, 66.

PREHISTORIC SACRIFICIAL MOUND IN AUSTRIA.

Professor Woldrich gives an account of the discovery of a sacrificial mound in the vicinity of Pulkau, in Lower Austria, in which he succeeded in finding a great number of remains of animals that, in his opinion, had been sacrificed in some religious rites, possibly in connection with human victims, some remains of which were also discovered. Numerous implements were met with, some of them of stone, some of bronze, and others of bone and horn; pottery also was found, some of which was very tastefully ornamented. The principal animals observed were the peat dog, the peat ox (*Bos brachyceros*, var.), and a larger species (*B. primigenius*); the goat, sheep, fallow deer, and stag.

The occurrence of the fallow deer among these remains is considered of great interest, as substantiating the assertion of Jeitteles that this animal was originally a native of Europe, and not, as generally supposed, introduced from an adjoining continent. Specimens of the pig, of the horse, and of various birds were also found, but the latter were not distinguishable. The conclusion reached by Professor Woldrich was that the whole belonged to the bronze period, and that the epoch was one when stone implements were still used in connection with bronze.—31 *C, January*, 1873, 1.

ANTIQUITY OF MAN IN BRITAIN.

Mr. Geikie, director of the Geological Survey of Ireland, in a lecture recently delivered upon the antiquity of man in Britain, calls attention to the differences between the paleolithic and neolithic stone periods of that country, marked by the occurrence of rude stone implements in the former, and polished ones in the latter. He estimates a wide interval of time between these two periods, the paleolithic being characterized by the occurrence of the implements referred to in caves and in river gravels, associated with the remains of animals which are now either extinct or which have retreated far to the north, and are only to be found in an arctic climate—the former including the cave bear, the Irish deer, several species of rhinoceros, elephant, etc.; the latter the reindeer, the glutton, and the musk-ox.

He concludes that paleolithic man must have entered on the stage ages before the valleys of the south of England were hollowed out to their present depth; that during his long occupation the rivers succeeded in cutting out these valleys, and that not until after this was effected did paleolithic man disappear and neolithic man take his place, no neolithic remains occurring in the ancient river gravels.

Mr. Geikie then inquires into the nature of this break, and the causes which produced the simultaneous disappearance of paleolithic man and the old pachyderms, and the subsequent introduction of neolithic man and the animals of an almost totally different form. This he explains by the intervention of the glacial epoch, and concludes that during the paleolithic period man experienced two kinds of climate, one almost arctic, the other mild and genial, the two represented by the preglacial and interglacial periods.

After the unknown period of time in which the last glacial changes were completed and the surface of the land was again exposed, neolithic man made his appearance. Mr. Croll estimates the commencement of the glacial epoch as being at least 240,000 years ago, and the period itself as lasting for

1600 centuries. If man be of preglacial age, his antiquity in Britain is therefore fully 200,000 years.

While Great Britain was still joined to the Continent, neolithic man and his associated animals made their appearance (the winters being severe enough to freeze over the rivers in the south of England), coming in from the east and south, or from regions whence they had been previously displaced by these climatological changes. However the intervals indicated may have been bridged over for them elsewhere, Mr. Geikie is quite satisfied that they were entirely absent from Great Britain for a very long period of years.—18 *A*, *February* 14, 1873, 523.

ALLEGED OCCURRENCE OF MAN IN THE MIOCENE OF TURKEY.

Sir John Lubbock announces the discovery, by Mr. Frank Calvert, near the Dardanelles, of what he considers to be conclusive evidences of the existence of man during the miocene period. Among these is a fragment of a bone, belonging probably to the *Dinotherium*, or the mastodon, on the convex side of which is engraved a representation of a horned quadruped, "with arched neck, lozenge-shaped chest, long body, straight fore-legs, and broad feet." There are also, according to Mr. Calvert, traces of seven or eight other figures, which, however, are nearly obliterated. He also found in the same stratum a flint-flake and several bones broken as if for the extraction of marrow. If this discovery be genuine (it yet is far from being credible), it would appear to prove not only that man existed in the miocene period, but that he had already made at least some progress in art.—12 *A*, *March* 27, 1873, 401.

ANTIQUITY OF MAN IN CORSICA.

The existence of osseous breccia in the vicinity of Bastia, in Corsica, has been long known to naturalists, and a point of special interest among these remains was a species of *Lagomys*, a small tailless animal allied to the hares, certain species of which are found at the present time in the alpine and sub-alpine regions of Europe and America. Quite recently, however, the interest in their occurrence has been increased by the determination that, among other bones in these deposits, were those of man, several well-marked remains having been brought to light. It is very well known that it is many years since the climate of Corsica was fitted for such animals as the *Lagomys*, and we may infer that it and its associates belonged to the earlier period of European prehistory, when semi-arctic conditions prevailed in southern latitudes.—6 *B*, *February* 10, 1873, 379.

THE DILUVIAL SKULL OF NAGY KÂP, IN HUNGARY.

To the very small list of authenticated crania of great antiquity, now best represented by the Engis skull and the Neanderthal skull in Europe, the Calaveras County skull, and that from the "drift" of Illinois, deposited by the Smithsonian Institution in the Army Medical Museum at Washington, is to be added one recently discovered in the loess of Nagy Kâp, in Hungary. This is announced by Luschan to the Anthropological Society of Vienna, and described in its *Mittheilungen*. The genuineness of the "find" is considered as quite beyond question, the most accurate investigation furnishing no reason to believe that it was not deposited simultaneously with the loess. A flood excavated a cutting through this formation to the depth of eight or ten feet, and at six feet from the surface the bones forming the subject of the announcement were revealed. The skull is purely brachycephalic, differing in this respect from the other diluvial European crania, which are dolichocephalic. The cubical capacity of the skull could not be determined, in consequence of its being filled with earth; but, as far as an examination was practicable, seemed to be about the average of that of men of the present day. There appeared to be nothing peculiar in the form of the frontal sinus, which constitutes so strong and marked a feature of the Neanderthal and Illinois crania just referred to.—31 *C*, *November* 30, 1872, 301.

FURTHER DISCOVERIES AT MENTONE.

Mr. E. Rivière announces the discovery of another human skeleton in the sixth cavern of Baoussé-Roussé, in the region in which the discovery of a human skeleton and of numerous prehistoric remains attracted so much attention last summer. The examinations which had been previously made in these proved to have been but cursory, and a more thorough investigation has recently brought to light the skeleton referred to. It is by no means as complete as the one found by him in one of the other caverns, but has some interesting peculiarities. The dimensions were those of a man of large size, supposed to be nearly six feet and a half in height, a characteristic which is shared by the other specimen. Like this, it showed that the primitive people inhabiting these caverns were in the habit of burying their dead upon a hearth, ornamented with trinkets, and accompanied by their weapons. The ashes and earth of the hearth were filled with fragments of bones, the remains of repasts—either those of every-day life or funeral feasts.—6 *B*, *April* 21, 1873, 1027.

GEOLOGICAL AGE OF THE MOA.

Dr. Haast, in discussing the subject of the moas (*Dinornis*) and moa hunters of New Zealand, advances the opinion that the various species of moa began to appear in New Zealand in the post-pliocene period, and that they have been extinct for so long a time that no trustworthy traditions have been handed down to the present day concerning them. He thinks also that a race of *Autocthones*, probably of Polynesian origin, was contemporaneous with the moa, by whom it was hunted and exterminated. A species of wild dog existed at the same time, which was likewise killed out by the moa hunters. These people, he thinks, were low in civilization, only using rudely chipped stone implements. The Maoris, their descendants, on the other hand, had, when the earliest Europeans arrived in New Zealand, attained the art of manufacturing finely polished stone implements and weapons. He believes there is satisfactory evidence that the moa hunters were not cannibals, and that they cooked their food. They must have had access to the northern islands, where they procured obsidian, and likewise must have traveled far into the interior of the island to obtain the flint of which their stone implements were made. Many of these early implements were of nephrite and greenstone.—13 *A*, *November* 1, 1872, 414.

PREHISTORIC CANNIBALISM IN FLORIDA.

Professor Wyman has concluded, as the result of explorations among the shell mounds of Florida during the past winter, that the aborigines by whom they were constructed must have been decided cannibals, as in eight different instances he has found considerable quantities of human bones in the shell heaps, the bones themselves being broken up and split, just as in the case of the bones of other animals. This, he is satisfied, was not the result of burial, but was done for the purpose of obtaining the marrow, probably after the flesh had been devoured.

WORKING OF MICA MINES IN NORTH CAROLINA IN PREHISTORIC TIMES.

Among the rarer and more interesting remains found in the mounds of the West are plates of mica cut into different shapes, and evidently preserved as objects of great rarity and value; and, in the absence of this mineral in the Mississippi Valley, the question has frequently arisen whence the material could have been derived.

A recent communication from Professor W. C. Kerr, the State Geologist of North Carolina, tends to throw some light on this subject, and to open an interesting chapter in regard to the American prehistoric man. The use of mica in the arts, it is well known, has been increasing very rapidly for the last few years, and the old localities have become in a measure exhausted. This has made it necessary to search out new deposits of the mineral, and it is in North Carolina that the finest and largest plates of this substance have been met with. The work of collecting mica is carried on upon the largest scale in the high and rugged region between the Black Mountain, the Roanoke, and the head waters of the Nolachucky, principally in Mitchell County, North Carolina.

The region in question has long been known for the existence of numerous open works and tunnels, which, at first sight, were supposed to have been made in the search for silver or other valuable metal. Professor Kerr, in his capacity of State Geologist, was led to investigate this question, and very soon found, in every instance, that the excavations referred to were much older than the earliest discovery of the country by the Spaniards, and that in all cases they were found in ledges of coarse granite, which contained nothing but large patches of mica. So uniformly was this the case that, after a while, the search for mica mines was mainly confined to the hunt after these prehistoric excavations, which, whenever cleared out and carefully examined, always revealed the mineral in question. This result was so constantly met with that Professor Kerr has been satisfied for some time that in these mines we have the work of the contemporaries of the mound-builders, and the localities whence they derived the mica. What use they made of it we can not say; but it is suggested that it may have served the purpose of mirrors, or possibly have been used as windows, as well as for ornament.

According to Professor Kerr, the number and size of these mines is remarkable, some of the open cuts being more than a hundred feet in diameter and twenty or thirty in depth, even after the caving in and filling up of centuries of weathering. The tunnels often extend inward several yards, but are said to be too small for a man of ordinary size to work in. These show distinct marks of the tool in the granitic wall, as if made by a chisel-shaped instrument about an inch broad. Numerous plates of mica are found in these tunnels and excavations, some of them trimmed to particular shapes; but nothing in the way of implements has been hitherto detected, with the exception of one small piece of wood, about an inch thick and two inches wide, and more than a foot in length, having a slight depression near one end, as if for the carrying of a light.

These ancient works are known among the people as "sink holes" and "caves," and in them are frequently found blocks of mica weighing 500 to 1000 pounds, having plates three feet in diameter. Many curious minerals are often found associated with the mica in the feldspar matrix, the most abundant and conspicuous being beryls, some of which have been found weighing twenty pounds.

These facts, as already stated, open up a new chapter in the history of our aborigines, illustrating the character of the commerce carried on at a very remote period, and showing the magnitude of the operations, and the extended period of time over which they must have been prosecuted, to enable a people furnished with nothing better than wooden and stone tools to produce excavations of so great magnitude.

THE BABY HIPPOPOTAMUS, IN LONDON.

The infant hippopotamus, born at the Regent's Park Zoological Gardens, London, on November 5, 1872, was, at the date of the last accounts, alive and flourishing. The Zoological Society has awarded its silver medal to Mr. A. D. Bartlett, the superintendent of the Gardens, in recognition of his skill in rearing it. A young rhinoceros (*R. sumatrensis*) was also born recently on board a vessel in the Victoria Docks, London; but it has since died.

THE PIGMY HIPPOPOTAMUS OF LIBERIA.

Among the rarest of large animals known to naturalists may be mentioned the pigmy hippopotamus of the river St. Paul, in Liberia, described as *H. liberiensis* by Dr. Morton, of Philadelphia, many years ago. This weighs only from 400 to 700 pounds, instead of the 2000 or more of the common hippopotamus. It is quite abundant in the river St. Paul, and sometimes strays two or three miles from the water, when it is readily killed by the natives. Like the other hippopotamus, it is dangerous when irritated, but does not attempt to attack the Africans in their canoes.

This animal, although described many years ago, is still very little known, and we believe has never reached Europe alive until quite recently, when a young one, caught in the Great Scarcies River, in Africa, was landed at Liverpool about the middle of March, but died shortly after its transfer to the Zoological Museum of Dublin. Although several months old, it weighed but twenty-three pounds, and measured only two feet in length, while the young hippopotamus born in London weighed at birth ninety-three pounds, with a length of four feet two inches. It is said that the abundance of hippopotamuses in the coast rivers in the neighborhood of Zanzibar renders navigation in small boats quite unsafe, as the animals show an uncomfortable tendency to rise under the vessels and crush them with their tusks.—2 *A, March* 15, 1873, 181.

THE FALLOW DEER INDIGENOUS IN EUROPE.

According to Professor Jeitteles, the fallow deer of Europe is not, as generally supposed, a recent importation from

Africa, but was widely distributed all over Europe during the diluvial period, and in still later times. Subfossil remains of this species have been found in the neighborhood of Rome, in Southern Russia, Upper Austria, Baden, Abbeville, and Olmütz. The same writer divides the wild dogs into two groups: first, the jackal of the Mediterranean fauna, which he considers the wild ancestor of the domestic dog of the stone age; second, the prairie wolf of North America, the wolf-dog of North Africa, the Pyrenean wolf, the prairie wolves of Eastern Europe, the dingo, the Senegal dog, and perhaps the wolf of Japan, all of which, in his opinion, are varieties of one and the same form, which he calls *Canis lycoides*, and which first appeared in a domestic state in the bronze age.—13 *A*, *November* 13, 1872, 434.

NEW EOCENE MAMMAL.

Professor Cope announces a new genus of eocene mammalia from Southern Wyoming, under the name of *Synoplotherium*. This, which was about the size of a black bear, probably belongs to the family of proboscidians, or else constitutes a connecting link of the perissodactyla.—5 *D*, *November*, 1872, 595.

NEW FOSSIL CARNIVORA.

Some time ago Professor Leidy described a genus of extinct animals from Wyoming, which appeared to be distantly related to the tapirs, in which two large, long teeth projected from the extremity of the lower jaw in front, in contact, and in appearance much like the cutting teeth of rodents (the beaver, for example). This he called *Anchippodus*, and two species were noted. More recently Professor Cope discovered a genus of carnivora which presents nearly the same structure of lower jaw, the two terminal parallel teeth being very large and strong. They are evidently canine teeth, which have come together by the omission of all, or nearly all, the intervening teeth (incisors). They work against three teeth on each side of the upper jaw, at the end against incisors, and sideways against a huge tiger-like canine. The molar teeth are all flesh teeth, to the number of six on each side (the lion and tiger have only one); but these are not very effective as meat-cutters, and have a conic point in front. The claws of this animal are, however, very exceptional, being so broad and flat as to be almost hoofs, while other parts of the feet differ much from all carnivora known. The species has been named *Synoplotherium lanius*; it was about the size of the black bear, but had a larger head, and a long, slender tail. While its claws were worthless as weapons, its teeth were very formidable. It has been suggested that it preyed on the turtles which so abounded during the same period. The teeth of the specimen found were much worn from use of hard food.

Another genus was also found by Professor Cope, which resembles the last one in many respects, and was another representative of the same type. Its lower tusks were not so long and large, and the claws not quite so flat. It was called *Mesonyx*. What peculiar habits these flat claws are related to is a matter for curious speculation. The two genera certainly add features from outside to those proper to the carnivora.

OROHIPPUS AGILIS.

Professor Marsh, of Yale College, has recently described, under the name *Orohippus agilis*, a very interesting fossil animal, allied to the horse. It was less than a fox in size, but its skull and skeleton show many equine characters which indicate that the genus is intermediate between *Anchitherium* and the less specialized mammals of the *Palæotherium* type. There were four well-developed digits in the fore-foot. The radius and ulna were separate, and the latter bone was stouter than in *Anchitherium*. The orbit was not inclosed behind, and there was no antorbital depression. There were three upper molars and four premolars, and the first premolar was nearly as large as the rest. The genus, therefore, supplies the only missing link in the genealogy of the horse. This unique specimen is from the eocene of Wyoming.

MAYNARD ON THE MAMMALS OF FLORIDA.

A catalogue of the mammals of Florida, with notes on their habits, distribution, etc., by C. J. Maynard, has been published in the *Bulletin* of the Essex Institute of Salem. From this we learn that the panther and the wolf are still quite common in that state. The little striped skunk (*Mephitis bicolor*) is very abundant in certain sections, and was first detected by Mr. Maynard as occurring east of the Mississippi River. It is confined to the narrow strip of land between Indian River and Turnbull Swamp, as far north as New Smyrna, and as far south as Jupiter Inlet.

The manatee is mentioned as still occurring in large numbers about the inlets of Indian River, and also on the west coast, between Tampa Bay and Cape Sable. Several species of bats are also mentioned, not hitherto found in this state. An interesting paragraph is given in regard to the domestic hog, which appears to have run wild, and to be very numerous. They are generally black, and furnish an interesting illustration, according to Professor Wyman, of the idea of natural selection, and the survival of the fittest. The light-colored hogs, according to his statement, contract a disease by eating a plant called the paint-root, which causes their hoofs to drop off, whereas the black ones are not affected by it. Mr. Maynard finds, however, that it is only the hogs with black hoofs that can safely eat the paint-root, the black hogs with white hoofs being made lame. The mere existence of a certain plant causes the hogs of a certain section to assume a dark color, since, if the hoofs are dark, the whole animal is usually so; and at the same time it is found that in some sections of the state, where this plant does not grow, white hogs are as plenty as the black.

In addition to this matter of natural selection, the settlers prefer hogs of a dark color, since they stand a better chance of escape from the bears by night, being much less conspicuous. Mr. Maynard finds, however, that a protective color is assumed by the hogs, and that those that have lived for generations in the piny woods are of a reddish hue, corresponding exactly with the color of the fallen pine leaves.

DIFFERENCE BETWEEN COLUMBÆ AND GALLINÆ.

Mr. Tegetmeier calls attention to the very great difference in many respects between the gallinaceous and the columbine birds, considering it very remarkable that naturalists should so frequently unite them. Thus he remarks that the pigeon never lays more than two eggs, and in many cases only one.

The young, when hatched, are in the most helpless state that it is possible to conceive. Their legs and wings are of the most rudimentary character. Their eyes are closed, and for eight or ten days they are fed with a curdy secretion of the parent bird, which involves the necessity of the pairing of the old birds, and setting on the nest by turns. The young inserts its beak into the mouth of the old one, and takes out either the secretion referred to, or grain or other food, previously swallowed by the parent and disgorged by it. The young pigeon grows with marvelous rapidity. In a month it leaves the nest, with a complete set of nestling feathers, and is capable of flight, which, within another fortnight, can be well sustained, and the bird shortly flies in pursuit of its own food. These nestling feathers are gradually changed, and, if the bird is early hatched, the adult plumage is completed in autumn, the bird having changed its dress only once.

The gallinacea, on the other hand, always lay five or six eggs (for instance, the peacock), to eighteen or twenty, in some of the smaller kinds. These eggs are usually highly colored, instead of being white, as are those of the pigeon. The young bird is able to run about and feed itself as soon as hatched. The moult is entirely different from that of the pigeon. The quill feathers of the wings are the first to appear, becoming visible in two or three days after birth. Before a fortnight they begin to shed, and the second step is followed by a third, and this by the permanent, adult plumage of the autumn. The tail feathers change in a similar manner. Usually, in the pigeons, the sexes are nearly or quite identical in color as well as in size, while in the gallinacea they always differ. There is also an essential difference in the structure of the skull, easily appreciable in any specimen.—19 *A*, *September* 7, 1872, 248.

A NEW FOSSIL BIRD.

Some months ago Professor Marsh communicated to the public the discovery, in the upper cretaceous shales of Kansas, of a new form of fossil bird, to which he gave the name of *Ichthyornis*, describing several species, the type being *I. dispar*. Its most striking characteristic consisted in the possession of biconcave vertebræ. In close connection with the remains were found portions of the jaws of an animal having decidedly reptilian affinities, both jaws containing numerous teeth, implanted in distinct sockets. These were small, compressed, and pointed, and all similar in shape. There were about twenty teeth in each ramus of the lower jaw, and probably as many in the upper. The series extended over the entire margin of the dentary bone, the front teeth being near the extremity.

A careful separation of all the parts of the matrix of this specimen now satisfies Professor Marsh that the jaws really belonged to the bird remains; and that we have here an instance of the long-sought-for link between the bird and the reptile, still more decided than in *Archæopteryx*. The distance between the two had been narrowed by successive discoveries, and is now bridged over by this remarkable fact.

The greater part of the skeleton of this genus, according to Professor Marsh, is generally bird-like in character, the lower jaw being long and slender, and abruptly truncated just behind the articulation for the quadrate bone. This extremity, and especially the articulation, is said to be very similar in character to that of some recent aquatic birds. The skull is of moderate size, and the eyes placed well forward. The scapular arch and the bones of the wings and legs are strictly ornithic; and the sternum has a prominent keel and elongated grooves for the expanded coracoids. The metacarpals are united, as in ordinary birds. The bones of the posterior extremities resemble those of swimming birds. The vertebræ, however, are all biconcave, the concavities at each end of the centre being distinct and nearly alike. Although it has not yet been possible to determine the fact, it is surmised that the tail was elongated, as in *Archæopteryx*. Its size was about equal to that of a pigeon. A supposed second species of *Ichthyornis*, described as *I. celer*, proved, on subsequent examination, to be generically distinct, and has been termed *Apatornis celer*, and is made the type of the genus *Apatornis*. Upon the two Professor Marsh has founded a new sub-class, *Odontornithes*, and the family *Ichthyornidæ*.

It is, however, not impossible that both genera are sufficiently related to *Archæopteryx* to warrant their being likewise included in the sub-class *Saururæ*, although it is not yet established that *Archæopteryx* had biconcave vertebræ.—4 *D*, *October*, 1872.

DEVELOPMENT OF A GUADALOUPE FROG.

A French naturalist, resident in Guadaloupe, has recently made some curious observations on the mode of development of a small terrestrial frog, of a species common in the West Indian islands (*Hylodes martinicensis*). It is very abundant both in fully grown and very small examples; and as the observer could not discover any tadpoles, his curiosity was excited to learn whence they came. The shores of the island are precipitous, and the streams all torrents, frequently dry during part of the year, so that the eggs could not have been deposited in these; moreover, there are no suitable lakes in the island, and they could not have survived in the surf of the sea. He then proceeded to examine a number of egg-like bodies, common in damp places, in packets under the forest leaves. They are about three to four millimeters in diameter, much too large for the egg of such a frog.

He discovered that these inclosed a cavity, in which he observed a minute tadpole, with four legs and a tail, revolving in the fluid which surrounded it. This communicated with the air by a pore, which passed outward through an exterior gelatinous enlargement. The tadpole continued its rotary movements until it issued from its case, when it was discovered to have lost its tail within a very short time.

The observer will ask whether this frog always possessed this habit, or whether it was not assumed on the island taking its present form and character through volcanic and other phenomena. Similar modifications are to be observed in tree-toads which inhabit dry regions. In two genera their eggs are placed in the back (*Nototrema opisthodelphys*), and the integument surrounds them by a fold until they are covered, except at the hinder end. Other tree-frogs hatch their young in water which accumulates in the axils of the large leaves of some palms.

FAYRER ON THE POISON SERPENTS OF INDIA.

In ophiology an important contribution has been published by Dr. Fayrer in his monograph on the *Thanatophidia*, or poisonous serpents of India. This work is illustrated by many fine plates, the drawings for which were made and colored, mostly from life, by native students at the School of Art in Calcutta, and they illustrate twenty-nine species. Special attention has been paid by the author to the effects of the venom, its remedy, and statistics respecting the number of deaths resulting therefrom. It appears that in a single year the number of deaths *known* to have resulted from snake-bite in the Bengal presidency alone amounted to the frightful number of 6219, of which 959 were ascribed to the cobra.

GEOGRAPHICAL DISTRIBUTION OF PERCOID FISHES.

In a paper by Vaillant, lately presented to the Academy of Sciences in Paris, upon the geographical distribution of some of the fresh-water percoid fishes, it is remarked that species of this group are found all over the world, with the exception of the southern hemisphere, in which only a single genus occurs. In Oceania there is but one form, *Enoplosis*, on the shores of New Holland. He finds that the fresh-water kinds, either in identical species or in forms closely related to each other, have a much greater area of geographical distribution than the ordinary marine forms, and that such genera as *Perca*, *Labrax*, *Siniperca*, and *Percalabrax* are extra tropical, and peculiar to the northern hemisphere; but that they are replaced between the tropics by *Lates* and *Centropomus.* He finds a very close relationship between certain European and American species, such as the common yellow perch, the *Lucioperca*, or the wall-eyed perch, *Labrax*, etc.

POSITION OF LIMULUS IN THE ANIMAL KINGDOM.

In an elaborate paper by Mr. Alph. Milne-Edwards upon the anatomy of the king-crab (*Limulus*), of which the American *Limulus polyphemus* is the well-known representative on our Atlantic coast, the conclusion is announced that these animals are neither arachnida, modified by an aquatic life, nor crustaceans, as has been generally supposed by zoologists, but that they constitute a special type united to the arachnida by various analogies, though having certain features of the organization of crustaceans. The group was formerly abundant; at present the *Limulus* is the only living representative. The recent and fossil species have been united by Mr. Milne-Edwards into a class, under the name of *Merostomata.*—6 *D, December* 9, 1872, 1611.

EXPERIMENTS ON AQUATIC ARTICULATES.

Mr. Felix Plateau has lately published a second part of his elaborate physical chemical inquiry into the aquatic articulates, this paper being devoted to the resistance of these animals to asphyxia from submersion, to the action of cold and the action of heat, and to a maximum temperature. The general conclusions to which he arrives are, as regards resistance to asphyxia from submersion, that the coleoptera resist a complete submersion for a very long time, but that the aquatic coleoptera and hemiptera, so far from being more able to sustain a similar exposure, are really no way superior to the terrestrial insects in this respect, and, in fact, sometimes succumb more quickly. The cause of this inferiority would seem to be their greater activity while in the water, and the consequent more rapid expenditure of the oxygen, while the land insects use comparatively little effort.

As regards the effect of cold, the aquatic insects appear able to sustain an indefinite exposure in the water at the temperature of freezing, but the time during which they can remain in ice at that same temperature is exceedingly short. The first cause of rapid death under these circumstances appears to be the deprivation of motion, and the consequent absorption of the bodily heat, without the possibility of restoration.

As regards the action of heat, the author states that the most elevated heat sustained without injury was between 33.5° C. and 46.2° C., consequently between very narrow limits. These temperatures correspond to those of a considerable period of submersion in the water of the articulate animals, whenever the salts of soluble gases do not exercise an injurious influence. If the results which have been furnished by aquatic articulates are compared with those obtained with animals of other groups, it will be found that the highest temperature of the aquatic animals, whether vertebrate, articulate, or molluscan, does not exceed 4.5° C.—*Bull. Acad. Royale de Belgique*, IX. and X., 172 and 320.

A TAMED WASP.

One of the novelties of the 1872 meeting of the British Association was the exhibition by Sir John Lubbock of a social kind of wasp, belonging to the genus *Polistes*, which he had taken and tamed in the Pyrenees during the past summer, and had kept by itself for three months. At first it was rather free in the use of its sting, but afterward ate sugar from his hand, and permitted him to stroke it.—15 *A*, *August* 31, 1872, 273.

PROTECTIVE FLUID OF CYMBEX.

According to Von Rossum, the larva of the genus *Cymbex* emits a colored fluid with great force through several apertures, for the purpose of protecting itself from the attacks of birds and other animals. This substance has been chemically investigated, and proves to be mainly an albuminoid compound, having much the reaction of white of egg. The coloring matter is supposed to be chlorophyl, or something similar to it.—5 *A*, *January*, 1873, 110.

DO FLIES EAT POLLEN?

The question has sometimes arisen as to whether flies actually eat the pollen of plants, or simply carry it away on their legs and backs. Mr. A. W. Bennett, however, reports the result of examinations prosecuted by himself of the stomachs of various diptera, which were found to contain large quantities of pollen grain, showing that it must have been actually consumed. In reply to the query as to the possibility of insects which are organized for sucking devouring such solid bodies as the pollen grains, it is answered by Müller that the transverse denticulations found in the valves at the end of the proboscis of many diptera are especially adapted for chewing the pollen grains, and for dividing the threads by which these grains are often bound together.—12 *A*, *December* 19, 1872, 132.

BENTHAM ON PHYLLOXERA.

Mr. Bentham, in his anniversary address to the Linnæan Society, in speaking of the grape-vine louse, remarks, as a general summary of his observations already made, that the *Phylloxera*, like other aphides, goes through a number of apterous generations of a single sex, but multiplying with enormous rapidity; for one or two individuals will lay as many as 500 eggs, fertilizing without previous copulation. It also gives birth occasionally to a winged generation of both sexes, the females of which lay only two or three eggs each.

The apterous *Phylloxera* is also dimorphous, a smooth-bodied form living in little galls growing on the leaves of the vine, where it is comparatively harmless, and a tuberculate form living in the modules it produces on the root fibres, causing first the smaller and then the main roots to rot, weakening in the first instance, and finally killing the whole vine. Each form has its winged generation.—12 *A*, *June* 13, 1873, 133.

CONTROLLING SEX IN BUTTERFLIES.

A suggestive article as to the possibility of controlling sexes in butterflies has been communicated to the *American Naturalist* by Mrs. Mary Treat, and from the results of numerous experiments she finds occasion to believe that the larvæ to which the freshest and most tempting food was supplied in unlimited quantity nearly always developed into female butterflies, while those for which the supply of food was limited almost as uniformly proved to be males. Dr. Packard is, however, inclined to think that the sex of this insect, as well as that of all animals from eggs, is determined at or about the time of conception, or, at least, early in the embryonic condition. In the honey-bee, especially, it has been proved that the sex is decided at the time the egg leaves the ova-duct. The sex in man, according to Koelliker, becomes fixed toward the end of the second month of fœtal life.—5 *D*, *March*, 1873, 127 and 175.

DISCOVERIES BY THE "CHALLENGER" EXPEDITION.

One of the first fruits of the *Challenger* expedition is presented by Dr. Suhms, naturalist of the expedition, in the form of a description of a new genus of amphipod crustacean. This was obtained off Cape Vincent, on raising the trawl from a depth of 1090 fathoms; but it is not certain whether it belonged to the bottom, or was accidentally swept into the trawl at some point nearer the surface. The genus has been named *Thaumops pellucida*, and is characterized by its transparent body and numerous faceted eyes. Another crustacean obtained is entirely without eyes.—12 *A*, *March* 13, 1873, 372.

BLOOD ENTOZOON.

A blood entozoon has lately been described by Dr. T. R. Lewis as occurring in a patient suffering from a tropical disease called *chyluria*. The worms appear to be present in very large numbers in the blood, and in some of the secretions; indeed, they were first observed in the urine. Nothing, so far, is known of their manner of development, nor how they gain entrance to the body. Their average length is 0.0175 of an inch, and they are therefore much smaller than the *Trichina spiralis*.—12 *A*, *February* 13, 1872, 289.

RELATION OF ENTOZOA TO THE GROUSE DISEASE.

English sportsmen are greatly exercised over the prevalence of a disease among the grouse in the Highlands, which even threatens their extermination, or, at least, a very serious diminution of the numbers and strength of that noble game bird. This is in every respect different from the diseases that have heretofore prevailed on the moors, as the birds are in perfect plumage, but wasted to skeletons, with large quantities of undigested berries in their crops. In the seasons of 1847, 1856, and 1865, the infected grouse exhibited a dull disordered plumage and attenuated bodies. In 1867 they were in good plumage and healthy in appearance, perfectly plump, although the liver was discolored and soft.

The precise nature of the disease has not yet been established, although Dr. Macdonald is of the opinion that it may be due to the ravages of entozoa, or intestinal worms. Another correspondent of *Land and Water* is inclined to assign as the cause the insufficient supply of young and tender shoots of heather for the bird's food, since the rank and decayed fibres, old seeds, and berries, lack the nutrition necessary for the healthy condition of the grouse, and to the want of a suitable cover for their protection in winter. Another very important difficulty, in his opinion, is the overstocking of the moors, and the overtrapping of birds of prey, and of so-called vermin. Quite a number of naturalists have given this as the probable cause of the deterioration of these birds, since it is a well-known law of nature that the weak and sickly first fall a prey to the attacks of their enemies, those that escape requiring that great degree of vigor of flight which is due to a high condition of health.—19 *A*, *November* 9, 1873, 450.

GIANT CUTTLE-FISH IN NEWFOUNDLAND.

The *Semi-Weekly Chronicle*, of St. John's, Newfoundland, some time ago contained an account of the capture of a very large cuttle-fish, and in its issue of November 19, 1872, it notices a second occurrence of a similar character. The animal was found floating on the water in Witless Bay, Newfoundland, by several men who were out fishing, and who succeeded in cutting off one of the arms. This was *twenty-seven* feet in length, while the body also was said to be about *twenty-seven* feet long, and as large round as a pork barrel.—*St. John's Chronicle*, *November* 19, 1872.

ALLMAN ON TUBULARIAN HYDROIDS.

The second and concluding portion of the important work of Dr. Allman (*A Monograph of the Gymnoblastic or Tubularian Hydroids*) has lately been published by the Ray Society. The first part, which appeared in 1871, was devoted to the consideration of the relations, morphology, development, and physiology of the hydroids in general. The second part contains descriptions of the genera and species of the *Gymnoblastea*, and their systematic relations *inter se*.

The author has especially insisted on the necessity of taking all the stages of growth of the hydroids into consideration in the appreciation and perfection of the natural classification of those animals. "With the possible exception of the *Monopsea*, in which no hydriform *trophosome* exists, the individual hydroid can only be understood by regarding it as the product of two factors, one of them finding its expression in the *trophosome* (a sexual or nutritive form), and the other in the *gonosome* (sexual form); and whether the *gonosome* remains permanently attached to the *trophosome*, or becomes in whole or in part free, attaining thereby an independent existence, it is equally necessary that it should take its place in our diagnoses of families, genera, and species."

The terms *trophosome* and *gonosome* express the association of the hydroids (*hydrosoma*) at different stages of development. With the exception of the one doubtful case referred to, "the associated zooids are always of two kinds. In one (1) the zooid is destitute of all power of true or sexual generation, and has as its proper function the general nutrition of the colony; (2) the other group of zooids has nothing to do with the general nutrition of the colony; it has as its proper function true generation, and the zooids which compose it give origin to the generative elements—ova or spermatozoa—either directly or after having first developed a special sexual bud." For the former (1) the term *trophosome* is employed; for the latter (2), *gonosome* (p. 23).

The author adopts the subkingdom *Cœlenterata*, considering its introduction by Frey and Leuckart "an important reform in zoological classification," and admits two classes—viz., *Hydrozoa* (having no stomach sac differentiated from the general body cavity), with five orders, *Hydroida*, *Siphonophora*, *Lucernariæ*, *Discophora*, and *Ctenophora;* and *Actinozoa* (distinguished by a stomach sac differentiated from the general body cavity), with two orders, *Zoantharia* and *Alcyonaria.*

The special group monographed (*Gymnoblastea*) forms one of the five suborders (*Eleutheroblastea*, *Gymnoblastea*, *Calyptoblastea*, *Monopsea*, and *Rhabdophora*) into which the order *Hydroidea* is divided. Of the five suborders, one (*Rhabdophora*) is represented only by the fossil *Graptolites.* The suborder *Gymnoblastea* is the most numerous in forms. This suborder contains those hydroids developed from an ovum through the intervention of a hydriform *trophosome*, whose zooids are invested in a "perisarc," and permanently attached, and which are especially distinguished by the absence of hydrothecæ or gonangia. The most familiar forms on the American coast are *Tubularia*, *Syncoryne*, and *Bougainvillia.* In the monograph, twenty-one families are recognized and described, and forty-nine genera are combined under them. Each family is characterized, first, by the peculiarities of the *trophosome*, and, second, by those of the *gonosome.* The forms not found in British waters are indicated by a triple asterisk (${}_{*}{}^{*}{}_{*}$) prefixed to the name. The work is illustrated by twenty-two plates, containing many colored figures, and eighty-four wood-cuts in the text.

HAECKEL ON THE CALCAREOUS SPONGES.

Professor Ernst Haeckel, in his *Biologie der Kalkschwämme*, proposes to prove the correctness of the evolution theory by a new method, and he wishes to give an analytical proof of the common descent of all the species of one uniform group. For him personally the synthetic proof is sufficient, but such is not the case with the majority of naturalists, who require analytical evidence.

In order to furnish this it is necessary to find, first, a group of a relatively simple form of organization; second, one in which the morphological characters predominate over the physiological; third, one that shows sufficient plasticity and elasticity of form. All these requirements are best answered by the sponges.

The sponges have for a long time been brought into connection with the protozoa; but in order to arrive at any correct and satisfactory conclusions regarding their proper position, it is necessary to start from and to study the simplest forms among them, and then determine with what groups they may show the most affinities. Beginning upon this principle, from *Olynthus* and *Archispongia*, it is found that the *Acalephæ* present themselves as the next related group. Comparing *Hydra* and *Cordylophora*, which forms have been most thoroughly studied, Professor Haeckel enumerates the points in which they show affinities and similarities, and those in which they differ. The differences between the simplest hydroids and the simplest sponges, as shown in the anatomical character, are of very inferior importance when compared with the weighty points in which they correspond. The conclusion reached, therefore, is that the zoophyta (*Cœlenterata*) divide into *two* main branches—first, *Spongiæ;* second, *Acalephæ*.

In his book Professor Haeckel has given two systems of classification, the one a *natural* one, based upon the phylogenetic principles of evolution, and the other upon such characters as are at present employed by anatomists in classification, giving for the *natural* system 21 genera, with 111 species, and for the *artificial* 39 genera, with 289 species. The line of distinction between species and variety he considers as very difficult to draw.—*Biologie der Kalkschwämme*, 1872.

LAKE DWELLINGS NEAR LEIPSIC.

According to Dr. Fritsch, the discovery has lately been made of lacustrine dwellings in the vicinity of Leipsic, as the result of certain engineering operations undertaken to regulate the course of the River Elster. After passing through a series of layers at a certain depth, the workmen found a series of oak piles, pointed below and decomposed above, and supporting a certain number of oak trunks placed horizontally; and on the same level with these were found certain lower jaws and teeth of oxen, fragments of antlers, broken bones of various mammifers, shells of an anodon, fragments of pottery, two polished stone hatchets, etc.—3 *B*, *June* 19, 1873, 291.

HUIZINGA ON ABIOGENESIS.

Professor Huizinga, of the University of Groningen, has lately published in *Nature* an account of some recent experiments on abiogenesis, and finds occasion to agree with Dr. Bastian and others that bacteria do become developed in certain hermetically sealed solutions in spite of the utmost care being taken to prevent them or their germs from penetrating therein. The precautions consist in exposing the solution during the process of sealing to a temperature considerably exceeding that of boiling water. The solution used by him is essentially that recommended by Cohn and others, and is prepared with certain mineral salts, as of potash, magnesia, calcium, and a quantity of grape-sugar and peptone. There was not the slightest evidence of other organisms than bacteria—not even fungi of any form. It is, however, yet to be ascertained whether the germs of the bacteria were in reality not introduced in the solution, and whether a much greater degree of heat is not required for the destruction of their vitality than that employed in these experiments.—12 *A*, *March* 20, 1873, 380.

BLOOD CORPUSCLES OF THE SALMONIDÆ.

Mr. George Gulliver announces, as the result of recent investigation, that the red blood corpuscles of the *Salmonidæ* are the largest, as far as his observation extends, to be found in any of the osseous fishes; and in this respect the American brook trout (*Salmo fontinalis*) stands at the head, its blood disks measuring as much as $\frac{1}{1455}$ of an inch, the smallest of those enumerated (*Clupea harengus*) being $\frac{1}{2665}$ of an inch. Although the dimensions of the corpuscles are generally pretty constant in the same species, there is yet considerable variation in species of the same genus, as may be seen in the case of the herrings, the pilchards, for instance, showing disks $\frac{1}{2133}$ of an inch in diameter.—11 *A*, 1872, 833.

PECULIAR BODIES IN THE BLOOD OF FEVER PATIENTS.

According to Obermeier, the blood of persons laboring under relapsing fever contains peculiar filiform bodies, which exhibit very active spontaneous movements. A drop of blood extracted from such a patient, and mounted as usual, with the necessary precautions, presents these bodies among the corpuscles when magnifying powers of 400 to 900 are employed. They appear as extremely delicate threads, of the thickness of a fibrine filament, and of the great length of from one and a half to six times the diameter of a red blood corpuscle, or more. Several of the bodies may be seen on the field at once; and so long as the preparation is fresh, they exhibit active movements, not only changes of form, waving, and alternately coiling and uncoiling, but also changes of locality, by which they slowly or suddenly escape from the field of view. Altogether the movements remind one of spermatozoa. Hitherto Obermeier has found these filaments during the fever only, and shortly before or during the crisis, not in the interval. Sometimes they are to be seen one day and not the next. He could not find similar bodies in the blood of healthy persons, nor of persons suffering from other diseases. Of their nature he will not yet give a decided opinion.

DIGESTION OF NON-NITROGENOUS FOOD.

The distinguished physiologist, Brücke, has been making some investigations upon the substances produced in the digestion of the non-nitrogenous constituents of food, ordinarily called carbohydrates. He distinguishes, in the first place, between the dextrine which is colored red by iodine and that which is not colored at all by this reagent; calling the former erythrodextrine, and the latter achrodextrine. Commercial dextrine, made by roasting raw starch, is a mixture of erythrodextrine and soluble starch or amidulin. That made by Payen's method—in which the starch is moistened with nitric acid, dried and roasted—contains, besides erythrodextrine, both achrodextrine and sugar. Starch treated with sulphuric acid yields first amidulin, then erythrodextrine, then achrodextrine and sugar. The process of malting produces achrodextrine in quantity. When now the contents of the stomachs of dogs, killed from one to five hours after a meal made up mostly of starch, were analyzed, large quantities of soluble starch and of erythrodextrine were found, while achrodextrine and sugar existed only in traces; in the small intestines, on the other hand, there was no erythrodextrine, but sugar was always present. The small amount of sugar in the stomach is ascribed to the checking influence of the acid of the gastric juice upon the saliva; the action of this very acid producing, however, the soluble starch present, while the conjoined successive action of the saliva and the acid produces a part of the erythrodextrine. The chief part of this substance Brücke has proved is due to the lactic acid fermentation, which he thinks is a normal digestive process, intended to prepare the starch for more rapid transformation into sugar in the duodenum, under the influence of the pancreatic juice.—21 *A*, 1873, 294.

THE FOSSIL HORSES OF SOUTHERN EUROPE.

Mr. Sanson, in a paper upon the fossil horses of the quaternary period, remarks that it is probably an error to consider such remains as belonging to the *Equus caballus*, or true horse, or some of its varieties; and he states that it is quite impossible to distinguish, by the imperfect fragments usually examined, between this species and the *Equus asinus*, or the original of the domestic ass. As the result of careful comparisons on his part, he finds that almost the only specific distinction between the horse and the ass is to be found in the orbital apophysis of the frontal bone. This, in the ass, is very much wider than in any of the horses, and its external surface and anterior border are decidedly rugose, in place of being smooth, as in the horse; and its edge, which in the horse is an arc of a circle, in the ass is in the form of the capital letter V. The external orbital meatus is also much larger in the asses; but it is difficult to frame a positive diagnosis in this respect. The form of the apophysis will always be its characteristic. From his own investigations, he is more strongly inclined to conclude that the fossil remains of *Equidæ* of Southern Europe are much more likely to belong to the ass than to the horse, the former being more particularly adapted to a southern habitat. He therefore thinks it is well to urge upon inquirers renewed diligence in their criticism, so as to determine more accurately the comparative ranges of the two forms.—1 *B, March* 23, 1873, 477.

NUMBER OF GLYPTODONTS, OR EXTINCT GIANT ARMADILLOS.

It is known to naturalists that Professor Burmeister has been for some years collecting extensive material at Buenos Ayres for his studies of the gigantic extinct mammals, represented in our epoch by the armadillos. He has recently published a summary of the present state of our knowledge in the *Archiv für Naturgeschichte* (38. Jahrg., I., 250–264), and has enumerated thirteen species; these form a peculiar family (*glyptodonts*, or *biloricata*), which is distinguished from the armadillos by (1) the gigantic dimensions of the body, (2) the inarticulated shell, or carapace, (3) the development of a breast shield, or plastron, (4) the constancy in the number and form of the teeth, and (5) the great differences in the skeleton. The species are now grouped in the following manner:

I. Some have four toes before as well as behind, those corresponding to the thumb and great toe of man being wanting. This group is confirmed by other characters, and is represented by the following species:

1. *Panochthus* (Burm.), with (*a*) *Panochthus* (*Dœdycura*) *giganteus* (Serres), (*b*) *Panochthus tuberculatus* (Owen), and *P. bullifer* (B.).

2. *Hoplophorus* (Lund), with (1) *Hoplophorus euphractus* (Lund), (2) *H. elegans* (B.), (3) *H. pumilio* (B.), and perhaps *H. minor* (Lund).

II. Others have four toes before and five behind, and those corresponding to the inner or thumb and great toe of man are present, the one wanting on the fore-foot being the outer of the other species, and corresponding to the little finger of man. The species of this group are recognized, viz.:

3. *Glyptodon* (Owen), with *G. clavipes* (Owen), *G. reticulatus*

(Owen), *G.* (*Schistopleurum*) *asper* (B.), *G.* (*Schistopleurum*) *elongatus* (B.), and *G.* (*Schistopleurum*) *lævis* (B.).

All these species attained a large and even gigantic size, some having been about twelve or fifteen feet long. In external appearance, though true mammals, they had much resemblance to tortoises.

All the known species have been found in the later tertiary beds of the Argentine Republic and contiguous territory.

INTERNATIONAL EXPOSITION OF HORNS.

Circulars have been issued by Captain Grant, of London, looking forward to an exhibition in that city, on the 1st of May, 1874, of a collection of the skulls and horns of the hollow-horned ruminants, such as oxen, goats, sheep, and antelopes; the object being to bring together as large a collection as possible, with a view of showing the variations in size and structure of each species, and the absolute number in public or private museums. Captain Grant estimates that there are fifteen species of the group known in Europe, thirty-nine in Asia, eighty-nine in Africa, and eight in America, or one hundred and fifty in all, and it is desired to have from twenty to fifty specimens of each species exhibited.

The collection is to be classified and grouped by competent authorities, and marked with the names of those who shot or exhibited them. Preliminary to the exhibition, the circular has been widely distributed throughout Europe and America, in order to secure a list of specimens available for this purpose. A blank page is provided, to be filled out, with headings referring to the name of the animal, the exact latitude and longitude where shot, found, or bred, sex, age, length of horn along the curve, distance between the tips, circumference, and whether the skull is attached or not.

Should this exhibition prove to be satisfactory, it is proposed hereafter to have another of the solid horns of animals, such as those of the elk, deer, and even the rhinoceros.

FOSSIL BLACK-HEADED DUCK IN BELGIUM.

Professor Van Beneden announces the discovery of remains of a fossil bird in the Rupelian clay of the tertiary of Holland, and identifies them unhesitatingly as belonging to the *Fulix marila*, or black-headed duck (shuffler), a species well known to sportsmen and naturalists as common to both Europe and America. This identification, if correct, of which Mr. Van Beneden seems to entertain no doubt, is an interesting fact, as carrying back this species through a very remote antiquity. The remains discovered consisted of a complete sternum, a large portion of the skull, the clavicle, humerus, and other portions of the skeleton.—*Bull. Acad. Roy. des Sciences, Bruxelles*, 1873, 354.

RESPIRATION IN FISHES AT DIFFERENT AGES.

A series of experiments lately made by Quinquand, and announced to the Academy of Sciences in Paris, will be of much importance in the practical question of the culture of young fish, and their transportation in small bulk and in a limited quantity of water from one point to another. According to this author, the amount of oxygen consumed by the same fish is in proportion to the time—twice as much being required in two hours as in one. The relative power of respiration, however, in fish diminishes with the increase in weight; as a carp of three and a half pounds consumes, in proportion, scarcely more than one fourth as much as one of three fourths of an ounce in the same space of time. There appears to be comparatively little variation in the amount of oxygen required in the same time by different species of fish of the same weight. In fish weighing less than one pound, the activity of respiration is considerably greater in proportion than in those that are heavier. Carp weighing from one to two pounds consume from one seventh to one ninth as much oxygen as man in the same time, and of the same unit of weight of living matter. Tench weighing over one pound have a respiratory activity one ninth as much as man. As already stated, the activity of respiration is greater in fish of small size. Thus a tench of four and a half ounces only consumes two ninths as much oxygen as man in proportion to the weight; while one a little less than an ounce requires half as much. It is known that among mammals the new born young resist asphyxia much more vigorously than adults. The contrary seems to be the case among fishes. Thus eels weighing one hundred and fifty grains perished twenty-four hours sooner than others of six hundred grains placed in the same vessel. The cutaneous respiration of fish, as already shown by Humboldt, is quite feeble; an eel of ten ounces absorbing in its cutaneous surface 0.30 of a centigramme of oxygen in an hour, and another of sixteen and a half ounces absorbing 0.58.—6 *B*, *May* 5, 1873, 1141.

ABSENCE OF FISH ABOVE THE YOSEMITE FALLS.

It is a curious fact, as reported by Mr. Livingston Stone, that there are no fish in the Merced River or any of its tributaries above the walls of the Yosemite Falls. The streams which unite to form the Merced above the falls are the Nevada or Main Stream, the Lenaya, the Illilonette, and the Yosemite, all well supplied with clear, cold, and beautiful water, but totally destitute of fish of any kind. Connected with these streams are nearly a hundred lakes, from two hundred yards to a mile in diameter, and equally destitute of life. The average altitude of these lakes is about 8000 feet above the level of the sea.

Mr. Stone suggests the expediency of stocking these waters artificially with trout, especially the *Salmo spectabilis*, which inhabits only the coldest waters of the Sacramento. But it may be a question whether it will be practicable to accomplish this purpose satisfactorily in the probable absence of a sufficient quantity of food, which perhaps more than any supposed inaccessibility may be the cause of their absence. Insect larvæ and crustaceans, which might furnish nutriment to cyprinoid fishes, even if not fed upon directly by the *Salmonidæ*, are possibly unable to sustain the low temperature of the streams.

A similar absence of fish life to that referred to by Mr. Stone is seen in the upper waters of the Hudson, in the Adirondack region. In ascending Mount Marcy via Lake Henderson, from the old Adirondack Iron-works, Avalanche Lake, quite a large and deep body of water is met with, and this is said to be uninhabited by any kind of fish; and it is quite certain that Opalescent River, the bed of which travelers ascend in climbing the mountain, and which is a stream of considerable size, is likewise entirely destitute of fish. The only form of animal life that was observed by a party of naturalists, who were engaged in the inquiry, consisted of the larvæ of some species of salamanders, probably *Desmognathus fuscus*, the adults of which are very abundant on the upper levels of the mountain.

REPRODUCTION IN THE EEL.

The method by which reproduction is accomplished in the eel has been for a long time one of the problems of zoological science, and, although much attention has been directed toward its solution, it is not until quite recently that any thing like a satisfactory indication has been obtained. Indeed, such has been the interest in the question, and the desire to obtain some definite conclusions, that rewards have been offered by quite a number of the learned bodies of the Old World for a satisfactory essay on the subject. The peculiarities in the natural history of the eel are well known, and especially the fact that, while spending the greater part of its life in fresh water, this is but a preliminary to its breeding in the sea. The salmon, shad, alewife, and other species, as is well known, obtain their growth in the sea, and run up into fresh water to spawn; precisely the reverse being the case with the eel. The young swarm in the early spring in the mouths of rivers, and are known to go upward as far as the very head waters of these streams and their tributaries, sometimes in such numbers as almost to clog the channel. The adventurous visitor to the Falls of Niagara who may essay the exciting feat of passing under the falls during the summer months will have his attention called to the immense number of young eels of a few inches in length writhing about the slippery rocks along which he is passing. Under ordinary circumstances these fish find little difficulty in ascending falls, by making their way through the interstices of the rocks, or even by crawling out at night, if necessary, and thus passing on to a higher level. This feat is impossible at Niagara, as shown by the absence of eels in the waters of Lake Erie. The eels remain in fresh water probably for a period of several years, or until they have reached a considerable growth. They then commence their descent, and are often taken in immense numbers in the fall of the year, in baskets and other special contrivances for their capture. When they get back to the sea, it is probable that they remain there. So much has been known of the general facts; but the precise nature of their reproduction has, as stated, been until lately a mystery. The anatomy of this fish has been frequently investigated; but it was not until the labors of Cruvelli and Maggi that we have come to any thing like a clear understanding of the process. The somewhat startling conclusion is reached by these gentlemen that the eel is strictly a hermaphrodite, and that eggs are fertilized by sperm in the body of one and the same individual. Professor Ercolani has repeated the experiments of the gentlemen mentioned, and, while differing considerably in conclusions as to the morphology and functions of the several parts, agrees with them that eels are complete hermaphrodites, which we may therefore consider as tolerably well established. Cruvelli and Maggi find a very curious distinction between two species of European eels — the intestines in one being almost a straight line, and in the other being very flexuose; these differences being accompanied by external peculiarities in the relative position of the anus.—1 *B*, *October* 6, 1872, 9.

INFLUENCE OF EXTERNAL CONDITIONS ON THE STRUCTURE OF INSECTS.

In a paper by Dr. Horn upon the Coleoptera of the Rocky Mountains, published in Professor Hayden's report on the geology of Montana, an interesting generalization is made in reference to the relations of external physical conditions to the structure of insects. The doctor remarks that from an examination of a large number of specimens of *Eleodes*, as also of other genera, he finds that the higher the elevation, or the color of the climate, the rougher and more deeply sculptured is the species, and that the smoother forms are to be found at lower latitudes, or in places nearer the level of the sea. For this reason he has no difficulty in establishing many so-called species of *Eleodes* and of *Omus* as geographical races of a smaller number of species, and in which the law referred to is clearly indicated.

He also finds that species every where in our fauna appear to be distributed on lines of country presenting as nearly as possible similar meteorological conditions. Thus many Oregon forms extend southward into California, gradually seeking a higher mountain habitat as the region becomes warmer. Two species—*Trogosoma harrisii* and *Phryganophilus collaris*— extend their habitat from Maine to California, following the cooler regions westward from Maine through the Canadas and Red River region, thence northward nearly to Sitka. From the latter point southward to Oregon both occur at the ordinary level, and rising as a more southern region is reached, until, at the latitude of Visalia, they occur only a short distance below the snow line, at an altitude of from ten to twelve thousand feet.—5 *D*, *June*, 1873, 360.

DISCOVERY OF DANAIS ARCHIPPUS NEAR MELBOURNE.

Professor M'Coy, of the University of Melbourne, announces the discovery near Melbourne, in April, 1872, of quite a large number of specimens of an American butterfly, the *Danais archippus*. He had previously received specimens from Lord Howe's Island, on the northeast coast of Australia, and from the Clarence River, in New South Wales; and on the present occasion they were detected at numerous points within fourteen miles of each other. The fact is an extremely interesting one, as there seems to be no reason to consider the species as a permanent inhabitant of Australia, and it was suggested that they may have been brought there by some atmospheric current.—10 *A*, *June*, 1873, 440.

NUMBER OF THE RED BLOOD CORPUSCLES.

By means of a simple apparatus, Malassez has succeeded in counting the red corpuscles in the blood of several animals. A known quantity of the blood is mixed with a preservative fluid, and this is introduced into a flat capillary tube of known volume, and viewed under a microscope, the eye-piece of which is divided into squares. Knowing the number of corpuscles in a square, the number of squares which include the tube, and the volume of the tube, it is easy to calculate the number of corpuscles in a cubic millimeter. (An ingenious microscopic slide for this and many other similar purposes has been devised by Mr. D. S. Holman, of Philadelphia, and is figured in *Nature* for May 22, 1873, p. 79.) In mammals the number of red corpuscles in each cubic millimeter varies from 3.5 to 18 millions. The average number in human blood is 4 millions; in that of camels, 10 to 10.4 millions; in that of goats, 18 millions; and in that of the porpoise, 3.6 millions. Birds have fewer, the maximum being 4, the minimum 1, and the mean 3 millions. Fishes have still fewer than birds, and cartilaginous fishes a less number than osseous. The latter will average from 700,000 to 2,000,000; the former from 140,000 to 230,000. The number, therefore, decreases as the animal is lower in the scale, while the size increases. But the inverse proportion of the one to the other is not constant, since, for example, the llama and the dromedary have larger corpuscles than man, and more of them. So in the case of birds, the corpuscles gain more by the increase in their volume than they lose by the diminution in number.

NEW BONE CAVE.

A bone cavern has lately been found in the cliffs to the southwest of the Bay of Kirkcudbright, on the coast of Scotland, which has been thoroughly explored, with the result of bringing to light numerous fragments of animals, such as the ox, red deer, goat, pig, horse, pine-marten, etc. Intermingled with them were fragments of bronze inplements, bone needles, and other bone implements. A single piece only of wrought stone has been found, and, so far, no flint implements of any kind.

NEW VERTEBRATE FOSSILS.

Wonderful as have been the discoveries of extinct vertebrate life in the tertiary and cretaceous deposits of the West, the developments made in Colorado during the summer of 1873, by the expedition of Professor Hayden, appear to be the most marvelous of all; the species found being not only numerous, but entirely peculiar to the region, and, with scarcely an exception, new to science. In several papers lately published by Professor Cope, we find descriptions of no less than fifty-three species of mammals, five of serpents, seven of saurians, and four of tortoises; and it is believed that a careful study of the immense collections made will ultimately reveal double this number. The precise locality and its exact geological position have not been announced, but will doubtless be given in a detailed account which will accompany Professor Hayden's report.

The bed was discovered by Mr. James Stevenson, of Professor Hayden's party, and the exploration was made by Professor Cope, under its auspices.—12 *A*, 1873, 394.

ABORIGINAL MONEY.

At a late meeting of the Academy of Sciences of San Francisco, Mr. R. E. C. Stearns presented a paper upon the money of uncivilized man, exhibiting specimens of this circulating medium and of the shells from which it was derived. He remarks that the durability and ease of manipulation of shells have long caused them to be employed in domestic intercourse and trade; and, among these, he first enumerated the common clam of the eastern coast of the United States, the purple portion of which constituted the wampum, or one class of their money, while another was made from the axes of a species of *Pyrula*. In each shell about half an inch in diameter of the inside is of this purple color, and this was converted into beads, which they called *Suckanhock*, or black money, and had twice the value of their white money, or wampum proper, which was made of the *Metauhock* or *Pyrula*. This was used not only among the Indians, but among the whites; and it is remarked that the solid cash with which the salaries of ministers were formally paid included black and white wampum.

The money of the west-coast Indians is a species of tusk shell, or *Dentalium*, resembling a hollow elephant's tusk, the worth depending upon the length of the shell. These are strung on cords and worked up in various forms of beaded and other ornaments, having a distinct value among the Indians, according to the size of the shell and their number, quite as fixed as that of the specie or the paper money of the United States. The use of the money cowry in Africa is well known, many tons of the shells being annually imported to Great Britain, and again exported for barter with the native tribes.—*San Francisco Bulletin, July* 11, 1873.

TRANSLATIONS OF ASSYRIAN AND EGYPTIAN TEXTS.

The Society of Biblical Archæology has lately undertaken to publish a series of translations of all the important Assyrian and Egyptian texts which exist in the various collections of England and the Continent, thus presenting in the English tongue the remains of the oldest and most authentic literature in the world. *Nature* remarks that nearly all the principal translators have offered their services for this purpose, and while each author will be alone responsible for his portion of the work, the general arrangement of the materials will rest with the president of the society.

The selection of records will embrace the entire range of Egyptian and Assyrian history and literature. The first volume is shortly to be issued by Messrs. Bagster & Sons.—12 *A*, *June* 5, 1873, 112.

THE PREHISTORIC RACES OF AMERICA.

Shortly before his death, the late Colonel J. W. Foster completed the manuscript of a work upon the prehistoric races of the United States, which has just made its appearance from the press of S. C. Griggs & Co., of Chicago. This contains an excellent summary of the present state of our knowledge of the aborigines of North America, as illustrated by the remains found in mounds, shell heaps, and ancient mines, as well as by their crania. Beginning, for the first chapter, with a notice of the recent progress of ethnology, and with the evidences of the antiquity of man in Europe, the second chapter is devoted to the proofs of this antiquity in the United States, and the authenticity and value of the remains found in the gold drift of California; and the Calaveras skull, the plummet from San Joaquin Valley, etc., are passed under review.

A chapter is devoted to a notice of the mound-builders and the geographical distribution of their work, and another to the shell heaps of the coast, followed by one on the general nature of the mounds and their inclosures, and the arts and manufactures as shown by these remains. The chapter on ancient mining by the mound builders is very interesting, the author having himself prosecuted very extensive investigations on the subject during his connection with the surveys in the Lake Superior region. The special characteristics of the mining of the aboriginal man of America are discussed, and references made to certain peculiar forms of implements noticed by Colonel Foster at the late meeting of the American Association at Dubuque.

The inquiry as to the origin of the mound-builders is answered by a suggestion that they were derived from the tropics rather than a migration from the Old World, as there is no appreciable difference between the crania of the ancient races in Brazil and Central America and those of North America. The volume concludes by a chapter upon the unity of the human race, and one upon chronometric measurements as applied to the antiquity of man.

The whole work is an excellent compendium of the state of our knowledge of this subject up to a recent period; and however readers may differ from the conclusions of the author, the work is eminently worthy of the study of all interested in the department of ethnology.

THE CESNOLA COLLECTION.

The acquisition, on the part of the Metropolitan Museum of Art in New York, of the valuable collection of curiosities gathered in Cyprus by General Di Cesnola, is a fact of much note, especially as great efforts were made to retain it in Europe. It was purchased from the owner by Mr. John Taylor Johnson, of New York, for the sum of $50,000 in gold, and is to be exhibited in the Douglas mansion on Fourteenth Street. The collection embraces over ten thousand specimens, in great variety, including representatives of different historical epochs, and embracing objects of art from the rudest to the most finished character. Among them are large numbers of statues of various sizes, articles of pottery, ornaments, weapons of war and of the chase, bottles, coins, etc.—*New York Herald, January* 29, 1873.

THE CANSTADT RACE OF MANKIND.

A very important ethnological work has lately been commenced by Quatrefages and Hamy, entitled *Crania Ethnica —Les Crânes des Races Humaines*—in which it is proposed to present a systematic account of the principal types of the human skull, both ancient and modern. The materials are to be found in the various collections of Paris and those of foreign countries, which have been placed at the command of the authors.

The first *livraison* is especially occupied by an inquiry into the so-called fossil races of man, which, however peculiar in their general character, the authors maintain to be still persistent in various parts of the world. This race they call the Canstadt race, from the fact that its first discovery was, in 1700, at Canstadt, Stuttgart, as the result of certain investigations undertaken by the order of Duke Ludwig, of Würtemberg. The importance of this fragment, although figured by Jäger and Fraas, has only recently been recognized, and it is brought prominently forward in the present work.

The essential characters of this Canstadt race are especially seen in the male sex—namely, a remarkable flattening of the cranial vault, accompanied by a very decided degree of dolichocephaly, or the backward projection of the posterior region of the cranium; a development, sometimes enormous, of the frontal sinuses, and the very oblique direction of the forehead, the depression of the parietals in their postero-internal third, etc. These characteristics are very much reduced in the female sex. Thus, the superciliary ridges disappear almost entirely, the projection of the occipital is much less marked, but the flattening of the cranial vault and some other characters are persistent. The term *dolicho-platycephalic* has been applied to this cranial type, so well marked in the aggregate of its characters.

The skulls from Canstadt, Enghisheim, Brux, Neanderthal, and Denise are believed to belong to the male sex, while those of Staengenaes, Olmo, and Clichy are considered as females. All of these are without the lower jaw. Separate lower jaws, believed to belong to the same race, are those of Naulette, Arcy-sur-Cure, Clichy, and Goyet. The skull from Forbes' Quarry, in Gibraltar, is thought to belong to the same period, although this is not absolutely certain. Unfortunately this is the only perfect one of all that supposed age. It exhibits a large, massive face, with very large orbits, the nostrils much distended, and the upper mandible extending decidedly forward.

The authors proceed to remark that this general type of cranium is not confined to the geological period, but that it is found in the dolmens, and in the tombs of the Middle Ages, and that even in modern individuals such characteristics have been noticed in Scotland, Ireland, England, Spain, France, Sweden, Denmark, Switzerland, Austria, and Russia. No illustrations of this type have been hitherto noticed from the eastern borders of Europe to Australia, but in this latter continent some of the tribes living in the neighborhood of Port Western have a decided similarity—a fact first pointed out by Huxley, and justified by a careful comparison.

The authors inquire whether this modern exhibition of the Canstadt type can possibly be the result of atavism (the reappearance of a primitive form among its descendants at long intervals), or a continuous manifestation of a persistent race. The latter they think most probable, and consider it to result from the diffusion of this special race of mankind over a particular region of the world. They are decidedly of the opinion, however, that this form of cranium is not at all incompatible with an intellectual development equal to that of a less exceptional condition, as among its more modern illustrations are individuals distinguished by their intelligence, besides numerous historical personages, among whom they cite Kay Lykke, a Dane, who was distinguished in the politics of the seventeenth century, and whose skull is figured in the *Ethnica;* Saint-Mansuy, bishop of Toul, in the fourth century; and Robert Bruce, the Scottish hero.

These facts show how great is the error of attaching to any particular cranial form an absolute idea of intellectual or moral superiority.—6 *B*, *June* 2, 1873, 1313.

THE RELATIONSHIP OF THE COYOTE TO THE POINTER DOG.

In a paper upon the prairie-wolf, or coyote, of North America, published in the *American Naturalist* by Dr. Elliott Cones, a critical inquiry is made into the relationship of this animal with the several species of native dogs, this with special reference to the theory broached by Jeitellès and others as to the identity of the prairie-wolf with the dog of the bronze period of Europe. He finds the relationship between the coyote and the pointer dog to be very close, this being strengthened by the total absence of curve to the tail in both species. In a table of comparative measurements, Dr. Cones shows that the pointer and coyote differ less in size and proportion than many individual coyotes do from each other, and that there is no essential discrepancy in the general build.—5 *D*, *July*, 1873, 387.

FOSSIL LEMUR IN FRANCE.

The cranium of a fossil lemur has lately been discovered by M. Delfortrie in the deposits of phosphorite, or compact phosphate of lime, worked in the department of Lot, in France.—15 *A*, *August*, 1873, 245.

NEW FOSSILS DISCOVERED BY PROFESSOR COPE.

Professor Cope, under date of July 15, publishes notes of some new, extinct mammalia from the tertiary deposits of the Rocky Mountain region. One of these he names *Ælurodon mustelinus*, an animal about the size of the domestic cat. Another is the *Aceratherium megalodus*, which he characterizes as about the size of an Indian rhinoceros, but with much larger teeth. In some respects it has decided relations to the genus rhinoceros.

NEW FOSSIL MAMMAL FROM PATAGONIA.

Professor William H. Flower has communicated to the Royal Society an account of a new fossil mammal from Patagonia, obtained by Dr. Robert D. Cunningham in deposits of uncertain age on the banks of the River Gallegos. The molar teeth of this animal resemble those of the genus rhinoceros, to which it would appear to be related through *Hyracodon*, and it is also allied more remotely to *Macrauchenia*, though still more so to the *Nesodon* and *Toxodon*. The animal had the complete typical number of teeth, namely, twenty-two above and twenty-two below, arranged in an unbroken series, and nearly of even height, presenting a remarkable gradual transition in character in both jaws from the first incisor to the last molar.—12 *A*, *July* 10, 1873, 214.

CAUSE OF MORTALITY AMONG SCOTTISH GROUSE.

A writer in *Land and Water* attempts to solve the problem as to the unprecedented mortality among the Scottish grouse during the present season, on the supposition that this is due to the great amount of rain during the last autumn and winter, which saturated the moors, and converted their soil into a kind of pulp. This prevented the grouse from obtaining a ready access to the fine silver sand, which, in his opinion, is an absolute requisite for the proper trituration in the stomach, and consequent digestion of the food. He says that the poor birds were driven to the banks of the streams in a vain effort to obtain this material, where they perished by hundreds, and that the water-courses in some places were obstructed by their carcasses. In addition to this there was a heavy snow-storm in May, which destroyed every nest and egg.—2 *A*, *August* 16, 1873, 122.

ADDITIONS TO YALE COLLEGE MUSEUM.

American naturalists are congratulating themselves upon the acquisition by Professor Marsh, for the museum at Yale College, of the finest specimen of pterodactyl yet discovered. This was recently found in Bavaria, and was especially characterized by exhibiting distinct indications of the membranes connecting the bones of the wing, which in this respect somewhat resembled those of the bat. Of the numerous specimens of this flying reptile in public and private museums, no others have exhibited this character to any thing like the same degree, and much emulation was excited in regard to its acquisition. It is understood that the British Museum, the Berlin Museum, the Museum of Comparative Zoology at Cambridge, and other great establishments, were all negotiating for the purchase; but Professor Marsh was the only one who gave carte blanche by telegraph to the owner, authorizing him to name his price.

Another important addition made by the Professor to the museum of Yale is the Zeltner collection of Central American antiquities, gathered by Mr. Zeltner during a period of several years' service as French consul at Panama. The collection embraces a very fine series of gold images from the Chiriqui graves, as well as about a hundred pieces of pottery. They constitute the originals of the illustrations of Zeltner in his work on the antiquities of Chiriqui.

PTERODACTYL IN THE CAMBRIDGE MUSEUM.

Among the recent additions to the Museum of Comparative Zoology at Cambridge is a very complete specimen of pterodactyl, which is believed by Professor Agassiz to be one of the most perfect illustrations of the genus extant. It has already furnished him the means of correcting some important errors, its special value being in the fact that the two sides are preserved upon corresponding slabs, such details as are not appreciable in one slab being evident in the other.

The restorations by Wagler and Goldfuss are proved by this specimen to be imperfect or unnatural; that of the former, in regard to the bend of the articulations of the fore-arm, and the omission of the metacarpal joint; that of the latter, in the suppression of an entire joint of the hand, the metacarpal part of the whole hand having been overlooked. The number of fingers also appears to have been incorrectly stated, the specimen of Professor Agassiz showing only three short fingers in the hand and four perfect ones in the foot. This is the case, at least, in the type of *P. longirostris.*

A LARGE FISH.

Messrs. Middleton, Carman, & Co., the well-known fish dealers in the Fulton fish market, New York, received several specimens of an enormous fish, known as the "Black Groper." One of these, presented by them to the National Museum at Washington, was identified by Professor Gill as *Promicrops guasa*, and belongs to the family *Serranidæ*, to the typical genus of which (*Serranus*) it was originally referred. It is an inhabitant of Cuban waters and the West India seas, but has not hitherto been satisfactorily identified as occurring on the coast of the United States, although the young may perhaps have been described under another name.

These fish, it is reported, were taken in shad seines, in the mouth of the St. John's River, Florida, and must have been almost a match for their captors, as the one presented to the National Museum weighed 750 pounds, and had a length of nearly eight feet, with a circumference of about seven. In form and general appearance it somewhat resembles the sea-bass, but has small eyes, placed much farther forward, and the tail fin is round; as indicated by the name, the color is almost black. Nothing special is on record in regard to its habits, unless it be the fish referred to in Elliot's "Sports of North Carolina," as "of gigantic size." The flesh of this fish is excellent, though rather coarse, and brings a good price in the Havana market. They may probably be considered as among the largest of the marine fishes on the coast of America, exceeded only by the sharks and rays, and by species of the sword-fish and tunny groups.

A cast has been made at Washington of the specimen, which, with the skeleton, will be placed on exhibition.

RELATIONS OF THE MEGATHERIIDÆ.

On a previous page of the *Record* we gave an abstract of a memoir by Dr. Burmeister on a group (*Glyptodontidæ*) of extinct gigantic "edentate" mammals of South America related to the living armadillos. We are now enabled to add the results of the latest investigations into a related group (*Megatheriidæ*) of the same order, also confined to America, but common to North and South, as published by Professor Paul Gervais, of Paris. The megatheriids have their nearest relations among the sloths of the present epoch, but form a very distinct family, having less strict affinities also with the glyptodonts. They are supposed by Gervais to have differed in habits, although agreeing in being ground and not arboreal animals, their great size forbidding their residence among trees like their living relations. Most of them are believed by Gervais to have lived upon ants and termites, their powerful claws having probably been employed for digging into the ant-hills; but, at the same time, it is conceded that they may have in part subsisted on vegetable matter. One of the genera (*Lestodon*), however, was carnivorous.

Nine genera are admitted by Professor Gervais, and are distinguished by differences of dentition as well as of the skeleton. They are distributed as follows:

1. *Megatherium*—North and South America.
2. *Cœlodon*—Brazil.
3. *Lestodon*—known only by remains in the museum at Paris.
4. *Megalonyx*—North and South America. Remains from Cuba have been described under the names *Megalochnus* and *Myomorphus*.
5. *Mylodon*—North and South America.
6. *Scelidotherium*, or *Platyonyx*—South America.
7. *Spherodon*—South America.
8. A new genus, unnamed, from the Argentine Confederation.
9. Another new unnamed genus, represented by a heel bone (calcaneum), obtained in Brazil, and which indicates an animal as large as the *Scelidotherium*, and larger than the *Megalonyx*.

In the opinion of Professor Gervais, the edentates constitute not an order, but a sub-class of mammals; and of such a sub-class the tardigrades (including the sloths and the megatheriums) would form an order.

RECENT EXPLORATIONS OF PROFESSOR COPE.

Professor E. D. Cope has recently returned to Philadelphia, after completing an extended examination into the vertebrate paleontology of certain tertiary strata in Colorado and Wyoming. A rough estimate places the number of species obtained by him during the season at one hundred and fifty, principally *Mammalia* and *Reptilia*, of which from seventy-five to one hundred are new to science. About one hundred species were obtained from the miocene in Colorado. This fauna possesses many points in common with that of the White River, in Dakota, but includes many species, and some higher groups, not known to occur in the latter region. Thus five new species of serpents and seven of lizards are the first of either order discovered in the American miocene. Among *Mammalia*, several new genera and species of *Insectivora*, mostly of small size, are added, while the discoveries of new *Rodentia* are quite as numerous; two new genera are called *Heliscomys* and *Fricium*. Several new feline and canine genera and species were procured, noteworthy among which are some sabre-toothed tigers. Of hoofed animals, the most striking are the six new species of the new genus *Symborodon*, which is an ally of *Titanotherium*. They are described as resembling the rhinoceros in many respects, the points wherein they differ constituting resemblances to the *Eobasilidæ*. Thus they were more elevated than the rhinoceros, and had shorter feet. They bore a pair of horns on the front or snout, above or in front of the eyes, as indicated by solid cones, in some of the species reaching a foot in length. The largest species, *S. bucco* (Cope), was as large as the African elephant, the smallest, *S. acer* (Cope), equaled the Indian rhinoceros. Portions of over fifty of these animals were obtained, twenty-five of which embraced crania. Some of the artiodactyls are remarkable for their small size, one species not exceeding a squirrel in bulk.

The earliest appearance of serpents in geologic time is, so far as known at present, in the eocene period. Professor Owen was the first to determine the existence of these animals during the period of the London clay, naming the most prominent genus *Palæophis*, and stating its relationships to be to the boas. Remains of serpents are so rare that they had never been observed out of Europe until 1868, when the first American species were obtained by Professor Cope from the eocene of New Jersey. In 1870, he procured fossil rattlesnakes from the cave formations of Virginia, and, later, harmless species from similar localities in Pennsylvania. In the following year, Professor Marsh described five species from the eocene of Wyoming. During the past season an important intermediate station of geologic time was discovered for them by Professor Cope, in the miocene of Colorado. He has recently described five new species of three genera, stated to have been mostly of the innocuous group. Thus in the serpents, as in the gar-fishes, the various gaps in the record are being rapidly filled.

BINNEY ON GEOGRAPHICAL DISTRIBUTION OF MOLLUSKS.

Mr. William G. Binney has lately published, in one of the *Bulletins* of the Museum of Comparative Zoology of Cambridge, a paper upon the geographical distribution of the terrestrial air-breathing mollusks of North America, in which he establishes much the same faunal provinces that Professor Baird ascertained to exist from a study of the birds. He recognizes three principal provinces, a Pacific, a Central, and an Eastern. The Pacific province coincides with the Pacific water-shed of the United States, and extends from San Diego in the south to Alaska in the north. The peninsula of Lower California is considered as belonging rather to Mexico. The Central province reaches from the Rocky Mountains on the east to the Sierra Nevada Mountains on the west, and is embraced between Mexico and the British possessions. The Eastern province comprises the remaining portion of the continent north of Mexico.

Several subdivisions are established by Mr. Binney upon the study of the shells, the Pacific province being divided into the Californian and the Oregonian regions, the former embracing the whole of the State of California, the latter the rest of the west coast of the United States, including Alaska. The two overlap near Humboldt Bay.

No subdivisions are established for the Central province, and but two are recognized in the Eastern province. The first of these is the northern region, embracing the whole of the northern portion of the continent, including Greenland and Alaska, and extending southward about to the borders of the United States, and running down the Appalachian chain of mountains to Chesapeake Bay, thus including all of New England, a portion of New York, New Jersey, Pennsylvania, and Maryland, lying east of the Alleghanies. The entire region lies to the south of the northern region, but extends only to the Rocky Mountains on the west. Southward it reaches the alluvial region of the Atlantic coast, the dividing line not being very sharply defined.

The southern region embraces the peninsula of Florida, with the adjacent islands, together with the alluvial region of the Atlantic and Gulf States.

Some sub-regions are recognized in the principal regions, the most important of which is one called the Cumberland. This covers the southern portion of the Appalachian chain situated in East Tennessee, and the adjoining portion of North Carolina, with an offshoot into the mountains of West Virginia. It is in this sub-region that we find the largest number of species of land shells in any portion of North America, or ninety in all. Of these, twenty-four are peculiar to it, while sixty-six inhabit other portions of the interior region. It is equally prolific in individuals, which, too, are highly developed. This is explained by the nature of the country, which consists of low mountains, thickly wooded, well watered, and with a genial climate and fertile soil. A peculiar feature of this Cumberland region consists in the tendency to carination of a large number of its species.

It is in the interior region alone, according to Mr. Binney, that we have any evidence of the existence of land mollusks in former geological times, immense numbers of shells occurring in the post-pliocene deposits of the Ohio and Mississippi Rivers.

In regard to the origin of the land shells at present found in North America, Mr. Binney believes that a small group has been received from the circumpolar regions, certain species existing that are common to America, Europe, and Asia. He thinks a long period of time has been required to effect their distribution over the continent, and that they are not a recent addition to our fauna, but may antedate the creation of our strictly American species.

The southern region exhibits evidences of immigration from other faunas, Florida possessing West Indian and South American species, and Texas having many from Mexico. He, however, finds evidence of a distinct creation in regard to a large portion of our Southern fauna in the way of numerous entirely peculiar species. He can account for the characteristics of the American fauna in the Eastern province only by the admission of a distinct creation, dating back at least as far as the post-pliocene times, since which period scarcely any change has occurred. Little can be said as to the origin of the fauna of the Central and Pacific provinces, although Mr. Binney finds reason, even there, to imagine a distinct creation. A great number of American land shells have been introduced into the country by the agency of man.

INTRODUCTION OF LAND SHELLS INTO SCOTLAND.

An interesting experiment has lately been made in Scotland, under the auspices of the Perthshire Society of Natural Science, in the way of acclimatizing sundry species of land shells, about seven thousand living specimens of *Helix virgata*, *Helix pisana*, and *Bulimus acutus* having been turned out during the summer of 1872.—12 *A*, *August* 7, 1873, 294.

HABITS OF BLACK BASS.

A writer in the Germantown *Telegraph* communicates some interesting facts in regard to the breeding habits of the black bass, as observed by him in the Delaware River and elsewhere. He remarks that as the time for spawning draws near, the male and female fish come together in pairs, each pair having a separate spawning-ground. A gravel bottom is usually selected which is free from sticks and stones, which is cleared for a space of about two feet in diameter, readily recognized by its clean, regular appearance. When the eggs are deposited and impregnated by the male, both watch with great assiduity over the bed, driving off every intruder. When the eggs are hatched, the entire family moves away, the parents attending upon their young until able to take care of themselves, when they drop away one by one. The writer remarks that he has seen a bass an inch and a half long with a fish three fourths of an inch long in its mouth. Their growth is very rapid, being as much as from two to four inches in a month. The author having watched some in a stream recently stocked with them, was able to appreciate their increase in size from week to week. They reached the length of five or six inches by autumn.—*Germantown Telegraph, July* 30, 1873.

ORIGIN OF NERVE FORCE.

Mr. A. H. Garrod has published an article in *Nature* upon the "Origin of Nerve Force," in which, after referring to the deficiency of our knowledge respecting the source of the current which traverses the nerves, and is brought into play through the instrumentality of its several parts, he states that it is almost universally acknowledged that the current itself is electricity in some form; but whence it is derived few have ventured to decide. The question is more difficult than it would otherwise be from the fact that, in all those animals which exhibit external electrical phenomena to any extent, as the Torpedo and Gymnotus, there are elaborate special organs for the development of the shocks which they produce; but nothing of this character can be detected in man or other animals whereby an electrical current could originate; and although the brain and ganglia are often compared to the batteries of a system of electric telegraph, how they could act, if this were so, it is impossible to explain. The available source of energy capable of giving rise to the nerve current is yet unrecognized; but this, according to Mr. Garrod, is to be found in the differences of temperature between the interior and the surface of the living body. This difference is, itself, a source of power; and in hot-blooded animals there is always a considerable discrepancy in that between the surface and the interior; there being a regulating action of the skin, by which a uniform internal temperature is maintained in the latter, always hotter than the surface, whatever that of the external medium may be. In cold-blooded animals, the temperature of the interior is but slightly different from that of the water or air in which they live; but that it must be higher is evident from the fact that destruction of tissue is continually going on in their bodies, which is always necessarily attended with the evolution of heat.

The only assumption involved in this hypothesis of the origin of the nerve force is that a thermo-electric current can be generated between soft tissues of different composition or structure. Mr. Garrod calls upon physicists to decide this question experimentally, and thus prove, or disprove, his hypothesis. He considers the nervous system perfectly suited to the distribution of a current so generated, there being two sets of conductors: the one to carry the currents from the skin to the central organ, which arranges the direction they must take; and the other to send them on to their destination. These are found in the afferent and efferent nerves. No return current or conductor is necessary, since the termination of the nerves in the skin, where they lose their insulated coverings, places the extremities of the afferent and efferent nerves in communication through the intervention of the mass of the body tissues.

This hypothesis, in Mr. Garrod's opinion, explains some of the special phenomena of the nervous system. Thus it is well known that the impulse to action is much more powerfully felt in cold weather than in summer, when the air is hot and the temperature of the surface is higher. Again, in a hot-water bath, where the temperature is nearly that of the body, great lassitude is experienced, in consequence, as is suggested, of the cessation of the nerve current, consequent on the approximation of the temperature of the surface of the body to that of the interior. This faintness is immediately removed by the application of a cold douche.

When great muscular exertion is to be sustained, as in running or rowing, the clothes must be very thin, as instinct teaches us that the surface of the body should be kept cool. As the termination of the nerves in the skin must correspond, on this hypothesis, with the cooled end of the thermo-electric battery, the brain, which is well supplied with blood, and is the part of the body to which most of the nerves are directed, must be compared with the heated end; and as, by the conversion of heat into electric current, the nerve force is developed, it is evident that heat, to a certain extent, must disappear, as such, in the brain, and that that organ must be colder than the blood which enters it. This is precisely in accordance with the observations of Dr. John Davy in the case of the rabbits he experimented upon, the results of which have never been shown to be incorrect.—12 *A*, *July* 31, 1873, 265.

CONDITION OF THE LIVER DURING LACTATION.

Investigations with various animals, by L. de Sinety, show that there is a peculiar fattiness of the liver which begins, continues, and ends with lactation, and is independent of the period of pregnancy; and that the fat is deposited in portions of the liver entirely different from those in which it occurs as the result of infiltration, degeneracy, or artificial processes. In the former case, the fat is found, for the most part, in the cells adjoining the central vein, very seldom in the external ones; while in the latter the process of deposition is from the exterior toward the interior. This localization of fat deposit was most decided in the livers of the human subject, and in dogs, and less so in the herbivora.—28 *C*, *March*, 1873, 141.

THE BLOOD CORPUSCLES OF THE BATRACHIANS.

Mr. George Gulliver has lately published a table of measurements of the red blood corpuscles of Batrachians, from which we learn that the animal possessing those of largest dimensions is the *Amphiuma tridactylum* of the Southern Atlantic States, in which the longest diameter of the corpuscle is $\frac{1}{363}$, and the shortest $\frac{1}{615}$ of an inch. The next to this is the *Proteus anguinus*, in which the longest diameter is $\frac{1}{400}$, and its shortest $\frac{1}{727}$ of an inch. Measurements are given of the blood corpuscles of various other species of salamandroids, as also of frogs and toads; and Mr. Gulliver generalizes upon his observations as follows:

1. The largest red blood corpuscles belong to the *Proteidæ*, and the largest of all to *Amphiuma* of this family.

2. The smallest corpuscles occur in frogs and toads; and the smallest of all in some species of *Bufo*, though the common toad has slightly larger corpuscles than the common frog.

3. The corpuscles are much larger, without exception, in the Urodela (tailed) than in the Anura (tailless batrachians).

4. The difference between the corpuscles of *Siredon* and *Lepidosiren* is scarcely appreciable (or naught), save that the nucleus is smaller in the former.

5. *Amphiuma* and *Sieboldia*, both caducibranchiate spe-

cies, have much larger corpuscles than the perennibranchiate *Siredon*.

6. The corpuscles are not so large in *Sieboldia*, which is the largest species, as in *Amphiuma* and *Proteus*, which are much smaller species; and so, too, of *Triton* and *Lissotriton*.

The conclusion of Rudolph Wagner, that the largest size of blood corpuscles related to the persistency of the gills in the salamandroids, is not borne out by the observations of Mr. Gulliver. He finds they are largest in *Cryptobranchus* and *Amphiuma*, both of which have gills only when young, losing them at an early age. Neither is there any relation between the size of the species and the size of the corpuscles, since these are larger in the little *Proteus* and *Amphiuma* than in the gigantic *Sieboldia*. Although Mr. Gulliver has previously shown the existence of such a relation in one and the same order of mammalia and birds, the rule does not apply to the group of vertebrates just referred to.—11 *A*, 1873, 163.

ABSOLUTE AMOUNT OF BLOOD IN ANIMALS.

An investigation has lately been made by Steinberg in reference to the absolute amount of blood in various animals, as the result of which we learn that the relative weight to that of the entire body in the rabbit is as one in twelve to thirteen; in the guinea pig, one to thirteen; in dogs, one to eleven; in puppies, one in sixteen to seventeen; in cats, one in ten to eleven; and in kittens, one in seventeen to eighteen; showing a much less percentage in the young of cats and dogs than in adults.—21 *A*, *June*, 1873, 646.

ON COLOR BLINDNESS.

Professor Dor describes various experiments to settle the question as to the nature of color blindness. The method that he uses most frequently is that of viewing spectral colors with a polarization prism. Dor rejects the theory of Young and Helmholtz, that supposes three elements in the retina, namely, those that respectively perceive red, green, and violet or blue colors. He objects to this view on the ground both of absence of anatomical proof, and, again, because of the distinct vision of many of those who are afflicted with color blindness; and, again, because the spectrum, as observed by two persons that came under his notice who had no perception of red or violet, was of normal length. He finds that all those pathologically color blind suffer from atrophy of the optic nerve by reason of cerebral or spinal injuries, the atrophy being of a peculiar nature, such that the fibrous and cellular layers of the retina and the optic nerve to the brain were atrophied, but not the so-called rods and cones. In retinal diseases, on the other hand, the perception of colors is not perverted, though diminished. Dor therefore concludes that color blindness is a cerebral affection.—12 *A*, 1873, 375.

THE INJURIOUS INFLUENCE OF COMPRESSED AIR ON THE HUMAN ORGANISM.

It is well known that in many engineering enterprises it is necessary for men to work beneath the earth in an atmosphere of compressed air, whose influence upon the health and life has frequently been considered as highly injurious; while by others it has been maintained that the influence is not necessarily injurious. A series of exact experiments on this subject has been made by a number of French and German physicists, whose conclusions may be summed up as follows: All observers of the influence of compressed air agree that the sufferings connected therewith depend less upon an increased pressure than upon a sudden return from a compressed atmosphere into the normal air, whereby the blood that has been strongly compressed in the membranes of the body is too rapidly driven to the lungs and the heart, and causes injurious hemorrhages. It is important now to determine what rules shall be adopted whereby accidents from this source may be lessened.

First. The laborers in compressed air should be only sound and strong persons, having especially strong lungs.

Second. The compression of the air in the working-chamber should be gradual, so that the maximum compression is reached fifteen minutes after the workman enters the chamber.

Third. The compression of the air should not exceed three atmospheres.

Fourth. The time during which the workmen continue in the chamber should not exceed four hours.

Fifth. The men should be provided with water-proof boots and woolen stockings, to protect their feet from the cold and the wet.

Sixth. When the workman comes from the chamber of compressed air, he should enter into an intermediate chamber, in which change from compressed to normal air should take place gradually during the space of about fifteen minutes.

Seventh. The workman should, before passing from the warm air of the chamber to the cold air, exchange his damp clothes for those that are warm and dry.—*Technische Blätter Vierteljahrschrift, Bohemian Polytech. Assoc.*, 1872, 32.

FOOD OF THE BASKING SHARK.

Among the sharks inhabiting the northern seas, the Basking Shark (*Selache maximus*) occupies a very prominent place on account of its enormous size — individual specimens of thirty to forty feet in length being not at all uncommon, and exceeding in size any others of the group with which we are familiar. It is said that sharks over sixty feet in length have been found in the vicinity of the Seychelles and Philippine Islands; but nothing approaching that size is seen in the basking shark of Europe and North America.

With all its great bulk, the animal is provided with extremely minute teeth, so small, indeed, as to indicate a different mode of life from that of the ordinary species. Its inoffensive nature is well known, as it is constantly hunted for the oil of its liver; and it is never found to make any resistance when disturbed, much less to attack man spontaneously.

Naturalists have long since observed a peculiar sieve-like apparatus in the mouth, resembling a comb with very long teeth, the precise function of which has not been well established.

Dr. J. S. Steenstrup, the eminent Danish naturalist, however, has lately come to the conclusion that the animal feeds upon minute crustaceans and other objects; and the general results of his inquiry are ably summed up by *The Academy* as follows: 1. The basking shark has the interior of its mouth furnished with a fringe or branchial mesh, which presents the appearance of small rays like whalebone, about five or six inches in length. These meshes are situated along the enormous branchial slits, and serve as a strainer to collect particles of food. 2. This branchial fringe is of the same nature as the ray-like bodies so long preserved in the museums of Copenhagen, Kiel, Christiania, and Trondhjem. 3. The existence of this sieve-like apparatus indicates, with certainty, that the mode of life of this shark resembles that of the whalebone cetaceans; and that, so far from its being a fish which is dangerous from its carnivorous propensities, it lives on small animals, caught in masses by means of this sieve. 4. The presence of these rays and their teeth-like structure furnish quite peculiar generic characters to *Selache*. 5. The form and nature of these branchial rays show that the genus *Selache* existed in the seas of Europe at least in the tertiary period, as the *Hannovera aurata* of Van Beneden has been found in the Belgian crag. The similarity, in habits, of this shark to the great *Rhinodon typicus* of the tropics, as described by Dr. Percival Wright, is alluded to by Steenstrup, who likewise very justly suggests that the food of both fishes is of the same nature.—13 *A*, *July* 15, 1873, 269.

DETERMINING SEX IN BUTTERFLIES.

A paper was recently published in the *American Naturalist* by Mrs. Mary Treat, in which she attempts to show that whenever lepidopterous larvæ are deprived of food, or this is stinted in amount, in the interval between the last two stages, males are produced in most cases; but when the food is regularly supplied, and in quantity sufficient for the wants of the larvæ, the opposite sex is almost invariably produced. These observations are indorsed and supplemented in a paper by Mr. Thomas G. Gentry, as published in the proceedings of the Academy of Natural Sciences of Philadelphia, his conclusions having been suggested by having confined a number of larvæ of *Attacus cecropia* in a box, and neglecting to supply them with food for four days. These larvæ had advanced toward their final change, possibly within a week or ten days, when, on opening the box, the greater number were found to be concealed within cocoons; the remainder wandering about, as if seeking some opening by which to escape. These were at once removed to another box and provided with nutriment, upon which they immediately commenced feeding. In a few days they began to assume the chrysalis form; and after several weeks Mr. Gentry was surprised to find that those which changed first proved without exception to be males, while the last lot, consisting of a dozen cocoons, were, with only two exceptions, females.

This suggested to him further experiments in the same direction, as the result of which he came to the conclusion, first, that males are the invariable result when the larvæ are fed upon diseased or innutritious food; second, that in the fall of the year, when the leaves have become deprived of their usual amount of sap, males are generally produced; third, that more males are produced late in the season than females; fourth, that the sexes in early life can not be distinguished; or, in other words, that there would appear to be no such distinction as male and female, the change being brought about late in life through the medium of nutrition.

These facts are in corroboration of a simple law announced by Mr. Thomas Meehan in regard to the vegetable kingdom—namely, that sex in plants is the result of grades of vitality, or, as suggested, viability; and that this power of life is a mere matter of nutrition, the highest grades of vitality, only, producing the female sex.

In the same number of the proceedings of the Academy Mr. Meehan furnishes an additional illustration of this fact as the result of experiments upon the common black walnut (*Juglans nigra*), which satisfied him that there is not so great an expenditure of vital force in the production of male as of female flowers.—2 *D*, 1873, 283–290.

DISTRIBUTION OF CALIFORNIA MOTHS.

In an article upon the distribution of the California Moths, communicated by Dr. A. S. Packard to the Boston Society of Natural History, and published in the *American Naturalist*, some interesting conclusions are derived from a study of the subject, which strongly corroborate the views of Professor Gray, in regard to the distribution of plants, as presented by him in his address before the recent meeting of the American Association at Dubuque. The *Phalænidæ* of California, according to Dr. Packard, appear to be composed of four elements: first, of species of genera exclusively American (North and South); second, species of genera which occur in Europe, especially in Southern Europe around the Mediterranean Sea, Western Asia, and Asia Minor, and even on the Pacific in South America. This is the most characteristic of the fauna, next to number one. The third group comprises a few arctic and circumpolar species of cosmopolitan genera. The fourth group embraces species common to both the Pacific and Atlantic States.

A careful inquiry into the facts has led Dr. Packard to the conclusion that, among the Lepidoptera at least, there is the same close relationship between the fauna of California and Europe as has been noted in other groups of animals, as well as of plants; Eastern America, on the other hand, being more closely related to Eastern Asia than it is to Western America. Similar facts have been observed in regard to the Neuroptera and the Crustacea—*Limulus* being found only on the eastern side of Asia and America; and, while the European *Astaus* belongs to California, *Cambarus* occurs only east of the Rocky Mountains.

The fishes of Eastern Asia and Eastern America show a closer relationship than those of the two sides of the American continent, as do the batrachians and reptiles of Northeastern Asia and Northeastern America. It is, however, in the plants that these relationships can be most distinctly indicated; and the theory suggested by Professor Gray, and adopted by Dr. Packard, is to the effect that co-specific or co-generic forms in California, Europe, and Asia are the remnants of a southward migration from polar tertiary lands, during tertiary, and even, perhaps, cretaceous times; and, in proportion to the high antiquity of the migrations, there have been changes and extinctions causing the present anomalies in the distribution of organized beings which are now so difficult to account for on any other hypothesis. For this reason, Dr. Packard thinks it not improbable that those species of insects which are more or less cosmopolitan are the most ancient; and that the anomalies in the distribution of *Limulus* accord with its isolation from other crustacea; geological extinction having gone hand in hand with geographical isolation. The *Limulus* was a common form in Europe in the Jurassic period; and in the next lower (the Permian), we find other forms of the same group and some Trilobites. Dr. Packard expects much light to be thrown upon this subject by the careful study of the tertiary deposits of the West, and of the arctic tertiary and cretaceous formations.—5 *D*, *August*, 1873, 453.

PAVONARIA BLAKEI, A NEW ALCYONOID POLYP.

Much discussion was excited some time since in regard to the precise character of certain transparent switches, or rods, found on the western coast of North America; and although considered by some as the vertebræ of fishes, they were generally believed to belong among the invertebrates. The best authorities, however, agreed in considering them as a species of alcyonoid polyp. Mr. R. E. C. Stearns, of San Francisco, having lately obtained some fresh specimens from the Gulf of Georgia, thinks them a new species of a genus *Pavonaria* (Cuvier)—an alcyonoid polyp belonging to the group *Pennatulidæ*, and named by him *P. Blakei*. The most perfect specimen examined by him was five to six feet in length.—*California Mining Press, July* 31, 1873, 265.

ENTOZOA AND ENTOPHYTA IN MAN.

At a meeting of the British Medical Association in London, the President, Sir William Fergusson, referring to the present state of our knowledge on the subject of entozoa, calls attention to the recent discovery of the occurrence in the human blood of immense numbers of a nematoid worm, the most remarkable feature being the apparent harmlessness of the affection, the existence of thousands at a time in the system appearing to do but little injury. According to Dr. Lewis, persons infested with these worms must have had them for years, and still seem to be in good health, and exercising all their customary avocations. He inquires why it is that they do not cause an obstruction of the system, or abstract the nutriment that the body should possess; what becomes of them when they die; where they decay, etc.; and says that these and other points require further investigation for their determination.

Another subject referred to by Sir William Fergusson was that of diseases, chiefly of the skin, caused by cryptogamic plants, paralleled by other forms (such as the itch) produced by animals. He finds that many affections previously obscure are now better understood, and are attributable to the presence of bacteroid bodies, provisionally assigned to the vegetable kingdom. He thinks that it is certain that these minute cells, penetrating from without by surface wounds, or perhaps by the intestinal surface, pass into spaces or blood vessels (on the walls of which they colonize and live); or enter living cells and are carried to distant parts of the body, growing there, and blocking the vessels, causing a sort of embolism; or else they adhere to and grow on the valves of the heart, and may, in one way and another, cause various diseases, and in some cases originate a disease which is fatal in a few days' time. He thinks, therefore, that as there has been a disinfecting surgery, we shall soon have a disinfecting medicine, for the purpose of accomplishing the destruction of these insidious enemies.

Another obscure disease, which must be referred to some organic cause, whether animal or vegetable, is the painful and obstinate sore known in India as the Delhi or Damascus boil, and in Syria as the Aleppo evil. This, which is widely spread in the East, affecting men and dogs, though not fatal, is yet in the highest degree harassing and troublesome. To Dr. Fleming we owe the discovery that a constant element of the ulcer is a small cell, which is presumably of animal origin, containing nuclei, and growing remarkably fast. The substance from this cell, which will reproduce the disease almost invariably, is very tenacious of life, and resists all the ordinary chemical elements; the common modes of treatment having proved ineffectual. Dr. Fleming has found, however, that if the cells are treated with *potassa fusa*, the sores will be cured as if by magic. This application is said to be an infallible one; and the discovery is such as to entitle Dr. Fleming to the thanks of millions who have been affected by the disease or are liable to its attacks.—20 *A*, *August* 9, 1873, 151.

TERRESTRIAL MOLLUSCA IN THE BAHAMAS.

In the last number of the annals of the Lyceum, N. Y., is a paper by Mr. Thomas Bland, "On the Physical Geography of and the Distribution of Terrestrial Mollusca in the Bahama Islands." The author describes the banks and islands of which the Bahama group consists, the principal being the Little and Great Bahama Banks, the Crooked Island, Caicos and Turk Islands Bank, and Great Inagua. He shows that the number of species of terrestrial mollusks found on the islands is about eighty, of different genera, and all, with one exception (*Schasicheila*), represented in the West India

Islands on the northern side of the Caribbean Sea. It appears that no less than fifteen species are common to the Great Bank and Cuba, of which nine occur also in Florida, while the more easterly of the Bahamas (Turk Islands and Inagua) have, in common with Cuba, four species only. The latter islands, the distribution both of genera and characteristic species considered, are proved to have relations with Hayti rather than Cuba.

One species of a genus (*Polygyra*), which has its chief development in the Southern States, is found in Bermuda as well as in certain of the islands on the Great Bahama Bank.

In a former paper Mr. Bland argued, from the distribution of the land shells, that the West India Islands on the eastern side of the Caribbean Sea (from Trinidad to the Antigua Bank) are the remains of an ancient northerly prolongation of the South American continent. In the present paper he contributes evidence in support of the suggestion of Professor Dana, that the peninsula of Florida, Cuba (with the islands to the eastward of it), and the Bahamas, all were once a part of a greater Florida, or southeastern prolongation of the North American continent.

ON THE NATURE OF APTYCHUS.

As is well known to paleontologists, the fossil remains known as *Aptychi* have of late been almost universally conceded to be in some way connected with *Ammonites*, but whether as opercula, jaws, or otherwise, has been in dispute. Some excellent naturalists have adopted the belief that they represented the jaws of the living *Nautili;* since, on the one hand, they had a general correspondence with the jaws, and, on the other hand, the nautili had no other hard parts at all analogous to them. But of late the proofs of their belonging to some other part of the organization have accumulated, and it has recently been urged, with a strong degree of probability, that they were closely connected with the nidamentary glands in the female *Nautilus*, and in reality constituting protecting organs of those glands. This view, first enunciated by the late Professor Keferstein, has been strongly supported by Zittel, Waagen, and Favre, and has the merit of being based on a comparison with the structures of the recent *Nautilus*. Although, as already remarked, there are no hard parts in the latter, the nidamentary gland is situated on the siphonal side of the outer chamber of the shell, above the adductor muscle, and outside of the ring of adherence, which last leaves an impression in the shell. In the ammonites of the Solenhofen limestones (the tranquillity of the deposition of the sediments having favored preservation), similar impressions have been found; they begin at the margin of the aperture, toward the middle of the sides, follow the spiral of the shell backward toward the septum, and finally bend toward the siphonal wall; the *Aptychus* is above and outside of this impression (*i. e.*, nearer the siphonal side), as is the nidamentary gland in *Nautilus*, and this position is in the strongest degree suggestive of the nature of the organism in question, that is, that it serves as covering the nidamentary gland.

Professor Waagen, assuming as proved this relation, avails himself of the presence or absence (for it is not present in all *Ammonites*) of the *Aptychus*, and its several modifications, for the distribution of the *Ammonitidæ* into sections, and subordinates the genera admitted by late naturalists in the following manner:

A. Nidamentary gland, without solid integument (*i. e.*, without *Aptychus*):

Phylloceras Suess, *Lytoceras* Suess, *Arcestes* Suess, *Pinacoceros* Mojsis, *Trochyceras* Laube.

B. Nidamentary gland, with a solid integument (*i. e.*, with *Aptychus*).

I. Gland simple, not divided:

1. Integument horny (*Anaptychus*). *Arietites* Waag., *Ægoceras* Waag., *Amaltheus* Montf.

2. Integument calcareous. *Aptychus numida*, Coq. Shell unknown (*Sidetes* ?).

II. Gland double, with the *Aptychus* calcareous:

1. *Aptychus* possessing furrows on the external side: *Harpoceras* Waag., *Œkotraustes* Waag., *Oppelia* Waag., *Haploceras* Zitt., ? *Scaphites* Park.

2. *Aptychus* thin, granulated externally: *Stephanoceras* Waag., *Perisphinctes* Waag., ? *Peltoceras* Waag., *Cosmoceras* Waag.

3. *Aptychus* thick, smooth, and punctated externally. *Simoceras* Zitt., *Aspidoceras* Zitt.

The genera here noticed are distinguished by the size of the chamber (long or short), the character of the margin of the aperture, sculpture, and umbilicus.

BIRD COLLECTIONS IN LONDON.

A large number of the best private collections of birds in London have been concentrated at No. 6 Tenterden Street, Hanover Square, which will probably become hereafter the head-quarters of the active London ornithologists. Among these collections is a very valuable one of the birds of the Old World and of North America, belonging to Mr. Henry E. Dresser; also the American collection of Messrs. Salvin and Godman, and the Old World series of Lord Lilford and Captain Shelley. This location is also in close proximity to the offices of the Zoological Society, where the secretary, Mr. Sclater, keeps his unrivaled collection of New World species.

BRIGHTON AQUARIUM.

The sea-water aquarium at Brighton, England, has been a great success from a commercial point of view, a result no doubt due in part to the extraneous attractions, in the form of concerts, etc., introduced by the directors. The geological department, however, has not been neglected under the able management of Mr. Henry Lee, and the supply of new animals, many of them of wonderful form and habit, has been a perpetual source of attraction to the visitors. They have now several porpoises, and the octopus has bred freely in confinement.

HUMAN FOSSILS FROM THE LA PLATA.

Gervais reports that among some collections made in the Argentine Republic by M. Seguin there are some human bones in association with the bones of extinct mammalia. He promises soon to give a detailed account of them.—15 *A*, *August*, 1873, 245.

NEW SCAPHIRHYNCHUS IN TURKESTAN.

Among recent discoveries in Turkestan is that of a new species of the sturgeon family, belonging to the genus *Scaphirhynchus*, and has been named by Professor Kessler *S. fedtchenkoi.* This genus is best represented by an American species belonging to the Mississippi River and its tributaries, and one much sought after by foreign museums. A second species was secured on the recent Khivan campaign.—13 *A, November* 1, 1873, 414.

FLIGHT OF URANIA LEILUS AT PANAMA.

The Panama *Star and Herald* of June 25 announces the usual migration of the brilliant butterfly *Urania leilus*, and which were so abundant as to appear in their flight like dried leaves driven by the wind. As usual, their course was from west to east; but whence they came and whither bound has not been ascertained. All the females caught were nearly full of eggs.—*Panama Star and Herald, June* 25, 1873.

AN AQUARIUM FOR CENTRAL PARK.

The New York papers have contained quite a number of articles urging the propriety of establishing an aquarium in Central Park, equal to that of Brighton, in England. It is much to be hoped that measures will be taken at an early day for accomplishing this object. There is nothing more attractive to the public than a well-arranged establishment, where the different marine objects may be seen in their native element. Distorted stuffed skins, or shriveled and offensive preparations in alcohol, give but a very inadequate idea of the appearance of the living objects which they attempt to represent. If the Central Park authorities are unwilling to go to the expense of erecting an establishment of this kind, it may not be amiss for them to authorize it to be done by private enterprise, a small fee being charged for admission. The Brighton Aquarium, the largest and most elaborate yet erected, is a pecuniary success, and there is no doubt that, in a city like New York, the number of persons who would visit such a collection would be ample to support it on a large scale, as it would be especially attractive to children, and a means of education, by object-teaching, of the greatest value. New York is favorably situated for securing all the varieties of animal life belonging to the sea. An abundance of water can, of course, be readily obtained, while the fishing vessels could easily be engaged to bring in some of their most interesting captures, these to be supplemented by the results of a special mission for the same object. The services of the

United States Fish Commission could doubtless be secured toward the same end, the very complete apparatus used in its service frequently capturing in a single day what would fill a large number of tanks. We trust, therefore, that this idea will not be lost sight of, and that at an early date we may have the pleasure of chronicling the erection and successful operation of the New York Aquarium.

REPORT OF THE CENTRAL PARK MENAGERIE.

The report of the Central Park Menagerie for the year ending May 31, 1873, has been published by its director, Mr. William A. Conklin, and presents satisfactory evidence of the growing favor evinced toward this interesting and important appendage of the Central Park, and of its excellent management. We learn from it that the number of species as well as of specimens received during the past year is much greater than heretofore, and that the total footing is 806 animals, an increase of 205. While some of these were only on temporary deposit, of the permanent collection of the Park there were 199 quadrupeds, 347 birds, and 35 reptiles. Among the births in the museum there were two lions, one leopard, two pumas, one camel, and one hyena.

A notable feature of the museum, during the winter season especially, consists in the presence of many large and rare animals deposited by Messrs. Barnum, Bailey, Rich, Van Amburg, Reiche & Brothers, and others. Among those kept for Mr. Barnum are two giraffes, two sea-lions, one manatee, and one Malayan tapir. A complete list of the vertebrates exhibited in the Park, giving both the scientific and popular names, adds greatly to the value of the report, and shows that, considering the small amount of money that is available for the purpose, the director is to be congratulated upon the success with which his trust has been administered.

THE GARDENS OF THE ACCLIMATATION SOCIETY OF PARIS.

It may be remembered that among the notable results of the siege of Paris by the Germans was the injury done to the garden of the Society of Acclimatation in the Bois de Boulogne, most of the animals contained therein having been killed, either as food for the people or as absorbing too much of what was necessary for the sustenance of the community.

After the return of peace, a subvention of $36,000, payable in three years, was made by the Municipal Council of Paris to the society, and this timely contribution, administered with judgment by M. Geoffroy Saint-Hilaire, the director of the establishment, has resulted very satisfactorily. On the 1st of January, 1872, the buildings contained 121 mammals, 853 birds, 94 cocks and hens, and 138 ducks and geese, or a total of 1206, valued at $9060. A year later, on the 1st of January, 1873, the collection embraced 510 mammals, 3217 birds, 503 cocks and hens, and 1916 ducks and geese, or a total of 6146, valued at $31,672.—10 *B*, *January*, 1873, 72.

CATALOGUE OF RHODE ISLAND MOLLUSCA.

A catalogue of the shell-bearing mollusca of Rhode Island has lately been published by Mr. Horace F. Carpenter, and has special reference to the collection in the museum of the Franklin Society of Providence. According to this catalogue, there are in the state 36 species of terrestrial mollusca, 39 of fluviatile, and 131 of marine, or a total of 206.

THE MUMMIED HEADS OF THE PERUVIAN INDIANS.

Among the most curious objects in certain ethnological museums (that of the Smithsonian Institution at Washington included) may be mentioned a peculiar form of human head, as diminutive in size as that of a monkey, the general features well preserved, the hair long and dense, and the lips usually sewed together with a large number of cords, which hang down from them. Tufts of feathers and other objects are frequently used for the embellishment of the preparation. On examination it will be found that this head is composed exclusively of the skin, all the bones and flesh having been removed, but the precise mode of preparing this has for a long time been a puzzle to every one.

Quite recently Mr. Buckley, an English traveler in the Andes, took back with him to England several specimens of these objects, and explains the mode of preparation. According to his statement, the head is removed from the body, and, after being boiled for some time with an infusion of herbs, the bones, brain, etc., are taken out through the neck. Hot stones are then put into the hollow, and as they cool they are continually replaced by others. The head is by this process contracted, and the skin reduced to the size desired. A string is then run through the head, which is suspended in the hut, and solemnly abused by the owner, who is answered by the priest, speaking for the head, after which the mouth is sewed up to prevent any chance of a reply. This abuse is repeated on feasts and on any special occasion. The heads are essentially trophies of victory, corresponding to the scalps of the North American Indians, being usually those of enemies killed in warfare.

The tribe among which this mode of preparing human heads is practiced is that of the Macas, as well as sundry sub-tribes occupying the country immediately on the eastern side of the Andes, a few degrees south of the equator. The head in the National Museum is from one of the sub-tribes called the Jibaros.—*Jour. Anthrop. Institute*, III., 30.

FOSSIL CORALS OF THE EOCENE OF THE WEST INDIES.

In a paper on the fossil corals of the eocene formation of the West Indies, Professor Duncan states that the affinities and identities of the fossil forms with those of contemporaneous reefs in Asia and Europe, and the limitation of the species of the existing Caribbean coral fauna, establish the correctness of the views put forth by S. P. Woodward, Carrick Moore, and himself concerning the upheaval of the Isthmus of Panama after the termination of the miocene period.—16 *A*, *October*, 1873.

NUMBER OF AMERICAN BIRDS.

Messrs. P. L. Sclater, secretary of the Zoological Society of London, and Osbert Salvin, editor of the London *Ibis*, have commenced the printing of their long-contemplated catalogue of birds of America south of the United States. This will be of great value to ornithologists in view of the zoological accomplishments of the gentlemen mentioned, and the richness of the material to which they have access. In their own private collections are embraced nearly all the birds enumerated in their catalogue, the percentage of desiderata being very trifling. The catalogue is arranged in systematic order, the species of each genus being enumerated under it, with an indication of the locality. Of the family of Tanagers alone the authors enumerate 306 species, of which they possess specimens of all but twenty-three. The catalogue appears in small folio, about the size of an English Blue-Book, and is provided with ample margin for manuscript notes. The total number of species to be enumerated by them is 3565; and allowing 435 for those not occurring south of the United States and for undescribed species, we will have 4000 as an approximate estimate of the bird fauna of the New World.

ETHNOLOGY OF THE PEAT BOGS.

At a recent Congress of Prehistoric Anthropology held at Brussels Mr. Steenstrup made a communication upon the peat bogs of Denmark, in which he remarked that these have been divided into three classes, according to the plants which have principally contributed to form the different layers—namely, the Skovmoser, or forests; the Kjaesmoser, or prairie bogs; and the Lyngmoser, or the bogs composed of moss or heath.

The Skovmoser are those which are of most interest, since we can find in them layers superimposed one upon another, which can even permit us to determine the epoch of the animals which have perished in the peaty mud. The layers found near the exterior are usually in the best condition, as they are usually in their natural position, having escaped the changes that have acted upon the centre. Here we find the remains most characteristic of the forest in the following order: first, the aspen (*Populus tremula*); second, the pine (*Pinus sylvestris*); third, the oak (*Quercus sessiliflora*); fourth, the alder (*Alnus glutinosa*); fifth, the beech (*Fagus sylvatica*). This last grows to-day throughout Denmark.

These facts have, of course, long been known; but quite lately Nathorst has found that beneath the layers already mentioned occurs an arctic flora, composed of *Betula nana*, *Dryas octopetala*, *Salix herbacea*, etc. These latter deposits are not of fluvial origin, but have been formed by water filtering across the walls of the basin, and are all of a local vegetation; so that we have a local series of layers marking all the modifications of the Danish climate. The arctic flora corresponds to that of the southern boundary of Lapland, or that of the sea-level of Denmark. At present flint implements have only been collected in the layers of the *Pinus sylvestris;* but Mr. Steenstrup has found them in layers of the arctic flora. He has found bones of the reindeer several times, but only in the lower layers. The moose occurs also both in these and in the upper layers.

CURIOUS FISH.

Considerable interest has been excited by the announcement of the capture, by Seth Green, equally famous as fisherman and pisciculturist, of a huge fish in Chautauqua Lake, which the newspapers of the interior of New York find it difficult to classify. They describe it as six feet in length, and weighing 134 pounds; as having one back and three belly fins, a head of remarkable construction, a mouth opening far back, and wide enough to receive a nail cask. The inside of the mouth is said to be covered with a species of coarse hair, resembling the small feathers or down of an ostrich. Projecting from the upper jaw is a species of shovel blade, which it is thought must have been intended for throwing food into the mouth. As the fish has no teeth, it was supposed to subsist upon animalculæ or other substances floating in the water.

The notices proceed further to state that there is no fish described as belonging to the lakes at all resembling the one referred to; and what it is, and how it got into the lake, are questions extremely puzzling. But the solution of the mystery seems to be exceedingly simple. The fish is nothing more than the well-known paddle-fish of the Mississippi basin, or the *Polyodon folium* of naturalists—an ally of the sturgeon, and a species of great interest, being much sought after by foreign museums on account of its zoological and paleontological relationships. It is, however, quite abundant in the Mississippi and Ohio, being sometimes captured in considerable numbers, though not very often of the size of Seth Green's specimen.

The occurrence of the fish in Chautauqua Lake is not particularly remarkable, as that is one of the sources of the Alleghany River, from which it could readily enter the lake.

THE CLASSES OF VERTEBRATES AND THEIR RELATIONSHIP.

At the meeting of the National Academy of Sciences, held in New York on the 28th of October, 1873, Professor Gill made a communication on the number and characteristics of the classes of Vertebrates, and their various degrees of relationship.

The mind, untrained in scientific logic (he remarked) in its generalization respecting the animal kingdom, instinctively associates its subjects into groups determined by the nature of their habitat; and hence we have had the Vertebrates separated into (1) those especially adapted for progression on land (Quadrupeds); (2) those especially fitted for progression through the air (Birds); and (3) those adapted for life in the water (Fishes); while the residue, not readily combinable with either of those classes, are either, as it were, overlooked, or, as the Serpents, annexed as a kind of appendix to the Quadrupeds, because they most resemble certain of those animals—the lizards. It was, therefore, a great advance when Linnæus established a peculiar class (Mammalia) for the viviparous quadrupeds and the whales, and thus for the first time subordinated habitat and adaptation therefor to structure. While at the present day the ancient ideas have almost entirely disappeared from the system of nature so far as regards the terrestrial vertebrates, they are still to a great extent prevalent in the appreciation of the relations of the aquatic ones; for among the vertebrates collectively known under the name of Fishes, there are differences more marked and radical than those between any of the higher classes of the branch. Professor Gill therefore proposes not only to distinguish several classes among the so-called fishes, but to widely remove them, and recombine them as follows:

On the one hand is the lancelet (*Branchiostoma*), distinguished by the extension of the notochord (primitive basis of the back-bone) to the anterior end of the vertebral column, the attenuation of the spinal cord forward, and its simple structure, the absence of auditory organs, the simple tubular structure of the heart, and the development of the liver simply as a diverticulum of the intestine. This type is called by Häckel the *Subphylum Leptocardia* or *Acrania*.

On the other hand are all the other Vertebrates, which agree in the termination of the notochord behind the pituitary fossa, the enlargement of the spinal cord forward into a brain, the development of auditory organs, the division of the heart into (two to four) chambers, which in part (one or two) specially receive the blood, and in part (one or two) specially distribute it to the body again, and the differentiation of the liver as an independent and highly specialized organ. This group is named by Häckel the *Subphylum Pachycardia* or *Craniota.*

The numerous forms belonging to the last "subphylum" are again divisible into two great groups.

In one, the skull has no cincture girdling the mouth, and consequently no lower jaw, there are no pectoral members nor scapular girdle, and there is but one nasal sac, which has a median external aperture. To this section belong the Lampreys and Hags, the representatives of the class of *Marsipobranchs.*

In the other, the skull has a cincture surrounding the mouth, its inferior portion being specialized as a lower jaw; they have (archetypically at least) a pectoral member and a shoulder-girdle developed, and there are two nasal sacs, each having an olfactory nerve distributed to an external aperture. These Vertebrates are again divisible into three groups or super-classes.

1. In the first (*Lyrifera*), the shoulder-girdle forms a lyriform or furcular-shaped apparatus, the scapulæ and their adjuncts of both sides being connected together below along the median line, and an air-bladder (sometimes lung-like) is atypically developed (sometimes, however, atrophied), and (1) either connects with the œsophagus by a single duct or (2) is entirely closed. To this super-class belongs the classes of Fishes and Elasmobranchiates.

2. In the second (*Quadratifera*), the shoulder-girdle is represented by the scapulæ and their appendages, which are limited to the respective sides, a sternum is differentiated, and instead of an air-bladder are two lungs (each with a special canal), which communicate with the pharynx. The lower jaw is compound, and is articulated with the skull by the intervention of a special bone—the os quadratum. In this super-class belong the Batrachians, the Reptiles, and the Birds; the last two forming the group *Sauropsida.*

3. In the third (*Malleifera*), the shoulder-girdle is represented by composite scapulæ, limited to the sides or back; a sternum is differentiated, respiration is entirely effected by highly specialized lungs communicating with a common trachea, and the lower jaw is composed of simple rami, and articulated directly with the skull, the os quadratum of the

other vertebrates being converted into one of the auditory ossicles (the malleus). This super-class is represented by a single class—the Mammals.

Professor Gill declares that the more these groups are studied in all their relations, the more natural do they appear, and concludes with the following exposition of their succession in a descending series:

Branch VERTEBRATA.

A. Sub-branch CRANIOTA.

Super-class MALLEIFERA.

I. Class Mammalia.

Super-class QUADRATIFERA.

(Sauropsida.)

II. Class Aves (Birds).

III. Class Reptilia (true Reptiles).

(Batrachopsida.)

IV. Class Batrachia (Frogs and Salamanders).

Super-class LYRIFERA.

V. Class Pisces (true Fishes).

VI. Class Elasmobranchiata (Sharks and Rays).

Super-class MONORRHINA.

VII. Class Marsipobranchia (Lampreys and Hags).

B. Sub-branch ACRANIA.

VIII. Class Leptocardia (Lancelet).

Pre-eminently the most homogeneous of the classes is that of Birds, all the living representatives of which are claimed to belong to a single order, for which the name Eurhipidura (alluding to the fan-like tail) is proposed.—4 *D*, vi., 432–435, *December*, 1873.

MESMERISM OF ANIMALS.

In a lecture at Leipsic on hypnotism in the lower animals, Professor Czermak first discussed the statement that if a crab be held by the tail with one hand, and the other hand, with the fingers curved slightly downward, be passed over it from the tail toward the head with a stroking motion a certain distance above it, but not touching it, the animal will in a short time fall into the so-called magnetic or mesmeric sleep, and can then be set up vertically on its head and claws; furthermore, that if the movement of the hand now be made in the opposite direction, the magnetism will pass off, and the animal will return to its normal condition. He showed that the so-called magnetizing operation had nothing whatever to do with the condition of the animal, and that a similar state could be induced by hanging it up by a cord tied around its tail. He remarked that the animal is most prone to pass into this somnolence in the fall and winter, and suggested as an explanation of the phenomenon that excitability of the nervous system of the crab is impaired, and the organs of motion are consequently disturbed in their functions, when the animal is placed in such an involuntary and unusual position. He also noticed the well-known fact that if a chicken in a sitting position on a table be gently pressed with one hand upon the supporting surface, the head and bill pressed down with the other hand, and a chalk line drawn from the tip of the bill, the fowl will remain perfectly powerless in the position given to it for some time after the removal of the hands. Professor Czermak found that the chalk line was not essential to the success of the experiment, and also performed it with other birds (as swans), but did not succeed with pigeons. He also ascertained that subjects least accustomed to association with man, and that seemed most unruly before the experiment, pass most rapidly and soundly into the somnolent condition. This phenomenon was explained by Kircher, in 1645, upon the hypothesis that the chicken imagined the chalk line to be a cord holding its bill down after the finger had been removed. As a physiological explanation, a mechanical irritation of the brain and nerves by pulling might at once suggest itself. It is known that certain excitements of exterior nervous apparatus will often exert a decided effect on the nervous centres, the brain, and the spinal cord. This is very evident in the case of a frog having its fore-legs tied together to excite a portion of the nerves of the skin. It will then, when placed on its back, remain perfectly powerless, and only regain its activity when the cord is removed; while a frog that is free can not be made to remain upon its back. There can be no doubt that this is a reflex phenomenon; but the case of the chicken may not be equally so. The peculiar, unusual position of the animal may doubtless co-operate; and although the chalk line can be clearly demonstrated to be unnecessary, yet there are facts that indicate that it may not be without its influence in attracting and fixing the attention of the fowl. It is suggested that this constrained attention may afford a physiological explanation of the phenomena in question by affecting certain portions of the brain, and the involving of other portions by sympathy.

The following experiments serve to illustrate the characteristic effect of constrained attention. If a thread be suspended over the comb of a chicken so that the ends hang down over the eyes, the fowl will remain in a perfectly cataleptic condition, and finally pass into somnolence, so deep, indeed, that it will permit all possible movements, as turning the head up and down, etc., without giving any signs of life. Again, if a pigeon be pressed gently upon a table, so that it can not use its wings, and a finger be placed before its eyes, and moved back and forth, following the motion of the head so that the eyes must continually notice it, the bird will soon become quiet, and will not fly away when the hand is removed. Similar consequences result in case of many human beings. If the eyes be directed fixedly to one point for some time, they fall into a sleep which may be regarded as the simplest manifestation of mesmerism.—1 *C*, IX., 49.

REGULATING THE GROWTH OF BONE IN YOUNG ANIMALS.

M. Ollier announces, as the result of recent experiments, that he has succeeded in very considerably modifying the growth of bone, by local irritation during the period of development, lengthening it or arresting its growth, according as one part or the other of the bone is dealt with. Thus, an irritation upon the central part of the long bones, if of sufficient amount and long continued, causes elongation; but when this affects the periosteum, the marrow, and the bony substance properly so called, it produces hypertrophical phenomena. The methods of producing this irritation, and the consequent growth of the bone, are very varied. Incisions, excisions, cauterizations of the periosteum, irritation of the marrow by perforation, and the implantation of foreign bodies are followed in young animals by an elongation of the bone. It is by no means necessary to produce suppuration in order to accomplish this result, a subacute but prolonged irritation being more efficient and less dangerous. The increase thus secured is in proportion to the persistence of the experiment, and may amount to one tenth of the total length of the bone. This elongation is produced, not by interstitial growth of the bony substance, but by greater activity in the development of the cartilage cells, since, as in natural growth, it is the cartilage which forms the principal and most exclusive agent in increasing the length of bone.—1 *B*, *April* 13, 1873, 19.

NEW FOSSILS DISCOVERED BY PROFESSOR COPE.

Professor Cope, under date of July 15, publishes notes of some new extinct mammalia from the tertiary deposits of the Rocky Mountain region. One of these he names *Æluro-don mustelinus*, an animal about the size of the domestic cat. Another is the *Aceratherium megalodus*, which he characterizes as about the size of an Indian rhinoceros, but with much larger teeth. In some respects it has decided relations to the genus rhinoceros.

ANTIQUITIES OF THE SOUTHERN INDIANS.

No more important work on the subject of American ethnology has appeared since the Smithsonian Institution published the memoir of Squier and Davis on the Aboriginal Monuments than the work by Charles C. Jones, of New York, on "The Antiquities of the Southern Indians" (particularly of the Georgia tribes), which has just left the press of Appleton & Co. Colonel Jones has been known for many years as a historian and ethnologist, and he has published several important papers on the early history of Georgia.

In the present volume, which is well illustrated by thirty plates, we find a reproduction of some of these earlier memoirs, woven into a connected whole, with the introduction of much new matter. The descriptions of objects are based almost exclusively upon specimens in the author's collection. The significance of the aboriginal remains in the Southern States is elucidated by reference to the writings of John Bartram and other early historians, who visited the country when the Indians were very numerous, and in the full exercise of all their rights and of all their avocations. Their manners and customs are treated of successively in detail, and a great deal of light is thrown upon what has been generally considered very obscure in connection with these people.

The different kinds of mounds are discussed; whether those of observation and retreat, those used as sites of houses or villages, or those for burial, and for other purposes. The shell mounds, the stone graves, the rock walls, and fortified towns, all pass under review. The work closes by a consideration of the various implements among the Indians, such as the arrow and spear heads, axes, agricultural tools, fishing apparatus, articles used for games and plays, pipes, idols, pottery, shells, etc.

ACQUIRED HABITS OF THE TUMBLER PIGEON.

Mr. Darwin, in a recent communication to *Nature*, refers to a very remarkable East Indian variety of the tumbler pigeon, called the Lotan, and one which has been known in that country as possessing certain peculiarities, transmitted from generation to generation, for nearly three hundred years. It is only necessary to shake this bird, or, in the case of one variety, to touch it on the neck with a stick, in order to cause it to roll over backward on the ground. This it continues to do with great rapidity until utterly exhausted, so that it will die unless taken up, held in the hands, and soothed, when it will recover. This is believed by Mr. Darwin to be a hereditary transmission of possibly some accidental injury to the brain, as it is well known that if the base of the brain of a pigeon be pricked with a needle, the bird will roll over backward in the same manner as do the ground tumblers.

One pigeon thus pricked recovered perfectly, but continued ever afterward to perform somersaults like a tumbler, although not of the breed. The movement appears to be of the nature of a recurrent spasm or convulsion which throws the bird backward, as in tetanus; it then recovers its balance, and is again thrown backward. Whether the performances of the common tumbler, which are carried on in the air, are related to those of the ground tumbler is uncertain, although Mr. Darwin thinks that in this case the tendency may have originated in some accidental injury, or from some morbid affection of the brain.—12 *A*, *April* 3, 1873, 417.

ODONTOPTERYX, A NEW FOSSIL BIRD.

The discovery of a fossil bird with teeth implanted in the jaws, in distinct sockets, recently made by Professor Marsh, has been followed by the announcement on the part of Professor Richard Owen of a related form, in describing a portion of the skull of the *Odontopteryx toliapicus*, from the London clay of Sheppey. The remains obtained consisted of the brain-case, with the basal portion of both jaws, in which are seen denticulations which are intrinsic parts of the bone, and not simply attachments or insertions, as in the case of other vertebrates, as well as in Professor Marsh's bird. These denticulations, or tooth-like portions of the jaws, are of two sizes, the smaller being about half a line in length, and the larger from two to three lines, separated by several of the smaller ones. All are of a triangular or compressed conical form, the larger ones resembling fangs. Sections of the denticles show unmistakably the characters of bird bone. The total length of the skull was five or six inches. The bird seems to have approached most nearly to the duck family, in some of which, as in the goosanders and the mergansers, the beak is furnished with strong pointed serrations. In them, however, the tooth-like processes belong to the horny bill only, and, according to Professor Owen, the production of the alveolar margin, as far as known, is peculiar to the new fossil.

Professor Owen concludes that the *Odontopteryx* was a warm-blooded, feathered biped, with wings; and further, that it was web-footed and a fish-eater, and that in the catching of its slippery prey it was assisted by this armature of the jaws.—12 *A*, *July* 10, 1873, 215.

ALLEGED SHOWER OF FISH-SCALES.

It is stated that during a heavy thunder-storm near Lake Providence, Louisiana, a number of small bodies were found on the ground immediately after the shower, scattered along the shore of the Mississippi River for a distance of forty miles above the lake; as many as half a bushel being collected around one house. These, on being submitted to critical examination, proved to be scales of the common gar-fish of the South (*Lepidosteus*). The species inhabits the shallow, muddy waters of the South, and sometimes attains a length of five or six feet, and is especially characterized by being inclosed in an almost impenetrable coat of mail (the scales in question), so compact as almost to resist the penetration of a bullet.

It is very difficult to give credence to this story, as the gar-fish are not particularly abundant, and the method of aggregation of so large a number of detached scales would be a problem extremely difficult of solution. Perfectly authentic instances are on record of small fish, shells, etc., being taken up in storms and scattered over the earth; but when it comes to special portions of fishes which weigh from five to fifty pounds each, the draft upon one's faith is rather too severe.

HABITS OF THE CRAW-FISH.

One of the more novel applications of the general science of pisciculture is to the breeding and rearing of craw-fish, which, in Europe especially, constitute a much-sought-for delicacy, and in the United States are becoming quite fashionable as an article of luxury. A preliminary to a successful treatment of these animals for commercial purposes must necessarily consist in a careful inquiry into their natural history. This has recently been done, in the laboratory of Professor Coste, in Paris, by Chantran, who has lately published an interesting memoir on the subject. According to this writer, copulation between the sexes occurs during the winter, especially in November, December, and January, and the fertilization takes place on the exterior of the body of the female, which lays her eggs from two to forty-five days after the meeting of the sexes, according to the degree of the maturity of the eggs. At the critical moment the abdominal appendices of the female secrete a viscous mucus for several hours, after which she throws herself upon her back, and curls her tail toward the mouth of the oviduct, so as to form a kind of basin, in which the eggs are received one by one as they are expelled from the ovaries. The eggs then become adherent to the mucus just referred to, which is found to be penetrated by the spermatozoa, which soon make their entrance.

The incubation of these eggs usually lasts six months, and the young moult ten days after leaving the shell. Their food at this time consists of egg-shells and the shed skin, while the stronger of the young devour the weaker. Other moults take place in succession from twenty to twenty-five days apart, so that the shell is renewed at least five times in the space of eighty days, usually falling in the months of July, August, and September. From this period until the April following there is no other moult. The skin is again shed successively once a month, in May, June, and July, making eight changes for the first twelve months of the life of the animal. During the second year there are five moults, and in the third year generally two, and sometimes three. The male craw-fish is mature from the commencement of the third year, the female at the end of the fourth. At this age the latter has only one moult per annum; the male, on the contrary, has two, which may explain the larger size, since the growth is in proportion to the number of these changes of skin. It usually requires forty-eight hours for the new skin on the back of the crab to arrive at a sufficient degree of persistence, although the legs become completely hardened in twenty-four hours.—*Jour. Acad. Nation. Agric., etc., February and March*, 1873, 99.

HIBERNATION OF FLIES.

An interesting statement is presented by Goubareff upon the hibernation of flies, subjected to alternations of heat and of excessive cold in Russia, as taking place in the Russian establishments used for the production of vapor-baths, which are kept heated only on the days when the bath is to be applied. One or two of these had been heated only twice in six months—on the 3d of January and 15th of February. The thermometer in the open air indicated a temperature of $-13°$ Fahr., and one in the interior of the house stood at 14° Fahr. An immense number of flies had established themselves in this building from the month of August, and had been sluggish since the month of October; but when the house was heated up to 106° Fahr., they became as active and lively as in the heat of summer, immediately returning to their original torpor whenever the cold obtained the mastery in the abandoned building.—6 *B, March* 24, 1873, 785.

FLIGHT OF THE ISTHMUS BUTTERFLY.

According to the Panama *Star and Herald*, the beautiful Isthmus butterfly, *Urania fulgens*, according to Salvin, and not *U. leilus*, as generally supposed, the immense migrations of which from east to west excite so much attention every year, continued abundant through the month of August, although the problem as to the points where it begins and ends its journeys is still unsolved.—*Panama Star and Herald, August* 24, 1873.

H. BOTANY AND HORTICULTURE.

WHY THE WINTER OF 1871–72 WAS INJURIOUS TO VEGETATION.

The transactions of the Massachusetts Horticultural Society contain a recent report from prominent Boston horticulturists upon this subject. The causes combining to produce the results were the unprecedented drouths of the two preceding summers, enfeebling the roots, and preventing strong and vigorous growth; the want of snow, and the severe cold of the winter freezing the ground to an unusual depth; continued and violent winds, causing a constant evaporation of sap, which the roots were unable to replace; and sudden and extreme alternations of heat and cold. Evergreens suffered most severely, for two reasons: because their roots are for the most part near the surface, and because, unlike deciduous trees, they are never completely at rest, and require a certain amount of sap to maintain their foliage. Hence the evaporative action of the winds was peculiarly injurious to them, and hence, also, they the more readily succumbed to the sudden intense cold of March, following some days of warm weather, which had excited their leaves to as great activity as was possible at the season.

This reasoning is confirmed by the experience of the past season, which has been the direct reverse of the preceding one—a wet, warm summer, a moderately warm autumn, a well-ripened growth, a constant and abundant covering of snow during the winter, though with a degree of cold almost unprecedented. As the result, evergreens never have done better; while, owing to the small amount of frost in the ground, the roots of deciduous trees have been unusually active, the movement of the sap throwing forward the buds, which, in the case of fruit-trees, appear to be in many instances killed.—*Trans. Mass. Hort. Soc., March*, 1873.

DISTRIBUTION OF SEEDS BY WINDS.

Mr. Alfred W. Bennett has called attention to the comparatively little-known article by Kerner upon the influence of the wind on the distribution of seeds in the mountain regions; and, referring to the popular impression that the winds perform a very important part in the distribution of plants, quotes from Kerner and from Mr. Bentham to show that the assumption rests upon insufficient data. If that portion of thistle-down which has been carried to a considerable distance by a high wind be examined, it will generally be found to have left its seed behind it. And it frequently happens that seeds well winged, or provided with light pappus, are less widely distributed than other forms of compositæ without such pappus.

The rapid spread of the common thistle, in any new country, is referred to the persistent vitality of the roots quite as much as to the dispersion of the seeds; and if the individuals are examined, they will generally be found to be all of one sex, showing that they must have been propagated by the division of the same individual. Reference is also made to the Canadian water-weed, *Elodea canadensis*, which filled up the water-courses and canals of England within a few years of its first appearance; and it is stated that to this day the male plant is entirely unknown in that country, and that all may have sprung, by subdivision, from the first imported specimen.

The memoir of Mr. Kerner is based upon a careful examination of plants growing on moraines, and of the seeds found on the surface of glaciers; and he finds that a large number of these, constituting the moraine flora, are species widely distributed over the high mountains in immediate proximity to the glacier. Again, in regard to the seeds on the glaciers, he finds not a single one which does not belong to a species inhabiting the adjacent mountain slopes or valleys; and he is therefore of the impression that the conveyance of seeds, even when provided with apparatus calculated for being floated in the air by horizontal currents, takes place only within very circumscribed limits; and that the prevalent opinion, that they may thus be carried for very great distances, is not supported by facts.—12 *A*, *June* 27, 1872, 164.

INFLUENCE OF CLIMATE AND MANURES UPON PLANTS.

In the *Journal* of the Horticultural Society of London is given a second report by M. T. Masters upon extended experiments, made at their gardens, to determine the effects of various fertilizers (mineral manures, ammonia salts, and nitrates) upon different species of plants. Aside from the results possessing an economic value, certain conclusions are drawn of a more scientific nature, in relation to the inducement of specific changes. No absolute change in habit was in any instance observable, the effect of the manures being simply to enhance the vigor of growth, or the reverse, and more decidedly in the leaves, stem, etc., than in the flowers or fruit. Nothing favored the inference that, by the agency of any manure or vicissitude of climate, any change that would be deemed of specific value could be artificially induced. On the contrary, it would appear, as all other evidence yet obtained shows, that "specific" character is not influenced by external conditions, but is an innate quality transmitted by hereditary descent.—*Jour. Hort. Soc., London, January* 7, 1873, 124.

FLORA OF THE ISLAND OF ST. PAUL.

The island of St. Paul, in the Indian Ocean, is believed to contain the smallest phanerogamic flora in the world, there being really only two indigenous species, although seven others have been found, six of them grasses and one a sedge. The two native species referred to belong to the genera *Plantago* and *Sagina.*—13 *A*, *July* 1, 1872, 253.

RISLER'S RESEARCHES ON EVAPORATION FROM PLANTS.

The following propositions are presented by Mr. E. Risler, as the results of his researches on the evaporation from plants: Evaporation from plants is not lessened when the surrounding air is saturated with aqueous vapor. Absorption of the vapor in the air by the leaves has never been observed. Plants in general evaporate but very little during the night-time. All plants evaporate more in the sun than in the shade. With luzerne, the quantity evaporated in the sun is four times as great as in the shade, even when the difference in temperature is not very considerable. Thus the direct influence of light, independent of its heat, is demonstrated. The yellow rays of the spectrum are most active. With Indian corn, the difference of evaporation in sun and shade is still larger than with luzerne, while some plants are much less influenced; the willow, for instance, shows very little difference. This is, in Mr. Risler's opinion, one of the reasons why some plants thrive better in shade than others. Humidity or motion of the air exerts no appreciable influence upon evaporation, although it was ascertained that evaporation increased with the approach of a storm, even when heat and light had not increased. The moisture of the soil is of the greatest importance. After rain or watering, the evaporation increases; with continued dryness, the plants wilt, but frequently recover with the disappearance of the sun, when the absorption of water by the roots becomes greater than the evaporation by the leaves. When a large volume of soil is accessible to the plants, the supply of moisture is larger and more regular. Hence the practical conclusions. A crop requires the more water the more densely it is planted. When older and more vigorous plants stand in the same soil with younger and less developed ones, the former will take up more water than the latter, and these will suffer, if the moisture do not suffice for both. Also, with the water, the stronger plants take more of the nourishment in solution; hence the injurious influence of trees and weeds upon young plantations. The water taken from that portion of the ground with which the roots are in immediate contact is replaced by the surrounding soil, so as to establish an equilibrium of moisture in accordance with the laws of diffusion. A soil will suffer less from dryness the better it is manured. With an equal surface, the evaporation from the young leaves is less than from those that are fully developed. Mr. Risler, from his careful experiments and observations, has also deduced the absolute amount of evaporation for several important crops, and ascertained that, in many cases, the quantity of water evaporated is much greater than that obtained from rain during the growing season, the plants drawing their supply from the moisture previously accumulated in the soil. Hence the value of deep culture, which extends the area accessible to the roots. Forests evaporate much less water than cultivated land: they consume, in fact, not one half of the fallen rain, and thus serve as a source of supply for the adjoining regions. Their ramified roots prevent a too rapid rush of the water, and the washing of the surface soil, etc.; but Mr. Risler maintains that it is by no means proved that woods actually increase the rain-fall by contributing in any way to the condensation of atmospherical humidity.—28 *C, March,* 1872.

PROTEINE-GRANULES, AND ASPARAGINE IN GERMINATION.

An exhaustive and interesting investigation of the so-called aleuron-granules in ungerminated seeds has lately been conducted by W. Pfeffer, embracing careful microscopic examination, supplemented by new and ingenious micro-chemical methods, and at times by detailed chemical analysis. This has not only afforded reliable information in regard to the chemical and physical constitution of these properly called proteine-granules, but has also presented essentially new views of their relations to other ingredients of seeds, as well as of the part they play in their ripening and germination. These granules—present in all ripe seeds, and previously only known with certainty to be intimately connected with the proteine matter of the reserved food of the plant—were found to consist essentially of proteine substances, apparently in an amorphous or in part crystalloid form. The latter having a seemingly crystalline exterior, are made up entirely of proteine matter, and are imbedded in the body of the granules, which likewise consist of proteine matter; they can be soaked, but are insoluble, in water; and are not present in all seeds. The mass of the granule may be insoluble, or partially or totally soluble, in water, but is always soluble in dilute potash. The proteine substances constituting it are, by themselves, insoluble in water, but are rendered soluble by the presence of phosphate of potash in the proteine mass. Other substances are inclosed at times by the granules, as oxalate of lime in some cases; and in all seeds, though not necessarily in all the granules of the seeds, may be found globoids—that is, clusters of globular or botryoidal masses of compounds of magnesia and lime, with a phosphoric acid associated with some undetermined organic body. The oil of the seeds, according to previous views, also present in the proteine-granules, is found exclusively in the matter filling the interstices between the granules, which contains proteine matter, besides the dried protoplasmic body of the cells. Some of these substances are always of the form that deports itself toward solvents like the insoluble modification of egg albumen. The proteine-granules first form, out of an emulsion of oily and albuminous matter, in the ripening seeds when they begin to dry; the crystalloids, as well as the crystals and globoids, are noticeable earlier, and serve as nuclei of the proteine-granules. In germination, a similar emulsion is formed by solution of the granules, the inclosed bodies being distributed in the cell fluids, the globoids and crystalloids being gradually dissolved. A very interesting connection between the nitrogenous substance asparagine, and the reserve proteine matter of the seed was traced in the germination of the *Papilionacæ.* The substance recognizable in the cells by aid of the microscope was obtained in characteristic crystals by treatment of the germinating plants with alcohol; and the fact was established that, as the plantlet grew, asparagine assumed the place of proteine matter, and was distributed farther into the roots and stems, about as far as the sugar formed from starch and oil, passing like these in the cells of the parenchyma. With farther development of the plant it gradually and entirely disappears. It may be concluded, therefore, that the reserve proteine matter of the seed is transformed in germination into asparagine, out of which albuminous matter is again subsequently formed. Chemical analysis confirmed the fact that the increase of asparagine at first is proportional to the decrease of proteine matter, and that the total amount of nitrogen (even on the exclusion of additional nitrogen) remains constant. Since asparagine contains more nitrogen than the proteine matter, it is extremely probable that portions of carbon and hydrogen are either directly or indirectly eliminated in respiration, and since the asparagine is subsequently reconverted into albuminous matter, and the non-nitrogenous matter does not afford carbon enough for this purpose, the operation will be partially checked in plants prevented from the assimilation of carbon by cultivation in the dark.—19 *C, February* 1, 1873, 45.

FERTILIZATION IN GRASSES.

The contrivances for effecting cross-fertilization among the grasses, *i. e.*, the impregnation of the ovary of one flower by the pollen from another in preference to its own, are numerous and very various. The agent employed for the purpose is the wind, insects having little to do with it. The fine pollen grains are smooth and non-adherent; the anthers hang suspended from long filaments open at the base, and shed their contents when moved by the least breath of wind; the feathery stigmas expose a large surface, with numerous hollows and projections, upon which the pollen may lodge; and thus, in very many cases, cross-fertilization is almost inevitable. The same result is often aided otherwise, as has been recently shown by Prof. Hildebrand, of Freiburg, following Delpino, of Florence. Diœcious grasses (in which the male and female flowers are on separate plants) are few, but many monœcious species are made, in effect, diœcious as respects fertilization, either by the male flowers at the top of the stem losing their pollen before the female flowers below have exserted their stigmas, as in Indian corn, or by the stigmas preceding the maturing of the anthers, as in *Coix lachryma* (Job's Tears), or by the position of the male flowers below the female, as in wild rice, or by their wide separation on distant branches. In some species, however, the arrangement seems adapted rather to secure fertilization between the flowers of the same plant.

So in those grasses where the male and female organs are in the same flower. In sweet vernal grass, and various others, the stigmas are exserted before the anthers, and remain in condition to receive the pollen but for a very short time. In rye, the anthers first slowly appear, and shed a part of their pollen into the air; after some hours the stigmas become receptive, by which time the anthers have opened more widely, and the rest of their pollen escapes. Here self-fertilization is possible. In wheat, the flower opens suddenly, the anthers appear, let fall a third of their pollen upon the stigma, and the rest is dispersed in the air. The whole process is completed in less than half a minute. In the oat, the anthers hang down outside of the flower and discharge most of their pollen into the air; but in damp and cold weather the flowers remain closed, and are self-fertilized. In many other cases the mode of fertilization is likewise determined by the weather. In canary grass, the anthers and stigmas appear together, but upon opposite sides of the flower. In other grasses, the stigmas often remain fresh and receptive of pollen from other flowers a considerable time after their own anthers are emptied. In barley, the flowers remain closed, and are all self-fertilized; but sometimes those in two rows, out of the six which compose the head, open, and are fertilized like those of wheat. Numerous other instances are cited in which, by like means, sometimes the one method of fertilization is favored, sometimes the other, but with little uniformity of plan, even among species of the same genus.—*Monatsbericht Akad., Berlin, October*, 1872, 737.

DISTRIBUTION OF ATROPINE IN THE PLANT.

According to Lefort, atropine is more abundant in the leaves of the deadly nightshade before flowering than afterward, so that they should be collected for manufacturing purposes between flowering and fruitage. The quantity in the roots varies very greatly, the young roots yielding more than roots of two or three years old, because the latter contain a smaller proportion of bark.—21 *A, December*, 1872, 110.

CHANGE IN THE OIL OF SEEDS IN GERMINATION.

A series of experiments by Mr. Muntz, instituted to ascertain whether seeds containing fatty oils, when germinating, are decomposed into glycerine and acids, and whether one of the constituents is absorbed sooner than the other, resulted as follows: 1. During the germination of oily seeds, the fatty substance progressively separates into fatty acids and glycerine. 2. The glycerine disappears as soon as liberated. 3. At a certain time the young plant contains no free fatty acid. 4. While the embryo is growing, these fatty acids absorb oxygen slowly but progressively, the amount of which, in the above experiments, never exceeded three fourths' per cent.—28 *C, March*, 1872.

CHANGE OF TEMPERATURE DURING THE GERMINATION OF SEEDS.

Professor Wiesner has ascertained that, during the germination of seeds, the temperature increases before the development of carbonic acid begins, and he believes that water is condensed within the tissues of the seed, and heat thus liberated. He considers this as proof that the increase of temperature is, to a certain extent, independent of the chemical process. In another series of experiments, different seeds were exposed to increased temperature, and it was found that some, as beans, the seeds of conifers, etc., will not suffer from a heat of 158° Fahr.; while in willows, for instance, the germ of the seed is killed by simple exposure to the sun.—28 *A, March*, 1872.

MOVEMENT OF THE SAP IN PLANTS.

The latest views in regard to the still somewhat obscure subject of the motion of sap in plants are given by W. R. M'Nab, of the Royal College, Dublin, in a recent number of the *Garden*. Two distinct currents exist, a slow and a rapid. The rapid current relates exclusively to the process of transpiration, varying, therefore, with the season and the time of day. It takes place in the day-time, during sunlight, and the fluid passes up in the *walls* of the wood-cells of the fibro-vascular bundles. The slow movement is connected with the transport of assimilated matters from one part of the plant to another, chiefly from the leaves to the growing points of stems and roots, or wherever cell multiplication or cell enlargement is going on. It is quite irregular, may move in any direction, depends on osmose chiefly, and is a true movement from cell to cell. The rapidity of the first current, as calculated by Sachs, was 23 centimeters (nearly 10 inches) per hour in the silver poplar. M'Nab observed a rate of from 42 to 46 centimeters per hour in October, and considers that this would have been doubled in June. Of the total water present in the cherry laurel (63 per cent. of its entire weight), he regards 6 or 7 per cent. only as water of transpiration.—*The Garden*, 1873, 115.

CINCHONA IN JAMAICA.

It is well known that the various species of cinchona-trees, when transplanted from their native region in South America, although retaining their botanical characteristics, do not always furnish the same quantity and quality of alkaloid, this being influenced by latitude, moisture, and other conditions. A recent examination of cinchona bark from trees growing in Jamaica has, however, proved very satisfactory, the total amount of alkaloid obtained being considered reasonably large, and likely to improve with the age of the trees. The *Cinchona calasaya* is the most promising, exhibiting a percentage of quinine of great economical importance. In this respect it had a decided superiority over the same plants cultivated in

India. On the other hand, the *C. officinalis* is less valuable than the Indian product.—*Am. Jour. Pharmacy, December*, 1872, 548.

EXHALATION OF MOISTURE BY PLANTS.

Dr. Deitrich, the superintendent of the experimental station near Cassel, communicates the following results of experiments to determine the amount of moisture exhaled by plants: First, for the same species of plant, the amount of vegetable matter produced is in direct proportion to the amount of water given off; second, the amount of nutritive matter taken up is also related to the amount of water exhaled; third, the amount of moisture exhaled varies with different species of plants. According to the amounts exhaled, the experiment establishes the following order: buckwheat, clover; then lupines, beans, and oats, equal; summer rye and wheat, equal; and, last, barley.—28 *C, January*, 1873, 39.

FERTILIZATION OF YUCCA.

According to Professor C. Riley, a species of yucca depends for its fertilization entirely upon the action of a small moth of very peculiar construction, called by him *Pronuba yuccasella*, this adding another to the many cases of mutual dependence between the plant and the animal. The larvæ of the moth, in their turn, live upon the plant by devouring its seeds. There is a curious adaptation of means to an end in the modification of the parts of the female moth, especially of the maxillary palpi, which are formed into prehensile tentacles, by which she collects the pollen to insert it into the stigmatic tube.—5 *D, December*, 1872, 766.

EDIBILITY OF THE ROOTS OF THE WILD RICE.

Professor Gray, in the *American Journal of Science*, calls attention to an article by Dr. Hance upon a Chinese culinary vegetable named *Kan-sun*, the shoots of which constitute one of the finest vegetables known, being, when boiled, much like green corn, but of a peculiar, rich delicacy. These shoots come from a plant very closely allied to, or perhaps even identical with, our American wild rice (*Hydropyrum latifolum*=*Zyzania aquatica*), and it is suggested that the wild rice may at any rate afford similar esculent roots. The professor, therefore, thinks the suggestion worth attending to; and it is to be hoped that some one will try the experiment as to the edible qualities of the plant in question.—4 *D*, *August* 3, 1872, 151.

THE SEQUOIAS OF CALIFORNIA, AND THEIR HISTORY.

Dr. Gray's address before the American Association at its last meeting, recently republished with supplementary notes and appendix, discusses certain scientific questions suggested by a visit to the "Big Trees" of California. More remarkable than either the size or age of these trees (and none of them is over two thousand years old) is their *isolation*. The only existing species of the genus are restricted to limited portions of California, one to the Coast Range, the other yet more narrowly to a few spots in the Sierras. Were they created thus isolated both systematically and geographically? are they destined to a more extended range? or are they but the scanty remnants of a race now almost extinct? The first suppositions are shown to be as improbable as unscientific. The third forms the main subject of the address.

The only near relatives of the red-woods are our Southern cypress, ranging from Maryland to Mexico, and the *Glyptostrobus*, which is found in China. Yet geology teaches that in the tertiary period these families were not thus separated, but that the cypress, several Sequoias, and a *Glyptostrobus* existed together in Europe. To show the connection of these facts, a comparison is made of the present floras of the three regions, Eastern and Western America and Northeastern Asia. It is found that while there is very great dissimilarity between the characteristic forms of the Atlantic States and California, there is as remarkable a likeness between the vegetation of the same states and Eastern Asia. Various instances are cited of plants of very limited range in the Atlantic States, which occur again, the same or nearly so, in Japan or Eastern Asia, and nowhere else. And of all the numerous species which are common to these regions, either identical or with slight differences, only one third are also found on the intermediate Pacific slope of America, and of the corresponding genera less than one fourth.

Now the only known cause of resemblance is inheritance (always attended with some difference, especially under changed conditions), and the supposition of a common remote ancestry is the readiest method of explaining these similarities in so remote floras. In a discussion of this subject in 1859, Dr. Gray considered this ancestral vegetation as occupying in the pliocene, or a still earlier period, the then temperate high northern regions of the earth. The glacial period which followed, extending southward, drove this vegetation gradually before it, while the differences of climate, which marked, then as now, different longitudes, determined the survival or destruction of species and the degrees of difference in resultant forms. Under varying or similar conditions, species became modified in the same or different directions.

Recent geological discoveries, which establish the antiquity of present species, have confirmed this view. The cypress has been found fossil not only in the miocene of Europe, but also of Spitzbergen, Greenland, and Alaska. Remains of at least three species of Sequoia, closely allied to our own, exist abundantly in the same formation, showing that these and kindred species were once prevalent throughout the arctic regions, and extended southward into Central Europe and our own Rocky Mountains. The Chinese *Glyptostrobus* and the Gingko, now confined to Japan, had their near representatives occupying a like wide range. The *Libocedrus* of California was, with the Sequoias, in Spitzbergen; and the oaks and other common trees of the Atlantic States had numerous and close representatives in the flora of polar latitudes. And these same forms may be traced yet farther back into the cretaceous period.

The conclusion reached is that the facts justify the opinion that the essential types of our actual flora are marked in the cretaceous period, and have come to us through the tertiary without notable change; that the present existing species are the lineal descendants of the ancient ones; that the adaptation of vegetable life to successive times and changed conditions has been maintained not by absolute recreations, but by gradual modifications; that "order and exquisite adaptation did not wait for man's coming, nor were they ever stereotyped." An earnest protest follows against the thought that such conclusions should have an irreligious tendency. As

Christian faith outlived, unharmed, the notion of the fixity of the earth, so will it the idea of the absolute fixity of the species inhabiting it, and "in the future, even more than in the past, faith in an *order*, which is the basis of science, will not—as it can not reasonably—be dissevered from faith in an *ordainer*, which is the basis of religion."

MILK-TREE.

Such trees in various parts of the world as yield a milky juice are among the most serviceable to mankind, some of them furnishing gutta-percha and India rubber, while others supply a liquid which does not solidify, and may be used as a nutritious article of food. These are usually known as cow-trees; and one of the most valuable is the *Brosimum galactodendron.* This is found on the sea-coast of Venezuela, in the form of a tree frequently over one hundred feet in height. The milk, which is obtained by making incisions in the trunk, has a very agreeable taste, resembling that of sweet cream, the only unpleasant feature being that it is somewhat glutinous, although it is very nourishing and wholesome. It is consumed freely by the people, and is, indeed, one of their most important resources. In a pharmaceutical point of view, the *Clusia galactodendron* of Venezuela and of Western New Granada is of great importance, from having the very singular and valuable property of being almost a specific in dysentery. It contains a resinous and astringent principle and an aromatic tonic substance. It is said that wherever this tree occurs dysentery is considered of no moment, the milk being procurable very readily, and used upon the slightest occasion.

According to Mr. R. B. White, out of numberless cases of severe dysentery occurring in a party of five to seven hundred men engaged in constructing a road in a very unhealthy climate in Western New Granada, near Buenaventura, a fatal case was never known to occur, the administration of the milk, even at the eleventh hour, curing cases that had been considered almost hopeless.

The special advantage of this remedy is that the cure is radical, a subsequent relapse being very rare. This milk has been kept a year without its taste or medical properties being affected; and it is suggested that it be brought to Europe or

America, and tried in cases of cholera, for which it would seem applicable—14 *A*, *October*, 1872, 321.

LITHIUM IN PLANTS.

By means of the spectroscope, lithium has been detected in the ashes of many plants. Dr. Focke states that it is found so constantly in some species, especially of the genera *Thalictrum*, *Carduus*, *Cirsium*, and *Salvia* (meadow rue, thistles, and sage), while other plants growing with them are wholly free from it, that probably this substance is essential to their perfect development. European and Columbian species of tobacco may be distinguished from those of North America and Brazil by the very much larger proportion of lithium in their composition.—*Abhandl. nat. Verein zu Bremen*, 1872, III., 251.

WAX ON PLANTS.

According to Professor de Bary, the wax found in plants is not a simple coating on the surface, as if laid on with a brush, but consists of a dense forest of minute hairs of wax, each having one end on the epidermis, the other, either rising straight up, or rolled and curled among its neighbors. A microscopic examination always reveals the true form. The locality in which the wax is first detected is the cuticle and the elements of the epidermic cells, and not the slightest trace is seen in the cell contents or in the chlorophyle. Certain insects also appear to be coated with whitish hairs, but which are, in reality, composed entirely of wax.—13 *A*, *July* 1; 1872, 253.

SALTPETER IN THE BLITE PLANT.

According to Boutin, the dry leaves and stems of the plant known as the Blite (*Amarantus blitum*), and one very common in the cultivated lands of Poitou, contain 11.68 per cent of its entire weight of nitrate of potash or saltpeter. It grows wild in various parts of France, and in the opinion of the writer, if cultivated in good soil, would produce 7000 to 8000 pounds to the acre, which would represent, for the same area, a quantity of nitrogen amounting to 112 to 145 pounds, and of potassa 350 to 450 pounds. It acquires its entire growth in the course of two to three months, and has a great number of seeds, which are small, black, and very brilliant, and of a lenticular form. It is thought that the application of this plant as a manure may have a great advantage over guano, especially for vine-dressing, on account of the great quantity of potash it contains, this being an element of primary importance for the formation of bitartrate of potassa. It is a question whether the plant derives its nitric acid directly from the soil in which it grows, or whether it absorbs its elements from the air, and combines them under the influence of the bases of potash and lime derived from the soil. It is supposed, however, that the greater part of the nitrogen is drawn from the air in a free and uncombined condition.—3 *B*, *February* 27, 1873, 391.

FOREST GROWTH IN THE WABASH VALLEY.

In a description of the vegetation of the bottom lands of the Lower Wabash, Mr. Robert Ridgway gives numerous particulars respecting the dimensions and habit of the prevalent forest trees. These number nearly 100 species, of which about 70 exceed 40 feet in height, about 50 exceed 70 feet, and nearly 30 are known to reach or exceed the height of 100 feet. The ordinary height reached by the forest mass is about 130 feet; and above this general level occasional trees rise to an altitude of 200 feet, or perhaps more.

The largest of these trees is the sycamore (*Platanus occidentalis*), attaining sometimes a diameter of 20 feet and a height of 200, with the lowest branches 90 or 100 feet above the ground. The tulip-tree (*Liriodendron tulipiferum*) is the second in size, being found 180 feet high, and 37 feet in circumference. A stick from this tree is mentioned as measuring 74 feet in length, being straight and symmetrical, and tapering from 23 to 18 feet in circumference. The tallest cottonwoods (*Populus monilifera*) are equally high. The pecan (*Carya olivæformis*) reaches 175 feet in height, with a clean, straight trunk of 60 to 90 feet. Among the oaks the most stately and symmetrical is the "Spanish oak" (*Quercus coccinea*, var.), frequently 150 feet high, and 15 to 20 feet around; while the most massive is the burr oak (*Q. macrocarpa*), of equal height and rather larger diameter. The white ash follows, nearly 150 feet high; the black walnut, 125 feet high, and over 20 feet in circumference; and the white oak, 140 feet high, and over 17 in circuit. The tallest tree in proportion to its girth is the sweet gum, exceeding an altitude of 160 feet, with a clear shaft of over 100 feet, and a maximum circumference of 17 or 18 feet. The honey locust attains a height of 120 feet, the red maple exceeds 100, and even a sassafras has been measured with a height of 95 feet. —5 *D*, 1872, 658–665.

PROPAGATION OF THE MISTLETOE.

The English mistletoe (*Viscum album*) grows abundantly through the southern countries of England, but is almost entirely confined to the orchards. This is readily started by rubbing the fruit upon the bark of the tree, when the mucilage which covers the seeds causes their adhesion, and if the season be sufficiently moist, they take root upon germination, and the young plant attaches itself at once to the branch. Several attempts have been made to introduce into England the *Loranthus Europæus*, a similar parasite which frequents the oaks of Austria and other parts of Southern Europe. Dr. Moore has at length succeeded in some measure by bruising the soft bud gently upon a young oak-shoot of the previous year, and inserting in its centre the seed of the mistletoe. Seeds thus planted in January, 1870, germinated in the spring of the following year, and the resulting plants are yet living.—*The Garden*, 1873, 81.

HABITS OF DROSERA.

Mr. Ziegler has lately been making some studies upon the cilia of the *Droseras*, or sun-dew plant, which, as is well known, exude from their tips a viscous secretion by which insects are secured. Whenever an insect is thus taken, the external cilia bend round and cover the insect, as if in the clasp of the hand, and do not relax their hold until at the end of several days, when they open, in order to secrete mucilage more and entrap a new prey. It is an interesting fact that albuminated animal substances, under ordinary circumstances, will not exercise any evident action upon the cilia of the plants in question; but if they are held a few minutes between the fingers, they acquire the property of causing the cilia to contract. If, however, these same animal substances are then moistened with distilled water and dried in a sand bath, they lose the property they had acquired from the fingers.—6 *B*, *May* 6, 1872, 1227.

BREAD FUNGI.

Rochard and Legros announce, as the result of their investigations, that the different forms of mold which are developed upon bread do not represent any kind of epidemic; and only exhibit themselves when the bread is badly made with inferior flour, or kept in unsuitable conditions. Bread thus manufactured becomes a favorable soil for the development of fungi, which may be of various colors, orange, green, etc. The humidity and acidity of bread, and the keeping it in dark places, are the most favorable causes of the development of mold.

Of the red mold of bread, the occurrence of which has sometimes produced so much alarm, two forms have been observed. The green spots in bread are sometimes caused by *Aspergillus glaucus*—sometimes by *Penicillium glaucum.* The black spots which are very frequent, and which often unite the orange and green, depend upon the presence of *Rhisopus nigricans*, and sometimes with the addition of *Botrytis grisea.* —3 *B*, XL., 223.

GROWTH OF ALGÆ IN AQUARIA.

Charbonnier has called attention to what he states to be a fact, that when aquaria are exposed to light, the glass sometimes becomes coated with green algæ in the course of two or three days, while at other times five or six, or even eight or ten days are needed for the same result. He noticed that every month the vegetation has its maximum of intensity at the time of the full moon, while there is almost none of it at the new moon. At full moon a daily cleaning is needed, whereas outside of this period even once or twice a week will be sufficient. In explanation, he remarks that vegetable germs lying at the bottom of the water are raised in sunlight by the gas bubbles which they then give off, and which continue attached to them for some time. When night comes on, the bubbles disappear, and the plants sink again, but if there is strong moonlight, the production of gas continues, and they are kept floating; hence the superabundance met with at full moon.—18 *A*, *March* 7, 1873, 599.

EQUISETUMS AND CALAMITES.

Dr. M'Nab traces a closer resemblance between the existing equisetums ("horse-tails") and the fossil calamites of the coal period than has hitherto been recognized. A comparison of the habit of growth and of the microscopical structure of both leads to the conclusion that the difference is but small. Both have the same large under-ground stem, running for a considerable distance, branching, and giving off aerial shoots of short duration, mostly annual in equisetum, and probably not more persistent in the calamite. The cone-like fruit is in both terminal upon these erect cylindrical shoots. The widest difference is probably in the arrangement of the parts of these cones, the equisetum having all the leaves of the fruit modified, and bearing spore cases; the calamite having only the alternate whorls as modified. The character and arrangement of the various tissues in the two appear to be closely similar.—*Trimen's Jour. Bot., March*, 1873, 79.

ANCIENT VEGETATION IN ENGLAND.

Mr. Thistleton Dyer, in a review of Syme's *English Botany*, calls attention to the fact that at the close of the pliocene period Northern Europe, including the greater portion of the British Isles (which were then connected with the Continent), was covered with a continuous sheet of ice, which entirely exterminated any vegetation that might have previously existed there. The surface of the islands, therefore, appears to have been a *tabula rasa* in the entire absence of vegetation. As the surface gradually rose above the ice and water it became slowly stocked with life from the Continent, with which, as stated, it was joined.

The climate, which had been milder during the period of submersion, became again cold; the mountains were once more clothed with glaciers, though less extensive than before. The first vegetation introduced must have been of an arctic character, this giving way as the climate ameliorated, and new plants pressed forward from the South.

Of this ancient vegetation there are still remains on the summits of the mountains and elsewhere, such as the Scotch fir (*Pinus sylvestris*), found also in the bogs of Ireland and at the bottom of those in Denmark. Subsequently the beech came in, and other species of similar physical peculiarities, and Ireland and Southwestern England received contributions from the western flora of Europe. It is an interesting fact that of 120 plants which are eastern as regards Great Britain, only eighteen reach Ireland, and but five extend to its western side. The British flora is therefore simply an extension of the Continental flora, with which it is no longer continuous in area. There are no species in the British Isles which are peculiar to them. The time which has elapsed since their separation from the main-land has not been sufficient to permit that differentiation of form which might result in distinctions of specific value.

This fact is strongly in contrast with what we find in Madeira, where the island is clothed with vegetation which is as old as the miocene, and very different from that of the nearest continent. As a general rule, the species of plants shown to be common to Great Britain and the Continent exhibit comparatively little difference in the way of definable varieties; this, however, being indicated, if at all, by the bramble and dog-rose, of which the British sub-species and races are somewhat different from those of France or Hungary.—13 *A, February* 15, 1873, 68.

SENSITIVENESS IN PLANTS A MEANS OF SECURING CROSS-FERTILIZATION.

F. E. Kitchener, in *The Journal of Botany*, adds another to the many curious methods by which cross-fertilization is secured in flowers. In the musk plant (*Mimulus moschatus*) the opened flower is horizontal, the stigma close against the upper part of the throat, with two broad expanded lobes, the viscid stigmatic surfaces looking downward, and two pairs of unequal stamens, shorter than the style, with the anthers opening downward, and in such a position as to make it improbable that any of the pollen should, without interference, reach the stigma. Any insect, however, having entered and covered his back or proboscis with pollen, would of necessity leave a portion upon the stigma in his retreat, were not this also effectually prevented by the sensitiveness of the lobes, which shut closely together immediately after being touched by the insect in entering. Only in case of his having previously visited some other flower, and bringing a contribution of its pollen with him, is impregnation probable.—*Trimens' Jour. Bot., April*, 1873, 101.

INFLUENCE OF ATMOSPHERIC PRESSURE ON THE GROWTH OF PLANTS.

The important researches of Bert upon the effect of variations of atmospheric pressure on the phenomena of animal life have lately been extended by him to the consideration of plants, especially in reference to the germination of barley and wheat, which contain albumen, and of cress and turnips, which do not. He finds that, on diminishing the pressure, the germination is proportionally slower, and that it stops at lengths between one and a half and four inches, the seeds not dying, but only becoming inactive. He attributes this to a stoppage of the oxidation necessary to development of the embryo, because of the feeble tension of oxygen.

With increase of pressure to two or three atmospheres, the seeds appear to profit somewhat, but above one and a half to two inches there is evident disadvantage, especially for seeds with farinaceous albumen. At very high pressures the seed is killed; it is also killed when submitted to compression after development has commenced. The too great tension diminishes the oxidation; and on examination of the compressed air in which seeds have been sown, it is found that the consumption of oxygen has been much less than at normal pressure. These results have an important bearing on the geographical distribution of plants—a subject which M. Bert hopes to treat of on some future occasion.—18 *A, July* 4, 1873, 401.

THE INFLUENCE OF ELECTRICITY ON THE GROWTH OF PLANTS.

M. H. Bridgman, of Norwich, England, has lately investigated the influence of electricity on the growth of plants, and has used for this purpose a very weak galvanic battery, or rather a single element with weak acids, in order to obtain a very weak current. He takes a three-inch square glass plate, and after laying upon it two strips of sheet tin close to but not touching each other, covers the plate with felt soaked in rain water. On the latter he spreads a thin layer of cress seeds, that have previously been well soaked in rain water. The two wires of the battery are then brought into contact with the strips of tin, and their other ends stuck through the felt. The electric current is immediately established, one half of the felt having positive, the other negative electricity. On another piece of moist felting, entirely disconnected from the battery, is placed also some cress seed, in order to observe the difference in the growth of the two portions of seed. After the lapse of four days, the seed on the positive side of the first piece of felting gave signs of germination, while their hulls were shriveling up, and had become black. On the negative side of the felting the seeds were at the same time swollen, and their hulls, which retained their natural color, were beginning to burst. In six days' time the first shoots broke forth. The seeds on the second plate of felt, which were not under the influence of electricity, first sprouted many days later. The most peculiar result of this trial was, however, that while on the negative pole, where there was every sign of stronger development, the root sprout sank downward into the moist felting; on the other hand, on the positive felt the root sprouts rose upward from the blackened and dried up seeds. The upward movement of the root sprouts has already, in 1867, been observed by Blondeau; but he ascribes it to the influence of electricity in general, and not especially to the positive electricity.—7 *C*, 1873, 411.

NEW TEXT-BOOK ON BOTANY.

A translation is being prepared in England of the most thorough text-book of botany in existence, Dr. Julius Sachs' *Lehrbuch der Botanik.* The Board of Studies of the Natural Science School at the University of Oxford, in their recent programme, recommended the book to candidates for degrees; and the delegates of the Clarendon Press of that university have acquired from Dr. Sachs the right of translation and the use of the numerous and excellent wood blocks. Mr. A. W. Bennett has undertaken for the university the translating and editing of the English work, which will probably become the standard publication on the subject.

COHN ON BACTERIA.

Dr. Cohn, who has written a great deal upon bacteria, defines them as "chlorophyl free cells of spherical, oblong, or cylindrical form, sometimes twisted or bent, which multiply themselves exclusively by transverse divisions, and occur either isolated or in cell-families." He divides them into four groups or tribes, and indorses Burdon-Sanderson's method of distinguishing bacteria from torulæ, namely, that the latter, or fungi-spores, may be transported in the air, while bacteria require a surface of water for this purpose. Bacteria have near affinities with algæ, and resemble green plants in taking up their nitrogen from ammonia compounds, which animals are unable to do. They differ from green plants in not being able to take their carbon from carbonic acid, but requiring carbohydrates and their derivatives. Cohn gives proofs that, practically, a temperature of 176° Fahr. destroys the life of bacteria, and prevents their development in an organic infusion.—18 *A*, *April* 11, 1873, 90.

THE GROWTH OF SEEDLING PLANTS.

Dr. J. C. Draper, whose father is well known for his long series of investigations into the chemical properties of light, has recently published, in continuation of his earlier investigations, the result of some observations and experiments on the growth of plants under the action of light, as compared with their growth when deprived of light. He maintains that he has established the proposition that the continuous absorption of oxygen and formation of carbonic acid is an essential condition of evolution of structure, both in plants and animals. This opinion is, in so far as it relates to plants, the opposite to that which is commonly held, inasmuch as it has been generally supposed that plants absorb carbonic acid and evolve oxygen in the course of their growth—contrary to Draper's idea. The inquiry in reality narrows itself down to the examination of the growth of the plants which contain chlorophyl, or the green coloring matter. Regarding these plants, the statement is generally made that they exhale oxygen under the action of light, and exhale carbonic acid in the dark. Dr. J. C. Draper, following in the path of his father, Professor J. W. Draper, maintains that, in the actual growth or evolution of structure in the plants, oxygen is absorbed and carbonic acid formed, but that the leaves, under the influence of light, absorb carbonic acid, and decompose it in order to produce the gum or other materials that are subsequently made use of by the plant in the evolution of its structure. These two processes go on at different rates in light and darkness, and, by a proper consideration of them, the discrepancies that have hitherto been noticed by accurate observers seem to disappear. Besides certain observations made upon the leaves, Draper adduces an interesting fact, which lends support to the opinion that the process of growth in seedlings developed in the dark is very similar to that occurring to those grown in the light. It is well known that many plants so poison the soil that the same plants can not be made to grow therein until the poisonous excretions from the roots of the first crop have been destroyed by oxidation. In the case of pease, this poisoning of the soil takes place in a very marked manner, no matter whether the pease have grown in the dark or in the light. In general, Draper concludes that the whole history of the plant, from the time the seed is planted to its death, is a continuous story of oxidation, except when sunlight is falling on the leaves. The seed is put into the ground, and during germination oxygen is absorbed and carbonic acid exhaled. If the seedling be kept in the dark, oxygen is never exhaled, carbonic acid is, and the plant not only grows, but all visible structures, except flowers, are formed in a rudimentary condition. The growth during the night-time is attended by the evolution of carbonic acid, while during the day-time the bark of the stem and branches is throwing off carbonic acid.—12 *A*, 1873, 373.

SPECIES OF PLANTS OF THE UNITED STATES DESCRIBED IN 1873.

The following new species and genera of phænogamic plants and ferns, from within the limits of the United States, have been published during 1873:

Aquilegia chrysantha. GRAY, Proc. Amer. Acad., p. 8, 621. New Mexico.

Wislizenia Palmeri. GRAY, l. c., 622. Lower Colorado Valley.

Polygala subspinosa. WATSON, Amer. Naturalist, p. 7, 299. Arizona and Nevada.

Frankenia Jamesii, TORREY. GRAY, l. c., 622.

Brewerina suffrutescens, new genus and species. GRAY, l. c., 620. California.

Calandrinia Nevadensis. GRAY, l. c., 623. Utah to California.

Pachystima Canbyi. GRAY, l. c., 623. Virginia.

Linum adenophyllum. GRAY, l. c., 624. California.

Lupinus Wyethii. WATSON, Proc. Amer. Acad., p. 8, 525. Oregon.

Lupinus Burkei. WATSON, l. c., 525. Northern Nevada to Wyoming.

Lupinus arcticus. WATSON, l. c., 526. Oregon to the Arctic Ocean.

Lupinus Sitgreavii. WATSON, l. c., 527. Arizona.

Lupinus barbiger. WATSON, l. c., 528. Southern Utah.

Lupinus Palmeri. WATSON, l. c., 530. Arizona.

Lupinus Kingii. WATSON, l. c., 534. Utah.

Lupinus Bridgesii, GRAY. WATSON, l. c., 538. California.

Petalostemon flavescens. WATSON, Amer. Naturalist, p. 7, 299. Southern Utah.

Dalea amœna. WATSON, l. c., 300. Arizona.

Dalea Hallii. GRAY, l. c., 625. Texas.

Hosackia Torreyi. GRAY, l. c., 625. California.

Astragalus Lemmoni. GRAY, l. c., 626. California.

Astragalus ampullarius. WATSON, l. c., 300. Utah.

Potentilla Breweri. WATSON, Proc. Amer. Acad., p. 8, 555.

Potentilla Grayi. WATSON, l. c., 560.

Ivesia Muirii. GRAY, l. c., 627.

Peteria Thompsonæ. WATSON, Amer. Naturalist, p. 7, 300. Southern Utah.

Whipplea Utahensis. WATSON, l. c., 300. Utah.

Œnothera multijuga. WATSON, l. c., 300.

Œnothera Fremontii. WATSON, Proc. Amer. Acad., p. 8, 586. Kansas and New Mexico.

Œnothera hispidula. WATSON, l. c., 599. California.

Œnothera Torreyi. WATSON, l. c., 600. California.

Petalonyx nitidus. WATSON, American Naturalist, p. 7, 700. Nevada.

Cymopterus purpureus. WATSON, l. c., 300. New Mexico and Arizona.

Peucedanum Newberryi. WATSON, l. c., 301. New Mexico and Arizona.

Angelica Wheeleri. WATSON, l. c., 301. Utah.

Garrya flavescens. WATSON, l. c., 301. Nevada to New Mexico.

Brickellia longifolia. WATSON, l. c., 301. Nevada and Arizona.

Aplopappus cervinus. WATSON, l. c., 301. Utah.

Aplopappus cuneatus. GRAY, l. c., 635. California.

Aplopappus pinifolius. GRAY, l. c., 636. California.

Acamptopappus sphærocephalus, new genus. GRAY, l. c., 634. New Mexico.

Bigelovia Cooperi. GRAY, l. c., 640. California.

Erigeron Nevadensis. GRAY, l. c., 649. Nevada and California.

Erigeron argentatus. GRAY, l. c., 649. Nevada.

Laphamia megalocephala. WATSON, l. c., 301. Nevada.

Filago Arizonica. GRAY, l. c., 652. Arizona.

Silphium gracile. GRAY, l. c., 654. Texas.

Wyethia Arizonica. GRAY, l. c., 655. Arizona.

Viguiera reticulata. WATSON, l. c., 301. Southern California.

Encelia nudicaulis. GRAY, l. c., 656. Utah.

Encelia microcephala. GRAY, l. c., 657. New Mexico.

Pugiopappus Breweri. GRAY, l. c., 660. California.

Chætadelpha Wheeleri. GRAY. New genus and species. WATSON, l. c., 301. Nevada.

Monotropa fimbriata. GRAY, l. c., 629. Oregon.

Gilia debilis. WATSON, l. c., 302. Utah.

Convolvulus longipes. WATSON, l. c., 302. Nevada.

Fraxinus coriacea. WATSON, l. c., 302. Nevada and Arizona.

Oxybaphus glaber. WATSON, l. c., 302. Utah.

Abronia villosa. WATSON, l. c., 302, Arizona.

Eriogonum Thompsonæ. WATSON, l. c., 302. Utah.

Eriogonum villiflorum. GRAY, l. c., 630. Utah.

Polygonum Torreyi. WATSON, l. c., 664. California.

Polygonum imbricatum. NUTT. WATSON, l. c., 665. Colorado to Oregon.

Dirca occidentalis. GRAY, l. c., 631. Oregon.

Salix Nevadensis. WATSON, l. c., 302. Nevada.

Calochortus aureus. WATSON, l. c., 303. Utah.

Calochortus flexuosus. WATSON, l. c., 303. Utah.

Androstephium breviflorum. WATSON, l. c., 303. Utah.

Asplenium Bradleyi. EATON. Bulletin of Torrey Bot. Club, p. 4, 12. Tennessee.

Notholæna Newberryi. EATON, l. c., 13. California

DAWSON ON CANADIAN FOSSIL PLANTS.

Principal Dawson, of Montreal, has added to the list of important scientific memoirs from his pen a report on the fossil plants of the lower Carboniferous and Devonian of Canada, constituting one of the more recent publications of the geological survey of Canada. This gentleman occupies a high position as a fossil botanist, sharing the honor of pre-eminence with Dr. J. S. Newberry and Professor Leo Lesquereux. The paper is amply illustrated, and will doubtless become a standard work.

In a recent notice of the geological survey of Ohio, we mentioned inadvertently that the report on the fossil plants was prepared by Professor Lesquereux. This was an error, as no one is more competent for this work than the head of the survey, Professor Newberry; and a memoir on the subject, soon to appear from his pen, will form one of the most important features of the report of the survey.

ARCTIC PLANTS FROM POLARIS BAY.

Some specimens of plants collected by Dr. Bessels, in Polaris Bay, and presented by him to Captain Markham, were recently submitted to Dr. J. D. Hooker for determination, as being the most northern point where any phanerogamous plants were ever secured. The species proved to be *Draba alpina*, L.; *Cerastium alpinum*, L.; *Taraxacum densleonis*, Desf. var.; and *Poa flexuosa*, Wahl.—12 *A*, *Oct.* 9, 1873, 487.

VIRTUES OF EUCALYPTUS GLOBULUS.

The Australian tree *Eucalyptus globulus* (and perhaps other species of this genus) is attracting much attention at the present time from its properties as a sanitary agent, certain French writers insisting that where it is planted it effectually dissipates all tendency to intermittent fever in its vicinity. The tree grows with incredible rapidity, and is said to take up from the soil ten times its own weight of water in twenty-four hours, at the same time emitting antiseptic camphoreted vapors. By the first of these properties it dries up marshy lands, and by its emanations tends to counteract the noxious elements which would otherwise poison the atmosphere.

According to Dr. Gimbert, the first essays with this tree were made at the Cape of Good Hope, where in two or three years a very remarkable change in the public health was appreciable. In Algiers it is said that quite a number of settlements that had been notoriously unhealthy before its introduction became entirely changed in this respect.—12 *B*, *October* 30, 1873, 380.

COMPLETION OF DE CANDOLLE'S PRODROMUS.

A fact of much interest in the history of science is the completion, in a seventeenth volume, of the great botanical work, "Prodromus Systematis Naturalis Regni Vegetabilis" by M. Alphonse de Candolle. The work was commenced fifty-two years ago by the father, and at his death was continued by the son, and a grandson (the son of Alphonse de Candolle) who performed important service in finishing the book. We learn from a communication made by De Candolle to the Academy of Sciences in Paris that the first seven volumes were almost entirely prepared by his father, who died in 1841.

From that time others were enlisted in the service, and no less than thirty-five persons in all were engaged upon the work, each author taking some special monograph, and working it up to the best of his ability. Among those mentioned as having contributed most to the "Prodromus" are Messrs. Bentham, of London; Meissner, of Basle; Dunal, of Montpelier; Müller, Decaisne, Moquin-Tandon, Duchartre, and others.

The work treats of 214 families, 5134 genera, and 58,975 species. Extensive as it is, however, it only reaches to the end of the dicotyledons, and thus joins on to the great work of Kunth on the monocotyledons.

The author is justly proud of the influence which this work has exerted upon the progress of botany, and the use which is made of it in preparing other monographs. It has also done a great deal toward introducing the principles of the natural system, especially in the division of families, genera, and species, as well as the true principles of nomenclature, and particularly that of the law of priority.

The total number of new genera and species described in the work is given at 657 for the one, and 11,790 of the other. —6 *B*, *October* 20, 1873, 866.

PROPAGATION OF EUCALYPTUS.

According to Mr. Stanford, the best method of propagating the *Eucalyptus globulus*, or Blue Gum, the Australian tree which has become so noted for its health-imparting qualities, is by forcing the seed in a hot-house, and, when started, planting in a sheltered position. For the first three years the trees must be placed under cover in winter, and the fourth and fifth years they should be protected for several feet from the ground by wisps of straw. When the trees are kept indoors in winter, it should be in a high greenhouse, with plenty of light and little water. Mr. Stanford has now in his park growing seedlings five years old and thirty feet in height.—20 *A*, *November* 22, 594.

COMPOSITION OF WITHERED LEAVES.

A comparison and analysis, by Professor Krauss, of different species of leaves falling under the effect of summer drought with those cast in the fall, showed that, with about the same amount of starch and potash, the former are richer in albuminous matter and phosphoric acid, and their fall consequently occasions a loss to the plant; furthermore, since starch and potash generally accompany each other, he infers that the starch has not been lost by conversion into carbonic acid in the diseased leaves, but has passed back into the plant with the potash. It seems also that the starch and albuminous matter are not intimately combined in their circulation, since the latter, together with phosphoric acid, are left behind in the dried leaf. It also appears that starch and potash are the more mobile elements.—19 *C*, *August* 30, 1873, 328.

I. AGRICULTURE AND RURAL ECONOMY.

DETECTION OF ORGANIC MATTER IN THE ATMOSPHERE.

Mr. A. H. Smee closes a glass funnel by drawing out its neck to a fine point, places it in a stand, and fills it with ice. He allows the aqueous vapor that condenses from the atmosphere on the outside to drop into a vessel, and measures the quantity thus accumulated in a given time, and determines the ammonia by one of the usual methods. By this means, called "distillation by cold," substances that are decomposed by high temperature can be condensed. The perfume of flowers, for example, can be distilled by placing them under a bell-jar with the funnel.—15 *C*, 1873, 14.

PROTECTING VINEYARDS BY ARTIFICIAL CLOUDS.

The idea was suggested, not long since, of protecting the vineyards of France during critical periods of cold by the formation of artificial clouds that should prevent excessive radiation from the soil, and the experiment was recently tried at Suresnes. In a vineyard of about 50 acres there were placed 360 iron vessels containing a heavy oil. All these being lighted at once, a thick black cloud was soon interposed between the vines and the sky. During clear and calm weather these clouds remain in place, and thus perfectly answer the purpose. The expense of this operation, including pots, oil, and labor, was estimated at about 40 cents per acre, and those who witnessed the experiment were assured of its value and its practical availability.—18 *A*, *March* 21, 1873, 9.

COMPARATIVE TEMPERATURE OF SOILS.

A memoir was published by Becquerel, in November, 1872, upon the comparative temperature of soils at a given depth, and of the same composition, but the one covered with a short vegetation, and the other bare and sandy. The observations were made with the electric thermometer, by which it was shown that, from the autumn of 1871 to the summer of 1872, the mean temperature, at a depth of from 2 inches to 24, under a turfed and under a bare soil, was always different in the two; and that, during all the months of the year, the temperature of the sodded soil was generally higher than that under the denuded surface.

A further inquiry was entered into as to the effect produced upon similar soils by a rainy season, the observations being made for two months, when the rain was almost continuous; and it was found that, during November and December, 1872, the rain being almost constant, the mean temperature of the soil covered with vegetation, up to the depth of 24 inches, was nearly always superior to that of the denuded soil at the same depth. In November, the temperature at 6 o'clock in the morning, at different depths, was generally nearly 2 degrees Fahr. higher under the sod than under the denuded soil, down to a depth of about 12 inches. At 3 o'clock P.M. the difference was less. During a clear sky the temperature under the sodded surface was nearly $1\frac{1}{2}$ degrees below the mean temperature, and 1.80 to 3.60 degrees above that of the bare surface. With a cloudy sky, the temperature of the covered soil equaled that of the air; during rainy days the temperature under the sodded surface, at a depth of 20 inches, was 1.15 degrees less than that of the air; under the sodded soil the temperature was about the same.

As a general rule, it was found that the covered soil was about 1.80 degrees Fahr. warmer than the uncovered, whatever the nature of its composition, during a moist and rainy season. This may, perhaps, be explained on the supposition that, when soil is covered with vegetation, the roots of the latter form a kind of felting which prevents the ready passage of the rain having the temperature of the air, so that the covered soil assumes the temperature of the air more slowly than the uncovered.—6 *B*, *February* 10, 1873, 311.

PRODUCTION OF NITRITES IN THE SOIL.

In an article by Dr. Jeannel upon the production of nitrites in the soil, and upon the functions of humus, it is stated that the calcareous humus, or the vegetable earth, in drying, determines the combination of the elements of the atmosphere, in the form of nitric acid, which is immediately saturated by the lime. In this way may be explained the barrenness of land destitute of lime, and that of pure peat, and the necessity of adding calcareous substances, independently of the recognized requirements of lime as an element in the constitution of the plants.

The renewal of the oxygenated combinations of nitrogen in the calcareous humus is an important fact, which explains the exceptional fertility of lands alternating between frequent rains and dry heat, as in the season of 1872, these alternations being, in fact, equivalent to an addition of manure. This reiterated renewal, and the singular affinity of the humus for the soluble salts, especially those of ammonia, explain the effect of fertilizing substances in fallow lands. It also elucidates the fertilizing influences of tillage, which multiplies the surfaces exposed to the alternations of moisture and dryness. The nitrates and nitrites, formed at the expense of the atmosphere by the calcareous humus, are reduced by the humus itself, and the vegetable matter in general, to a condition of inferior oxidation, which probably paves the way for the absorption of nitrogen by the roots; and it is highly probable that the nitric acid is replaced, little by little, by the carbonic acid in the air.—9 *B*, *July* 25, 1872, 594.

INFLUENCE OF SALINE SOLUTIONS ON FELDSPAR.

A series of experiments has been made by Birker and Ulbricht, upon the influence of saline solutions and other agents on the weathering and decomposition of feldspar, from which it appears that the action of distilled water, with or without air, is practically the same. Calcium, carbonate, calcium-nitrate, with and without carbonic acid; gypsum, with or without carbonic acid; potassium, carbonate, and bicarbonate, and ferrous hydrate, had little more action than water alone. Carbonic acid and calcium carbonate, with carbonic acid, showed an increased action on the alkalies and silica. In the experiments with lime a much larger quantity of alkalies was dissolved, the lime at the same time entering into combination with the silica. Sulphate of ammonia had an energetic action, more especially on the potash; only in the experiments with this salt, and in that with lime, was potash dissolved in larger quantity than soda.

In the case of the ammonia sulphate, the base had entered into some combination with the silica, which was not decomposed either by washing until all sulphuric acid was removed, nor by heating to 210° Fahr. Eichhorn (*Jahresh. f. agricultur. Chimie*, 1859–60, 16) has already shown that silicates, which are decomposed by hydrochloric acid as chabazite, absorb ammonia from its salts. Magnesia acted more energetically than any other agent, seven times more alkali and three times more silica being dissolved than with water alone. Its somewhat less action in combination with carbonic acid was probably due to the crystallizing of bicarbonate on the sides of the vessel.

Sodium nitrate dissolved about double the quantity of potash that water did, but its action was less than that of sodium chloride. These comparative results are in unison with those of Dietrich on basalt.—21 *A*, *May*, 1872, 386.

IMPORTANCE OF SILEX IN THE SOIL.

Silica gives hardness and stiffness to the straw and leaves of cereal grain. When wheat or rye is sown where a brush-heap or pile of logs has been burned to ashes, the straw will be unusually stiff, and the leaves much harsher than other straw growing in the vicinity, but away from the area of the burning. The potash of the ashes and the silica found in the soil are taken up by the growing plants, and form a coating of liquid glass, which is spread evenly over the straw and leaves of the growing grain, as a metallic coat of arms was used in old times to cover the body of a soldier. When the growing straw of wheat is inclosed in a thin tube of elastic glass, the innumerable spores, which frequently fill the entire atmosphere like flakes of snow, and which produce rust, do not find a congenial place for their lodgment and complete development. But when the plants do not have access to a generous supply of silicate and potash, the stems are so limber that they are easily prostrated by driving storms, so that the ears of grain will be developed only in part. When silica is available only in small quantities, the spores from which fungi spring adhere to the leaves and stems, where they find a suitable spot for their development, and thus the productiveness of the plant is seriously impaired. The practical value of silica is further perceived in the yield of excellent fruit. If the soil near an apple or a pear tree, that has hitherto borne knotty and rusty fruit, receive a liberal dressing of sand, which supplies silica, and of wood-ashes, which furnish the potash—the substance required to make glass—Nature will employ those ingredients, to a great extent, in covering the leaves with an elastic glass, and the fruit with a thick, transparent varnish, produced from the silica and potash, which will protect the leaves from blight, and the fruit from rust, scales, and cracks. This fact has been demonstrated repeatedly in some fruit-producing localities, where wood-ashes or coal-ashes have been scattered about pear-trees and apple-trees so liberally that all grass and weeds were destroyed. Flint, sharp sand, and quartz are composed, for the most part, of silica. Hence the propriety of mingling scouring-sand with the soil in which flowers are cultivated. Divest the soil of all silica and alkali where useful plants and beautiful flowers are to be grown, and not one would attain to perfect development, simply because silica and potash are eminently essential to impart stiffness to the stems and elasticity and tenacity to the leaves. When grape-vines, for example, which are growing in a sandy soil, have access to potash in abundance, the leaves will appear as tough as leather, and no mildew nor rust will ever affect the foliage or injure the fruit.—17 *A*, *May* 1, 1872, 261.

FUNCTION OF ORGANIC SUBSTANCES IN THE SOIL.

A number of experiments by Grandeau upon the part which organic substances in the soil play in the nutrition of plants led to the following conclusions: 1. In fertile soils the mineral ingredients necessary to the plant are present in the form in which stable manure furnishes them. 2. The fertility of a soil depends essentially upon the amount of mineral matter in the organic substances that are soluble in ammonia, the organic matter acting as a vehicle of the mineral matter. This has suggested the combination of the two as a manure, to be applied directly to such soils as require stimulation. Quite recently an establishment in Paris, which manufactures glue and gelatine on a large scale, and, of course, has a great quantity of bone on hand, has succeeded in manufacturing a compound of this earth with roasted animal refuse, which proves to be extremely efficient for the purpose in question.—18 *C*, *October* 16, 1872, 666.

INFLUENCE OF SPRING WATER ON MEADOW-GRASS.

Beyer, in a series of experiments upon the influence of river and spring water upon meadow-grass, has come to the following conclusions:

1. That meadow-grasses can come to full development by means of the food contained in river or spring water, as represented by Vincent.

2. That during the first period of growth from such dilute solutions, the food is devoted to the formation of roots, and that only after a large root-surface has been formed can the organs above the surface obtain sufficient nourishment to arrive at maturity.

3. That the quality of the water has a separate and distinct influence on the total produce, and on the development of different grasses in the same mixture of seeds. With river water, *Holcus lanatus* became developed in the mixture of grass-seed in a greatly preponderating proportion, whereas with spring water few plants of *Holcus lanatus* developed; but the product of the mixed meadow-grasses was greater.

4. That an apparently totally barren soil, with proper irrigation, can grow grasses for a short time.

Among other experiments, Beyer tried an almost sterile soil, from which the finer particles had been washed out. This was kept moistened with distilled water. The seeds germinated well, and were vigorous during the first two summers, but refused to grow afterward.—21 *A*, *June* 20, 1872, 518.

EFFECT OF DIFFERENT MANURES ON THE PRODUCTION OF OPIUM.

Experiments by Dr. Dietrich gave the following results: The blue German poppy not only yields the largest amount of opium, but also that richest in morphine. Opium from unmanured land contains less than one half per cent. of morphine; that from land manured with saltpeter had three to four times this amount; while that from land manured with sulphate of ammonia contained thirteen times as much. The application of potash and phosphoric acid, alone or mixed, did not essentially increase the amount of morphine. He concludes, therefore, that the ammonia of the atmosphere does not afford sufficient nitrogen for the formation of vegetable products rich in that element; that nitrogenous fertilizers are of the highest importance for this purpose; and that the presence of nitrogen in the manure, as an ammonia compound, is more favorable to the formation of morphine than as a nitrate.—28 *C, January*, 1873, 18.

FISH GUANO.

A sample of Norway fish guano, from Meinert, in Leipsic, was found to have the following percentage of composition: Moisture, 9.85; mineral matter, 32.73; organic matter, 57.42; the amount of phosphoric acid being 13.30, and of nitrogen, 8.48. At about seven cents per pound for phosphoric acid, the price of nitrogen is entirely too high—higher than in fertilizers which contain it in the form of ammonia salts.—8 *C, September* 19, 1872.

EXPERIMENTS ON A SUBSTITUTE FOR PERUVIAN GUANO.

In experiments made by Professor Jörgensen with phosphate of lime (Baker guano), soda, potash, sulphates of magnesia, lime, and ammonia, and stable manure, in different combinations, it was found that, with barley, the best results were obtained by the simultaneous application of sulphate of ammonia, phosphate of lime, the alkalies, and sulphates of lime and magnesia. About the same followed the use of stable manure. The preparations of sulphate of ammonia and phosphate of lime came next, the nitrogenous matter seeming to assist in the solution of the mineral ingredients of the soil. The results with other combinations were no better than on unmanured portions. The average results were very good, as the soil was naturally a good one, had been well manured in previous years, was thoroughly drained, and kept clean, and it was only in the last years of the experiments that the above differences manifested themselves. In one particularly dry season, the portion treated with stable manure was most productive, and the unmanured portion next—indicating that in dry seasons concentrated artificial fertilizers had an injurious rather than a beneficial effect. Stable manure, on the contrary, seemed not only to generate moisture in its decomposition, but also to attract moisture from the atmosphere. With beans, the second best crop was obtained by the use of alkalies alone, or combined with other manures. The general results seem to substantiate the observation that the use of a mixture of all the fertilizers essential to plant growth, especially of the three in which the soil is deficient, viz., nitrogen, potash, and phosphoric acid, is better than employing them separately; since one, by reason of the accidental deficiency of the others in the soil, may not be able to exert its full effect. The author concludes that it is possible, by a mixture of the active ingredients of Peruvian guano, to produce a substitute for that fertilizer.—28 *C*, *January*, 1873, 19.

IMPROVED USE OF STABLE MANURE.

Mr. Von Horskyfeld, the owner of large landed estates in Bohemia, has since 1854 introduced a method of treating the accumulating stable manure which differs from the usual process, and for which he claims many advantages, viz.: economy of time, space, feed, and bedding, a great saving of money and of hands, and no necessity for such contrivances as cellars, tanks, pumps, etc.; also, a far better product, no losses occurring from evaporation and rot; and, finally, a decided improvement in the condition of the cattle-yards, which never show any trace of manure, either solid or liquid. He says all these favorable results are obtained in the following way: The manure is not removed from the stable until it reaches the height of five feet; the straw for bedding is cut into lengths of about five inches, and thus more readily absorbs the liquid portion, and facilitates the distribution of the manure in the furrows. The entire mass is constantly compressed by the weight of the animals, and thereby kept moist, while air and consequent putrefaction are excluded. After about three months, this manure is carried to the field, and immediately covered in the furrows, where it readily decomposes and yields all its strength to the soil—fully double its usual value, according to Mr. Von Horskyfeld's experience. Besides this, the air in the stables is never tainted by exhalations injurious to the health of the cattle.—9 *C*, 1872, VI., 82.

REARING OF OSTRICHES FOR THE FEATHERS.

The artificial rearing of ostriches is fast becoming a regular business, the number of establishments in South Africa, where this avocation is prosecuted, increasing continually, and causing a considerable rise in the price of young birds.

In 1861 a pair of ostriches six months of age could readily be bought at the Cape of Good Hope for ten shillings English, while now a single bird a few days old is sold at £5, and one of three or four months brings £8 to £10. The trade in feathers has also shown a marked variation. Thus in 1860, 2287 pounds were exported, worth £19,201, while in 1870 29,000 pounds were worth £87,074; or, in other words, a pound of feathers in 1860 was worth £8 0*s.* 4*d.*, and in 1870 it brought only £3.

Mr. Heugh, of Aberdeen, South Africa, has a farm of 600 acres, on which 70 ostriches are inclosed, partly by stone walls 4 feet high, and partly by wire fencing, filled in with bushes to prevent the birds from inadvertently running against them. The first crop of feathers, from 54 birds about 14 months old, weighed about 14 pounds — all taken from the wings.

Recent quotations of ostrich feathers in the London market (March 4) are: "For prime whites, £35 to £38 per pound; good light feminines, £10 to £15; black, £2 to £5; drabs, 15*s.* to £2 10*s.*"—3 *C, February* 10, 1873, 120, and 19 *A, March* 22, 1873, 271.

THE INCUBATOR FOR HATCHING OSTRICH EGGS.

A practical application of the "Incubator" has lately been made to the hatching of ostrich eggs at the Cape of Good Hope, and with the most satisfactory results. In the establishment at Hilton, 72 chickens have been already hatched this season; the total number reared there since its inception amounting to 155. Of 45 eggs placed in the apparatus at one time, it is thought that 42 will produce healthy chickens. —19 *A, April* 5, 1873, 315.

CARBOLIC ACID IN POULTRY-HOUSES.

A writer in the *London Field* strongly recommends the use of carbolic acid for destroying insects in pigeon and poultry houses, asserting that it neither injures the birds nor tends to drive them from their nests. He uses it in the form of a solution of two ounces of common carbolic acid to three quarts of water, applying this once a week with a watering-pot, after the house has been carefully swept out. Besides the lice and acari that it destroys, it is also efficient in driving out fleas. For the purpose of expelling lice from the bodies of the pigeons, the proposed method is said to be to mix one part of Calvert's liquid carbolic acid with thirty parts of water, first mixing the acid with a very little glycerine, adding the water, and shaking well before use. This is to be applied with a small brush to the roots of the feathers about the lower part of the belly and around the vent, where the greatest number of insects will always be found. This application leaves no stain, kills the vermin instantaneously wherever it touches them, and two or three applications, at intervals of a few days, are sufficient to make the foulest specimen thoroughly clean. The writer also uses Calvert's carbolic acid disinfecting powder, dusting it often over the bodies of even the young birds, without injury to them, and with equally good results.—19 *A*, *August* 17, 1872, 173.

DESTRUCTION OF INSECTS IN POULTRY-HOUSES.

Fumigating poultry-houses with sulphur, thrown on glowing coals in an earthen vessel, and keeping the house closed for several hours, is said to be a perfect remedy for insects of all kinds. The poultry must, of course, be removed before the experiment.—16 *C*, VI., 173.

SUBSTITUTE FOR MILK FOR CALVES.

An article of food for calves, suggested by Liebig, analogous to his substitute for milk for children, has been thoroughly tested by Von Rothenhan, with the most favorable results. Its cost is about half that of milk; it is easier to prepare than other substitutes for milk of an inferior character, and which are not as eagerly taken by the calf; and it never produces diarrhœa nor other injurious consequences. For the latter reason it is also specially adapted to young pigs. It may be prepared as follows: 1 quart of water, 1 quart of skimmed milk, 1130 grains of bruised malt, 1130 grains of wheat flour, and 90 to 100 drops of a solution of bicarbonate of potash in 11 parts of water, are stirred together, allowed to stand for half an hour, then well boiled, with stirring, and finally filtered through gauze to remove undissolved flour, etc., which might cause flatulence, etc. It will keep 24 hours, and must be prepared daily, and given warm. For the first six weeks all the milk is given the calf, then the mixture is gradually substituted for a portion of the milk, until eight quarts of the mixture and no milk are given per day. As much clover and white hay as it will eat are supplied at the same time. After three months only half as much of the mixture is fed, with the addition, however, of about half a pound of oil-cake, and in the fall of boiled potatoes also. It may likewise be given to calves at first, when milk does not agree with them.—28 *C, January*, 1873, 18.

REMEDY FOR COLIC IN HORSES.

Chloral-hydrate has been highly recommended by the Agricultural Central Association in Potsdam as an excellent and certain remedy for colic in horses. Half an ounce of it is given in a pint of castor-oil. This remedy, however, should be administered with caution.—9 *C*, No. 3, 1872.

PROPER LIGHT FOR STABLE WINDOWS.

The regulation of the admission of light into stables by the proper location of the windows has been found to be of the highest importance. A side window, according to numerous observations, is apt to produce weakness in the eye on that side; a window immediately in front of the manger throws a glare of light into both eyes, in the highest degree injurious; while one higher up, in front, tends to render a horse over-sighted, and consequently liable to shy at low objects. —10 *C, September*, 1872, 129.

EXTIRPATION OF SILK-WORM DISEASE.

Perfect freedom from disease of the silk-worm moth, from which the eggs for a succeeding crop are to be obtained, is considered of the utmost importance, since eggs from diseased insects are sure to produce diseased worms. For the purpose of securing the desired result, the Susani method is now largely adopted in France and Italy. This consists in placing the male and female in a little tulle bag, about four inches long and two inches wide, which, after being closed, is hung up on a wire. After the eggs are deposited inside the tulle bag, both moths soon die, and are then taken out of the bag, put into a mortar, and crushed to powder. Distilled water is next poured on the powder, and a drop examined under a microscope. If the drop appear clear, both moths were healthy, and the eggs are considered healthy likewise. Should, however, a glass-like, crystalline body of an oval form be observed in the drop, the eggs are doubtful, and are rejected. If two such bodies are seen, the tulle bag is burned at once.

Susani employs 25 girls during the whole winter, each of whom makes 200 examinations daily. There are sometimes as many as half a million bags at a time hung up in large, warm rooms, where the work is carried on. This tedious but sensible proceeding has proved very effective, and it is hoped that, in time, Italy may be freed from the ravages of the silk-worm disease.—2 *A*, *November* 23, 1872, 347.

DECLINE OF THE SILK-WORM DISEASE.

Mr. Guérin Méneville, an eminent practical entomologist of France, and one who has devoted much attention to the maladies of the vine and of the silk-worm, finds occasion to conclude, from recent investigations, that the silk-worm disease has run its course, and has already left certain mountainous portions of France and adjacent regions. In these the eggs produced are generally sound, whether treated according to Pasteur's system or in the ordinary manner; and it is found that the same eggs, carried to a country where the disease is decreasing, will, in a large percentage of cases, yield sound worms, and that where the crisis has not been passed they almost all become worthless.—3 *B*, *Feb.* 27, 1873, 397.

CURE OF SILK-WORM DISEASE.

Guisque maintains that the diminution of the disease is simply the result of the important researches and inquiries of Pasteur, and that to him the French people and the world at large owe the discovery and application of a method so beneficial in its results.—6 *B*, *March* 24, 1873, 783.

DESTRUCTION OF MAY-BUGS ON A LARGE SCALE.

In the royal forests of Bischofsroda a successful experiment has lately been made in destroying May-bugs on a large scale. The *modus operandi* was suggested by the observation that these bugs always select warm and loose ground for the deposition of their eggs. Consequently, seventeen artificial breeding-places were prepared by covering fresh cow-dung with fine earth; and by the middle of July these were found full of eggs or grubs, of one-quarter inch in length on the sides most exposed to the sun. After carefully collecting these eggs, etc., they were burned outside the forest.—9 *C*, 1872, VI., 86.

THE PHYLLOXERA SCOURGE.

The subject of the ravages of the *Phylloxera*, or grape-vine louse insect, continues to occupy the minds of vine-culturists in France, although the winter season has not been favorable to the prosecution of many experiments. Mr. Faucon, who has been among the more diligent investigators into the natural history of this insect, reports that he has not lost sight of it for any moment, but has made repeated examinations of the roots of the vines as well as the plant itself, and has satisfied himself that the excessive rains have caused the death of a great many of the insects; and that this will always take place whenever the submersion of the roots of the vine is complete for a sufficient length of time, or else when the rains are capable of producing a corresponding effect. The dead insects preserve their shape and natural color in winter for a long time, if protected from contact with the atmosphere; but as soon as exposed they dry up, and the color becomes a dark brown or black. It requires, therefore, a very practiced eye to distinguish the dead insects from those which are only hibernating, this sometimes being impossible even by the aid of the lens.—6 *B*, *March* 24, 1873, 768.

BRITISH REPORT ON PHYLLOXERA.

The British government has lately published a Blue-book upon the *Phylloxera vastatrix*, or vine louse insect, embracing a letter from the British minister in Portugal, calling attention to the ravages of the disease, and mentioning the action taken by the government of Portugal toward the extirpation of the evil. The other documents presented are from the British consul at Oporto, and numerous papers from the French authorities. Dr. Hooker, to whom the whole subject was referred, informs the government that the only really effectual remedy at present discovered, and one which, of course, can be applied only partially, is a complete flooding of the vineyards in winter. He also states that in many instances, on the first symptoms of an attack, the prompt destruction of the plant (burning it on the spot), and the subsequent treatment of the soil with carbolic acid, will be of much importance. It would appear that vines of American species have been less affected in the Rhone district than the native varieties.—12 *A*, *December* 19, 1872, 131.

SULPHURET OF CALCIUM A REMEDY FOR PHYLLOXERA.

According to Wissocq, sulphuret of calcium dug in around the roots of vines will have a very powerful effect in destroying any *Phylloxera vastatrix* that may happen to infest them. This gives rise to a true sulphuric acid, in consequence of the moisture of the soil and the gentle disengagement of carbonic acid. It serves equally well to destroy caterpillars and other injurious insects which are frequently so difficult to remove from vegetation.

The same substance is also recommended for the destruction of miasms (or the agencies by which epidemics are transmitted), and also as not being open to the objections to the ordinary disinfectants introduced into water-closets, such as sulphate or chloride of iron, which, while destroying the hydrosulphuric acid, allows the development of more dangerous emanations.—6 *B*, *November* 4, 1872, 1092.

THE VERMIN ASPHYXIATOR.

Those who have suffered from the ravages of the ground squirrels and gophers in California, and of equally annoying animals elsewhere, will welcome a satisfactory method of exterminating these depredators, devised by Mr. Bateson, the inventor of what he calls the "Patent Vermin Asphyxiator," for destroying animals in burrows, and for other purposes. The apparatus consists of a vessel capable of being perfectly closed, in which sheets of paper saturated with sulphur, or other substances, may be burned, and the fumes forced out through a flexible tube by means of a fan, which delivers the noxious gases with a pressure sufficient to drive them into the minutest crevices.

In the course of a public exhibition of the apparatus, recently given in London, numerous experiments were tried; among them the destruction of aphides on plants, of weevils in grain, of snakes in a hole, of rats in a drain-pipe, etc. For destroying rabbits, squirrels, or other animals in burrows, it is only necessary to introduce the flexible tube or nose into one of the apertures, close up the rest, if this can be done conveniently, and then force a continuous stream of the gas through the burrows. A few minutes' application is sufficient to destroy every living thing within the influence of the apparatus.

One advantage of this new method is its perfect safety, sulphurous acid being one of the best preventers of combustion known, and capable, therefore, of being used for extinguishing flames, in case of need. Other incidental applications of the Asphyxiator are as a disinfectant and as a deodorizer. It is well known that sulphuric acid is used very extensively for destroying the germs of small-pox, scarlet fever, yellow fever, cholera, etc.; although there are sometimes difficulties in its application, which the present arrangement seems to obviate. The inventor claims that one or two of the machines can easily disinfect a vessel, on battening down the hatches and working the apparatus from the deck. For cases where the dislodgment of an animal, as of a rabbit, etc., is desired, rather than its destruction, what is called a smoke paper is used, which, when burned in the machines, produces unbearable fumes that soon accomplish the desired effect.—2 *A*, *July* 20, 1872, 41.

VALUE OF SEA-WEED MANURE.

It has long been customary on the sea-coast to use seaweed (*Fucus*, *Laminaria*, etc.) for a manure, its value for this purpose being considered by many as scarcely inferior to stable manure. This applies, however, to sea-weeds proper, the eel-grass (*Zostera marina*) being of a very different character, and, on account of its slow decomposition and different chemical combination, of much less value. An especial feature of the true sea-weeds consists in their large percentage of nitrogenous matter and in the great amount of ash, one analysis giving for dry sea-weeds nearly 7 per cent. of nitrogenous matter, 75 of cellulose, and about 18 of ash. The amount of nitrogen proper may be estimated at from $1\frac{1}{2}$ to 2 per cent.

The principal objection to the use of sea-weed as a manure consists in its very small percentage of phosphoric acid.

This, however, can be very easily remedied by the addition of some phosphate, such as bone-meal. In the large amount of potash and gypsum it contains, sea-weed serves admirably as a dressing for grazing-lands. It is also very well suited to potatoes and other roots, tobacco, flax, and growths requiring a good deal of potash. As an element in compost, it is quite unrivaled, owing to the readiness with which it is decomposed, and the intimate combination which it enters into with other substances.—8 *C, July*, 1872, 12.

EFFECT OF FOOD ON THE URINE OF ANIMALS.

Upon feeding one goat on green clover and beet leaves, and another exclusively on milk, Weiske, of Proskau, noticed that the urine of the first was turbid and alkaline, and effervesced with acids (as is normally the case in the herbivora), while that of the last was perfectly clear of acid reaction, and free from carbonic acid, or like the normal urine of the carnivora; it was also of low concentration, and high comparative percentage of nitrogen, as shown by the following analyses of 100 cubic centimeters:

	I.		II.
Solid matter	11.08 Grams		1.75 Grams.
Nitrogen	1.11 "		0.33 "
Hippuric acid	0.10 "	(or 1.8 on meadow-grass).	
Ash	5.19 "		0.57 "

—19 *C, November* 9, 1872, 368.

ARRESTING DECAY OF POTATOES.

Professor Church, of Cirencester, the eminent agricultural chemist, announces that sulphite of lime appears to exercise a very remarkable influence in arresting the spread of decay in potatoes affected by the potato disease. In one experiment the salt was dusted over some tubers, partially decayed from this cause, as they were being stowed away. Some months afterward, the potatoes were found to have suffered no further injury. A similar trial with powdered lime proved to be much less effective.—1 *A, August* 30, 1872, 105.

UTILIZATION OF DISEASED POTATOES.

The extensive failure of the potato crop in Great Britain, in consequence of the prevalence of rust and rot, is a subject of grave moment, as bearing upon the welfare of the laboring classes; and a method of utilizing the diseased potatoes has been made public at the instance of the British government. This depends upon the fact that the starch of the potato is not affected by the disease, but retains its nutritive properties.

The process consists in rasping the peeled tubers, upon a bread grater, into a tub of water. The starch sinks to the bottom in a few minutes, and the diseased matter, woody fibre, etc., is suspended in the water, and should be poured off with it. Fresh water is then to be added, the starch stirred, and again allowed to settle. Two or three such washings will thoroughly remove all impurities, and render the starch fit for use. If dried, it can be kept any length of time, and can be used, like arrow-root, for puddings and cakes, or, mixed with flour, as bread.—22 *A*, *August* 31, 1872, 202.

THE POTATO DISEASE IN GREAT BRITAIN.

A very interesting article upon the recent outburst of the potato disease in Great Britain has been communicated by Mr. L. G. Smith to the October number of Hardwicke's *Science Gossip*. In this the author refers to the fact that it was not until 1841 that the disease was brought prominently into notice, although as far back as 1830 a disease of the potato was known in Germany under the name of the dry rot. In its more recent manifestations, it appears to have been observed in Canada and the United States, but not before its memorable outburst in Western Europe in 1845.

The true cause of the evil is now well ascertained to consist in the disorganization of the tissues of the plants, caused by a fungus known as *Peronospora infestans*. This never develops itself on the upper surface of the leaf (which appears to be quite impervious to its attacks), and it seldom originates in the stems; but the mycelial threads pass down from the leaves, and soon reach the tuber. The stem and leaves then rapidly rot and fall off upon the earth, in an offensive mass. So rapid, indeed, is the growth of the fungus, that in a few days it will spread from plant to plant over a large tract, giving to the field the appearance of having been attacked by frost. The prime cause of the death of the leaf is probably to be found in the choking of its breathing pores, resembling in a measure the action of croup in the human subject. The emission of perspiration or moisture from the leaf is thus prevented, and the plant becomes surcharged with moisture, which rapidly rots the stems and leaves, the mycelium preying upon the tissues.

It is very common to find a species of aphis upon the leaves and stems of the infected plant, and many persons have ascribed to this minute insect the origin and perpetuation of the evil. It is, however, the opinion of most authorities that the disease is primarily caused by the fungus, which attacks perfectly healthy plants, and that the aphides simply find in the resulting decay a suitable and agreeable resting-place.—4 *A*, *October*, 1872, 332.

WHY THERE IS NO REMEDY FOR THE POTATO DISEASE.

In reply to an assertion in the *London Magazine* that our ignorance of a satisfactory remedy for the potato disease is rather a stigma upon modern science, an eminent naturalist retorts that the investigations necessary to determine the desired remedy require large expenditures of time and money; and that, if those who are practically interested in the subject—our governments or the farmers—do not think it sufficiently worth their attention to induce them to employ scientific men for the special object of working out this problem, the omission to do so can not be imputed to the latter. Very little, indeed, so far as we know, can be done to arrest the disease, from the fact that the infection spreads so rapidly that the first intimation of its presence may be the destruction of the crop in an entire field. It is said that potatoes escape with little or no disease in the neighborhood of chemical works; which is due possibly to the effect of the sulphurous acid or other gases that are noxious to the fungus growth, without injuring the more highly organized potato plant.

The application of finely divided sulphur is beneficial here, as in other plant diseases. It is stated that if, as soon as the disease has attacked the fields, the stems be all cut down close to the ground, the infection will not extend to the tubers; and when the crop is nearly ripe this may be a judicious application, but it necessarily has the effect to stop any further growth. Even in this case, however, the potatoes may be serviceable for seed for the coming year. After reviewing all that has been said on the subject, Mr. Thistleton Dyer comes to the conclusion that the only way in which there is any reasonable hope of relief from the scourge is in obtaining early maturing kinds. August, in England at least, is the month when the disease is worst, especially if the weather be both wet and warm. If the crop can be secured before this period, the evil will be avoided. The production of early kinds, so as to cause a systematic improvement, is possible only with time, united to skill and patience.—4 *A*, *November*, 1872, 254.

AID IN ADVANCING THE GERMINATION OF SEEDS.

As a means of promoting the germination of fruit and other seeds, a German horticulturist recommends the following simple preparation, as tested by his own experience: Seeds of apples, pears, etc., are placed in a tumbler or glass jar, with a sufficient quantity of rain-water to cover them, and kept in a room at a temperature of from 62° to 65° Fahr., the water to be renewed when its odor indicates spoiling. After about a fortnight the germs appear, when the seeds should be slightly dried by spreading them upon a cotton or woolen cloth, and then planted immediately. Locust seeds and others having hard shells are equally benefited by such soaking.—10 *C*, 1872, VII., 111.

PREVENTION OF ROTTING IN FINE FRUIT.

It very often happens that fine fruit, especially pears and apples, is attacked by birds and insects so as to make a wound, which, if left to itself, will cause the fruit to rot. It has been found that by cleaning out the place affected, and removing all the dirt and disorganized and bruised matter, and filling up the cavity with plaster of Paris, further decay may be arrested, and the fruit become fully ripe. A little space may be worked out from under the edges of the skin, so that when the plaster is pressed inward it will keep its place. The exclusion of the air, consequent upon this application, is all that is necessary to prevent the progress of decay. This would, of course, be inexpedient in many cases, but when large and valuable apples and pears are involved, the trouble will be but trifling in comparison with the result accomplished.—9 *B*, *August* 12, 1872, 620.

SEEDLING PLUM-TREES.

An inspection of the plum orchards and nurseries of Hagensdorf, in September, 1871, demonstrated that seedling trees had withstood the severity of the winter much better than those propagated from suckers. Of the latter, thousands of old trees were killed, as well as beds of young ones, while adjoining beds of seedlings were entirely unaffected. It was also noticed that trees which abounded in sprouts were more generally affected than those from which the sprouts had been removed at an early period. It is also contended that seedlings send out their roots more vertically, and deeper down, and in consequence are more likely to reach moisture in dry weather, and less liable to injury by the plow in cultivation, or to send up suckers.—9 *C*, *October*, 1872, 145.

DISEASE OF TIMOTHY GRASS.

A new disease threatens to impair the usefulness of the timothy grass (*Phleum pratense*, *L.*), the great favorite of our agriculturists. It was first observed in Silesia, and Prof. J. Kühn ascertained its cause to be a parasitical fungus (*Sphœria typhina*, *Pers.*). A dense tissue of a grayish-white color forms, usually at the third joint above the ground, though it sometimes appears at the lower nodes. Propagating organs (*gonidia*) develop rapidly, and Mr. De Barry believes the mycelium of the parasite to be perennial in the stem; its origin is as yet unknown. Early cutting, and pasturing by sheep, are recommended as means of preventing its spread.—28 *C*, 1872, IV., 241.

EFFECT OF TIME OF SEEDING ON GRAIN.

Prof. Thiel of the Agricultural School of Darmstadt, while attributing the failure of development of much of the seed sown, in great part, to defective seeds, to the variable depths at which they are deposited when a drill is not used, and to the numerous injurious insects, suggests that the effect of unfavorable weather, in addition to all other causes, especially with winter grain, may cause the destruction of a great number of plants already developed, and that, consequently, a most important point to be determined, in connection with certainty of crops, is the proper time for seeding. In order to substantiate this opinion experimentally, portions of ground were seeded with rye and wheat, at intervals of eight days, Dec. 14 to Nov. 27, when heavy frost prevented further seeding. The number of fully developed stalks was compared with the number of seeds germinated, as well as with the whole number planted. The differences in development were estimated by the number of stalks and heads, and the length of the stalks; the number of grains, according to the author's view, in small patches, not affording a proper criterion for comparison, even if the ravages of the birds did not render their complete determination impossible. In the tabular statement given the numbers are in all respects favorable to the three early seedings. In spite of the differences in time of seeding, there was a difference of only a few days in the shooting of the stalk, and in blossoming, so that the grain ripened about the same time; and in these facts may lie the poorer yield of the late seeding, even of the plants that reached maturity. These began to shoot under the influence of favorable weather in the spring, without having had time to assimilate sufficient nutriment for vigorous development. The author does not contend that a difference of eight days in seeding-time, at the right season, would necessarily have a decided effect, but that other influences, such as peculiarities of soil, character of preceding crops, etc., may be greater; and again he admits that the weather in the beginning of November may at times perhaps be less favorable to newly sown seed than in the middle of the month; but he claims that circumstances of this kind do not affect the general statement (as substantiated by his experiments), namely, that sowing seed at the proper time, *i. e.*, early in the season, insures greater certainty of germination and development, more vigorous and healthy plants, fuller growth, larger number of stalks and heads, and longer straw.—28 *C*, *January*, 1873, 47.

REPORT ON TEA-CULTURE IN JAPAN.

A communication from the Secretary of State has lately been published by Congress, containing an interesting account of the growth, culture, and preparation of tea in Japan and China, being compiled from a series of communications forwarded by the American legations in those countries. The dispatch from Japan was accompanied by a series of drawings, which, however, have not been reproduced.

According to this account, the export of tea from Japan during the year ending May 31, 1872, amounted to over fifteen millions of pounds, of which only 2688 pounds were sent to Europe, all the rest coming to the United States, and showing the importance of a trade which is increasing every year. It is stated that the tea-plant in Japan is propagated from seeds only, and matures for picking in three years. The first picking commences in April, when the leaves are most tender, and continues throughout May and June, but the leaves are then less valuable.

The leaves are dried on furnaces, and subjected to the usual manipulation, after which they are sifted and classified for the market. Each variety of tea is then shaken together to round off the corners, and the dust is separated, when the tea is packed in boxes and carried to market.

For the American market the tea is always refired before shipment, this being done by placing the tea in iron pans over a strong charcoal fire, constantly stirring it, for forty-five to sixty minutes. This process gives the so-called "toasty flavor" and the "greenish color," both of which, with a great increase of dust and broken leaf, are obtained at the expense of that delicate and rich flavor which the tea had after the country manipulation.

In the opinion of Mr. Shepard, the American chargé in Japan, all this refiring is unnecessary for the voyage to America, or, at least, an extra firing at the first preparation would answer the purpose, and he is quite positive that the preparation in question is a serious injury to the quality of the tea as a beverage. The greenish color demanded in the American market is not an essential to the tea, and is only obtained by strong firing and stirring in pans, or by an admixture of indigo, plaster of Paris, and soap-stone, such as the Chinese teas are treated with.

The best Japan tea, in its pure state, is a long twisted leaf, with but little dust or broken leaves in it, and of a brownish green, rather than a yellowish or grayish green. It is further stated that tea has been used in China, Japan, and Corea more than a thousand years, the first foreign export being to Holland early in the seventeenth century, and to England about 1660.

The very finest teas of Japan are wholly grown by the priests. They are cultivated under mats, to secure the desired degree of shade, and bring from $5 to $6 a pound in Japan, none of this quality being exported.

In the article upon the teas of China it is stated that indigo is used for coloring gunpowder-tea, and that in the southern districts of China Prussian-blue and gypsum are employed instead of indigo.—*Misc. Doc., House Rep., No.* 96, 1872, 3.

CONGRESSIONAL ACTION RESPECTING FORESTS.

A very important bill was lately introduced into Congress by Mr. Haldeman, of Pennsylvania, and has now become a law. It provides that every future sale of government land shall be with the condition that at least ten per cent. of the timbered land shall be kept perpetually as woodland; and if the land be not timbered, then the patent is to be issued on the condition that ten per cent. of the quantity is to be planted with forest trees within ten years, and kept forever as woodland. If this be done, an abatement of fifty per cent. is to be made on account of the expense of the planting. A violation of this agreement is to be met by the forfeiture of the land. It is also proposed that any one who may wish to acquire title to the public land, under the homestead act, can do so by proof of the fact that he has had, at the end of three years after taking possession, at least one acre under cultivation with timber for two years, and that this shall be continued until one acre in every ten is planted with trees, in clusters not more than sixteen feet apart.—*House Bill, Forty-second Congress*, 3008.

INFLUENCE OF SULPHURIC ACID ON WINE.

Dr. De Martin, discussing the influence of sulphuric acid upon the formation of wine, assures us that by adding a single gramme (15 grains) of the acid to a quantity of wine equal to 25 gallons, the following results will be observed: First, the fermentation will be more rapid and more quickly completed, and the sugar more speedily transformed into alcohol. Second, the red color of the wine will be more lively. Third, a careful chemical analysis reveals no more sulphuric acid in such wine than in specimens prepared by the ordinary methods employed in the South of France. It is most probable, indeed, that, in consequence of the numerous reactions which take place between the mineral substances, organic salts, and the albuminoid and colloid substances of the wine, the small quantity of acid added is rendered fixed and insoluble.

These results, in the opinion of the writer, confirm the experiments of Professor Chancel, who has ascertained that whenever the must is alkaline, the sugar, instead of being transformed into alcohol, is converted into lactic acid, from which wine, of course, can not be produced. The addition of the acid, however, counteracts the alkalinity of the must, and places the grape sugar in the conditions necessary to produce alcohol. In some instances, the precise source of the alkalinity referred to, although a serious matter, is not clearly understood; but Dr. De Martin suggests that it is possibly caused by the grapes becoming covered with mud in consequence of rain, which is thus accumulated in sufficient quantity to give an alkaline reaction to the liquid, resulting in a poor fermentation.—9 *B*, *June* 2, 1872, 506

PRESERVATION OF WINE BY HEAT.

In a memoir upon the employment of an elevated temperature for the improvement and preservation of wines, Vergnette-Lamotte gives the following conclusions as the result of his experiments:

1. If we heat new wines, rich in soluble matters, we give them the character of the wines of Spain and Portugal.

2. In the application of heat, we must take into consideration the amount of alcohol contained in the wine, its vinosity (proportion of alcohol) permitting us to lower the degree of heat needful for its improvement and conservation.

3. The age of a wine has a very great influence upon the character which it presents after heating. This process does not succeed with old wines.

4. It is equally needful to take account of the time the wine has been in the wood and in bottle.

5. Heating gives, in general, excellent results with white wines. In applying it to new wines, still rich in soluble matters, we preserve in them that precious quality technically known as "liqueur."

6. The degree of heat is a capital point; that suitable for superior kinds of Burgundy, rich in alcohol, is 112° Fahr. There exist, in fact, for each wine, peculiar conditions of heating.

Passing from the effects of heat to those of freezing, Vergnette-Lamotte considers that light wines containing little alcohol and little acid, and very thin wines, may have their value doubled by freezing. His process is of no use either for common wines or for those which already possess all the qualities demanded from a first-rate vintage.—3 *A*, *June* 15, 1872, 515.

ARTIFICIAL HUMOUS SUBSTANCES.

One great difficulty experienced by Dr. Detmer in the investigation of humous bodies was in their preparation in a pure condition from natural sources; but, while studying the well-known action of sulphuric acid on cane-sugar, he found that by boiling 3000 grains of sugar in 9000 grains of water and 900 grains of concentrated sulphuric acid, a considerable amount of humous matter was formed, which gave reactions identical with those of natural humus; and also that, contrary to the views of Mülder, the brown substance obtained by boiling sugar only for a quarter of an hour in dilute sulphuric acid is identical in composition with the black obtained by boiling for two hours—the deeper color of the latter being due to larger granules, which may be converted into a brown powder, as he had previously shown was the case with the black extract of natural humus.—28 *C*, *March*, 1873, 185.

CURAÇAO GUANO.

In external characteristics the Curaçao is very similar to the Baker Island guano, which indicates a similar mode of formation. It makes an easily divided, pulverulent mass, containing coarser, pulverizable particles, with fine scattered fragments of more or less decomposed coral. Under the microscope the powder exhibits white and brownish rounded grains, often transparent, and seldom single, crystals of phosphate of magnesia and ammonia. Its chief ingredient is basic phosphate of lime, with a small amount of carbonate of lime. Its reaction is slightly alkaline. Uric acid can not be detected, the small quantity of nitrogen present being partially in the form of organic matter, and partially consisting of a very small amount of nitric acid. In the sample, taken from the top layers, numerous remains of roots of grasses were discernible. Chemical analysis of an air-dried sample gave the following proportional composition: Phosphoric acid, 35.315; lime, 32.764; magnesia, 1.725; sesquioxide of iron, 0.590; potash, a trace; chloride of sodium, 0.820; sulphuric acid, 1.290; carbonic acid, 2.31; silica, 0.210; insoluble matter, 0.540; organic matter, 6.9; water, on drying at 212°, 7.3. The amount of nitrogen was 0.351 per cent. The amount of phosphoric acid corresponds to 77 per cent. of phosphate of lime, so that it is as important an article as Baker guano for the manufacture of superphosphates.—32 *C, April* 12, 1873, 199.

DISCOVERY AND USE OF NATURAL PHOSPHATES.

According to Dr. Meyer, the discovery of phosphorus in human urine, in 1669, by the alchemist Brand, did not reveal its importance in the economy of nature; and although, before 1700, its existence in some plants had also been demonstrated, no one seemed to suspect a connection between these facts, nor to inquire into the source of the phosphorus in either case, nor recognize in it a universal and indispensable constituent of the animal and vegetable kingdoms. Phosphoric acid was, of course, discovered at the same time; but, with the transmutation theory in vogue, was regarded as a mixture of oil of vitriol and muriatic acid until its specific properties were pointed out by Marggrof in 1743. It is a fact, indicative of the difficulties of the first stages of discovery, that the recognition (made by Gahn) of phosphoric acid in the bones did not take place for a full century after the detection of phosphorus, and a quarter of a century after that of phosphoric acid, although bones were universally and daily in the hands of all classes, and seemed to be just the portion of the body to invite the investigation of physicians, who were also almost always chemists. It was, therefore, a surprise when Dr. Gahn, in 1780, found the same acid abundantly present in the mineral kingdom in pyromorphite, and that Klaproth and Vauquelin ascertained that apatite was similar in composition to the earthy portion of the bones. The vast importance of these simple, isolated facts—of the discovery of phosphorus in the three natural kingdoms—was not dreamed of by these investigators, and they in nowise suspected the part played by the acid (one similar to that of carbon and nitrogen) in a continual, unchanging circulation through these kingdoms, as water, alone, was at one time thought capable of. It was also shortly after sought for in animal fluids, especially in the blood; and as soon as improved processes, especially of analytical chemistry, rendered it possible, the general statement became allowable that phosphoric acid is present in all animal fluids, circulates through all the channels of the body, and is absolutely indispensable in building up the solid portions, and in the performance of the functions of the most important fluids, although it was, in many cases, detected with difficulty in all the solids and fluids of animals, on account of its very small percentage. The origin of this phosphorus in the animal must be sought for in the vegetable kingdom, and it may be assumed that one per cent. of phosphoric acid is present in grain, one third per cent. in straw, one half per cent. in air-dried hay, one fifteenth per cent. in potatoes, and one twelfth per cent. in undried fodder. However, although it was recognized as indispensable to vegetable nutriment, agriculturists had no thought of supplying it or any other ingredient to the soil, artificially, until the well-known chemist, Klaproth, in 1799, in his investigation of leucite, was led by the unusual loss in his analyses to the discovery of potash in that mineral. He saw in this discovery the possibility of an entire revolution in the system of natural history; and from this point vegetable chemistry took a new departure, by earnestly inquiring into the origin of the constituents of the ashes, instead of remaining satisfied with the simple assumption that they were produced by the plant. Hence the invaluable practical results of the search after the source of phosphoric acid, and the final conclusion that such plants as grow on soils apparently free from phosphorus, and which yet accumulate phosphoric acid in the seed, are able to detect this substance, so essential to their life, more readily than chemical reagents can. The idea of maintaining and assisting the proper life of a plant by furnishing the necessary elements was first broached by Liebig, who showed that plants must obtain materials for their growth from the soil, instead of from the air and water alone, as previously supposed. Waters were examined as to the substances which they brought from the earth in solution, soils were analyzed, etc. Apatite was recognized as the original source of the phosphoric acid circulating through the animal, vegetable, and mineral kingdoms. Fertilizing with bones was first appreciated in England. Hunter, in 1774, recommended it, and experiments were made with bone-dust; and in Sheffield the waste from the manufacture of knife-handles, etc., was used in this way. While experiments were made in Germany in a few localities, and recommended by the government, bones were largely exported to England; and it was shown that, in 1822 alone, over 33,000 tons had been sent from the recent battle-fields to London. Although it was noticed that English farmers who employed bone-dust became prosperous, and that soils not worth cultivating before thereby grew fruitful, fertilizing by means of guano was the first method adopted by the Germans, and through it they learned to appreciate their domestic resources in bones. For centuries the manuring of vines and olive-trees with bones in Southern France was regarded as a peculiarity; for tens of years crops of grain, etc., had been doubled in England by application of bone manure; but the German exporters of bones remained blind—believed nothing, and learned nothing. A similar state of affairs existed in Holland, Scandinavia, and Russia, until the movement of 1848. In 1815 Hull imported 8000 tons, and the amount increased by more than 8000 tons each decade. With a domestic supply of bones worth $2,500,000, England imported to the value of $1,250,000. The introduction of guano checked for a while the bone-mills in Germany; but they soon came into use again, especially in Oberlausitz, characterized by its rational system of agriculture. The erection of sugar manufactories, with their demand for bone-black, put an end to the trade with England, and taught the appreciation of bone-meal as a manure, so that, by the middle of 1850, the export had dwindled to 800 tons. With more general use, the increased effect of a higher degree of pulverization was learned, sixteen to twenty hundred weight being used at first to the acre, then eight to twelve, and, after it was possible to convert them into an impalpable powder, four to five hundred weight sufficed. The effect was at first attributed to the portion of the bones not only least active, but to some degree preventive of fertilizing effect—namely, the fat; fresh bones consisting of 10 per cent. of fat, 30 per cent. of cartilage, and 60 per cent. of earthy salts, the latter containing, for the most part, the phosphate of lime, with some carbonate and common salt. It was only after some time, and by direct experiments with bones freed from fat, that it became an accepted fact that the fat played no fertilizing part, but rather the opposite, and experiments were instituted in the direction of more complete pulverization. First, bone-ashes were prepared; then, in 1850, the bones were steamed and then powdered, and afterward fermented bone-flour was produced.—32 *C, April* 26, 1873, 215.

FAILURE OF THE SYSTEM OF SEWAGE IRRIGATION.

M. Lefeldt was commissioned, by the Minister of Agriculture of Prussia, to visit England for the purpose of determining the value of the different systems of utilizing sewage; and he has lately published a report on the subject, which is not encouraging in regard to the employment of these substances as manure. His principal inquiries were with reference to the method of sewage irrigation. He shows that this, instead of being a matter of profit, is actually the cause of considerable loss; and he quotes the statements of experts to the effect that not a single sewage farm in England is worked to advantage, notwithstanding all calculations as to apparent gain; and maintains that it is utterly irrational to expect any thing but loss, even though the sewage itself may possess considerable manurial value.

In examining into the Edinburgh irrigation meadows, M. Lefeldt ascertained that, if the sewage water is allowed to flow upon the land until two days before mowing, the growth is found to be most luxuriant, with the single drawback that cattle refuse to eat the grass. The capillary tubes for some inches above the roots are found to be filled with unassimilated fœcal matter. It was also ascertained that at a considerable distance from sewage farms, when the wind was in the proper direction, the emanations were extremely offensive, requiring a long experience to become accustomed to them. In certain localities, where the sewage is disinfected with carbolic acid previous to irrigation, there was less complaint of offensive effluvia, and this is consequently suggested as a suitable preliminary treatment. According to the calculations of M. Lefeldt, an acre of land should not receive the secretions of more than from twenty to twenty-five persons. On this scale, London would require a farm of 150,000 acres to utilize its refuse.

The difficulty of irrigation with sewage lies in the fact that the purification and economical application generally go together. Purification alone is quite practicable, although at great expense; and economical utilization alone can occasionally be secured; but the attempt to combine both in a general way, and at the same time effect a result free from sanitary objections, and one that shall pay expenses also, is, in his opinion, entirely impossible.—1 *A*, *May* 16, 1873, 240.

ACTION OF MANURES ON THE GROWTH OF PLANTS.

Messrs. Masters & Gilbert have been investigating the action of manures in favoring the growth of certain species of plants; and for this object twelve different series of meadow plants were grown separately, in wooden boxes, both without manure and with five different manures, such as manures furnishing phosphates, potash, etc., ammonium salts, sodium nitrate, ashes and ammonia, and ashes with sodium nitrate. The soil employed was thought to have been too rich, and the results of the observations of the two seasons were somewhat contradictory. Of the three clovers, *Trifolium pratense* and *repens* were in the first seasons much benefited by the manure, while *Lotus corniculatus* seemed actually injured. In the second season the ash alone had little effect on the clovers; but in both seasons nitrogenous manures, with others, produced the largest crops. With six kinds of grasses the ash manure alone had little effect; and in almost every case the best growth was from a mixture of ashes with nitrogen. Observations on the development of roots induced the opinion that those plants which dispossess others under liberal manuring are those whose habit of growth gives them the widest hold on the soil.—21 *A*, *May*, 1873, 522.

NITROGEN IN FERTILIZERS.

Professor Hellriegel made a series of experiments to ascertain whether fertilizers should, necessarily, only restore to the soil the mineral ingredients removed with the crops, as Liebig contended, the atmosphere being relied upon for the nitrogen; or whether, as Stockhardt considered experimentally established, vegetation did not reach a fuller development by reason of the positive addition of nitrogen to the soil. Eight vessels were exhibited which had been filled with fine sand, previously thoroughly heated, and two planted respectively with pease, barley, buckwheat, and rape-seed; and to one of each of these different kinds nitrogen had been added. The plants in the latter appeared well developed, while those in the others were stunted. He concluded that nitrogen is essential to growth, that of the atmosphere not sufficing for thrifty growth, the first leaves being developed from the nitrogen of the seed and soil. Also, that the richer the soil in nitrogen, the more luxuriant the growth, and the greater the amount of nitrogen taken from the atmosphere; and that, consequently, nitrogen in fertilizers is not only beneficial, but necessary. Further incomplete experiments upon the effect of moisture, warmth, and light indicated unmistakably that water is not only a carrier of nutriment, but is itself nutriment, and that plants rely mainly on the soil for water; that there is a surprising difference in growth, other conditions being identical, when an ample supply of water above the natural quantity is given to the soil.—8 *C*, *April* 3, 1873, 110.

BREEDING RABBITS FOR FOOD.

Hochstetter, of Tübingen, regards the rabbit as the equivalent among the poorer classes to cattle among the wealthier, and earnestly advocates its cultivation. He gives detailed estimates of expenses, and of the receipts, from meat and skins, which make it appear that a single doe rabbit will afford a clear yearly profit of from $8 to $10, and states that he expects with three doe rabbits to have rabbit roast twice per week, at a saving of about $24 per year for meat.—8 *C*, *April* 3, 1873, 107.

ASH-COLORED BREED OF TURKEYS.

In the recent report of the Paris Société d'Acclimatation it is stated that M. Sénéquier, of Toulon, has cultivated a race of ash-colored turkeys, a little less in size than the average, but remarkable for their extraordinary fecundity. The female lays throughout the entire year, with a slight interval of repose. She covers her eggs with great assiduity, and is particularly recommended by M. Sénéquier for hatching out the eggs of exotic birds. He received the parents of the stock from one of his friends, who was ignorant whence they were originally derived. It may have been developed in that locality under the influence of long-continued topographical conditions. Specimens of these were to be brought forward at the exhibitions of the society in 1873.—10 *B*, *December* 1872, 878.

PROPER TEMPERATURE OF SILK-WORM HOUSES.

According to Dr. Collet, a heat of 86° Fahr. is absolutely necessary for the establishments in which the silk-worms are being reared; and to obtain this he proposes to introduce stove heat in these magnaneries, so as to have the temperature of 86° Fahr. up to the first moult, and 95° between this moult and the fifth. The advantages of this system of heating to a high temperature are that the rearing is accomplished in twenty days instead of forty, involving, in such acceleration, a much greater immunity from disease among the worms, and, as the windows can be kept closed, they are protected against sudden variations of temperature. The leaves fed to the silk-worms, too, are entirely eaten up, nothing being left but the nerves and the peduncles, instead of their being a considerable amount of waste, as under other circumstances. —3 *B*, *May* 8, 1873, 60.

EXTERMINATION OF FIELD-MICE.

The question of the best method of exterminating field-mice is one that occupies the attention of the German agriculturists to a much greater extent than in our country, where it is only exceptionally that the numbers of these pests become so great as to cause very serious mischief. Their ravages in America appear, in a considerable degree, to be confined to the destruction of young trees in nurseries during the winter season; but in Germany the loss of crops, annually, is said to represent a very considerable percentage. So grave, indeed, is the importance of the question, that it invokes, from time to time, the direct action of the government of the several states, which pay out large sums every year, although the price per capita for the destruction of the mice is fixed at a very low rate. They also give rewards for the best kind of traps and best modes of setting them, as well as of poisoning where traps are insufficient. Among the poisonous preparations authorized by the government of Würtemberg is grain soaked in an alcoholic solution of strychnine. But this is said not to penetrate deep enough to answer its purpose, the rains washing it off and rendering it innocuous, the strychnine being left as a powdered coating on the evaporation of the alcohol. This preparation has, therefore, been replaced to advantage by a solution of the arsenite of soda, or potash, colored red by fuchsin, so as to make it more distinguishable. This has proved to answer tolerably well; but a still more approved preparation consists in a mixture of one part of arsenic, two parts of meal, and two parts of brown sirup or sugar, made up into little balls or pills. This answers an excellent purpose for exterminating mice around the house; but if used in the field it becomes necessary to take some precaution to prevent its being devoured by birds and domestic animals. To avoid this difficulty it is placed within the mouse-holes or run-ways, which are then closed by stamping upon them. By the systematic application of this remedy, it is said that fields completely overrun have been freed from mice in the course of a few weeks.—1 *C*, 1873, x., 159.

DERMESTES DESTRUCTIVE TO SILK-WORM EGGS.

Among the various destructive insects which interfere with the naturalist by destroying his specimens, one of the most formidable, on account of the extent and rapidity of its ravages, is the well-known *Dermestes lardarius*, or ham beetle. This devotes itself especially to the dried muscle, as also to the skins of animals prepared without an abundant application of arsenic. Quite lately it has made its appearance as among the greatest pests of the silk culturist, in consequence of its habit of laying its eggs along with those of the female silk-moth; and the former, hatching out rapidly, destroy the eggs of the latter before they can be removed for further cultivation. It is highly probable that this habit, so inconvenient in the present case, when exercised upon the ordinary species of butterflies and moths, may serve an excellent purpose in preventing their undue multiplication; but it has become quite necessary to adopt some method to prevent this injury to the eggs of the silk-worm. The remedy consists in first thoroughly washing the wood-work of the chamber where the eggs are laid with a solution of carbolic acid, or by fumigating it with sulphide of carbon, another powerful insecticide, closing the windows, and then placing a screen of fine wire gauze outside the window so as to prevent the entrance of the dermestes.—10 *B*, *December*, 1872, 926.

EXHAUSTION OF GRAIN AND HAY BY RAIN.

According to Kühne, frequent wetting of hay, etc., should be avoided as much as possible, since in time it may thereby be rendered almost worthless as fodder. Two and a half pounds of unthreshed oats were sprinkled with an equal weight of water, which was allowed simply to slowly filter through into a vessel beneath, after which the oats were dried at a gentle heat. The filtration occupied one hour, and seven and a half ounces of a brown liquid were found in the vessel. The oats lost one fortieth of their weight, partly by extraction in the liquid, and partly by drying. Similar experiments with dry red clover and meadow-grass hay gave a loss of one tenth its weight by the former, and of one eighth for the latter, the filtration, however, occupying one hour and a half.—9 *C*, *April*, 1873, 56.

ALLEGED NEW POTATO DISEASE.

A new potato disease is described as having made its appearance near Jena, differing from the one commonly known in directly attacking the tubers, and not the leaves. The tuber becomes covered by a purplish felt, which is the mycelium of a fungus. The skin of the potato is sometimes apparently not penetrated by the mycelium, the contrary being the fact in other cases. In the latter event, the tuber becomes completely destroyed by a cancerous disease. The fungus belongs to the genus *Scleroticum*, and, according to Professor Holliss, the remedy will probably be the same as in the ordinary potato disease—namely, the selecting of early kinds, using only mineral and no animal nor vegetable manures, and with a careful selection of the best adapted soil. The Rev. M. J. Berkely, the eminent fungologist, however, has lately announced that this is the well-known "Copper Web," which some years is very destructive to asparagus, mint, and other crops, and has been known, to some extent, to attack the potato. It is figured in Tulasne's "Fungi Hypogæi," under the name of Rhizoctonia.—13 *A*, *April* 1, 1873, 135.

HASTENING THE RIPENING OF FRUIT.

Acting upon the principle that renewal of the earth immediately surrounding the roots increases their activity, and accelerates the maturing of all parts of the plant, including the fruit, Mr. Stall removed the earth about an early pear-tree, eight weeks before the normal period of ripening, for a space thirteen to fifteen feet in diameter, and to such an extent as to leave a depth of earth over the roots of only about 2 to 2.4 inches, which could be thoroughly warmed by the sun. He was surprised not only by the ripening of the fruit in the middle of July, but also by its superior juiciness and flavor. In another experiment, the removal of the earth from the north side of a tree, alone, caused the fruit on that side to ripen several days earlier than that on the south side. Frequent watering was of course necessary in the above experiments.—14 *C*, CCVII., 344.

VALUE OF UNWASHED WOOL.

Since the introduction of wool-washing establishments has rendered it possible not only to have wool washed, but also to sell unwashed wool, and thus avoid the trouble, as well as the danger to the health of the animal, of the washing previous to shearing, it has become of importance, in fixing the price of unwashed wool, to ascertain with exactness the actual loss by the washing previous to the shearing. H. Goedeck carefully selected average animals from his flock of Negretti and Rambouillet half-bloods crossed, and subjected small portions of wool, clipped about the middle of April, to the usual process for washing sheep, with the following result:

	Loss by washing. Per cent.	Pure air-dried Wool. Per cent.
1. Ewe (Negretti breed predominant)..	62.3	37.7
2. Ewe	52.9	47.1
3. Yearling ram	59.7	40.3
4. Yearling ewe	55.3	44.7
5. Ewe lamb	61.0	39.0

These numbers, he remarks, will undoubtedly be affected by breed, fodder, pasturage, etc.; but he suggests that the publication of the results of similar experiments by others, accompanied by description of their flocks, will in time afford a basis for the estimation of their sheep.—28 *C*, *March*, 1873, 180.

TIME TO CUT CLOVER FOR HAY.

Opinions of agriculturists being at variance as to the proper time to cut clover for hay, Professors Heiden and Voigt instituted a series of experiments to determine this point. Equal portions of a field were cut on the 9th, 17th, and 24th of July, at the periods respectively of budding, early blossom, and full bloom. The grass and resulting hay were carefully weighed, and analyses made. Their conclusions were that clover has less value as provender when cut late, on account of the diminution of the amount of nutritious nitrogenous matter, and the increase of cellulose or woody substance; and that an actual increase of nutriment in the crop from early blossom to full bloom does not take place. They conclude, therefore, that it is best to cut clover in early blossom. Furthermore, by reason of the woodiness of old clover, the nutriment it contains can not be as readily extracted by the animal, so that it is not practically as valuable as its analysis would indicate.—28 *C*, *March*, 1873, 151.

APPARATUS FOR DRYING GRAIN.

M. Coignet has recently devised an apparatus for the purpose of drying grain and other substances at a cheap rate, and without destroying the germinating power of the seeds at the same time. For this purpose the articles to be dried are placed upon perforated stages and traversed by a current of air from above, downward, heated to the proper temperature, from 104° to 122° Fahr., which he finds best to answer his purposes. A still higher temperature (namely, from 300° to 310°), applied in the same apparatus, enables him to dry certain animal matters, intended as manures, without causing the loss of their nitrogenous material; but, as such a temperature of dry air would be apt to cause combustion, he replaces this by superheated steam. In this way he has succeeded in preparing twenty cubic meters of manure per day; and he is of the opinion that in this way we can best make use of animals which, in foreign countries, as Buenos Ayres, Australia, etc., are killed for their hides and tallow, and the decomposition of which in great quantities is so liable to produce pestilence.—3 *B*, *April* 24, 1873, 718.

USES OF SUINT.

The suint of sheep's wool, or the matter which accumulates therein as the result of perspiration and other excretions, is now carefully collected in various parts of Europe, and made a source of revenue; so much so, indeed, that parties are always found willing to take the crude wool and return it thoroughly cleaned to the owner, finding a profit in the soluble matter obtained by washing. This has been disposed of in various ways; but quite recently it has been found to be excellently adapted to the economical manufacture of yellow prussiate of potash; as, after heating, it is found to consist of an intimate mixture of potash and nitrogenous carbon.—1 *A*, *April* 10, 1873, 183.

EFFECT OF MANURE ON WEEDS.

The application of manures suited to particular kinds of cultivated plants appears to have an excellent effect in checking the growth of weeds, which would otherwise prove injurious. In regard to clover, it was found that when the land was wholly unmanured the weeds formed fifty-seven per cent. of the entire yield; but that the application of gypsum reduced the proportion of weeds to two per cent. Nitrogenous manures had very slight effect, and phosphoric manures but little more. We must not from this, however, consider gypsum as an antidote to weeds in general, since it is a specific manure for clover, and gives it a power to struggle successfully with the weeds, and crowd them out.—3 *A*, *April* 26, 1873, 455.

NEW PHOSPHATE FERTILIZER.

It is announced by Dr. Breitenlohner that in Kladno, in Bohemia, phosphorus, so injurious in rendering iron cold-short, is removed, and at the same time converted into a valuable fertilizer, according to Jacoby's method, by treating the roasted, pulverized ore, in water tanks, with sulphurous acid gas, obtained by igniting sulphuret of iron. Phosphate of alumina is thus almost completely extracted, and is then precipitated (by expelling the sulphurous acid by heat) as a fine, white, bulky powder, containing traces of iron and manganese, a considerable amount of gypsum, and 30 to 40 per cent. of combined phosphoric acid. The acid supernatant liquid is next neutralized with lime or marl, when gypsum, also a fertilizer, is thrown down with a portion of the previously unprecipitated phosphate. If the large amount of mechanically combined water can be got rid of, this new source of phosphoric acid is worthy the attention of agriculturists, since about 2500 tons of the crude material are annually produced. Liebig was especially interested in it, and suggested the importance of combining the phosphoric acid with a base also assimilable by plants—perhaps with potash, by aid of a silicate of potash. Conversion, by fluxing into a superphosphate, as suggested by Jacoby, did not prove practical, on account of the hygroscopic character of the product; but by saturating sawdust with it, a superphosphate with 18 per cent. soluble phosphate is obtained, which is too moist for transportation. Peat is suggested by Breitenlohner as a valuable substitute for sawdust.—28 *C*, *May*, 1873, 268.

TENTH ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

The tenth annual report of the Massachusetts Agricultural College, presented in January of the present year, has just been published, and contains a considerable amount of matter of interest to agriculturists. Not the least important is the report on Commercial Fertilizers by Professor Goessman, in which he takes into consideration the subject of fertilization generally, in reference to the commercial fertilizers usually employed, and gives a sketch of the kinds recently introduced. He also presents the result of an analysis of a number of the fertilizers in use among the farmers of Massachusetts. In reference to stable manure, which is now the main fertilizer in ordinary farming operations, he states that its value depends more upon its influence upon the physical condition of the soil than in adding important constituents; and by a tabular statement of the ingredients he shows that, although the most complex of fertilizers, it can claim to possess this function only exceptionally, and that the permanent improvement of the soil depends almost entirely upon the introduction of other manures, whatever these may be; whether guanos, phosphates, or other substances. According to Professor Goessman, the use of any one mineral fertilizer is extremely inexpedient; sometimes because its percentage in such quantity may be highly injurious, and under any circumstances it involves an unnecessary waste of capital. A variety, therefore, should be sought for, in which some one ingredient or another may find its special application to any crop which may be cultivated.

The great number of artificial fertilizers now in market has induced the Professor to make a critical examination of the different kinds offered for competition; and as the farmer does not expect to pay for any thing but phosphoric acid, nitrogen, and potassa, the valuation of the several articles has been based upon the proportion which they possess of these ingredients. A standard of prices has been lately recognized by dealers in Massachusetts, which allows 16.25 cents for each pound of soluble phosphoric acid, 6 cents for every pound of insoluble phosphoric acid, 30 cents for nitrogen, and 8 cents for potassa. Thus, while one fertilizer is valued by him at $54 91 per ton, another making equal claim to consideration is worth only $32 28; the Guanape guano is worth $91 61 per ton. As a general conclusion, he finds that the Guanape guano, although inferior to the average Peruvian guano, is, at its present price, the cheapest ammoniated phosphate in the market.

DECREASE OF THE SILK-WORM DISEASE.

M. Guérin Méneville, in referring to the various forms of silk-worm disease, congratulates the people of France that, while the intensity of the epidemic has become enfeebled in certain sections, it is about disappearing entirely in many localities in the Var, and the high and low Alps of France; as also in the Pyrenees of Spain, Tuscany, etc. In these localities, for several years past, it has not been necessary to make use of the green cocoons of the Japanese worms, the gatherings being of the beautiful native yellow cocoons of much superior value. Nearly all the methods of rearing are in vogue, as in times anterior to the attack of the epidemic, and the failures are, similarly, in about the former proportions, arising from the same causes, such as want of intelligent care, badly located establishments, etc. Nearly all careful and well-instructed managers who use the improved methods of selection succeed in their work. For these reasons, M. Méneville is satisfied that the silk-worm epidemic will decrease more and more each year, and that very soon we may hope to see the silk-producing interest in its normal condition; and even though eggs may not be exported to China and Japan, it will, at least, be unnecessary to import any more from those countries.—6 *B*, *June* 30, 1873, 1612.

PRIZE FOR AN ESSAY ON THE POTATO DISEASE.

The Royal Agricultural Society of London has lately offered a prize of £100 sterling for the best essay on the potato disease and the modes of its prevention. The competing essays are to be sent in before the end of 1873, with the proviso that all the information they contain shall be founded on experience and original observation, and not upon compilations from books or other writings.

A summary of what is believed to be known on the subject, prepared by Mr. Caruthers, has been published by the Society to aid essayists in their labors. In this we are informed that the potato disease has been known for ages in the western countries of South America, but that its first ascertained appearance in the United States and Canada was in 1843. It re-appeared in these countries in the following year. In the latter half of July, 1845, it first appeared in Belgium, and within two months its presence was recorded in England, Ireland, Scotland, France, Germany, Denmark, and Russia. Since that period it has never been entirely absent from the potato crops, although less destructive in some seasons than in others.

The report goes on to state that there is no longer any dispute as to the real cause of the disease, namely, a microscopic fungus. That this is the cause, and not the effect, is shown by the fact that the disease has been produced in healthy plants by transferring the spores to the leaves or tubers. These spores or seeds are ovoid bodies, not more than $\frac{1}{800}$th of an inch long. When one of them rests on the under surface of the leaf, with sufficient moisture present, it pushes out a slender tube through its own ruptured coat, which penetrates the epidermis, passing rapidly through the leaf, branching and rebranching; the spotted appearance being due to the brown coloring matter contained in its slender root.

This root, or mycelium, as it is called, sends its branches into the air; and these are swollen at the extremities, bearing minute oval bodies, which are the seeds or the spores. It passes down the leaf-stalk into the stem, and thus reaches other leaves, as also the under-ground branches, and through them the potatoes themselves. In one experiment, spores placed on the leaves of a healthy plant on the 4th of February extended over the entire plant by the 9th.

Such cells as are pierced by the mycelium are destroyed, and the starch granules are consumed; putrefaction soon begins, first affecting the cell-walls, and then the starch. Although the minute spores may abound around the diseased plants and on the soil, they never appear to attack healthy plants through the roots, but invariably commence their ravages by attaching themselves to the stems or leaves. The proper method of arresting the progress of this disease appears to be the destruction, by fire, of the plants affected, whether leaves, stems, or tubers. If these are left to decay in the field, or get into the manure in the farm-yard, the mycelium or spores will be retained, ready to germinate whenever the necessary conditions are present.

Moisture is indispensable to the germination of these spores, and an excess is always dangerous. Thorough draining is therefore indicated under the circumstances. In conclusion, the report states that there is nothing in one variety of potato rather than another to predispose it to attack by the fungus, and that, whether the plants be healthy or otherwise, wherever the spore rests and finds suitable moisture, it germinates. When it has once obtained a footing, its quick growth, during which innumerable spores are developed, causes a rapid advance of the disease.—3 *A*, *July* 12, 1873, 41.

DESTRUCTION OF PHYLLOXERA.

Tessie du Motay remarks that, among the many propositions for the destruction of the *Phylloxera*, or the grape-vine louse, apart from the method of flooding the roots of the vine with water during the winter season, the application of sulphur is most efficient, and that the method of applying this, as is customary, in its crude form, does not meet the needs of the case, as it is not carried sufficiently far into the soil to act upon the insects. We must, therefore, resort to some very soluble and assimilable chemical compounds, and this is best done by using in succession two different liquids, the mutual decomposition of which will result in the separation of the sulphur in a nascent state.

Two processes are suggested by him for accomplishing the result. In the first of these he waters the foot of the vine with a solution of a soluble hyposulphite belonging to an alkaline or alkaline-earthy series. As soon as the acrid solution, in penetrating the soil, has reached the roots, he waters them anew with a solution containing a sufficient quantity of the acid phosphate of lime, soda, or potash, since the excess of the phosphoric acid saturates the base of the hydrosulphite originally employed, thus producing the nascent sulphur.

In the second method he waters the plant either with a hydrosulphate of sulphur, or with any other sulphate of the alkaline or alkaline-earthy series. As soon as this solution has penetrated the soil sufficiently to bathe the roots, he applies a solution containing a sufficient quantity of soluble hyposulphate to produce the nascent sulphur by double reaction. The same solution may be employed, alternately, for watering the trunk, the branches, or the leaves even, as well as the roots of the plant, with the object of destroying parasites.—3 *B*, *August* 7, 1873, 596.

EFFECT OF TOPPING POTATO STALKS.

Comparative experiments, to determine whether cutting off the stalks at the commencement of the potato disease protected the tubers without diminishing the yield, were made by Paulsen, by raising one row and topping another on the same day, at regular intervals. While the result showed that the separate rows, by like treatment, without disease, varied in yield, the topped plants had for the most part a larger proportion of large tubers than those that had been raised on the same day. It seems, however, that only water is taken up by the tubers after topping, since no increase of dried matter was found when the topping occurred so late that the stalk did not grow again, and under any circumstances the yield seemed poorer in quality and quantity than without topping. Although the stalks topped at the proper time had fewer diseased tubers, the spores of the fungus seem to be carried to the tubers through the stalks rather than by rain, otherwise the topped stalks would have received a supply from the neighboring ones. In warm, dry weather the increase in growth is greater than in cool, wet periods. Early kinds of potatoes seemed to do better than late ones. Heavy manuring, especially with horse or sheep manure, favored the disease, and increased the watery contents, and the yield was also less, although with luxuriant growth of the stalks.—28 *C, May*, 1873, 403.

UTILIZATION OF THE "CAT-TAIL."

To the list of waste vegetable products that are now becoming utilized is to be added the common "cat-tail," a plant that abounds in many marshy districts to a very great extent. M. Dupont prepares the fibre by boiling the cut and dried leaves for several hours in an alkaline solution, and then pressing between rollers, and washing. Thus prepared, it is valued at from $7 to $8 per hundred weight; and it is estimated that France is capable of producing at least 100,000 tons yearly. The fibre is yellowish, but takes dyes readily. It is quite tenacious, and can be worked up into cordage or converted into paper.—18 *A, May* 16, 1873, 217.

SPONTANEOUS COMBUSTION OF HAY.

A scientific basis has generally been conceded to the opinion that hay stored when not perfectly dry is liable to spontaneous ignition. The following communication by Ranke fully substantiates the opinion, and throws light on some of the conditions involved. Two stacks of second-crop hay, containing respectively about twenty-two and fifteen tons, in apparently perfectly dry condition, were formed in a barn, between the 5th and 10th of August, during excellent weather. The usual strong hay aroma was perceptible, increasing in intensity until the 17th of October, when it was replaced by an empyreumatic odor from the larger stack, which had a length and height of twenty-three feet and a width of sixteen feet. Although, externally, the color and temperature were perfectly normal, the removal of the hay was commenced on the 19th. The upper portions were so sweated that drops of moisture accumulated on the hay. At the depth of three feet, in another place at only one and a half feet, the hay became dry and hot, and a distinct empyreumatic odor was recognizable. At five feet sparks appeared in the stack, and at the same time also, suddenly, among the hay that had been thrown onto the wagon; and afterward it occasionally burst into flame on the wagon, although water had been applied in the stack. In cutting out a space to separate it from the smaller stack, which was unaffected, such quantities of an irrespirable gas were given out, probably carbonic oxide, that the workmen were driven back in from one to two minutes. The burning portion seemed to form a central nucleus to within one and a half feet of the bottom. It was in the condition of true carbon, with complete retention of the structure of the grass, and the property of leaving a mark on paper. It seems, therefore, that hay, as previously suggested by Buchner, in decomposing in this way, is converted into a highly porous carbon, contaminated with matter suitable for rapid oxidation, and, like many other forms of carbon, possessing pyrophoric properties, not, however, when cold. The presence of a considerable amount of empyreumatic matter and some water was demonstrated by heating it in a flask. After expulsion of these by continued heating, it cooled rapidly in the open air without igniting. Upon heating to 482°–570°, in a flask, in an oil-bath (to avoid possibility of direct ignition, as well as to secure complete expulsion of the empyreumatic matter), and then pouring it on a table, in a little pile, it rapidly fell to a temperature which could be borne by the fingers; but in a few minutes increase of temperature became perceptible, until suddenly portions began to glow, showing that the presence of empyreumatic matter and an elevated temperature are conditions of its pyrophoric property. By heating a portion in a small beaker in an oil-bath, and throwing it in a little pile upon a table, when it ignited in several minutes, the temperature at which the normal hay passed into this carbonized condition was found to be between the fusing-point of tin and lead (446° to 617°), an experiment adapted to lecture illustration.

The fact of spontaneous combustion thus established, it remains to investigate the progress of the change in a stack of hay which produces the necessary elevation of temperature for carbonization. The normal temperature and external appearance indicate that, owing to the poor conducting power of hay, all the heat evolved by chemical changes in the interior is accumulated there. May not mineral coal have been formed by a process somewhat similar? As practical precautions against conflagrations from this cause, careful drying is recommended, and also that stacks be not too large nor confined; and, finally, that intermediate layers of straw or of boards or poles be introduced in such a way as to facilitate ventilation. — 33 *C*, 1873, CLXVII., and 28 *C*, *May*, 1873, 318.

CONVERSION OF BONES INTO FERTILIZERS.

The following simple method, originating in Russia, has been found excellent in practice, as all the valuable ingredients of the material employed appear to be converted into soluble compounds, readily taken up by the plant. Unpulverized bones and wood-ashes are filled in a trench, thrown up three to four feet deep, in alternate layers, about half a foot thick, the bottom and top layers being ashes, and each layer being saturated with water. Stakes are driven into the pile, to the bottom, three feet apart, by removal of which, every eight or ten days, as much water is poured in through the holes as may be necessary to keep up the saturation of the ashes in the fermenting mass. After eight weeks, the ashes, and the bones, already softened, are mixed, by forking up the whole pile, and left to further decomposition, the necessary water being supplied from time to time as before. After three months, the mass having been stirred over thoroughly two or three times during the interval, the decomposition of the bones is so complete that only pieces of the larger ones are left, which are removed to another pile. For want of wood-ashes, horse manure may be used, in square trenches, the bones being soaked several days previously in water. The layers of bone should be three inches deep, and of manure twelve inches, and the water in which the bones were soaked is to be employed with other water to saturate the layers. The pile should finally be covered with a heavy layer of earth. In ten months the decomposition will be complete, as in the other case.—18 *C, July* 16, 1873, 464.

THE INFLUENCE OF FORESTS ON OZONE.

The elaborate report of Ebermayer on the physical influences of forests on the air gives the following, with reference to ozone, as the result of extensive observations made in Bavaria. In the open fields the air is richest in ozone, as also in the neighborhood of seas, and, in general, in places with great atmospheric moisture. In high places, it is usually richer than in the lowlands. There is more ozone in the air in forests and their neighborhood than in those regions distant therefrom; but in the interior of a room, or space inclosed with wood, the quantity of ozone was not greater; on the contrary, somewhat smaller than in the open field immediately in the neighborhood of forests. In the upper stratum of air within the branches of a tree, where the leaves are thickest, the air of the forest was always richer in ozone than in the lower stratum five feet above the ground: a phenomenon that apparently results from the fact that ozone is absorbed by the decaying vegetable matter on the ground. During heavy fog, the quantity of ozone is small, and often nothing at all. Similarly, only a slight coloring of ozone paper is remarked with continuous north and northwest winds, and beautiful dry weather. The change of wind to south or southwest brings about a decided ozone reaction, which is, indeed, always strongest on warm, stormy, rainy days. During high winds, the ozone reaction is greater than when light, and the air is rich in ozone during thunder and snow storms. —*Zeitschrift für Meteorologie*, 256.

J. PISCICULTURE AND THE FISHERIES.

BRITISH EXHIBITION OF FISHING PRODUCTS AT VIENNA.

The British Commissioners for the International Exposition at Vienna for 1873 arranged for a special department of fish as food. The following resolutions were proposed at one of their meetings, and the labor of carrying them out intrusted to Mr. Frank Buckland: First, it is desirable to show, in small aquaria, living specimens of the several varieties of salmonidæ and other fresh-water fish, as far as practicable. Second, painted casts should be procured and exhibited of all kinds of British and foreign fish used in England for food; they should be arranged, as far as possible, in genera and species; illustrations should, if possible, be given by chemical analysis of their value as articles of food; and where casts can not be procured, preserved specimens, or pictorial representations, should be exhibited. Third, measures should be taken to obtain a representation of nets and fishing implements of all kinds. Fourth, preserved fish of all countries and all kinds, as far as possible, should be exhibited, and arrangements for testing them be made, in concert with Messrs. Spiers & Pond.—2 *A*, *January* 27, 1873, 189.

STATISTICS OF CANADA FISHERIES FOR 1869.

In the report of the Secretary of State for the year ending September 30, 1871, upon the commercial relations between the United States and foreign nations, we find some facts relative to the fisheries of different parts of the world (principally Canada), which may be interesting as furnishing the means of comparison with those of our own country.

The British Colonial fisheries consist of those of the Dominion of Canada and of Newfoundland and Prince Edward Island. The total yield for 1869, as based partially upon estimates for the Province of Quebec, including most of those on the north and south shores of the River and Gulf of St. Lawrence, was valued at $1,046,240, while the estimate for the inland fisheries west of Quebec was about $100,000, and those of the Magdalen Islands, consisting mostly of herrings, amounted to $71,356. The largest items in the preceding estimate were: For summer cod-fishing, $309,615; autumn cod-fishing, $100,707; herring (barrels), $330,228; salmon, $63,180; sardines, $53,682; cod oil, $51,509; whale oil, $43,048.

The total value of the fisheries of the Province of Ontario was $326,472. That of the boats, nets, etc., employed in these fisheries, was $136,269; the number of yards of gill-net, 614,070; of men engaged, 1727.

New Brunswick returned an estimated value of $638,576. The number of men employed was 1991, with 38 vessels, 780 boats, and 130 canoes.

Nova Scotia returned a value of $2,501,507, employing 17,557 men, 635 vessels, 3558 whale-boats, 3793 skiffs, and 319 sail-boats, with 21,656 total tonnage.

For Newfoundland the total value was $7,005,807. For Prince Edward Island, $169,580. The principal item in the Newfoundland fishery related to cod-fish, and that of Prince Edward Island to mackerel.

It will be seen from the foregoing statistics that the fisheries of Newfoundland and Prince Edward Island exceed in value by more than $2,000,000 those of the Dominion of Canada, and that the larger portion of the "Canadian" fishery products are furnished by Nova Scotia.

The total annual products of the fisheries off the coast of the British North American Provinces, as shown by the statements embodied in this report, amount to nearly $23,000,000, as follows:

RECAPITULATION.

Quebec	$1,046,240 46
Magdalen Islands	71,356 00
Total	$1,117,596 46
Ontario	326,472 10
New Brunswick	638,576 10
Nova Scotia	2,501,507 00
Total Canadian fisheries	$4,584,151 66
Newfoundland	7,005,807 40
Prince Edward Island	169,580 00
Total Provincial fisheries	$11,759,539 06
French fisheries	4,000,000 00
United States fisheries	7,000,000 00
Total of all fisheries	$22,759,539 06

The facts here submitted in regard to this industry, in which the people of the British North American Provinces, of France, and of the United States participate, is an interesting illustration of the successful application of American enterprise and capital in developing the rich treasures of the sea.

Cod-fish is the staple article of export from Gaspé. This, when dry-salted and merchantable, is worth from $3 40 to $3 50 per cwt.; inferior, for West Indies, $2 80.

The catch of cod-fish in the bay and basin in the summer and fall of 1871 was: Cod-fish, 18,550 cwt.; mackerel, 603 barrels; herring, 720 barrels; salmon, 374 barrels. There are on an average 18 salmon to the barrel, making the catch 6732 salmon.

This is the only port in British North America from which whalers are fitted out. Four schooners captured 24 whales, making 16,335 gallons of oil, worth 40 cents a gallon. The "sulphur bottom" and the "hump-back" are the kinds captured here. The whale meat is relished by the fishermen, and sells at $4 a barrel.

The rivers York, St. John, and Dartmouth furnished about 340 salmon to sportsmen's rods in 1871. Trout were abundant; mackerel came into the bay in shoals; and lobsters were fine-flavored and cheap.—*Commercial Relations*, 1871.

FISHERY MODELS AT THE LATE SCANDINAVIAN EXHIBITION.

The section of fisheries at the Exposition of Scandinavian Industry at Copenhagen in 1872 was very suggestive, and embraced many interesting illustrations. They included various fishing implements, fish-breeding apparatus, etc. One object attracting special attention was a model, by Mr. Fiegler, of a Danish lake, representing it with great exactness, both in its physical and natural-history aspects. Specimens of fish were exhibited, as well as various specimens of the fauna and flora of the lake.

EXHIBITION OF FISHERY PRODUCTS AT VIENNA.

The German Fishery Association issued a circular early in 1873 announcing its intention of taking part, by authority of the government, in the Vienna Exposition, and of bringing together as full a series as possible of the apparatus used and the collections made during the German deep-sea explorations, as also a complete collection of the implements employed by the German fishermen, illustrations of the different kinds of products prepared from fish, and models of boats, traps, hatching-houses, etc. Applications for space in the exposition were made to the Bureau of the Verein prior to the 1st of February, and the collections themselves brought together in the course of the month of March, and then transmitted, under suitable superintendence, to Vienna. — *Circular of Fischerei-Verein.*

CLOSE TIME FOR SEALS IN THE NORTHERN SEAS.

The rapid diminution of seals in the North Atlantic, and the impending danger of the failure of a very important branch of the fisheries, have attracted the attention of parties interested in the subject; and on the 24th of January, at Peterhead, in England, a meeting was held of the managing owners of the seal and whale fishing-vessels belonging to that port for the purpose of determining the best method of arresting the threatened evil.

Mr. David Gray, a well-known captain in this trade, and one to whom science is indebted for many important observations on the habits and natural history of the narwhal and other northern species, stated that in consequence of the present mode of conducting the fishing in the Greenland seas, between Spitzbergen and Iceland, and the indiscriminate destruction of the cub seals and mothers which annually takes place during the early part of the season, these animals are likely to be nearly or quite exterminated before long. It was thereupon determined that the seals ought to be protected by a close time, and that an international agreement should be secured for prohibiting the prosecution of the business earlier than April 6.—2 *A*, *February* 1, 1873, 95.

IS SEAL OIL FISH OIL?

The much-vexed question as to whether seals are fish or not, as regards the oil to be obtained from them, has recently come up in a practical shape between the governments of the United States and Newfoundland. The fishery treaty lately entered into between the United States and Great Britain, and about to go into actual operation in the course of the present summer, provides that *fish* oil shall be admitted free, but that other oils shall pay a duty of ten per cent. This question is one that would be very easy of solution if it were purely zoological in its character, since, as every one does or should know, the seal and porpoise, as well as the whale, are warm-blooded mammalia, having nothing in common with the fish any more than has the man who, for the time being, goes into the water for the purpose of bathing. It appears, however, to be the general practice with commercial nations to class all oils obtained from marine objects, whether cetaceans, birds, or fishes, as fish oil, and on this ground it is possible that the claim of the Newfoundland authorities to have seals recognized as fish will be accepted.—*St. John's Chronicle, February* 25, 1873.

GLOUCESTER WINTER HERRING FISHERY.

According to the *Cape Ann Light*, the trade from Gloucester in Newfoundland herring came to a close about the end of March, when the last vessel arrived. The number of Gloucester vessels engaged in the business during the season was eighteen, these beginning the voyage during the closing week of November and early in December. The business was about equal to that of last year, but very much less than that of previous years, the number of vessels at one time in 1863–64 having been thirty-nine.

One schooner, with a crew of seven men, was lost during the season. According to a table given in the article quoted from, the average number of Cape Ann vessels employed since 1856 amounted to twenty-two, and the average loss per year to $8200.

EMDEN HERRING FISHERY OF 1872.

According to the report of the German *Fischerei-Verein*, the vessels engaged in the herring fisheries sent out from the town of Emden into the North Sea, not far from the coast of Scotland and the Shetland Islands, completed their work for the season early in January, and the results, although inferior to those of previous years, were considered fairly satisfactory. These vessels, six in number, were occupied from the middle of June, each making about four trips, or twenty four in all. The proceeds of the whole amounted to

1550 pounds of cod-fish, with 844 tons of salted, and 15 tons of smoked herring, the whole representing a value of 50,430 thalers. The management of the vessels and of the fisheries generally required the services of ninety men.—*Circular Fischerei-Verein*, 1873, I.

TRADE IN FROZEN HERRING.

A new branch of business has sprung up within a few years on the eastern border of the United States in connection with the herring fishery. It is only by degrees that we are learning the habits of the American sea-herring, and determining its places of resort throughout the year, especially its localities for depositing its spawn. The Bay of Fundy and the island of Grand Manan have for many years been the seat of a profitable summer and fall fishery of herring, these being usually of a small size, and of late years taken principally in weirs. The spring fisheries are mainly conducted in the Gulf of St. Lawrence, especially in the vicinity of the Magdalen Islands, which are resorted to by hundreds of vessels for the purpose of obtaining fares.

Within a few years past it has been discovered, quite by accident, that the Passamaquoddy Bay and other localities connected with the Bay of Fundy were occupied during winter by immense schools of large herring, much finer than those taken in the autumn. This, of course, was the signal for action on the part of fishermen, and the trade has increased, year by year, so that a large number of persons are now occupied in its prosecution. The fish are taken in gill nets, and, being allowed to freeze, are carried to market in that condition. As many as forty vessels were loaded this season, before the 10th of January, for Portland, Boston, and New York, all expecting to return for new cargoes: this in addition to what have been carried by the regular steamer.

It is estimated that the business has already netted the fishermen $75,000, with a prospect of as much more before its conclusion. The herring are taken within about thirty miles of Eastport, and are usually marketed from that port. They make their appearance in October, coming in in increasing numbers until April, when they apparently disappear. It is probable that the trade in frozen herring from Newfoundland will be entirely given up, as the fish can be obtained so much more easily in the Bay of Fundy, and two cargoes can be secured in the same time that one can be taken and marketed from Newfoundland, besides reaching their destination in much better condition. A considerable number are salted and smoked, and then put up in boxes of fifty or one hundred each, and shipped to various points in the interior.

The wholesale price of these fish is fifty cents per hundred, and the probable catch for the winter is estimated at 250,000—enough, according to Captain U. S. Treat, who is high authority in such matters, to load one hundred sail of vessels. When taken to market, the price to dealers is about eighty cents per hundred, that to consumers, of course, varying with the supply.

SHIPMENTS EASTWARD OF CALIFORNIA SALMON.

According to a recent table, 2,712,972 pounds of salmon were transported eastward over the Central and Union Pacific railroads during the year 1872.

IMPROVEMENT IN VALUE OF THE BRITISH SALMON FISHERIES.

According to Mr. Spencer Walpole, the salmon fisheries of England and Wales, which two years ago were valued at from twenty to thirty thousand pounds sterling, are now considered worth at least one hundred thousand pounds. This is the legitimate result of the measures taken by the British government, supplemented by private enterprise, in protecting this noble fish from destruction, as well as of the introduction into the waters of the young fish artificially hatched.—2 *A*, *February* 1, 1873, 95.

FISHERY LAWS IN GERMANY.

A committee of the German Parliament, in connection with one from the Deutsche Fischerei-Verein, is engaged in preparing the draft for a new law of the empire, for the protection of the fish and fisheries, more especially those of the inland waters. Although the details have not yet been completed, it has been decided that for the protection of the fish there shall be both the so-called "close time" (or a period during which no fishing is allowed), and also close ranges, or stretches, which, as being specially occupied by breeding fish, shall not be disturbed at all during at least two months of the year.

The absolute prohibition of the fisheries during certain seasons, excepting on the actual breeding-grounds of the fish, is not considered expedient, as the result would be to cause great distress among the fishermen, and, indeed, to drive them to other occupations; since, with their usually very small profits, they would not have the capital to enable them to lie idle during a lengthened period.

It is probable that a special committee will be ordered to examine the waters of the empire critically, and to decide in which fishing shall be absolutely prohibited, and those in which it can be freely allowed under proper restrictions and with proper apparatus, at all times excepting the close period. The close season will, of course, vary with the species; thus that for the trout and salmon will be in the autumn, just before the spawning season begins, and that for grayling and other species will be at various periods in the spring and summer months. The close period for each kind is not to exceed from six weeks to two months, and during this time fishing will be allowed about four days in a week, captures being absolutely prohibited for at least three days out of the seven. During the prohibited period it will be illegal to hold fish, or to offer them for sale, unless it can be proved that they were not taken under the forbidden conditions.—*Circular Deutsche Fischerei-Verein, March* 20, 1873.

MEETING OF THE AMERICAN FISH-CULTURISTS' ASSOCIATION.

The annual meeting of the American Fish-culturists' Association was held in New York on the 11th of February, at the office of Mr. George Shepard Page. The annual address was given by the president, Rev. William Clift, of Mystic Bridge, Connecticut, who presented a report upon the progress of pisciculture throughout the United States during the past year.

A paper was read by Mr. Page upon fish-culture, the point of principal interest being an account of the methods adopted in China. Some discussion took place upon a paper by Mr. Mather on the proper method of impregnating the eggs of trout, the author of the paper advocating the natural method, while some gentlemen were in favor of the artificial process.

A paper was read by A. P. Rockwood, of Utah, on the native fish of Utah; and another, by Colonel James Worrall, on the movement for the restoration of fish in Pennsylvania. A communication was presented by Mr. Paxton upon the subject of the diminution of whitefish in lakes Erie and Michigan, referring to a locality where six or eight years ago 60,000 were taken, while during the last season only 2000 were captured. He expressed his intention of starting an establishment for the breeding of whitefish at Windsor, Canada, where the authorities have offered facilities, and for which the Canadian government has made an appropriation.

In the course of a discussion as to the number of eggs to be obtained from a trout, it was asserted that fish weighing a pound produced 500, while some claimed that the number would be at least twice as great.

The officers for the current year are, William Clift, president; A. G. Collins, secretary; B. F. Bowles, treasurer; executive committee, Seth Green, E. A. Brackett, and M. C. Edmunds. The association adjourned to meet in New York City on the second Monday in February, 1874.—*Rural New-Yorker*, *March* 4, 1873.

CULTURE OF SEA-FISH IN FRESH WATER.

In the great interest manifested at the present time in the subject of the economical food fishes, as shown by the efforts taken to prevent their destruction and to increase their numbers by artificial propagation, to cultivate them in unusual localities, etc., we should not lose sight of what has already been done in earlier years in the same direction. Without referring to the practice of the Romans, or to the labors extended through so many centuries in stocking fish-ponds with carp and other species, we may recall the experiments of a more recent date by Mr. J. B. Arnold, of Guernsey, as long ago as 1829, detailed in the Proceedings of the Zoological Society of London for August, 1831. This gentleman had a lake of about five acres in extent near the sea-coast, and principally supplied with fresh water. Its bottom was muddy, gravelly, and rocky. During nine months of the year the water was drinkable for cattle, but, in consequence of a supply received through a tunnel which communicated with the sea, was rather salt in summer.

He introduced into this lake the gray mullet, bass, smelt, and various species of the flat-fish, such as the sole, turbot, brill, and plaice. All these were found to thrive admirably well, and to increase in numbers, the gray mullet especially having bred as freely as in the sea itself. The experiment was continued for many years with the most favorable results. According to Mr. Arnold, it was thought that hybrid fishes were produced in this way, as several were taken in the vicinity unknown to fishermen well acquainted with the species on the coast. He adds that the sea-fishes, after being naturalized in his lake, were transported to ponds of spring water, where they not only lived, but did well. Such fish were apparently more tenacious of life than those caught in the sea, and were more capable of resisting successfully the injurious effects of transportation in a small quantity of water for long distances.—11 *A*, *August* 23, 1831, 126.

SIXTH REPORT OF THE MAINE COMMISSIONERS OF FISHERIES.

The sixth annual report of the Commissioners of Fisheries of Maine, for 1872, has just been published, and contains an account of what has been done by these officers in the prosecution of their trust. In a state where the increase of the present reduced stock of salmon has received so much attention, the subject of fish-ways would naturally be of prominent interest; and the Commissioners report an examination of numerous localities, with a view either of determining the deficiencies of the fish-ways already established, or the places where they should be erected.

They render their acknowledgments to Mr. Brackett, one of the Fish Commissioners of Massachusetts, for furnishing to them plans of what they consider to be the best arrangement of the kind that has hitherto come under their notice. They state that a new fish-way has been built at Dennysville by Messrs. Lincoln, to replace an imperfect one previously erected. The fish-way at Milltown was kept open by the joint efforts of the fish-wardens of Maine and New Brunswick. They recommend the improvement of the fish-way at Orono, which is the only passage for the salmon of the Penobscot to the upper waters of the river, so as to make it accessible to shad and alewives.

In 1871 a number of salmon eggs were obtained by Mr. Atkins at his establishment at Orland, on the Penobscot, which hatched successfully in the spring of 1872. The survivors of these, 21,000 in number, were introduced, in May, into a small brook emptying into the Androscoggin River. Here they were visible during the whole summer and first of autumn, moving up and down the river, and daily making their appearance as high as the hatching-house where they were first placed in the stream. They disappeared during the high water of the fall rains (having perhaps made their way to the ocean), to re-appear at the end of two years as grilse, and subsequently as salmon. The general theory, however, is that they remain at least twelve months in rivers before going to the sea.

The Commissioners publish a letter received by them from Professor Baird, United States Commissioner of Fish and Fisheries, in reference to the importance of the erection of fish-ways, not so much for the upward passage of the salmon as for that of shad and alewives. He calls attention to the great diminution of the species of the cod-fish family on the coast of Maine, and connects this with the erection of obstructions preventing the anadromous fish from ascending the rivers. The diminution not only of the adult fish, but also of their fry, he thinks, has caused the abandonment of the coast by the outside fish that preyed upon them; and he concludes that if the fish-ways are opened and steps taken to restore the immense number of alewives and shad formerly existing, as well as of salmon, this renewal of their food will bring back the cod, haddock, etc., to the grounds where the fishermen of the past generation caught them in abundance.

REPORT OF THE FISH COMMISSIONERS OF RHODE ISLAND FOR 1872.

The third annual report of the Commissioners of Inland Fish-culture of Rhode Island, presented in February, 1873, has just been printed, and embraces a report of operations in reference to the introduction of shad, salmon, and black bass, and in regard to the construction of fish-ways. Shad were introduced into the Blackstone, Pawtuxet, and Pawcatuck, a supply having been furnished free of cost by the Connecticut Commissioners. A large number of salmon were obtained from Mr. Atkins, at Bucksport, Maine, as the result of a subscription on the part of the State of Rhode Island to the important enterprise conducted so successfully by Mr. Atkins, and an additional number were presented by the United States Fish Commissioner. Ten thousand young salmon were hatched out in the spring of 1872, and the greater part of them placed in the Pawtuxet River.

In the conclusion of their report, the Commissioners ask for an appropriation of one thousand dollars for the purpose of constructing a model fish-way at Pawtucket, proposing to use the newly invented device of Mr. E. A. Brackett for that purpose.

REPORT OF THE FISH COMMISSIONERS OF NEW YORK FOR 1872.

The report of the Commissioners of Fisheries of the State of New York for the year 1872 has been published, and gives a gratifying account of the progress effected in that state in the way of restoring the fish supply to its rivers and lakes. The work has been prosecuted under the direction of Messrs. Roosevelt, Seymour, and Smith, as Commissioners, with the well-known Seth Green as director of operations. The liberal annual appropriations, which we believe exceed those of any other state, have enabled these gentlemen to make great progress toward realizing the plans that they originally laid out for their action.

The shad-hatching during the year was as satisfactory as could have been expected, in view of the difficulties caused by the unexpected hot weather, the operations on the Hudson beginning on the 17th of May and ceasing on the 2d of July. The total number of mature fish caught during this period was 4527, from which 8,736,000 spawn were extracted, and from these nearly seven and a half millions of young shad were hatched and turned into the waters. As the entire catch of the Hudson River did not exceed a million of full-grown shad during the year, the addition of this number of young fish must undoubtedly have an important bearing upon the future supply.

The Commissioners earnestly renew the recommendation they have heretofore made for the establishment of a close time, in order to enable the fish to reach the upper portion of the river for the purpose of spawning, the number of gill nets and other obstructions at present in operation rendering such a passage almost impossible. Indeed, but for the strenuous efforts of the Commissioners to introduce young shad into the river, it is probable that by this time the shad-fishing would have almost entirely ceased. The Commissioners propose, therefore, that the use of nets be forbidden from Saturday night until Monday morning throughout the season, and that after a certain period the capture of fish in the summer be entirely prohibited.

The Commissioners report, in reference to the experiment of the introduction of young shad into the Genesee River in 1871, that in 1872 young fry were taken there in June five or six inches long; and that, two months later, fish seven inches in length, and weighing a quarter of a pound, were caught near the mouth of the river, where it empties into Lake Ontario, as many as a hundred being captured at once in a small net. Details of the result of experiments for stocking the tributaries of the lakes are given in the report, to which we must refer our readers.

PENNSYLVANIA FISHERY LAW.

A new fishery law has just been passed by the State of Pennsylvania, which provides for the appointment of three competent persons, to be known as the State Fishery Commissioners, who are to hold their offices, unless the commission is sooner dissolved by legislative enactment, for three years. Their duties are to forward the restoration of the inland fisheries, and to stock the same with suitable fish, and also to superintend the erection of fish-ways as specified in the act. Special attention is to be given to the construction of fish-ladders, of which there are to be built during the year 1873 one in the Columbia dam, one in the Clark Ferry dam, one in the Shamokin dam, and one in the first dam in the Juniata River, above its junction with the Susquehanna, for which $25,000 are appropriated. During the year 1874 ladders are to be placed in the Muncy, Nanticoke, and Lewistown dams, one in each of the first two dams occurring on the Lehigh River, above its junction with the Delaware, and one in the Towanda dam, in the north branch of the Susquehanna River, for which $30,000 are appropriated. During the year 1875 ladders are to be placed in the Newton Hamilton dam, in the Raystown branch dam, and in the third and fourth dams on the Lehigh River, above its junction with the Delaware, for which an allowance of $20,000 is made, the whole amount appropriated being $75,000.

It is provided that these fish-ways must be constructed in a manner satisfactory to the Commissioners, and are not to be paid for until approved by them. The Commissioners are authorized to appoint two fish-wardens in each of the reaches or stretches of the river immediately below the dams mentioned, who are to provide against any violation of the fishery laws. In the event of New Jersey making an equal appropriation, the expenditure of $3000 is authorized for the artificial propagation of shad in the Delaware River.

The provisions against fish-baskets, eel weirs, or racks, and similar contrivances, enacted in 1871, are to extend to all streams in the commonwealth, and the Fishery Commissioners are to take due notice of any violation of the law. They are required to select suitable locations for hatching-houses, to stock and to supply the waters of the commonwealth with useful food fishes, either by distributing the impregnated spawn or the fry. For the necessary material and services the sum of $10,000 is appropriated.

All persons hereafter erecting dams in any rivers of the state are required to supply fish-ways satisfactory to the Commissioners, under a severe penalty. The catching of fish of any kind with a seine having a mesh less than ten inches(?), or by any other appliance excepting the hook and line, between the 15th day of June and the 10th day of August, is to be considered a misdemeanor, and is liable to a fine not exceeding $100, and imprisonment not exceeding six months. This provision does not apply to the Delaware River below Trenton Falls.

The act further provides that the capture or possession of any shad taken in the Delaware River or its tributaries below Trenton Falls between the 11th day of June and the 10th day of August, or above the head of Trenton Falls, or any where on the Susquehanna or its tributaries within the state, between June 16 and August 10, shall be punishable by a fine of $5 for each fish, although a special exception is made in behalf of the Fishery Commissioners of the state, the co-riparian states, and the United States Commissioner of Fish-and Fisheries during the prohibited period for the purpose of natural or artificial spawning or propagation.

It is also provided that no fish whatever shall be taken, either shad or other species, between twelve o'clock at night, Saturday, and the ensuing midnight of Sunday, the penalty to consist of the confiscation of the boats and a fine of $100. Trenching upon fish-ponds is also made punishable, provided due notice be given at the ponds or preserves that said waters are private property. It is also enacted that no fish shall be taken except with hook and line within half a mile of any part of a dam or a chute in which there is now, or may hereafter be, any fish-way for the passage of fish up or down, the penalty for the violation of which is not to exceed $100. The provisions of this section do not take effect, however, until the first of March, 1874.

The Commissioners are to be paid their reasonable and necessary expenses for the performance of their duties, but receive no salary. They are required to file a bond in the sum of $10,000 for the faithful performance of their work.

The Commissioners appointed under the act are Messrs. H. J. Reeder, of Easton, B. L. Hewitt, of Hollidaysburg, and James Duffy, of Marietta.

OHIO FISH COMMISSION.

Ohio is to be added to the list of states that have authorized the appointment of Fish Commissioners, and otherwise provided for the preservation and increase of food fish within their borders. The appointees as Commissioners are John Hussey, of Loveland, John H. Klippart, of Columbus, and Dr. Elisha T. Sterling, of Cleveland, in whose hands we are confident the interests of the state in this direction will receive careful attention.

MICHIGAN FISHERY BILL.

The Legislature of Michigan has just passed a law providing for the establishment of a Board of Fish Commissioners, to consist of the Governor, and two persons (George Clark, of Ecorse, and George H. Jerome, of Niles) to be appointed by him. Their duty is to supervise the execution of all the laws now existing or hereafter to be made in relation to the fisheries, and to carry out the same. More especially they are to take charge of the artificial propagation of fish, and to report the result of their labors to the Legislature. A suitable location is to be selected for a state fish-breeding establishment, and for which the appointment of a superintendent, at a salary of $1200 a year, is authorized. An appropriation of $7500 is made for the year 1873, and a similar sum for the year 1874. The Commissioners are to receive the amount of actual expenses incurred while in the discharge of their duty, but no salary.

Wisconsin had previously made an appropriation of $500 for the same purpose, its expenditure to be under the direction of Professor Baird, United States Commissioner of Fish and Fisheries. So far, Indiana and Illinois are the only Lake States that have not recognized this interest, and initiated steps for its promotion. Pennsylvania has just made a liberal appropriation for the purpose, and it is hoped that New York will not hesitate to continue to furnish the necessary appropriations. At present the entire series of New England and Middle States, with the exception of Delaware, have taken action in the same direction. Nothing has been done by Maryland and Virginia, nor any of the more Southern or Western States except Alabama. California, it is well known, has a very efficient board.

HYBRIDS OF SALMON AND TROUT.

The attention of fish-culturists in Europe has lately been directed very extensively to the subject of raising hybrids between the different kinds of *Salmonidæ*, the favorite being a cross between the true salmon and the common trout. A large percentage of these hybrid eggs hatch out and develop into fish, which rapidly attain a large size and possess remarkable excellence of flesh. They have the very desirable characteristic of not wandering off to sea, but of remaining in the rivers during their lifetime, and of being in season throughout the year. What is most remarkable in this case is the fact that a number of them are actually fertile and capable of reproducing their kind; but the expense and trouble of obtaining a stock of hybrid eggs from parents of the two species is so trifling that direct crossing is generally resorted to.

We are not aware that the experiment of hybridizing *Sal-*

monidæ has yet been tried in the United States, but, from the great superiority of the brook trout of Eastern North America over the European, it is probable that an improved breed could readily be secured.

CULTIVATION OF FISH IN DITCHES AND PONDS.

Much attention is now being paid in Germany to the cultivation of fish in ponds and ditches, and it has been found, contrary to the generally received opinion in reference to such localities, that they are more favorable for the purpose than other large bodies of water, apparently fresh and pure in their character. This is doubtless owing to the great abundance of animal life, as well as to the more decided concentration of vegetable substances in the form of living plants of different kinds, including the algæ. This produces a constant evolution of oxygen needed for the respiration of the fish, and allows a larger mass of life to be crowded together in a given space. The reproduction of the species is also unusually rapid, and the young grow very quickly.—*Deutsche Fischerei-Verein*, 1873.

UNITED STATES SALMON-BREEDING ESTABLISHMENT AT BUCKSPORT, ME.

We have already referred to the experiment of Mr. Charles G. Atkins, in reference to the propagation of salmon, and to the success which has attended these efforts. It will be remembered that this gentleman commenced purchasing living salmon at the time they first entered the Penobscot River, in June, 1872, and continued to do so until the close of their run, and, placing them in a pond of some sixty acres, near Bucksport, detained them there until the true spawning season began. In this way he succeeded in obtaining over 600 mature fish, ranging from ten to twenty-five pounds in weight.

On their first introduction into the pond it was impossible to distinguish between the sexes, the males and females both being of a silvery color, and provided with short jaws. A very interesting change, however, took place in the males toward the end of October, the jaws lengthening, the upper being curved down, and the under one becoming provided with a vertical conical process, fitting into a hollow of the upper jaw. At the same time the skin assumed great brilliancy of tints, bright reddish spots developing all over the surface, and imparting a very handsome appearance to the fish.

The eggs were taken from the females before the end of November; and, after being impregnated properly, were placed in Mr. Atkins' hatching-house at Bucksport, to the number of nearly 1,400,000. They were kept at Bucksport until February, when they were sufficiently far advanced to permit their distribution. Mr. Atkins' operations having been prosecuted partly at the expense of the United States appropriation, and partly at that of several New England States, a division was made, and the share at the command of Professor Baird, United States Commissioner of Fish and Fisheries, was distributed among the New England States, New York, New Jersey, Pennsylvania, Ohio, Michigan, and Wisconsin, and placed in hatching-houses in the several states, where the process of development will be completed, a period of four months usually elapsing between the first taking of the eggs and the emergence of the young from its envelope.

The salmon, after being treated at Mr. Atkins' establishment, were allowed to go to the sea, care being taken to mark each with a tag, so that, if again taken, it might be identified. Although a passage-way was opened between the pond and the river, about two hundred fish preferred to remain and spend the winter in the pond; and it was not until the early part of March that they began to leave, going down into the river, and thence, in all probability, into the sea. This fact is in accordance with one that has recently been established as characteristic of the American salmon—namely, their tendency to spend the winter in fresh-water ponds, and then return to the sea, coming back in a few months in good health and vigor.

MARKED SALMON ON THE AMERICAN COAST.

In the operations on the part of the general government and of the New England States for securing salmon spawn for stocking our rivers and lakes, six hundred salmon were caught and preserved alive in the summer of 1872 by Mr. Charles G. Atkins at Bucksport, Maine. These were kept penned up for several months until November, at which time their eggs were ripe for treatment. But few of these fish were injured in the operation, and the rest were returned alive into the waters. Some of them immediately passed down to the sea, and others remained during the winter, and proceeded to the sea in the early spring.

For the purpose of determining certain questions connected with the rate of growth and the periodicity of return of these fish, Mr. Atkins took the trouble to affix to each, before liberating it, a tag of silver or platinum, upon which was impressed a distinctive number. The tags were oval, and about half an inch in length, attached in some cases to a band encircling the tail, and in others by a wire to the large back fin. A list was made indicating the weight and date of each fish; and Mr. Atkins has issued a circular, under date of April 22, asking that any salmon taken during the present season with one of these tags attached be sent to him for examination. He offers the market value, according to the weight, for each fish, and a bonus of $3 on their being sent to Bucksport. It is much to be hoped that fishermen and others who may come into possession of these fish may not fail to comply with Mr. Atkins' request, as the questions to be answered by the comparison of their condition with that of the last year are of the utmost practical importance.

TRANSPORTING SALMON EGGS TO NEW ZEALAND.

A renewed effort has lately been made in the direction of stocking the Australasian waters with salmon. The experiment of transporting eggs of salmon and trout into those waters has been repeatedly made, and, as far as the latter species is concerned, with distinguished success, this fish being now caught in large numbers and of great weight. There is, however, no positive evidence of the existence of the salmon in the rivers, although large fishes have repeatedly been seen, which could scarcely be any thing else; but none have been actually captured.

Special arrangements were made during January, 1873, to transport about 80,000 salmon eggs on the vessel *Oberon*, bound from London to Australia. In view of the necessary length of the journey, and of the fact that the temperature must, for a great portion of the way, be that of summer, the only possibility of success lay in retarding the development of the eggs by means of an abundant supply of ice. For this purpose a small house was built, the internal dimensions of which were thirteen feet by nine, and eight feet in height, inclosed in the bulk-heads abaft the foremast, and situated in the hold of the vessel below the water-line. This house was surrounded by a skin of powdered charcoal, about a foot thick, as a non-conductor, and is lined throughout with sheet lead. On the floor of the ice-house was placed a wooden grating to carry off the melted ice, while the boxes containing the ova were placed upon the grating, fitting closely to each other. Upon this grating were laid blocks of ice of about two feet cube, and then another tier of boxes also surmounted with ice; and the whole was not to be disturbed until the vessel reached its destination. It is hoped, in consequence of these precautions, that a considerable number of eggs will survive; the low temperature secured by the use of the ice retarding the development of the eggs to such a degree that on their arrival they can be transported to the hatching-troughs and there developed.

The eggs themselves are placed in pine boxes about twelve inches long, eight inches wide, and five inches deep, sufficiently strong to support the weight of the ice. The bottom of each box has a layer of charcoal, in small pieces, upon which broken ice is spread. A bed of moss is then superposed, and upon this the eggs are distributed; then a second layer of moss is put upon the top. Ice is also placed above this, and the lid screwed down.

In transporting the eggs of salmon and trout, it is usually customary to keep them in the original hatching-boxes until the eyes make their appearance, which with the true salmon requires from thirty to sixty days, according to the temperature of the water. They may then be packed in moss and transported to a great distance. In the present instance it was impossible to wait for this period to arrive, and the eggs were packed a few days after impregnation.

The total cost of this experiment will be very considerable, the ice alone costing $500, and the freight for the ice-house itself nearly as much more. It is not a little remarkable that the gentlemen who have charge of the experiment of stocking the waters of Australia and New Zealand with salmon have not turned their attention to California, where salmon are to be found much better fitted for the temperature of Australia than the European species. The Australian line of steamers from San Francisco could transport these eggs and deliver them in about thirty days, and with the almost absolute certainty of a successful result. In the case of the *Oberon*, from three to six months will elapse before the journey will be accomplished. The salmon of Japan and Kamtschatka, would also be equally, or even more eligible for the experiment.—19 *A*, *January* 18, 1873, 64.

NATURALIZATION OF TROUT IN NEW ZEALAND.

The Acclimatization Society of New Zealand announces the capture of a full-grown English trout, the result of spawn sent out from England, and hatched between the 28th of September and the 10th of October, 1868. They have been seen for the last three years, and a male fish was recently captured weighing ten pounds and three ounces. The question whether the trout are multiplying by themselves has been established by the capture of quite a number only about three inches long.

It is still uncertain whether the salmon which have been repeatedly transmitted to Australia and New Zealand have survived and multiplied. Large fish have been often seen in the rivers, which, it was thought, could be nothing else than these fish; but the subject has not been verified by an actual capture. We have already referred to the shipment of a fresh quantity of salmon spawn from England in January last, and we hope soon to learn of their safe arrival at their destination.—2 *A*, *May* 24, 1873, 368.

FOOD FOR DIMINUTIVE TROUT.

For a long time a special object with trout-breeders has been to obtain living organisms of sufficient minuteness to answer the purpose of food for the fry, especially during the period which intervenes between the absorption of the yolk sac and the age of about four months, after which they are more able to care for themselves. The material generally employed in fish-hatching establishments has been chopped meat, liver, muscular fibre, or other substances, which, when supplied in small inclosures, is very apt to produce foulness of the water, resulting in the sickness or death of the fish. Even under the most favorable circumstances the minute fresh-water crustaceans of the genera *Daphnia*, *Cyclops*, etc., are scarcely produced in numbers sufficient for the object desired.

Mr. Frederick Mather, a practical trout-breeder, of Honeoye Falls, N. Y., now proposes to use the larvæ of the common mosquito, as answering this purpose better than almost any thing else, as they remain alive until hatched, and in their different stages are admirably adapted to the wants of the trout. He estimates that about two barrels of rain-water will be required for each thousand fry, the insects to be strained out from time to time as fast as they are developed and thrown into the trout-pond. The young fry take this food with great avidity, and seem to thrive admirably upon it.

INCREASE IN THE GROWTH OF TROUT.

It is asserted by high authority that a single trout, in increasing in weight from the newly born stage to one pound, or from one pound to two pounds, will require fifty pounds of flesh for the operation; while much is wasted, the greater part is eaten. With a large number of fish the waste is less. It is estimated, however, that a thousand trout of one pound each can be brought to a weight of two pounds each at an expenditure of about 12,000 pounds of flesh. Horse-meat is principally used for this purpose in Europe, on account of its greater cheapness.

ALLEGED OCCURRENCE OF SHAD IN THE MISSISSIPPI.

In reference to the occurrence of shad in the Mississippi Valley, we learn from Mr. H. A. Pattison that while engaged professionally in the spring of 1867 in trying to close the Roman Crevasse in the Mississippi River, about sixty miles above New Orleans, he saw two fine shad taken with a dip-net from the water running through the crevasse. These were caught by a negro, who stated that he had never seen such fish before, and, being afraid to eat them, was perfectly willing to sell them. Mr. Pattison reports that he is willing to testify that they were equal in flavor to any he had eaten, either from the Potomac or the James River. The date of this occurrence was the 12th of April, 1867. He furthermore remarks that he was engaged in 1857 in the location of the Memphis and Little Rock Railroad, and that while on White

River he was informed by a former resident of North Carolina, who was perfectly familiar with the shad, that he had seen schools of them in the White River, in every respect undistinguishable from those in his native state. From the date, April 12, it would seem that the shad most probably enter the Mississippi about the beginning of that month, somewhat later than the period of their ascent of the rivers of Florida and Georgia.

SHAD IN THE SACRAMENTO RIVER.

According to the Sacramento *Daily Record*, a veritable shad was caught in that river, at Jackson's Ferry, on the 14th of March last, and, if so, was of course one of the first fruits of the enterprise of the California State Commissioners in the stocking of that river under the direction of Seth Green. The fish was about twelve inches in length, and weighed about a pound, and although not submitted to an expert for identification, it was yet recognized as a true shad by several persons who were familiar with this species in the Eastern waters.

Seth Green had offered a reward of $50 for the first shad actually caught in said river, the fact to be decided by good authority; and the captors of the specimen referred to now regret that they had not taken the necessary pains to submit it to such authority for identification.—*Sacramento Daily Record.*

SHAD IN CALIFORNIA WATERS.

The experiment initiated by the California Fish Commissioners in 1871, with the assistance of Seth Green, in the way of transporting young shad from the Atlantic to the Pacific, has borne actual fruit, as it appears by an article in the Rochester *Daily Union*, quoted from the Vallejo *Chronicle* of April 20, that a veritable shad was taken in a net at the junction of Carquinez and Vallejo straits, opposite the Navy-yard magazine. It was about sixteen or seventeen inches long, and, if a genuine shad, was about two years old. The sex is not given, although probably it was a male. We trust that the specimen has been preserved, so that its actual identification may become possible. Subsequent accounts state that on the 30th of April another shad was captured, and that on inquiry it has been ascertained that quite a number have been taken.—*Rochester Daily Union, May* 9, 1873.

SHAD IN THE ALTAMAHA RIVER.

According to Dr. S. W. Wilson, of Darien, Georgia, the supply of shad in the Altamaha River, in that state, has not materially changed during his recollection. The fish enter the river in the beginning of January, and are taken for about two months. They are captured by means of gill nets, the river being too much obstructed by drift-wood to allow seines to be drawn.

HATCHING STRIPED BASS ARTIFICIALLY.

A very important experiment was made by Mr. M. G. Holton, the foreman of one of the parties organized by Seth Green, under the direction of the United States Commissioner of Fish and Fisheries, for the multiplication of useful food fishes in the rivers and lakes of the United States. Mr. Green has been engaged since the early part of April in the work in question, commencing first on the Savannah River, and proceeding thence to the Neuse, the Roanoke, the Potomac, the Susquehanna, the Delaware, etc. The fact that the fish have become nearly extinct in some of the rivers, and the high state of the water in others interfering very materially with the success of these labors, the number of shad hatched out was considerably less than had been hoped for.

Noticing, however, that some of the rock-fish, or striped bass, taken at Weldon, appeared to be filled with ripe spawn, Mr. Holton made the experiment of securing this and placing it in the hatching-boxes, and in three days' time the young fish emerged from their shells, and were turned loose into the water. The number hatched was about 100,000, and were derived from two females — one furnishing about 100,000 eggs, and the other 20,000. Contrary to the general anticipation, the eggs of the striped bass proved to be easily managed, and are dry, separate when excluded, like those of the shad, and do not adhere to objects they touch, like those of the herring, yellow perch, and wall-eyed pike or *Lucioperca*.

The eggs are about the same size as those of the shad, but the young are rather smaller and with less capacious yolk-bag; so much smaller are they, indeed, that they readily escape through the wire meshes that constitute the bottom of the hatching-boxes.

As the rock-fish, or striped bass, is a far more valuable fish than the shad, and has been equally reduced in number, the feasibility of hatching them artificially is a fact of very great importance; and it is to be hoped that the experiment will be continued whenever the opportunity occurs, so as to restore the species to its native waters.

The eggs hatched out by Mr. Holton came from fish of about six and eight pounds respectively, and he is of the opinion that large fish weighing from forty to sixty pounds would readily yield a million of eggs. The eggs are rather more delicate and tender than those of the shad, bearing any compression less readily, on account of the greater thinness and transparency of the shell.

FEEDING OF CRAWFISH IN PONDS.

In the cultivation of crawfish for market purposes in Europe, it is customary to have three ponds or ditches, walled up with coarse stone; one of them destined for the one-year old animals, a second for those of two, and a third for those of three years. They are filled for three fourths of their depth with water, a stream of fresh water being introduced through a wooden trough. The fish are fed three times a day in the ditches with chopped liver, and with a mixture of one part flour and two parts bran, which is made up with water into balls, boiled, and then chopped up again. The refuse of fish is also used for the older animals.

Crawfish, like crabs of all kinds, are best for food during their breeding season, or when they are in a soft-shell condition, about the end of June or beginning of July. About six years are required to bring these crabs to maturity. They may be readily kept for market purposes for a number of days by inclosing them in boxes or tubs filled wlth grass, or other fresh vegetable matter. They must, however, be quite dry, and not partly immersed in water.

According to recent writers, the female does not reproduce during the first year, and during the second, though the eggs are visible, they do not possess an embryo. These are held under the tail by the feet. Impregnation takes place by the application, on the part of the male, of a glutinous material.

The female carries the eggs until June or July of the following year, at which time they hatch out. The young crab remains about eight days longer attached to the parent, after which it separates and takes care of itself. The animals are generally collected in July, August, and September, the capture being effected by means of small lines to which pieces of fish, frogs, etc., are fastened. The best time for this purpose is during warm moonlight nights.—10 *C, March* 1, 1873, 41.

CULTURE OF THE STERLET.

Dr. Knoch, in a communication upon the artificial culture of the sterlet (a much esteemed small species of sturgeon found in the River Volga), remarks that the best food for the newly hatched fish consists of the various species of *Cyclops* and *Daphnia*, such as are developed in quantity in connection with aquatic plants, like the water-cress, etc. These are devoured by this fish as greedily as they are by the whitefish (*Coregonus*) and the other *Salmonidæ*, which attain a wonderful growth in the course of four months.

Dr. Knoch refers to specimens of both the eggs and of the young fish prepared by him, in bichromate of potash, as exhibiting a remarkable state of preservation, and as being in a condition suitable for investigating the various stages of growth. In the same connection he also remarks that the method of dry impregnation which has been so successful with the salmon and trout is not suited to the sterlet, since the eggs, like those of many other fish (the *Cyprinidæ*, or Carp, especially), are so glutinous as to stick immediately to any object that they may touch, so that, when gathered from the parent and stirred together, they adhere to a degree which prevents the proper penetration by the spermatozoa. —*Bull. Soc. Imp. des Naturalistes de Moscow*, 1872, II., 351.

TREATMENT OF FISH-PONDS.

Where carp or other fish are kept in ponds or restricted localities, the fish, after spending the winter in a lethargic sleep, or at least rest, at the bottom, are frequently observed to rise to the top and swim violently on the surface; and unless the entire body of water of the pond be changed, or the fish transferred to some other locality, they inevitably die, this fate sometimes involving the entire population. The

German pisciculturists have lately been endeavoring to ascertain the causes of this very inconvenient occurrence, with a view of applying a practical remedy. According to some, it is produced by the freezing over of the pond, and the accumulation of snow on the resulting ice, exercising a pressure upon the water which materially affects the respiratory functions of the fish. This can hardly be a sufficient reason, however, since the resulting pressure is very slight compared to that which the same fish may experience at different depths in large bodies of water. Another alleged cause is the untimely disturbance of the fish, in various ways, before they have had their full measure of winter's rest, this being the result of a premature awakening of the fish, or of the intrusion of pickerel, or other predaceous species. Dr. Frauenfeld, however, is inclined to believe that this may be partly the result of the development of microscopic fungi in the water, especially as a common premonition consists of a change in the color of the water, which becomes turbid and altered in appearance, in consequence of the development of the fungi in large numbers. The effect of this is to use up the oxygen, and introduce into the water an excess of carbonic acid gas, thus rendering the water insufficient for proper respiration on the part of the fishes. With this suggestion, reference is made to the fact that certain fungi occasionally develop very rapidly on the surface of the snow, and that it is possible that the snow fungus, or some other, may develop equally in water of a certain minimum temperature, when the spores happen to fall into it. He advises, as the best method of remedying the difficulty, and one in accordance with practical experience, to plant the edges of the pond with water-cresses. This plant, as is well known, has a tendency to purify the water by the decomposition of the carbonic acid produced by the respiration of fish, thus restoring the eliminated oxygen to the water.—*Verh. K. K. Zool. Bot. Ges., Wien*, 1872.

MARITIME FISHERIES OF FRANCE FOR 1871.

The *Revue Maritime et Coloniale* for December, 1872, contains a summary of the maritime fisheries of France for the year 1871, and indicates a gratifying improvement in this interest as compared with the results for 1870. In that year the country was just recovering from the effects of the war with Germany, which caused the withdrawal of a large portion of the industrial population from their peaceful pursuits, and particularly affected those connected with the fisheries. Thus, while in 1870 there were 101,594 men employed in 17,833 vessels of 150,127 tons' burden, there were, in 1871, 110,486 men in 18,407 vessels of 142,774 tons. The decrease in the tonnage in 1871 was due to the smaller number of large vessels in the Newfoundland and Iceland trade. There was an equally gratifying difference in the value of the fisheries for 1871, as compared with those of 1870; the amount being $13,978,451 for the one, and $11,975,460 for the other, or a difference of $2,002,991 in favor of the latter year.

An exceptional cause of the increase in value of the fisheries, in 1871, is to be found in the unusual abundance and much greater yield of herring, due in part to the wider field of operations and new processes in their capture. The sardine fishery, too, was greatly augmented in 1871 over that of 1870. The cod-fisheries on the coast of Newfoundland and Iceland were less extensive in 1871 than in 1870.

The following statement shows the number of persons engaged in the sea-fisheries of France during 1871: In the cod-fisheries of Newfoundland there were employed 6014 persons, and in those of Iceland, 3847; those engaged in fisheries on the coast of France were 60,635; those depending upon fishing for a livelihood, 39,361; foreign fishermen on the French coast, 629; making the total of 110,486.—*Revue Maritime et Coloniale, December*, 1872.

LAWS REGULATING THE NEWFOUNDLAND FISHERIES.

In view of the possible danger of extermination of the seals on the coast of Labrador, which now furnish so important a resource to the inhabitants of Newfoundland, the Legislature of the Colony has lately enacted a law providing that no steamer shall leave for the seal-fisheries, nor take any seals on board, before the tenth day of March, under a penalty of $2000; and that no sailing-vessel shall leave port for the fisheries, nor take any seals on board, before the fifth day of March, under a penalty of $400. It is also provided that no property, nor right of property, shall be acquired by persons engaged in or prosecuting the seal-fishery, either in seals captured and killed, and left on the ice or in the water, not in nets, or in any seals of which the claimants shall have abandoned the search, or which they shall have neglected or refused at any one time to take on board.

The inquiries prosecuted by the Committee of the Legislature previous to the framing of this act elicited some interesting facts in regard to the natural history of seals. It was generally considered by those engaged in the seal-fishery that the number of male seals, at birth, exceeds that of the females, by at least three to one, and one witness expressed his belief that among old seals there are at least twenty males to one female. The number of young at birth rarely exceeds one, twins being quite exceptional. The male seal, it is said, manifests no particular care or attention for its offspring, which will be defended by the mother when abandoned by the father.—*St. John's Semi-weekly Chronicle, April* 29, 1872.

FISH INSPECTION LAW OF CANADA.

A very thorough and exhaustive fish inspection law has lately been passed by the Dominion Parliament, which contains many provisions which, in the opinion of some, might be introduced to advantage in the United States. The inspectors of fish are required to produce the proper branding-irons, which shall be applied in their immediate presence and sight. They are also to see that all kinds of pickled or salted fish have been well preserved, and are free from taint, rust, saltburn, oil, or damage of any kind, and all fish or oil must be packed properly in vessels of specified character and dimensions. The inspection is to be compulsory in all the provinces except Manitoba and British Columbia; and the exposure to sale of any pickled fish, without inspection, renders the holder liable to a penalty of $5 on each package, besides the forfeiture of the goods.

In regard to salmon, "No. 1" is to consist of the largest, best, and choicest kinds, well split, with the blood well washed out before being salted, and in every respect free from taint or damage. "No. 2" is to embrace the best salmon that remain after the selection of "No. 1," and must be also well cured and free from damage. "No. 3" consists of what remains after the selection of the first two qualities, and must also be good fish, free from damage.

"Mess Mackerel" is to include the best and fattest mackerel, well cured, and such as measure not less than 14 inches from the extremity of the head to the crotch of the tail, and must have the heads and tails taken off. "Extra No. 1" are the same as "Mess," with the heads and tails left on. "No. 1" must also be of the best class of fish, but need not measure more than 13 inches. "No. 2" are the best that remain after the selection of the above classes. "Large No. 3" must be 13 inches long; "No. 3," 11 inches.

All good-looking mackerel under 11 inches must be branded "Small Spring," or "Small Fall," while all sunburned or ragged mackerel, of whatever class, and not otherwise defective, are to be branded "No. 4."

"No. 1" of herrings, gaspereaux, and alewives, comprise the largest and best fish; the best of the remainder are to be marked "No. 2." Undersized herrings are to be "No. 3," with the addition of the word "small." Ripped herrings are branded "Split;" gibbed herrings, branded "Gibbed;" herrings not ripped or gibbed, branded "Round;" and spring-caught herrings, branded "Spring."

The best smoked herrings are to branded "No. 1," and the poorer ones "No. 2;" but no fish shall be passed or branded unless good, and properly packed; and, if in boxes, these are to be 18 inches long, 9 inches broad, and 18 inches deep, well nailed, with smooth tops or covers, the tops and bottoms to be at least half an inch thick, and the ends three quarters of an inch. Tainted, burned, scorched, and badly smoked herring shall be considered "refuse," and be so branded. A classification into "No. 1" and "No. 2," similar to that required for salmon, is to be applied to sea-trout, lake and salmon trout, and whitefish.

Green cod-fish in barrels, to be classed as "No. 1," must consist of the best fish, and measure at least 15 inches to the crotch of the tail. Any other kinds of fish, not enumerated, must be branded according to their character, and properly classified. Each tierce is to consist of 300 lbs.; half-tierce, of 150 lbs.; barrel, of 200 lbs.; half-barrel, of 100 lbs.; quintal, of 100 lbs.; draft, of 200 lbs.; box of herrings, of 25 lbs.; to be clear avoirdupois, exclusive of salt and pickle.

Due instructions are given in regard to the branding of whale and seal oil—"Pale" being "No. 1," "Straw" "No. 2," and "Brown" "No. 3." The law provides that the act is not to apply to fish landed in the Dominion in American vessels to be reshipped to the United States, unless at the special desire of the owners of such fish.—*Halifax Chronicle.*

RATE OF GROWTH IN TROUT.

It is stated that the experiment of Mr. George Shepard Page, of marking some of the large trout in Rangely Lake, with a view of determining their rate of growth, has borne practical fruit; and that a fish which in 1870 was labeled as weighing half a pound, proved to have attained two and a quarter pounds when taken in 1873, showing that it had increased about one and three-quarter pounds in three years.

RECENT FISHERY AND GAME LAWS OF THE OHIO LEGISLATURE.

The Ohio Legislature, at its last session, made several enactments of considerable interest in connection with the subject of fishes and fish-culture in that state, among them a general law in reference to the formation of companies for the purpose of propagating fishes and establishing fisheries. This provides that a certificate shall be made out, giving the name of the company, the place where the fishery is to be located, and the amount of capital stock necessary to establish, finish, and equip the same. The stock of the company is to be divided into shares of not less than five dollars each, and to consist of such sum as shall be specified in the certificate, more or less. The association shall have permission to make such rules and regulations for its government as it may deem best—fix the number and character of its officers, prescribe the time of their election, and make any other regulations necessary for the objects of the organization; and it is enacted that whenever any such company shall acquire the right to use any stream, canal, or reservoir for the establishment of a fishery for the purpose of propagating fish, it shall be unlawful for any person to fish therefrom without the authority of the company, any violation to be met by the fines provided for trespass. Navigable streams and the public canals of the state are, however, excepted from this provision, as also any waters which, by custom or usage, have been employed heretofore for the purpose of fishing therein.

Another act provides that it shall be unlawful for any one to shoot fish, or to use any kind of net or pound, in any waters of the state above the common level at high or back water of Lake Erie and of the Ohio River, or in the water of any lake, pond, or reservoir having a surface of not less than ten acres nor more than eighteen thousand, lying wholly within the state, whether the same be a natural or artificial body of water. Two thousand dollars are appropriated for building shutes over the state dam.

An enactment for the protection of fur-bearing animals provides that it shall be lawful to trap musk-rats, minks, and otter only between the 15th of February and the 15th of April following; and that poison shall under no circumstances be used outside of any building for the destruction of fur-bearing animals or of vermin. The entrance upon the premises of any one without his consent, for the purpose of trapping, hunting, killing, or pursuing the fur-bearing animals, is also prohibited, the fines for any offense against the enactment being not less than two nor more than twenty-five dollars. The capture for possession, for sale or otherwise, of deer is also prohibited at any other time than during the months of November and December.—*List of Ohio Laws.*

PACIFIC COD-FISHERIES OF 1873.

The cod-fisheries of the Pacific have been quite successful during the past season, all the fish taken being sure of a fair market. The prices in San Francisco are about one cent per pound less than for the Eastern cod. The total arrivals at San Francisco, up to the end of October, from the Alaskan and Siberian fisheries, amounted to 583,000 fish, of which 235,000 were from the Shumagin Islands, and 348,000 from those of the Sea of Okhotsk. The largest cargo brought in was that by the *Gold Hunter*, of 121,000.

GERMAN REPORT ON UNITED STATES FISHERIES AND FISH-CULTURE.

Drs. Finsch and Lindeman, who visited the United States during the summer and autumn of 1872 as a commission to investigate the condition of the fisheries and fish-culture in America, have lately presented their report to the Minister of Agriculture of Germany, and it has recently been published among the circulars of the *Deutsche Fischerei-Verein.* During their stay they visited most of the fish-hatching establishments of the United States, and they speak in terms of high commendation of those under the charge of Dr. Slack, Mr. Livingston Stone, Mr. Brackett, Seth Green, and others. Of the fish-ways that attracted their attention, that of Mr. Brackett is commended by them, as, in their opinion, best fitted to allow the ascent over natural or artificial falls of such fish as the salmon, shad, and alewife. They also paid particular attention to the subject of American oysters.

THE FISH OF THE CASPIAN SEA.

The Caspian Sea is extremely rich in various species of fish, many of these occurring in prodigious numbers. Indeed, according to Alexander Schultz, the yield is very much greater than that of the Great Bank of Newfoundland. Thus in one single district 15,000 sturgeon are frequently taken in a day, and when the fishing is interrupted for twenty-four hours the waters become almost choked by the abundance of fish, which are so numerous as to press each other out upon the shore. The total yield of the Caspian Sea for one year in fish and fish products has been estimated at 13,000,000 pouds (about 469,430,000 pounds avoirdupois), worth about $12,000,000.

There are several varieties of sturgeon among the fish taken, including the sterlet, as well as the carp and other cyprinoids, the salmon, the *Coregonus* (similar to the whitefish of the American lakes), several kinds of herring, etc. A peculiar phenomenon observed, especially among the sturgeon, is that of a kind of winter sleep. At the approach of cold weather they seek the deep portion of the rivers, and remain there in a state of torpor, during which they secrete a viscid matter, which forms a coating over the entire body, called by the fishermen a *pelisse.* During this period they appear to eat nothing, their stomachs always being found entirely empty.—*Report of A. Schultz, Vienna Exposition*, 1873, 40.

PRICES OF AMERICAN FISH-EGGS AND FRY IN ENGLAND.

According to a list of prices for eggs and young fish at the establishment of Mr. Parnaby, in Keswick, England, the securing of American fish for breeding-ponds is something of a luxury. The charges there indicated for the eggs of brook trout (*Salmo fontinalis*), the American salmon-trout (*Salmo trutta*), and the whitefish (*Coregonus albus*), are twenty-five pounds sterling per thousand; while for the fry of the trout and salmon-trout thirty pounds sterling are charged, and those of the whitefish are at the rate of one hundred pounds per thousand. The eggs of the British trout are two pounds ten shillings per thousand, and the young are three pounds. Even such prices as those last mentioned would be very acceptable to American fish-culturists if they could obtain them.—10 *B, February*, 1873, 167.

STATISTICS OF EGYPTIAN FISHERIES.

According to a report on the statistics of Egypt, we learn that in 1872 the maritime fisheries of six coast districts of that country employed 3761 men in 814 boats. In one district 15,000 quintals of fish were taken. The total value was about $250,000. The statistics of the fresh-water fisheries are too incomplete to admit of a summation, although the entire value was much less than that just given.—*Report of Egyptian Statistics.*

IMPORTATION OF CURED FISH INTO ENGLAND IN 1873.

According to *Land and Water*, the importation of cured and salted fish into England up to the 8th of November, 1873, amounted in value to £479,891, as against £376,636 for the same period in 1872.—2 *A, November* 8, 1873, 577.

GLOUCESTER HALIBUT FISHERY.

According to the Gloucester *Telegraph*, the recent enterprise on the part of the indefatigable Gloucester fishermen, having for its object the capture of halibut on the coast of Iceland, has not proved so successful as was hoped for, although they are entitled to much credit for their activity in thus seeking out new fields of labor. It is well known that the halibut fishery on the Georges (the celebrated banks east of Cape Cod) is almost exclusively in the hands of Gloucester men, and the dangers of the locality are aptly indicated by its being denominated the "Gloucester Grave-yard," on account of the annual loss of life and property.

The trade in Newfoundland and Magdalen Island herring and mackerel is also almost entirely carried on by the inhabitants of Gloucester. It is even stated that, a few years ago, it was proposed there to fit out a fleet for mackerel fishing on the coast of Norway and Sweden, but nothing came of it.

In 1870, Captain John H. M'Quinn fitted out the schooner *Caleb Easton*, of Boston, for a summer trip to the coast of Greenland in pursuit of halibut. He made a successful voyage, arriving home in October, and bringing with him 176,300 pounds of fletched halibut, 183 barrels of fins, and several barrels of salmon, the whole venture amounting to about $20,000. The success of this enterprise induced the fitting out of six vessels in the summer of 1871; but the result was not as satisfactory as that of the previous year. In 1872, however, six vessels were again dispatched to that coast, and brought in over 7000 quintals of fish. We are informed that the business has been resumed the present year by four vessels.

Encouraged by his success in the Greenland trip, Captain M'Quinn started out in the schooner *Membrino Chief* on the 23d of May, 1873, for the coast of Iceland, but unfortunately did not meet with the success which the boldness of the venture deserved. The fishing-grounds were reached on the 9th of June, and after remaining five or six weeks, and visiting various harbors, the result was so unsatisfactory that, on the 11th of July, the vessel sailed for home, reaching Gloucester on the 6th of August. The principal difficulty lay in the fact of the roughness of the coast, rather, perhaps, than in the scarcity of the fish; the season, however, being exceptionally unfavorable. It is said that there are two schools of fish which frequent the coast of Iceland, one arriving in April and the other in September, the visit of the *Membrino Chief* having fallen in the interval. It is quite possible that, should a renewed effort prove that halibut can not be taken to advantage, our fishermen may devote themselves to the capture of the cod, which occur there in great abundance, and are taken very largely by the French fishermen. The vessels employed for this purpose are of large size, and generally make two trips in a season. The fishing is done principally by hand-lines.

The capture of sharks occupies a prominent part in the fisheries of the coast of Iceland, and is generally followed by the natives in fishing-boats, and by small vessels from Denmark, the object being especially the securing of the livers, no account being made of the rest of the animal.—*Gloucester Telegraph, August* 13, 1873.

ARRIVAL OF SALMON EGGS IN NEW ZEALAND.

We chronicled some months ago the transmission to New Zealand, by the ship *Oberon*, of a cargo of salmon eggs, packed in ice, the vessel leaving London on the 20th of January, 1873. The *Oberon* arrived at Otago, in New Zealand, on the 2d of May, and on opening the boxes a large number of the eggs were found to be dead. Of the 100,000, however, about 15,000 to 20,000 appeared to be alive, and it was hoped that at least six to ten thousand would be hatched out. These were sent to a hatching establishment near Christchurch and placed in the boxes.

The expense of this experiment amounted to about $4000. At the time of the shipment some eggs of the same lot were placed in an ice-house belonging to the Wenham Lake Company, and when unpacked on the 5th of May were found to contain living embryos, after having been kept in ice for 112 days.

It is hoped that the salmon experiment in New Zealand will meet with the same success as that of the introduction of trout eggs into the same country, the proceeds of which have been taken in the form of fish weighing in some instances five pounds.

When the boxes containing the salmon eggs were opened, great differences were found among them as to the health of the contents; in some the percentage of deaths being very great, while in others it was much less. The greatest loss was in boxes packed with coarse brown moss, such as was taken from woods; the fresher and more green and soft moss, such as grows on the boles of trees, seeming to be very much more favorable for the preservation of the eggs. In one case only sixteen living eggs were obtained from a lot of three boxes.—2 *A*, *August* 2, 1873, 81.

SHAD IN THE ALLEGHANY RIVER.

According to the Rochester *Daily Union* of September 10, Mr. Seth Green had received from Tidiot, a branch of the

Alleghany River, a genuine shad, presumed to be the progeny of the stock deposited by Mr. Green in the Alleghany River at Salamanca in July of 1872, in behalf of the United States, and at the instance of the United States Commissioner of Fish and Fisheries. The fish is said to have been thirteen and a half inches long, and well developed, representing a little more than one year's growth of this kind of fish.

It is suggested by the editor that this fish had probably been down to the sea, and had returned. This, however, if true, would express a somewhat different habit from that which has been supposed to characterize the shad—namely, that they spend at least two years in the salt-water before coming back to the place of birth, or where they were deposited in the water.

If there is no mistake in regard to the identification of this specimen as the true shad, we have here a very important argument in favor of the propriety of continuing the attempt to introduce shad into Western rivers. The experiment in the Alleghany River was considered somewhat doubtful in view of the fact that the fish in moving to the sea would necessarily pass through a long extent of water poisoned by petroleum, and unsuited to the respiration of fishes.—*Rochester Daily Union, September* 10, 1873.

SECOND ANNUAL MEETING OF THE AMERICAN FISH-CULTURISTS' ASSOCIATION.

The report of the second annual meeting of the American Fish-culturists' Association has just been published in Albany, and contains a notice of the meeting held in New York on the 11th of February, 1873. On this occasion numerous topics connected with fish-culture were brought forward, and a committee was appointed to memoralize Congress, asking for an appropriation of $30,000 for the promotion of the culture of food fishes.

Among the papers presented was the president's address, containing a summary of what was done in fish-culture in 1872, recounting the measures taken by the National Commissioner and the State Commissioners for the introduction and increase of the salmon, shad, and other species. In a paper, by Professor Mather, on artificial spawning as practiced in the cultivation of trout, the opinion was expressed that, contrary to the views of most fish-culturists, natural spawning is preferable to artificial in every respect.

Mr. Dykeman, in a paper on the impregnation of trout eggs, gave the result of experiences at his establishment at Shippensburg, Pennsylvania. Mr. Charles Bell read a paper on the fecundation of fish, in which he denies that the spermatozoa are distinguishable as independent organisms, instead of being simply free moving cells. A communication was presented by Mr. George Shepard Page upon fish-culture abroad, embracing the results of inquiries made by him, through the State Department, in China and Japan, in regard to the practice in those countries. From this it would appear that artificial culture, as we understand it, is unknown in those regions, efforts there being limited to the gathering of the spawn, as naturally impregnated, and hatching them out; and also to keeping fish in reservoirs, where they can spawn, or where they can receive considerable accession of growth. Mr. A. P. Rockwood enumerates the native fish of Utah, including among them the lake trout, which sometimes weighs twenty-five pounds, the brook trout, weighing from one to three pounds, the sucker, chub, and a fish something like the cat-fish.

In addition to the papers actually presented at the meeting, the report embraces an extract from a letter of Professor Baird, United States Fish Commissioner, addressed to the Committee on Appropriations of Congress, on the subject of fish propagation.

TAKING CALIFORNIA SALMON WITH THE HOOK.

The question recently raised as to the propriety of introducing the California salmon into the Eastern United States, in view of the alleged impossibility of taking it by the hook, has been effectually set at rest by a communication from Livingston Stone, Esq., in charge of the United States salmon-hatching establishment on the Sacramento. This gentleman reports, under date of August 2, that salmon were then being taken in great numbers in the M'Cloud River, principally grilse, the bait used being salmon spawn. He does not state, however, whether any have been taken with the fly, although it is probable that if they will take one kind of bait, they will not refuse the other.

THE FRESH-WATER FISHERIES OF INDIA.

A very interesting and suggestive report has lately been made by Francis Day on the fresh-water fishes of India and Burmah, containing the results of his investigations, made as Inspector of the Fisheries of India, since 1866–67, as to the question whether there is a continual destruction of the fresh-water fishes in that region. The questions circulated were as follows:—"*For Collectors:* (1) Are breeding fish and very young ones destroyed in your district to any great extent? (2) If they are destroyed, how, in what places, and at what seasons? (3) What is the smallest size of the mesh of nets allowed or employed in your district? (4) What difficulties are there against regulating the size of the mesh of the nets? (5) What size between knot and knot of the meshes of nets do you consider advisable? (6) What objections exist against prohibiting the sale of the fry of fish in the bazars? (7) Are there any objections against prohibiting the capture of fish in hilly districts, as the Himalayas or the Nilgiris, during the first two months of the monsoon season, when they are breeding?"

Those for *native officials* were: "(1) What number of fishermen are there in your range, and are they only such, or do they pursue other occupations likewise? (2) What are the names of the fishermen castes in your district? (3) Are the local markets fully supplied with fish, or could more be sold? (4) What is the price of large and small fish in the bazar, and also that of first and second sort of bazar mutton? (5) What proportion of people eat fish? (6) Have the fish increased, decreased, or remained stationary of late years? (7) Are very small fish taken in any quantity during the rains? if so, how? (8) What is the smallest size of the mesh of the nets employed? (9) Are fish trapped in the irrigated field during the rains? (10) Enumerate the various sorts of fishing, and give the native names of every form of net, trap, or snare used in taking fish in your range."

The responses received were very numerous, and some completely exhaustive, so that the Inspector was able to come to very definite conclusions as the general result of his inquiries. These, as summed up, are as follows: "(1) That all the people of Sind, Assam, and Burmah, and the majority of those residing in other parts, are not precluded by their religion from eating fish; (2) that from the returns received (excepting Sind), more than half the markets away from the sea are insufficiently supplied with fresh fish; (3) that breeding fish and their fry are indiscriminately destroyed throughout the British possessions; (4) that the supply of fish in the waters (excepting Sind) is generally decreasing; (5) that the fisheries are mostly government property; (6) that non-regulation of the fisheries under British rule has had a disastrous effect; (7) that the natives let out tracts of the country to contractors, who alone might dispose of the fish, and certain conservative measures were likewise in existence; (8) that the contractors under British rule have in many places been abolished, every one being permitted to fish as he pleases; great innovations have crept in, and fixed engines are now universally employed, whereas they were not previously generally permitted; (9) that the fishermen, as a rule, unless in the vicinity of tidal rivers, are only thus engaged in addition to their other occupations, so are not dependent for their living on fishing; (10) that regular fishermen in many places have been compelled to give up this trade, and turn to other means of gaining a livelihood; (11) that fishing-weirs and fixed engines obstructing water-ways, the high-roads of fish, are every where employed, from entirely spanning rivers, to every outlet in each irrigated field from whence water is flowing, while the mesh employed is so minute that the smallest fry can not escape; (12) that fishing-nets, with meshes of the most minute size, are used for the purpose of catching every thing, and this in every district where the water will permit of it; (13) that, as a rule, more than half the minimum-sized mesh of the nets is less than one fourth of an inch between each knot, but even coarse cloths are employed to capture fry with; (14) that rivers and streams are dammed and the water laded out for fishing purposes; (15) that waters are poisoned almost every where to obtain the fish; (16) that the minor modes of fishing are most numerous, destructive, and wasteful; (17) that fish are in some places only killed to be thrown away, or carried off as manure, and that in localities where the supply does not equal the bazar demands; (18) that irrigation weirs are largely destructive by impeding the ascent of the fish to the waters where they breed, or the downward passage of those attempting to descend; (19) that irrigation canals are exceedingly injurious, if they have vertical falls in them, up which fish are unable to ascend; for, as the old ones descend down stream to feeding-grounds, they find a stone-wall in their way; but a fine stream of water not so obstructed, which leads them into one of these canals, and once over a fall, they can not reascend, but are destroyed there every time the water is cut off; (20) that the same destructive plan exists in nearly every irrigated field in India; (21) that there are certain vermin very inimical to fish, as crocodiles and otters, which should always be destroyed; (22) that in Great Britain, and other civilized countries, the poaching of fish is forbidden; (23) that where local restrictions on poaching fish have been tried in India, the result has been most beneficial."—*Report on Fresh-water Fisheries and Fishes in India and Burmah, by Surgeon-Major Francis Day*

INFLUENCE OF EXTERNAL PRESSURE IN THE LIFE OF FISHES.

Mr. Carbonnier has lately published an article upon the influence of external pressure upon the life of fishes, in which he takes the ground that when certain fishes are gravid with eggs they come into shallow water, on account of the less distress produced by the external pressure, and that after depositing their eggs, unless they are so situated as to be able to return to the deeper waters, they suffer very seriously, and sometimes perish; the natural means of reducing expansion of the abdomen being exposure to colder water and increase of pressure externally. He makes a special application of this generalization to the salmon and shad, remarking that when their ovaries are developed they ascend the rivers from deep water, and finally reach the localities where the water is very shallow. As the fish run up into shallow water, and the expansion of the ovary is a gradual operation, there is little inconvenience experienced; but as the emptying of the ovary takes place within a period of a few days at most, unless the fish are where they can return readily, and in a sufficiently short space of time, to the deeper water of the river or to the sea, they are liable to succumb to the shock.

It is on this theory that Carbonnier explains the fact that so many anadromous fish die in the course of the operation of reproduction, the case being applicable to the males with their shedding of the milt as well as to the females. Such mortality is less frequent in the sea, as the fish can, with very little trouble, and without any artificial impediment, secure that depth of water after the eggs are laid that will meet their requirements.

In the same connection, the author reminds us of the fact that nearly all species living at great depths come into shallow water to spawn, and considers this a proof of his hypothesis in regard to the pressure upon the swollen abdomen. He, however, makes no reference to the increasing temperature, as well as greater amount of light secured, both of which have a powerful influence on the development of the egg. Mr. Carbonnier calls attention to the difficulty which has been experienced in the artificial hatching of the L'Ombre-Chevalier, or *Salmo umbla*, a species of trout, and one of the most esteemed of this kind in Europe. This lives in deep, cold lakes, and comes to the shallow water at the proper period to spawn. Numerous attempts have been made to propagate this fish in ordinary ponds, but hitherto without success; until Mr. Ricot, of Clermont-Ferrand, made his experiments in a lake about three hundred feet in depth, representing a pressure of more than eight atmospheres. Here the old fish could readily return to the proper depth, and the young follow them at a suitable time.

An important point mentioned by the writer is in reference to the relation between depth and temperature. He remarks that in the waters of France the trout will not survive a temperature of over 60° at the surface; but if the water is deep enough to permit them to descend to a depth of ten to fourteen feet, they can readily sustain the heat of 62° to 65°; this, as he supposes, in consequence of the fact that the greater pressure neutralizes the expansion consequent upon the temperature. It is on the considerations just presented that he finds an explanation of the alleged fact that it is very difficult to keep fish alive in cans or vessels of limited magnitude immediately after the period of reproduction; such species as the carp and tench, which, under ordinary circumstances, can be kept in good condition for several hours, even in damp grass, dying in a vessel of water in a very short time immediately after spawning.—10 *B, January*, 1873, 16.

K. DOMESTIC AND HOUSEHOLD ECONOMY.

TRAVELERS' BEDS.

A very portable traveling-bed is manufactured by Sauerman, of Flensburg, Germany, which can be rolled up like a shawl in a cylindrical form, twenty-three to twenty-seven and a half inches long, and seven to nine and a half inches in diameter, the price ranging from $5 50 to $22, according to the size and quality. It consists of a light hair mattress, including single or double air pillows, a fine woolen coverlet, a camp-stool, attachments and cords for adapting the mattress as a hammock, and apparatus for filling the pillows with air.—16 *C*, VI., 171.

IRON VESSELS FOR TRANSPORT OF SPIRITS.

Iron vessels for the transport of spirits are found to be free from many of the defects of wooden ones, especially such as cause loss. They are made of sheets less than one tenth of an inch thick, of cylindrical form, about forty-seven inches long and thirty-two inches in diameter, with ends slightly convex. The bung is closed by rubber disks, and protected by wooden hoops on each side; there are thin iron hoops around each end, and the interior is protected from rusting by a coating of gum or dextrine.—16 *C*, VI., 173.

PLASTER AS A PROTECTION AGAINST FIRE.

After the conflagration in Paris, it was generally found that, with good plaster work over them, beams and columns of wood were entirely protected from the fires. In cases where limestone walls had been utterly ruined, on the outside, by the flames passing through the window openings, the same walls, internally, escaped almost unscathed, owing to their being coated with plaster. On many such plastered walls the distemper decorations were still to be made out. The iron roofs rendered good service, and the party walls of each house, carried up right through the roof, proved a most important precaution, for otherwise nothing could have prevented the disastrous conflagration from being more extensive than it was. It was also found that good wood-work in beams and posts, good wood floors, well plugged, and good wooden staircases, were safer and more to be depended upon than cast-iron columns and stone staircases, landings, and floors. Stone staircases, well protected by plaster, were fire-proof, although not so safe as wood in case of heavy débris falling upon them.—8 *A*, *September* 2, 1872, 131.

STEAM AS A FIRE-EXTINGUISHER.

Dr. Weidenbusch, of Wiesbaden, highly recommends steam as a fire-extinguisher, and suggests experiments as to the best method of employing it, as well by the use of portable boilers (where the connecting pipes would produce the chief difficulty) as by pipes and boilers arranged for each building. As an illustration of its efficiency, he gives the case of a factory about 196 feet long and 33 feet wide, the garret of which was filled with rags, shavings, leather-scraps, etc., in which, when the fire was detected, half the length of the roof was burning. The fire apparatus arrived about an hour afterward, and the extinguishing appliances of the building itself were so defective that the whole roof was in flames and had fallen in, and the lower story was on fire in different places. About two and a half hours after the outbreak of the fire a steam-boiler, separate from the building, and not in use for some hours, was fired up with wood, and the cast-iron pipes were cut by a daring carpenter who entered a room of the burning building. The effect was instantaneous. The room, filled with the steam issuing under high pressure (which, however, he does not consider essential), soon darkened, one portion after another ceased to burn, even the heaps of rags on the garret, with free access of air, were gradually extinguished, and after half an hour all danger was regarded as past. The effect was too marked to be ascribed to the fire-engines operating during the same time, and the firemen were more and more impressed with the fact that their labor was superfluous as the steam came into play.—15 *C*, 1873, 21.

NEW SUBSTITUTE FOR COAL GAS.

A company has been recently organized in Great Britain for the purpose of manufacturing a substitute for coal gas, and from the scale on which it is prosecuted very sanguine expectations of financial success appear to be entertained. The apparatus for the purpose consists of three iron gas-retorts, set in a furnace one above the other. Above the retorts, and heated to redness by the same fire, is a horizontal U-shaped iron pipe about four inches in diameter. The retorts are charged with a mixture of coke and iron, and steam from an ordinary pipe is then forced through the iron pipe, which; it is obvious, acts as a superheater. The superheated steam passes into the two lower retorts, being carried by pipes arranged in their axes at the farther end, and then returns through the mass of heated coke and iron. Passing through the third retort in the same way a large amount of gas is generated, which is cooled in a temporary condenser, and then carried to a gas-holder, and afterward purified in the usual manner.

The gas thus obtained is a mixture of hydrogen, carbonic oxide, and carbonic acid. To impart an illuminating power to it, the gas is passed through a chamber containing rectified petroleum spirit of a specific gravity of 0.68. By this process a considerable quantity of the spirit is taken up, and the volume of the gas is increased by about 25 per cent. It then burns with a brilliant flame, and is ready for distribution.

Although the various details of this process appear to present nothing new, their combination is one that has received the indorsement of a patent. The most serious question appears to be how far the illuminating power of the gas will stand the test of cold. The vapor introduced is, after all, a vapor, and, as such, capable of more or less condensation. Whether this will occur in cold weather, and, if so, to such an extent as to impair the value of the gas, is a question for inquiry. It is stated that the gas has been subjected to extreme cold without injuring its quality; but this will be determined, of course, whenever the matter comes to a practical experiment.

One objection urged against the gas produced by the new process lies in the large amount of carbonic oxide which it contains. This, as is well known, is a deadly poison, and one which, from its specific gravity, tends to settle permanently in closed spaces instead of passing off into the atmosphere. When burned, it is, of course, converted into the more harmless carbonic acid, and in this form may not be objectionable, but the danger resulting from a leak in the pipes is one worthy of serious consideration.—1 *A*, *February* 21, 1873, 86.

EFFECT OF RUBBER TUBES ON ILLUMINATING GAS.

The results of recent investigations by Zulkowsky show that a diminution of intensity of the light, perceptible without photometric aids, is produced by the passage of ordinary illuminating gas through rubber tubes only fourteen feet long, and that this diminution is not due to mixture of air by diffusion, but entirely to the partial absorption of some, perhaps all, of the illuminating ingredients. Furthermore, since these absorbed ingredients are given up in a vacuum, and without doubt also gradually to the air, the effect of such tubes is independent of the time they may have been in use. —3 *C*, *November* 18, 1872, 1128.

IMPROVEMENT IN BUNSEN'S GAS-LAMP.

The Bunsen gas-lamp has been so modified by Professor Finkener that the supply of gas, as well as of air, can be regulated by the simple rotation of a ring on the foot of the burner, and the non-luminous flame can consequently be diminished to any extent without liability to strike down. A somewhat similar arrangement has long been in use in ordinary Argand burners.

DURABLE COATING FOR LAMP-SHADES.

The following mixture is suggested by Dr. Sels as a coating, especially for lamp-shades, ceilings, etc., as preferable, in respect to beauty, permanence, and cheapness, to ordinary oil-paint, since it adheres firmly; remains of a brilliant white at high temperatures; contains no organic matter; and, by the use of suitable mineral colors, can have any shade imparted to it. Pure zinc white (oxide of zinc), thoroughly pulverized, is added to a solution of silicate of soda of 40° to 50° Beaumé, until the mixture has the consistency of ordinary oil-paint. The metallic surface to be coated must be thoroughly cleansed (zinc and some other metals must be treated with hydrochloric acid), then washed with water, and the above mixture laid on several times, by means of a brush, until the surface is well covered. It will require but a short time between the coatings to allow the previous one to dry. Too much of the mixture should not be made at one time, even where large surfaces are to be covered.—6 *C*, *October* 10, 1872, 286.

OZOKERITE CANDLES.

At the exhibition of chemical and allied products at Dublin, held during the past summer, the various forms of candles were prominent articles, and especially those made of ozokerite. This is a fossil, first mentioned by Meyer, who discovered it in Moldavia, in connection with the mines of rock salt. The material used by Messrs. Field & Co., who exhibited the candles in question, is obtained by them from the Carpathian Mountains, and the candles are said to be of great beauty. They have a very high melting-point, and do not soften nor bend at an ordinary temperature. They also exceed any other candles in their illuminating power. Thus 754 grains of ozokerite gave as much light as 1000 of the best spermaceti, 798 to 791 of paraffine, and 1150 of wax candles.—1 *A*, *October* 4, 1872, 160.

IMPROVED SOAP.

M. Miahle communicates to the Academy of Sciences of Paris an account of a soap which, according to his statement, combines the advantages of being prepared without heat, with the consequent avoidance of loss of glycerine in combination with the fatty matters, and of being free from that alkalinity generally present in soaps prepared in the cold. In its manufacture the ordinary toilet soap, made without heat, is cut into shavings, and exposed in a closed chamber to the action of carbonic acid gas. The soap absorbs a quantity of the gas proportional to the amount of caustic soda which has escaped saponification; and, by the transformation of the free alkali into bicarbonate, it loses all its causticity. It then constitutes a perfectly neutral soap, containing all the glycerine of the fatty bodies employed in its manufacture, and a certain quantity of bicarbonate of soda.—14 *A February* 22, 1873, 665.

REMOVAL OF INK STAINS FROM COLORED FABRICS.

To remove ink stains from colored fabrics where either oxalic acid or chloride of lime is undesirable, it is recommended to use a concentrated solution of pyrophosphate of soda.

The action is slow, and must be repeated—especially when the stains are old ones—and therefore a good percentage of patience has to co-operate with the above chemical application.—15 *C*, 1872, XIII., 208.

WASHING WOOLEN CLOTHING.

Articles of woolen clothing, washed in ordinary soap and water, not only shrink, but acquire a peculiar fatty odor, due to the decomposition of the soap by the lactic and acetic acids present in the perspiration, and consequent precipitation of the greater part of the fat of the soap in the fibre of the wool. According to Professor Artus, both of these effects can be prevented by steeping the articles for several hours in a warm, moderately concentrated solution of washing soda, then, after the addition of some warm water, and a few drops of ammonia, washing them out, and rinsing them in lukewarm water.—13 *C*, *September* 1, 1872, 1163.

SUBSTANCE FOR CLEANING SILKS AND WOOLENS.

A new substance for cleaning and whitening silks and woolens consists of a weak solution of the sulphuret of sodium, or of potassium, this having a very remarkable effect in removing the fat from the wool and the gum from silk. In the case of silk, the bath must be boiling; but for wool the temperature of the alkaline sulphuret should not exceed 122° Fahr. The more gum there is on the fibres of the silk, the greater is the amount of the sulphuret needed in the solution. The aluminates of soda and potassa have also been used for the same purpose.—9 *B*, 1872, XLII., 543.

PREVENTION OF CHARCOAL FUMES IN HEATING SMOOTHING-IRONS.

It is said that sprinkling common salt on the top of glowing charcoal used for heating smoothing-irons, and then placing the stove at the window for a few minutes, prevents the evolution of injurious fumes, and also effects a saving of fuel. —10 *C*, *February* 1, 1873, 30.

INVESTIGATIONS OF COFFEE AND TEA.

Recent investigations by Aubert, partly in connection with Haase, lead to the following conclusions: No caffeine is lost by roasting coffee to a light-brown color; but by continuing the operation until the beans become almost black, a small portion of caffeine escapes. On the other hand, the caffeine is more completely extracted from the dark-roasted beans, and consequently an infusion from a given weight of them will be somewhat richer in caffeine than that from the same weight of lightly roasted. It seems, therefore, that it may be left simply as a matter of individual taste as to the degree to which coffee should be roasted, and also as to whether it should be extracted by percolation or boiling, since it was also established that the caffeine passes almost entirely into an infusion. By comparative tests of tea and coffee, after preparing the extracts according to the usual household methods, the interesting fact was established that the amount of caffeine in a cup of good coffee, prepared from 260 grains of coffee, is the same as that in a cup of good tea prepared from 75 to 90 grains of Pekoe tea. It was also found that the other extractive principles can, for the most part, also be obtained by simple infusion, but that the amount obtainable in this way from strongly roasted coffee is larger than that from the slightly roasted, although the total amount, as ascertained by other methods, is the same in both kinds. In its physiological effects upon mammalia and frogs, caffeine seemed related to strychnine; but the experiments seemed to render it very questionable whether the physiological effects of coffee are to be attributed solely, or even mainly, to the caffeine present, since extract of coffee beans, free from caffeine, produced powerful effects on animals, and of a very different character from those of caffeine. A comparative investigation of these effects is proposed by Aubert, in which special attention will be paid to the considerable amount of active potash salts present in coffee. The experiments, up to this point, offer no explanation of the invigorating effect to which coffee owes its popularity.—13 *C*, *September* 1, 1872, 1167.

ENAMEL FOR COPPER COOKING VESSELS.

To enamel the inside of copper cooking vessels in which acid fruit and vegetables are cooked, and thus prevent the formation of the so-called "verdigris," the following method is recommended: Twelve parts of white fluor-spar, twelve parts unburned gypsum, and one part borax are finely powdered, intimately mixed, and fused in a crucible. The fused mass is then poured out, and, after cooking, is rubbed up to a paste. The copper vessel is to be coated inside with this preparation, applied by means of a brush, and the vessel placed in a moderately warm place, so that the coating may dry uniformly; after which it is subjected to a gradually increasing heat, till at length the preparation fuses. On cooling, the vessel is found to be protected internally by a white, opaque enamel, adhering very firmly to the copper, not chipping off by ordinary knocking and rubbing, and impervious to vegetable acids.—21 *A*, *September*, 1872, 850.

VESSELS FOR TRANSPORTATION OF MILK.

Wooden vessels, of about four and a half gallons' capacity, are highly recommended by Mr. Byern, a practical dairyman, for transportation of milk to considerable distances. He gives the following as his practice: The vessels, as soon as emptied, are rinsed with warm water and sent back; and since they remain in this half-cleansed condition twenty-four hours, they often acquire a decidedly acid odor, which is, however, completely removed by first washing them out thoroughly with warm, not boiling, water, then rinsing them with about three pints of a solution of washing soda for every twenty vessels, by pouring it from one to another. They are then placed, mouth downward, on a shelf in the open air until the next morning; and, shortly before using, they are again rinsed with cold water.—8 *C*, *October* 3, 1872, 324.

ACETATE OF SODA FOR PRESERVING FOOD.

A new process for preserving alimentary substances has lately been communicated to the Academy of Sciences of Paris, the essential feature of which consists in the use of acetate of soda instead of the common salt ordinarily employed. The substance to be preserved is to be placed in a barrel, with layers of the acetate of soda interposed in the proportion of one fourth, by weight; and in winter the temperature must be at least 68° Fahr. After twenty-four hours, the barrel must be turned, and in forty-eight hours the operation is completed; the salt having then absorbed the water of the meat, which may be kept in the pickle or dried in the air. Any vacant spaces in the barrel, after heading up, are to be filled with brine, of one part of the soda salt to three of water. The old pickle may be evaporated to half of the original bulk employed, and recovered for subsequent use.

For cooking, the meat thus prepared is to be soaked from twelve to twenty-four hours in tepid water containing one hundred and fifty grains of sal ammoniac to the quart. This salt decomposes the acetate of soda in the meat, forming common salt, and an ammoniacal acetate which causes the meat to swell, and restores to it the odor of fresh meat. It is claimed by the author of this process that, by simply removing the intestines, animals may be readily preserved whole. Fish, poultry, and game have been so treated. After salting, meat may be dried in the stove, losing thereby one fourth in weight. Fish can not be subjected to this operation of drying. Vegetables may be treated by this process, but before salting they should be heated until they lose their rigidity. In twenty-four hours they may be pressed, and dried in the air. When used, they must be steeped twelve hours in fresh water.

A necessary condition of the employment of this process is the keeping of the food thus prepared perfectly dry, as the salt is hygrometric, and absorbs moisture from the atmosphere.—3 *A*, *August* 3, 1872, 79.

NEW PROCESS FOR PRESERVING MEAT.

According to the London *Athenæum*, Mr. Mariotta has lately been calling attention to a new process for preserving meat fresh. This consists in dipping the fresh meat into melted butter and then packing it in salt. The examination of the specimens furnished by him is said to have been quite satisfactory; but, in the opinion of the *Athenæum*, it does not differ essentially from that of dipping the meat in paraffine, which answered for a temperate climate, but failed in a tropical region.—15 *A*, *December* 21, 1872, 1834.

PRESERVATION OF FOOD BY COLD.

A hint at what may possibly become an important method of preserving animal and vegetable substances for an indefinite length of time, without subjecting them, as at present, to the action of heat, and thereby materially affecting their texture and taste, is furnished by Boussingault to the Academy of Sciences of Paris. In a recent communication to that body, he states that, as long ago as 1865, he exposed beef bouillon in hermetically sealed vessels to the action of a freezing mixture at a temperature of 40° Fahr., keeping the same immersed in the mixture for several hours. On opening these vessels, quite lately, he found that the contents had undergone no change, and were precisely as before being submitted to the cold.

The juice of sugar-cane, exposed in a closed vessel to a similar degree of cold, was also preserved from any alteration. Boussingault refers in his article to the fact, well known to geologists, that a low temperature, continued for ages, prevents the decomposition of muscular fibre, instancing the fact of the discovery in 1804, at the mouth of the Lena River, in Siberia, of an elephant buried in the ice, which was so well preserved as to serve as food for the dogs of the native tribes.—6 *B*, *January* 27, 1873, 189.

RAPID PICKLING OF MEAT.

Roll the meat in a mixture of sixteen ounces salt, half ounce saltpeter, and one ounce sugar, so that all parts may be completely salted; then wrap closely in a piece of cotton cloth previously well scalded and dried, and place in a porcelain or other vessel. The cloth is essential with small pieces, to retain the brine formed in contact with the meat. After about sixteen hours, however, some brine will drain off into the bottom of the vessel, and it will be necessary then to turn the meat, still wrapped up, daily. A piece of six pounds, treated in this way for six days, then unwrapped and boiled, will be found quite palatable and sufficiently pickled. For larger quantities the cloth may be dispensed with, since the brine formed will be sufficient to cover the mass, provided the pieces are closely packed, and any unavoidable cavities filled with stones.—9 *C*, *December*, 1872, 180.

ENDEMANN PROCESS OF PRESERVING MEAT.

According to Dr. Endemann, an excellent method of preserving meat consists in cutting it into thin slices, and drying in a current of warm air not exceeding 140° Fahr. The operation should be completed in three or four hours, in which case the product is hard, and may be easily ground up in a mill, when it is in a condition fit for use. The fibrine and albumen are not coagulated, and consequently are still able to take up water, and thus expand to their natural condition. The meat powder prepared in this way has a light brownish-yellow color, a slight smell like that of roast beef, and a very pleasant taste. For making soup, two ounces are to be boiled, with the usual ingredients, in sixteen ounces of water. Such soup is much stronger than when prepared with half a pound of fresh uncut meat, as the latter does not give out its extractive material so completely after any amount of boiling.

Half a pound of this powder, if stirred into the proper quantity of water, with the addition of an egg, may be treated exactly as if it were the best fresh meat; and the fact that the fibrine and albumen in this meat powder are not coagulated renders it a valuable substance in cases of weakness, where stimulating food is required, as it is more easily digested than raw meat, while, on account of its minute subdivision, the action of the stomach is facilitated.—5 *C*, 1873, II., 15.

PREPARATION OF MEAT EXTRACT.

A new mode of preparing certain kinds of meat has lately been patented in Paris by M. Durand. This has more particular reference to the flesh of prawns, shrimps, and other delicate crustaceans, in regard to which, as is well known, much trouble is experienced in the picking out of the flesh from the external skeleton after boiling. The new method consists in placing the shrimps, while still alive, in a double metallic ring perforated with small holes, some coarse material being used as a filter. This ring is subjected to pressure, which squeezes the flesh out into a vessel placed below. This may be then mixed with the necessary seasoning, boiled, and dried by evaporation, so as to form a compact paste, which will keep for a long time, furnishing an excellent article of food. A similar process can be applied to the preparation of fish, the meat of which can be forced out, leaving the bones, scales, etc., behind. The flesh of both fish and crustaceans before cooking is very soft, and easily yields to the treatment indicated. This process might perhaps be applied to advantage in the case of shad and herrings, the bones of which constitute so great an objection to them as an article of food.—3 *B*, *May* 9, 1872, 94.

IMPROVED PREPARATION OF CURRANT JELLY.

A leading chemical journal in Paris does not disdain to give to the world a formula for the preparation of currant jelly "in the cold," which it considers to be a very great improvement over other methods, as it preserves entirely the natural taste of the fruit. For this purpose we take eleven pounds of white currants and a fourth or fifth part, by weight, of the red, according to the color desired, or the whole may be either red or white, as preferred. If the flavor is liked, one pound of raspberries may be added. The currants are to be stripped from the stems, and the raspberries carefully picked over, those recently gathered being the best. The fruit is to be mashed, and the juice squeezed out, either through a cloth, or, still better, by means of a small press.

The juice thus obtained is placed in an earthen vessel, and deposited in a cool place or in a cellar, when fermentation will sooner or later take place. At the end of about twenty-four hours all the froth produced by the fermentation, which will cover the whole surface, is to be removed, and the juice to be strained by means of a flannel bag or filtering-paper. The juice is then to be weighed, and an equal weight of finely powdered white sugar to be added. If raspberries are used, the quantity of sugar is to be reduced one tenth. The juice and sugar are to be carefully mixed, and then placed in jars. At the expiration of twenty-four hours a jelly of perfect transparency will be formed, which can be preserved for a long time by simply covering it as with ordinary jellies and preserves. It should, however, be protected from the action of moisture.—9 *B*, 1872, XLIV., 25.

PROPRIETY OF WASHING BUTTER.

In reference to the preparation of good table butter, Dr. Wilkens Pogarth remarks that there is a rather common belief that the process of washing injures its peculiar fine flavor, and renders the butter more perishable. The former part of the proposition Dr. Pogarth admits; yet, thinking the use of fresh water indispensable for removing the milk and hardening the butter, he recommends its application directly in the churn, avoiding working and kneading by hand or spatula.

Butter which keeps well is made in Holstein, by repeated salting and heavy pressure, without the use of water; but it is too salt to be considered fine table butter.—8 *C*, 1872, XXVI., 205.

IMPROVEMENT OF RANCID BUTTER.

According to *Land and Water*, rancid butter can be greatly improved in quality by washing it thoroughly in lime-water, and then clearing out the lime-water by a good washing in cold spring water. The lime-water is easily made by allowing a lump of lime the size of the fist to slake in a bucket of water, stirring it well, and afterward allowing the lime to settle. It is said that a large business is now done in England by sundry persons, who purchase rancid butter at low rates and sell it again at much higher prices, after manipulating it in the manner mentioned.—2 *A*, *December* 14, 1872, 387.

TEMPERATURE OF THE AIR IN MAKING BUTTER.

Recent experiments indicate that the best temperature of the air, as well as of the cream, for the rapid churning of butter, is from 54° to 59°, instead of the average of 66°, as generally taken. A cellar, with the temperature regulated by means of a thermometer, seems most suitable for the purpose, especially in summer.—8 *C*, *January* 23, 1873, 29.

SHIPPING BUTTER IN SEALED CANS.

For many years butter has been sent from Copenhagen to all parts of Europe in hermetically sealed tin cans. Although the business was commenced originally as an experiment, it has expanded to such a degree that during the last two years it has occupied several of the largest butter dealers of Copenhagen. The object of packing the butter in this manner is to protect it against the action of air and heat, and this is so completely attained that butter has been sent from Copenhagen to China and back again, without the slightest detriment to its edible qualities. The principal places of demand are China, Brazil, Java, Spain, and other countries, generally through London or Liverpool houses. The packages vary in size up to twenty-eight pounds, although those of four pounds are generally preferred. The cans are lined inside with wood, saturated with salt pickle, and when filled are soldered up. This treatment is thought to exert a very important influence in the preservation of the butter.—14 *C*, CCV., 279.

PRESERVATION OF RED WINE BY PASTEUR'S METHOD.

In the case of German red wine, treated according to Pasteur's method, by heating in corked bottles, in a water-bath, for half an hour, at 140° to 150° Fahr., Professor Neubauer has found (according to the judgment of connoisseurs, as well as his own) that after the lapse of a month they are superior, in all respects, to the same wine which had not been subjected to this process; and he states, as a result of more exhaustive experiments, that, while French, German, and Austrian red wines lose nothing in quality by this treatment, they acquire a most remarkable freedom from liability to deterioration. His experience with white (or bouquet) wine has been too limited for any opinion on his part; but he says that Dr. Buhl, of Deidesheim, has been in the habit for years of warming the finest bouquet wines, and has been able in this way to bring into market high-priced wines in less time than usual. His wines have not only endured transport to Egypt, but, after months of exposure to that climate, have been found excellent. He attributes the marked inferiority in color of German red wines, as compared with those of France and Austria, to incipient putrefaction of the coloring matter of the grapes, owing to the lateness of the time of gathering them.—13 *C*, *December* 1, 1872, 1568.

PREVENTION OF ACIDIFICATION IN BEER.

The commercial sulphite of lime, or, more properly, acid sulphite of lime, has proved effective in preventing the souring of beer, by the addition, when the cask is half filled, of one part of a solution of it, of specific gravity 1.06, to every 1000 parts of beer the cask is to contain. Acidification of wort, in the earlier stages, can also be checked by it, but the acid already formed can not be removed by it.—6 *C*, *November* 7, 1873, 448.

BEER MADE WITHOUT HOPS.

A so-called "Red Beer" is manufactured in a North German brewery without the use of hops, which is said to be of remarkable excellence. It flows thick and oily, like Burgundy, possesses an odor and bouquet between Rhenish wine and Burgundy, and the flavor of strong port, except that it is more spicy. It contains 7.2 per cent. alcohol and 4.2 per cent. extractive matter. From a very brief statement of the method of preparation, it seems that well-germinated, air-dried malt is exclusively used, which is crushed between rollers, mixed with cold water, and, by the addition of boiling water, gradually raised to 144° Fahr., and mashed four hours. The wort is run into the brewing kettle with twelve per cent. of dried mallows, instead of hops, until the color of red wine is imparted, and then tannin carefully added, not much being required, as the mallows have a clarifying and coloring action. It soon becomes clear in the coolers, and at 59° Fahr. is brought into the fermenting vat with the ferment, prepared twenty-four hours before by mashing a wort of air-dried malt and yeast, with a very small addition of tartaric acid. After thirty-six hours of active top-fermentation, the beer can be run into vessels in the lager cellars at 43° and 45° Fahr. To every eighteen gallons next add a solution of one and a half ounces of the best glycerine in one and three quarter pints of red wine, one tenth as much pure Cognac brandy, and a few drops of oil of orange flowers. The casks must be opened for a short time every two days, and, when perfectly clear, the beer is to be bottled, corked, and tied, and gradually heated, in water, to 122° Fahr., after which it will keep for any length of time.—9 *C, October*, 1872, 148.

PURIFICATION OF TALLOW FOR CULINARY PURPOSES.

During the siege of Paris, Casthelaz was led to experiment upon the purification of tallow from the foreign ingredients that render it unfit for culinary purposes, and he recommends the following process for removing its unpleasant rancid odor, and leaving only a slight fatty smell, which vanishes on using it. One hundred parts of tallow are first placed in one hundred parts of boiling water, so that it may melt. A solution of four parts of crystallized carbonate of soda in twenty parts of water is then added, and the mixture stirred, its temperature being kept above the melting-point of tallow, until a complete emulsion of the tallow is formed, when it is heated to boiling, and, under continued stirring, four hundred parts of water are added. After settling, the aqueous liquid is drawn off from beneath, the tallow collected, and again made into an emulsion with one hundred parts of water, and then washed with four hundred parts of boiling water to remove any carbonate of soda it may retain. The better kinds of tallow require treatment in this way twice, others three times; for the second treatment a two to four per cent. solution of the carbonate of soda is employed; at the third, a two to three per cent. solution. It is afterward simply washed with water, or water with the addition of one per cent. hydrochloric acid, and then with pure water. All the washings must be made with boiling water, and the mixture must be kept boiling for one-quarter to one-half hour, in order to expel volatile impurities. It is best to use distilled water, or at least water that has been freed from lime by carbonate of soda, to avoid the formation of a lime soap. The fatty acids are contained, mainly, in the first carbonate of soda liquid, and can be utilized for soap, stearine, etc. On a large scale, the boiling can be effected in wooden vessels by steam pipes.—13 *C*, *October* 1, 1872, 1300.

ACTION OF MICROZYMES ON MILK, ETC.

Béchamp some years ago announced to the world the discovery, on his part, of certain organic bodies, called by him Microzymes, and existing, as living organisms, among other conditions, in immense numbers in chalk, where, of course, they must have remained since the cretaceous period. Referring again to their bodies, he has lately called attention to their influence upon spontaneous coagulation, as also to the normal production of alcohol and acetic acid in milk. He maintains that the microzymes, of whatever origin, whether from the chalk or other calcareous formation, the atmosphere, the dust of the streets, or from animals or vegetables, all possess the power of forming alcohol and acetic acid, not only with glucogenous matters, but also with substances incapable of being converted into ordinary sugar, such as tartaric, citric, muric, and lactic acids, etc. In ripening and rotting fruits, it is the same agent which produces the alcohol and acetic acid that are so specially manifested. He refers, in conclusion, to the hypothesis of Liebig in regard to the alterability of albuminoid substances in the phenomena of fermentation. Béchamp, in opposition, affirms that in the fermentation of eggs the albuminoid substances remain unaltered; and he is prepared to show that in the souring of milk the caseine and other albuminoid substances remain undisturbed and with all their essential properties. He has been able to determine a rotatory property in caseine, fourfold that of pure albumen.—6 *B*, *March* 31, 1873, 838.

EFFECT OF SUNLIGHT ON FLOUR.

It is maintained that the inferior quality of certain kinds of wheat and rye flour is frequently due to the action of sunlight on the flour; even when in bags or barrels, the gluten experiences a change similar to that occasioned by heating in the mill. The tendency thus imparted to it, to become lumpy, and to form dough without toughness, is similar to that of flour from moist grain, or of flour when it is too fresh, or made from grain ground too early, or when adulterated with cheaper barley meal. Such flour can be improved by keeping for some weeks.—10 *C*, *February* 1, 1873, 30.

TO PREPARE EELS FOR COOKING.

By pouring a mixture of vinegar and salt over eels, in a suitable vessel, they are not only instantly killed, but, if allowed to remain in the liquid for a short time, the skin gelatinizes; and if cooked in this condition they are better flavored than when skinned. The skin can readily be removed at the table by any one not desiring to eat it.—10 *C*, *September*, 1872, 140.

ADULTERATION OF MILK.

According to Mr. J. Alfred Wanklyn, the most common modes of adulteration of milk consist in removing the cream in greater or less quantity, and in adding water; and consequently the testing of milk resolves itself essentially into the detection of the skimming and watering, and the measuring of the extent to which these operations have been carried. For this purpose, he finds it most satisfactory first to estimate accurately the normal composition of milk, or at least the average limits of variation in this respect, and then to find out what deviation from this average is presented by any given sample.

The result of many inquiries on his part is to show that the solids left by evaporation of cow's milk vary comparatively little, in different animals or in different seasons, and he thinks that a range of from 11.5 to 12 per cent. expresses about the average amount of these solids.—1 *A*, *October* 18, 1872, 187.

HARDENING OF DRIED PEASE IN BOILING.

While some pease become soft in boiling, others become horny and hard, and it has been a question whether this is due to the pease or to the water. Professor Ritthausen examined two samples of pease, one said to become soft on boiling, the other hard, and on boiling them in distilled water found these characters substantiated. The analysis of their ashes gave:

	Soft.		Hard.	
Phosphate of lime........	10.77	18.91	10.41	26.96
Phosphate of magnesia...	8.14		16.55	
Phosphate of potassa.....	59.74		37.43	
Sulphate of potassa.......	8.10		14.80	
Chloride of potassium....	4.72		6.23	
Potash...................	——		11.47	
Phosphoric acid..........	4.43		——	

From this we see that the soft-boiling pease contain a considerably greater amount of phosphate of potassa, smaller percentage of phosphatic earths, and more phosphoric acid than the other kind, which, for their part, are richer in the earth-phosphates, poorer in other phosphoric compounds, and contain an excess of potash.

In the action of water on those pease poor in phosphoric acid, that harden on boiling, the legumine, which is present in large quantity, although partially combined with the excess of potash, has also its function. It is decomposed with the separation of a compound of lime or magnesia, which becomes horny on heating, and brings about the hardening referred to. Cold water extracts from the meal of those pease that boil soft 4.24 per cent. of soluble legumine, while from the hard-boiling kinds only 1.73 per cent. can be derived. The difference in the amounts of nitrogen and sulphur was so slight that the hardening could not be ascribed either to a larger amount of albumen or of sulphuric acid. Some kinds of pease, however, represented as hardening on boiling, softened when boiled in distilled water; and analysis of their ashes gave nearly the same results as with those of the other character.—13 *C, January* 15, 1873, 142.

THE CUTTLE-FISH AS AN ARTICLE OF FOOD.

According to Mr. Simmons, the flesh of the large species of cuttle-fish was esteemed a great delicacy by the ancients; and at the present time the natives of the Polynesian Islands regard it with great favor as food. These fish are frequently met with throughout India and China, dried, and offered for sale. In Chili they are also considered a delicacy, and in Barbadoes a species of loligo is often eaten. Mr. Simmons, however, considers the flesh as tough, indigestible, innutritious, and uninviting. He further states that there is an extensive trade in a species of octopod in the waters of Tunis, and that they are consumed largely during Lent, as coming under the canonical head of fish. Three or four thousand hundred weight are generally marketed for this purpose.

They are taken in deep water by means of earthen jars, strung together and lowered to the bottom of the sea, where they are allowed to remain for a certain number of hours, during which the cuttle-fish enter into them. Sometimes as many as eight or ten are taken from every jar at each visit of the fishermen. In shallow water, earthen drain-pipes are placed side by side, for a distance frequently exceeding half a mile, and the cuttle-fish go into these, and are thus captured. In some localities the most successful method consists in constructing brush weirs, in which the octopods are inclosed by the falling tide.—17 *A, September* 1, 1872, 327.

DETECTION OF ADULTERATION OF COFFEE.

When burned grain, or any other substance containing starch, has been substituted for coffee, a dilute solution of caustic potash, shaken with a small quantity of the powder, filtered, and further diluted, yields, with a solution of iodine, the characteristic blue starch reaction.—13 *C, December* 15, 1872, 1628.

PROPER COMBINATIONS IN SOAPS.

According to Mignot, a perfect soap is one in which the fatty matters and the alkaline have been so thoroughly combined as to leave no excess of either component; a desideratum which is very seldom reached, as the soap is either too alkaline, in which case it parches and dries up the skin, or it is too fat, and thus makes the skin greasy, so that the dust readily adheres to it. The former inconvenience is the more serious of the two, as it very soon leaves its impress upon the skin. For this reason soap-makers are in the habit of employing an excess of fat, notwithstanding the inconvenience mentioned. Mignot now informs us that silica introduced into the soap, in the form of infusorial earth, will tend to neutralize any excess of the alkaline elements of the soap, as it is soluble both in soda and in potash, and it will at the same time take up the surplus of fatty matter by absorbing it, and combining with it to a certain extent. Infusorial earth, as is well known, occurs in different parts of the world in great quantity, and immense deposits are known in various portions of the United States, especially in Idaho, Nevada, and California.—3 *B*, *March* 6, 1873, 414.

PATENT WAGON LUBRICANTS.

A resin-lime soap, prepared by stirring eighty pounds of dry-slaked lime into one hundred pounds of rosin-oil, and heating, with continued stirring, until a pasty mass, free from lumps, is formed, which finally runs from the stirrer like sirup, is a principal ingredient of different forms of patent axle grease. Some of these are prepared as follows: Blue, by boiling five hundred pounds of crude rosin-oil one hour with two pounds of dry-slaked lime, allowing it to cool, drawing off the oil from the sediment, and stirring into it, while still warm, ten to twelve pounds of the above soap, until a blue mass of the consistency of butter is obtained. Yellow, by adding to this six per cent. of an extract of turmeric, prepared by boiling one part of turmeric with twenty of soda-lye. Black, by adding two pounds of lamp-black, rubbed up with rosin-oil, to one hundred pounds of the blue mass. Patent palm-oil lubricant is made by melting and stirring together ten pounds of the resin-soap and ten pounds of palm-oil, and then mixing in five hundred pounds of rosin-oil, and enough soap (two to three pounds) to give the consistency of butter; and, finally, seven to eight pounds of soda-lye, obtained from seventy pounds of calcined carbonate of soda, two hundred pounds of water, and thirty-five pounds of lime, as milk of lime. The cheap, thick, residual oils, from the manufacture of paraffine, can be improved as lubricants by thickening them, by melting them with lead-soap. Mixtures of petroleum, rosin-oil, and resin-soap are frequently used as lubricants, as well as glycerine.—18 *C, January* 29, 1873, 79.

FILTER OF SPUN GLASS.

According to Weiskopf, a filter, giving very clean filtrates with great rapidity, may be made by felting extremely fine filaments of spun glass, and employing them in the same manner as asbestos.

KEEPING LEATHER HARNESS PLIABLE.

It is well known that leather articles kept in stables soon become brittle in consequence of ammoniacal exhalations, which affect both harness hanging up in such localities and the shoes of those who frequent them. The usual applications of grease are not always sufficient to meet this difficulty; but it is said that by adding to them a small quantity of glycerine the leather will be kept continually in a soft and pliable condition.—13 *C, September* 15, 1872, 1239.

PITCHING COMPOUND FOR WOODEN VESSELS.

The following preparation has been patented by Werner, of Mannheim: Two and a half pounds of the best Courie copal is washed, powdered, dried on copper gauze or galvanized sheet-iron, and dissolved in one and a half pounds of concentrated sulphuric ether, and then diluted with ten pounds of rectified alcohol. The solution is then mixed with fifty pounds of alcohol, ten and a half pounds of seed lac, one third of a pound of spermaceti, a quarter of a pound of glycerine, a quarter of a pound of wax, and one pound of Venetian turpentine, and distilled in an apparatus having a worm.—6 *C, October* 31, 1872, 438.

HAIR ERADICATOR.

Professor Böttger recommends hydrated sulphuret of sodium as an extremely efficient and perfectly inodorous hair eradicator, and as being much more effective in this respect than hydrated sulphuret of calcium, previously recommended by him. The new extract is readily obtained by rubbing to a very fine powder one part, by weight, of crystallized sulpho-hydrate of sodium with three parts of fine prepared chalk. This mixture is to be kept in well-closed bottles until needed for use, when a small portion of it is made into a thick paste with a few drops of water, and applied by means of the back of a knife to the spot coated with hair. In a very few moments the thickest hair will be converted into a soft mass, and can be easily removed from the skin by washing. Care must be taken not to keep the substance too long on the skin, as it would corrode it.—14 *C*, CCV., 492.

MATCHES WITHOUT SULPHUR.

According to a method patented in France, non-explosive, non-hygroscopic matches may be made by impregnating the wood with a hot solution of a fatty material. The inflammable compound consists of phosphorus, 7; gum, 7; nitrate of lead, 40; glass powder, 5; water, 10 parts.—14 *C*, CCVII., 1873, 341.

GAS MANUFACTURE BY EVELEIGH'S PROCESS.

Exhaustive experiments have been made by Professors Odling and Keates with this process, which consists in distilling the coal at a low temperature, and redistilling the tar obtained; thus, it is claimed, obtaining more and better gas from a given weight of coal. They found no better quantitative, but a better qualitative production by the process, with entire absence, however, of the tar, as an accessory product. More fuel was also required than by the ordinary process, and, since the gas is given off more slowly, the outlay of capital in the works, as well as the running expenses, must be greater, and the increase in quality is no offset to these increased expenses.—14 *C*, CCVIII., 1873, 155.

THE NEW HYDROCARBON GAS.

Experiments have recently been made in England on the illuminating powers of a new hydrocarbon gas, produced by what is known as Mr. Ruck's process. The heating gas is almost pure hydrogen, obtained by passing steam through a horseshoe-shaped tube that goes through the red heat of a coke furnace. In this state the gas used for all purposes where heat without light is required—as, for instance, for gas stoves of whatever kind, or for boiling water and generating steam. When required to be used for lighting purposes, this heating gas is made to bubble through a reservoir containing rectified petroleum, of a specific gravity of about 0.68. It then passes at once into the pipes for circulation and consumption, and issues from these burners a very excellent gas, equal in illuminating power to sixteen and a half candles, with a consumption of five cubic feet an hour in an Argand burner. The experiments on the power of this gas for both heating and lighting purposes are said to have been thoroughly satisfactory, and the cost to be very much less than that of coal gas, even when the price of coals is much less than the very high rate which has prevailed in England during the last six months.

FLAME OF COMPRESSED GAS.

According to a communication of F. Benavides, a jet of ordinary illuminating gas, issuing under pressure through a slightly opened stop-cock, gives a flame of greater brilliancy than those of the street lamps, of only a few inches' water pressure. When the cock is opened wider the velocity of efflux increases, air is carried along with the gas, the combustion becomes more energetic, and the illumination feebler, or disappearing entirely, while the temperature is considerably elevated, as in the Bunsen burner. If the pressure and velocity, as well as the amount of escaping gas, are great, the flame only appears at a certain distance from the orifice, the dimensions of the dark space between it and the orifice being dependent on the pressure and the quantity of escaping gas. Under a pressure of two atmospheres, this distance is about one and a half inches, with a flame about fifteen and a half inches in length, 1.2 inches wide at the beginning, and about four inches wide at the end. The temperature of the dark space is very low, as shown by the slow rise of a thermometer placed in it; probably due to radiation from the flame. If a metallic wire is introduced into the dark space, and brought in contact with the flame, and then back into the dark space, the flame will follow it, and the dark space may be obliterated, but will re-appear on removal of the wire. A candle brought near to it, will show the aspiratory power of the flame. With a very narrow burner, and great velocity, no flame can be produced. The spectrum, with compressed gas, is discontinuous, showing five bright lines; with slow efflux, the spectrum is continuous; in the first case the combustion being more complete, and in the latter there being more unconsumed solid carbon. These observations, the author thinks, should be taken into account in lighting cities with great difference of level (as in Lisbon, where it amounts to over 300 feet), the jets in the higher portions approximating those of compressed gas in character; and in order to produce the same illumination as in the lower portions, from the same gasometer, the cocks should be less widely opened.—14 *C*, CCVIII., 1873, 156.

RELATION OF THE AIR TO CLOTHING AND SOIL.

The following statements of general interest are specially reliable, being contained in a lecture by Professor Pettenkofer, of Munich, who is known as high authority on such subjects: Although the warmth of the body is the result of respiration, it is a singular fact that the normal temperature of the blood of the African is the same as that of the Esquimau, or about 99½°, while the air surrounding them, and inhaled by them, may differ as much as 180° in temperature; neither does this temperature vary, in a state of health, more than two degrees, though the temperature of the air may vary 72°. The heat generated by the human body in twenty-four hours is sufficient to raise thirty quarts of cold water to the boiling-point; and of this the regular processes of nutrition require only a definite part, and the larger portion must be given off through radiation, evaporation, or conduction. When heat is lost by radiation, as in sitting near a cold window, or other cold object, the impression of a draught may be created, although the air be perfectly calm, heat being simply given up to the colder object. Thus, while the temperature of a room may remain constant, different sensations may be experienced, dependent on the surrounding objects. A much larger amount of the superfluous heat is lost by evaporation; and during severe exercise, when more heat is developed, evaporation is also more rapid, and the normal temperature of the blood restored. A "cold" is caught when the evaporation is too rapid. But little heat is lost by conduction. The particles of air in contact with the body become warm, and are replaced by colder ones, creating a current, which is insensible, because of less velocity than three feet per second. In better conductors cooling takes place more rapidly, water of 61° seeming much colder than air of 61°. These three modes of cooling, however, supplement each other, and act together. Thus a current of warm air cools more rapidly than calm cooler air, not only by reason of renewal of the air, but by favoring evaporation.

The chief object of clothing is to surround the body artificially with a warm climate, poor conductors being consequently selected. The cooling process is, however, simply checked by the clothing. Even the thinnest, finest fabric, as a veil, diminishes loss by radiation. But the inclosure of air is especially effective, and consequently garments of porous heavy material are warmer than those which are more compact. Felt shoes, permeable to air, are warmer than those made of leather or India rubber, while the latter soon become unendurable because of checked ventilation. The more hygroscopic the material, the colder the clothing, because it is a better conductor when moist. Linen and silk are for this reason colder than wool, and also because the latter retains its elasticity when moist, and keeps the air within its pores. And our bed, which is, in fact, our sleeping garment, is of special interest. It must be warmer than our waking clothing, since less heat is developed during sleep. Consequently, loss of sleep is very exhausting. The feather bed possesses in the highest degree feeble conducting power, elasticity, and permeability to air; but, if too thick or soft, resembles more an air-tight garment. The house, too, may be regarded as an extended piece of clothing, so gradual is the transition from bodily garments to it (the step from the wide garment of the Arab to his felt tent being a small one); and, in hygienic functions, they agree precisely in regulating our relations with the surrounding air. The ease with which a current of air may be blown through a brick, pieces of mortar, wood, etc., by glass tubes cemented to opposite sides, and the passage of water (so much denser) through these substances, show how imperfectly our walls, of whatever material, and however thick, exclude the air from us. We do not perceive the free passage of air through them because the current is too slow.

In providing ventilation for the hospital Lariboisière, in 1856, 700 cubic feet of fresh air per hour were considered insufficient for one person; and, at considerable expense, the apparatus was adapted to provide 1400 instead, with entirely unsatisfactory results, 2100 cubic feet being necessary for an adult, according to the investigations of the lecturer, and in hospitals much more, even as high as 5250 feet. Such change of air may be effected by difference of temperature or mechanical currents, the extent being dependent upon the size of the openings, crevices of windows, doors, etc. Most exhaustive investigations made by Pettenkofer showed that with a difference of 34° between the external and internal air of a room of 1895 cubic feet capacity, the air was entirely renewed in one hour, and more rapidly with increased difference of temperature; but by carefully pasting up the crevices it can be reduced to one third the amount. It is especially fortunate, therefore, for the poorer classes, that rooms can not be made air-tight, since want of warmth is less injurious than continued breathing of vitiated air. A stove, under favorable circumstances, will introduce 3150 cubic feet of fresh air per hour. Furnishing fuel to the poor in winter is equivalent to furnishing fresh air as well. The results of investigations, by Merker and Schultze, of the air of stables were precisely similar to the preceding. The nature, especially the thickness, of the wall in all cases causes variation in the amount of fresh air; and it also appears that the air of small rooms with few inmates is purer than that of large rooms with many. Ventilation is often neglected because of its inseparable association in the minds of many with draught, while in reality it need only be the proper renewal of the air of closed rooms by currents of insensible velocity. A draught, on the other hand, is the cooling of a limited portion of the body, either by stronger currents of air or by radiation, as to a cold wall, for example, from which a cold current of air then seems to reach the body. In the open air much stronger currents do not suggest a draught. Cooling but one side of the body disturbs the functions of the vasomotor nerves, not subject to our control, and they at once begin to act as if the whole body were cooled instead of but a part, and the decided change in the circulation of the blood becomes dangerous by its suddenness, just as when a cold drink is taken. While the permeability of the earth to water is generally noticed, the penetration of air to a great depth is overlooked, and also the fact that this stratum of the aerial ocean has its slow insensible currents, just as that in the walls of buildings, in clothing, etc. A bird in a glass vessel closed with a layer of earth can live for hours; a current of air can easily be blown through a tube a yard long filled with earth, etc. This air in the earth can be put in motion by differences of temperature as well as by currents of air. Thus the odor of gas has been found in houses without gas-pipes, and persons have been injured by it, the gas being drawn from very distant defective pipes in the winter by differences of temperature, since when the room was not heated the odor disappeared, and was found in an adjoining heated room. It seems, therefore, that the frozen earth was also penetrable to the gas. This movement of air in the soil renders animal life, though of a low type, possible at great depths; and to this life must be ascribed the excess of carbonic acid in the air of the soil, and, at times, its noxious properties. Accurate investigations show that the air in the soil of Dresden contains twice as much carbonic acid as that of Munich. This is a subject that demands more attention, on account of its hygienic relations, than it has received. A careless neighbor can render the air of the soil impure as well as its water, and thus contribute to disease.—8 *C*, *May* 15, 1873, 135, 143, 160.

CHEAP SUBSTITUTE FOR DOUBLE WINDOWS.

It is suggested by Dr. Oidtmann, in a pamphlet on the care of health, simply to add a second set of panes of glass, set in an inner rabbet, to a single sash, and thus inclose a stratum of dry air, about 0.2 to 0.4 of an inch thick. The excess of cost, it is said, will be more than covered by the economy of fuel in winter; and at 90°, in summer, a room thus protected will remain nine degrees cooler than when supplied with ordinary windows. The plan is also advantageous for hot-beds, etc. A good hard quality of glass, that does not become dull by decomposition, must be selected, especially for a southern exposure, since the interior faces can not be cleaned. It is necessary also not only that the glass should be perfectly polished, and not be soiled in putting it in, but, since the air inclosed ought to be dry, the glazing should be done when the air is in the best condition in that respect. Ice crystals, of course, never form on such windows. —34 *C*, *April* 1, 1873, 76.

CONICAL WASTE-PIPES.

It is found that freezing of the waste-pipes of kitchen sinks, etc., may be prevented by making them tapering toward the tap, so that any thin ice that may form on them may fall away by slight change of temperature, and complete stoppage can not take place even in continuous cold weather. Pipes about twenty-six feet long, about three inches wide at the top, and from 5.9 to 6.3 inches at the bottom, have proved very efficient, and cost little more than the usual cylindrical ones.—13 *C*, *March* 15, 1873, 395.

REMOVAL OF INK SPOTS FROM COLORED FABRICS.

A solution of pyrophosphate of soda, it is said, will quickly remove fresh ink stains (old ones less so), without affecting the colors of the fabric, as is the result when oxalic acid, chloride of lime, and chlorine water are made use of.—15 *C*, XIII., 1872.

RENDERING FOWLS TENDER.

It is stated, on the authority of a German cook, that turkeys and other fowls can be rendered unusually tender, if a glass of rum be poured into them an hour before killing, even if they are roasted immediately after being killed. — 9 *C*, *March*, 1873, 43.

GLUE FOR PARCHMENT PAPER IN MAKING SAUSAGE SKINS.

The secret of the composition of the glue employed for fastening the parchment paper of the artificial skins for sausages, and which resists boiling water and all forms of moisture, seems to be well kept; but the one indicated by Dr. Stinde, in the *Photographisches Archiv*, is claimed to be equal to it in all respects, if not indeed identical. Add to one quart of a good adhesive solution of gelatine or glue 370 to 440 grains of finely powdered bichromate of potash. Warm the mixture slightly on a water-bath when about to use it, and before applying it moisten the parchment paper. The latter, when glued with this preparation, as in the formation of the small cylinders for sausages, must be rapidly dried on a hurdle, and then exposed to the light until the yellow glue becomes brownish. These cylinders are then slowly boiled in a sufficient quantity of water, to which two or three per cent. of alum has been added, until all the chromate is dissolved out; and they are then washed in cold water and dried, and will look very inviting, if white gelatine has been used. Professor Böttger informs us that a similar result may be reached by using a concentrated solution of cellulose in ammoniacal oxide of copper. Thus, if cylinders of unsized paper (as stout Swedish filtering paper) are formed with this paste, and when thoroughly dry are drawn through a parchmentizing solution (viz., a cooled mixture of two volumes of fuming sulphuric acid and one volume of water), they will be beautifully parchmentized, and after the neutralization of the acid, washing, etc., will present a striking resemblance to natural intestines.—15 *C*, 1873, IV., 56.

COMPARATIVE ADVANTAGES OF CONDENSED MILK.

A first-class notice is given by Mr. L. P. Mertain, in a paper lately read before the Society of Arts, in Paris, in reference to the comparative advantages of natural and condensed milk. The inconveniences of the former, according to this writer, are—first, that the quality is very uncertain, being frequently adulterated to a great degree; second, that its material is altered in the transfer from the producer to the consumer; third, if it is delivered fresh and sweet, it remains so only a limited time, since it is well known that milk alters from hour to hour: for children and sick persons it has not a regular and uniform nourishing quality; fourth, the milkmen trouble themselves very little as to whether their milk has been taken from healthy cows or not, and whether it is of good quality: a large portion, indeed, of that which is furnished in towns and cities coming from diseased animals; fifth, the uncertainty and the late period of the arrival of the milkman often interferes seriously with the breakfast of the family.

On the other hand, the advantages of condensed milk furnished by established companies are—first, that it is pure and of uniform quality; second, that it is condensed in the country near the place where it is taken, and is in no way changed by transportation; third, it does not become altered, but remains sweet for any length of time, even when the boxes are left open; fourth, for children as well as the infirm it constitutes a uniform and regular nutriment, which can be depended upon for days, weeks, and months; fifth, a reliable company will always exercise the greatest care in taking no milk except that which is of good quality and in good condition (it should be transported in packages hermetically sealed and in no way disturbed); sixth, the milk is always at hand at any hour of the day or night, ready for any domestic use.—3 *B, May* 15, 1873, 96.

ACETATE OF SODA AS A PRESERVATIVE.

Dr. Sacc, whose new process of preserving animal and vegetable substances has attracted considerable attention, has lately published a more detailed account, which may be of interest and importance to some of our readers. The method consists in the use of powdered acetate of soda, instead of common salt or other article, and is equally applicable to the preservation of both meat and vegetables. For keeping meat fresh, this is placed in a cask with layers of the powdered acetate of soda interposed, in the proportion of one fourth of the weight of the meat. In summer, the action is immediate; in winter, it is necessary to place the casks or barrels in a room heated to 58° Fahr. As the salt abstracts the water from the meat, at the end of twenty-four hours the cask is turned upside down, or the meat is overhauled; that which was above being now placed below. The operation is complete in about forty-eight hours, and the meat may then be packed up with its pickle, or it may be dried in the air. If the casks are not full, they may be filled up by a fresh pickle, made by dissolving one part of acetate of soda in three of water. When the pickle is drawn off from the meat, half the salt evaporates in crystals, and may be used again.

Meat thus treated is prepared for cooking by steeping for at least twelve and not more than twenty-four hours in tepid water (according to the size), to which 150 grains of sal ammoniac have been added. This salt decomposes the acetate of soda that remains in the meat, forming chloride of sodium or common salt and acetate of ammonia, which causes the meat to swell and assume the color and reaction of fresh meat. Meat thus prepared may be applied to every use to which it is fitted when fresh, while the bones supply in abundance a very palatable soup.

According to Dr. Sacc, animals may be preserved entire, for market purposes, in a pickle of acetate of soda; fish, chickens, ducks, etc., being particularly adapted to this treatment, the only precaution necessary being that of the removal of the intestines. Under the influence of the pickle the meat loses about one fourth of its weight, and another quarter disappears when dried. Cold-blooded animals may be readily dried in a stove. If the attempt be made to dry salmon and trout in this way, they lose their brilliant red color, and at the same time a reddish oil is found, which quickly drains away, leaving an insipid and fibrous mass.

The process is said to be very well adapted to the preservation of vegetables, which generally lose thereby five sixths of their weight. When needed for use, it is only necessary to soak them for twelve hours in water, and then cook them as if entirely fresh. It is necessary to scald the vegetables until they lose their stiffness before applying the acetate of soda. At the end of twenty-four hours their juices are drained or pressed out, and they are then dried in the air. Mushrooms can be readily kept by pouring upon them a pickle made with equal parts of acetate of soda and water, and just moistening them with it. The temperature should be kept at about 86° Fahr. for twenty-four hours. They are then to be removed, pressed, and dried, in which process they will lose, like other vegetable substances, about five sixths of their weight. To prepare potatoes in this way, as they are not readily penetrated by the pickle, they must be first steamed, and then treated. All articles of food prepared by this process should be kept in a dry place, as they would otherwise absorb moisture very quickly in a damp atmosphere.—11 *B*, *May* 15, 1873, 277.

TRADE IN PRESERVED OR CANNED MEATS.

According to Dr. Senfleben, the application of scientific principles to the preparation of canned meats was first suggested by Liebig, and his meat extract obtained a world-wide celebrity. This was, after all, however, only a substitute for meat, since it did not contain the fat, or the larger part of the albuminous matter of the meat, and it was still a problem to preserve these substances, with the compact form and structure of the meat. All attempts in this direction fall under one of three classes: 1. Simply drying the meat rapidly after cutting off the fat, this yielding a slightly nutritious, but indigestible product, absolutely worthless after a few months as nutriment. Henley improved the process by expressing the juice from the meat, and drying it at a lower temperature, by which its aroma was preserved, and evaporating the juice in vacuo. 2. Treatment with chemical, disinfecting, and absorbing agents, such as packing in charcoal, injecting with solutions of alum, chloride of aluminum, sulphite of soda, sulphurous acid, sugar, and saltpeter, immersing in a weak solution of carbolic acid, or strong acetic acid, or in a solution of bisulphite of lime; or, finally, by suffocating the animal (as suggested by Professor Gamgee) in carbonic oxide gas, and hanging it in a chamber with carbonic oxide and vessels filled with charcoal impregnated with sulphurous acid. None of these methods, however successful on a small scale, would furnish the trade with an article that would keep for years. 3. Prevention of putrefaction by cold or exclusion of air. As to the first, nothing less than freezing will answer; packing in ice not being perfectly effective, even for a few days, as in shipping from Texas to New Orleans. Besides, the latitude would render such free use of ice, on a large scale, out of the question. Exclusion of air, then, seems to afford the only practicable and effective method on a large scale. Two years ago, Tallerman, of Victoria, attempted the transportation of fresh meat to England in hot tallow without success; and the only successful method left, and that seems to have a future, is packing in tin cans, removing the air by boiling, and hermetically sealing them.

Already at least forty-three establishments, with millions of capital, are engaged in this business in Australia. Twenty-five years ago the first attempts were made, and, the discovery of gold absorbing the capital for a time, they were resumed in 1867. In Victoria there are eleven companies and five private establishments, which use up on an average daily, during the winter months, 1000 sheep and 50 cattle. Operations are carried on on a similar scale in the other colonies, the weekly export of preserved meat from Sydney averaging 150 tons. The cans have the names and trade-marks of the firms on their labels, as a protection against imitation and adulteration. The process—in all essentially the same—is about as follows: The best pieces of meat are selected, all the bones are removed; they are packed in cans of from two to eight pounds, which are then closed by soldering, except a small aperture in the lid; half immersed and heated about four hours in a chloride of calcium bath, with a boiling-point of 260° to 270°, until all vapor has been driven out. The aperture is then closed with solder, and after remaining half an hour longer in the bath, the cans are removed, painted with oil colors when cooled, labeled, and are then ready for market. The ends become concave by atmospheric pressure. The meat is generally well cooked, and parts readily in cutting in the direction of the fibres, retains all its nutritious matter, is rich in fat and gelatinous, coagulated meat essence, and can be used cold, cooked with vegetables, or gently roasted. Although not quite as palatable as perfectly fresh meat, it is more so than salt meat, and far more nutritious and digestible, and with proper care will keep in the cans for years. An indication of its uses is found in its introduction into English and French vessels of war as an article of diet two or three times a week, as well as generally into the commercial and passenger marine, and many private houses. The chloride of calcium bath has been replaced in some cases by superheated steam. Smoking meat (especially pork) before using, thus preserved, according to some, adds very much to its good qualities. An improvement, known as the Jones patent, and employed by Forbes & Co., of Aberdeen, consists in connecting the cans, while being heated, with a vacuum chamber, so as to render a lower temperature effective, thus preserving the delicacy of fish, fowl, game, etc. It is well to remember that only selected pieces of meat can be preserved in this way, and that a pound of it, therefore, contains more nutriment than an average pound of fresh meat. The reports of the Board of Trade already show that the traffic in this article is extensive and rapidly increasing, so that it is predicted that the importation from Australia into England will soon amount to 10,000 tons per week.—14 *C*, CCVII., 417.

PROTECTION AGAINST MOTHS.

Pfleider, a German inspector of passenger cars, states that a single stem of hemp, with the leaves and blossoms, mixed with the stuffing of a car seat, will protect it from moths for years, and that hemp for this purpose should be gathered just when in blossom, dried rapidly in the shade, and kept in covered wooden vessels in a dry place.—15 *C*, 1873, 29.

UTILIZATION OF OLD FISH PICKLE.

It would hardly be supposed that so apparently innocent a substance as old fish pickle would have any special medical or physiological properties. The fact is, however, that in the earliest ages it was believed to have important medicinal qualities; and quite recently it has been used to a very great extent in the manufacture of propylamine and methylamine (maintained to be distinct bodies by some, and simply different forms of the same substance by others), now so largely employed as a remedy in acute articular rheumatism. Recent experiments also show that a small quantity of this pickle administered to poultry produces fatal results; and in France it is quite common, where the premises are infested by a neighbor's poultry, to soak grain in this pickle, and when dry to throw it out where the intruders can take it; the result in most cases being their death in a short time.

The poisonous properties of the pickle are almost entirely destroyed by heating, this causing the propylamine, to which this peculiarity is supposed to be due, to volatilize. It is remarked by Meinière, who has written a memoir on the subject, that the pickle obtained from American hog's lard does not exhibit any poisonous character any more than that which comes from butter.—11 *B*, *July* 1, 1873, 348.

THEORY OF PRESERVATION OF ANIMAL SUBSTANCES.

Dr. Sacc gives the following as the result of an elaborate investigation into the subject of the preservation of animal substances: That organic bodies are liable to spontaneous decomposition, varying with the kinds, with or without contact with the air, and with or without the intervention of microscopic or other plants or animals; also, that there is only one certain way of preserving organic substances, namely, by abstracting from them the whole or a part of their moisture by the assistance of some salt, which, remaining in part in their tissues, prevents the atmospheric air from entering, and preserves them from the attack of insects. The salt which best accomplishes this object, under the threefold effect of rapidity of action, the perfection of the products obtained, and their salubrity, he considers to be the acetate of soda.—3 *B*, *May* 22, 1873, 156.

DETERMINING THE PURITY OF BUTTER.

An important paper was recently published in the Liverpool and Manchester Medical and Surgical Reports, by Dr. J. Campbell Brown, in reference to the most practicable methods of determining the extent and character of the adulterations of butter. The various processes are principally chemical and spectroscopical, but are, to a considerable extent, sufficiently practical to form the basis of very definite experiment. As a preliminary, an ounce of the sample of butter to be examined is placed in a test tube seven eighths of an inch in diameter, and melted by the immersion of the tube in hot water. A thermometer with a pear-shaped bulb is then to be introduced, so that the bulb shall be in the middle of the fat, about an inch below the surface; after which the whole is allowed to cool spontaneously. If the quantity of water in the butter be large, it will collect in the tube below the fat. Caseine will also collect in the lower part of the tube. The temperature is to be carefully noted when solidification commences, and when it is complete.

If the butter is pure, the thermometer is obscured between 74° and 68°, and it is solid at 61°. An addition of beef dripping causes the thermometer to obscure at 79°, and to become solid at 72°. Mutton obscures the thermometer at about 85°, and it is solid at 84°. Lard obscures the thermometer at 84°, and is solid at from 79° to 70°, but often remains as soft as butter at a much lower temperature. Mixtures solidify at intermediate temperatures.

If pure butter be examined by the microscope, with a one-fourth or one-fifth inch object-glass, nothing will be seen excepting the characteristic globules, the granular masses of curd, and the cubical crystals of salt in the butter. The hard fats are present in the globules, in a state of solution, and not recognizable in a separate form. The presence, however, of single fusiform crystals, or star-like aggregations of needle-shaped crystals, indicates that melted fats are present. Starch, flour, Irish moss, etc., will be appreciable by the microscope as distinct from butter or fats.

For the determination of other points of the inquiry, special formulæ are given in the paper, to which we refer our readers. We have, however, given the tests which will most readily determine the presence of the more obnoxious adulterations.

It is proper to state that the series of theoretical considerations in Dr. Brown's paper have been stoutly contested by Dr. J. Alfred Wanklyn and others, and that quite an acrimonious controversy has arisen in consequence.—1 *A*, *July* 4, 1873, 1.

NEW WAY OF CLEANING SILVER.

According to Dr. Elsner, water in which pared potatoes have been boiled exercises a remarkable cleaning influence upon silver-ware of all kinds, especially spoons that have become blackened by eggs. Even delicately chased and engraved articles can, it is said, be made bright by this method, even better than by the use of the ordinary polishing powder, which is apt to settle in the depressions, requiring particular care in its removal.—14 *C*, 1873, CCVIII., 320.

CHINESE PREPARATION OF VERMICELLI.

A dough is prepared out of small green pease by soaking them thoroughly in water and grinding them between stones, adding water and pressing them through a sieve; then subjecting the mass obtained to pressure in a strong vessel, and thus removing the water. This dough, well softened with water, is poured through a gourd vessel, usually with ten holes in it, into a vessel of boiling water; the higher the gourd above the boiling water, the longer and finer the vermicelli. On removal from the boiling water the threads are immediately dried.—32 *C*, *July* 5, 1873, 346.

INDIGESTIBLE NATURE OF "CAFÉ AU LAIT."

In discussing the alimentary properties of *café au lait*, Marchand remarks that pure coffee is a valuable tonic and stimulant, which tends greatly to favor digestion after a meal; and that, of course, the nutritive qualities of milk are known every where. Whenever the two are mingled, however, we have a new compound, absolutely indigestible and unassimilable; because, when in sufficient quantity and in proper proportion, it forms a mass which entirely resists the solvent action of the stomach. This is due to the amount of tannin found in the coffee, which, when mixed with the milk, transforms the albumen, or caseine, into a kind of leather, precisely similar to a tanned hide.—3 *B*, *June* 19, 1873, 287.

CHINESE PREPARATION OF SOY.

Equal quantities of beans and wheat are boiled together, and then triturated between stones, and water occasionally added. The mass is cooked in a pan, and cut into thin slices, which are kept covered with straw for about twenty days. When completely fermented, the separate slices having become mouldy, they are washed with water, placed in a vessel, and their weight of water and salt added. In this condition they are kept for a number of days, and are finally again triturated between stones.—32 *C*, *July* 5, 1873, 345.

PETROLEUM FOR CLEANING GUNS.

Petroleum, among other applications, answers an excellent purpose for cleaning guns, it being only necessary to saturate with it some tow wrapped around the end of the ramrod, and to work this up and down a few times, and then remove the tow and renew the application, and wipe out with dry tow. The remaining film of the oil evaporates at once, and leaves no moisture in the barrel to produce rust. The oil, however, must be perfectly free from sulphur and similar impurities, as otherwise the metal will be attacked.—8 *C*, 1873, IX., 142.

BURGLAR-PROOF SCREW.

A screw, adapted to fastening locks, has been described by Tucker. It has a right-hand wooden thread at the head-end, and a smaller left-hand iron thread on the other end, or *vice versa*, the latter being supplied with a nut. An effort to remove it from one side by unscrewing at the head only tightens the nut, while an attempt to drive out the screw on the other side, after taking off the nut, is resisted by the wooden thread.—18 *C, June* 1, 1873, 686.

INSTRUMENT FOR TESTING MINERAL OILS.

A simple instrument for testing the quality of the petroleum oils has recently been brought to public attention, and though by no means accurate enough in its indications for scientific uses, it answers very well for an approximate method of determining the inflammability of such oils; and is so simple in its action that it requires no skill to operate, on which account it may prove useful in the household. It is called "Blair's Apparatus for Testing Hydrocarbon Oils," and is constructed upon the principle that the expansion and contraction of the several hydrocarbon oils under different temperatures is in a direct ratio to the percentage of naphtha or other inflammable liquids contained in it; an adulteration of a safe oil with naphtha increasing its rate of expansion to such an extent as to render the same easy of detection. The instrument is constructed, therefore, to enable one to compare the expansion of any oil to be tested with that of a standard safe oil—both being subjected to the same degree of heat. The instrument consists of a case holding two bottles, furnished with glass tubes of equal bore. In one of these bottles is placed the oil which serves as the standard of comparison; and in the other, to the same height in the tube, is placed the oil to be tested. The bottles are mounted upon a wooden support, suitably graduated. To be used, it is inserted in a vessel of water, of a temperature of 110° (the legal burning-point of safe oils), and the inference as to the safety or danger of the sample is judged from the cautionary words upon the support behind the tubes. To those who prefer not to test a sample of oil by the simple plan of attempting to ignite a few drops of it in a saucer with a match, the apparatus above described will be of service.

ILLUMINATION BY MEANS OF ELECTRICITY.

Dr. Crookes, of London, has recently published an interesting article showing the progress made in electric illumination during the past few years.

The first great step in the series of inventions was that made by Wilde, in the invention of his form of the magneto-electric machine. This machine produced the electricity necessary for the evolution of light by means of the rapid revolution of permanent magnets; and the great hinderance to the perfect success of the apparatus consists in the difficulty of attaining the extreme rapidity of revolution which was required.

The Berlioz machine revolved at the rate of three hundred and fifty or four hundred revolutions per minute; in the Wilde machine, the armature has sometimes made about twenty-five hundred revolutions per minute.

It is evident that at these high velocities the wear and tear of the material must be very great. It has, however, been discovered that the successive and almost instantaneous flashes of electricity produced so rapidly by this machine, as to seem like a continuous light, can be somewhat lengthened, so that extremely rapid revolutions are not necessary. The difficulties sought to be removed by Mr. Wilde are now overcome in a different manner by Mr. Gramme, and the Gramme machine promises to more nearly attain the efficiency required of such apparatus than the Wilde machine. In the former the magnets remain stationary, while the conducting wire through which the electric current flows, or at least a portion of that wire, is put in motion. These machines, therefore, give an absolutely continuous current of electricity, rather than a current intermitted a thousand times or more per minute. The constancy of the strength of the current is convincingly shown by the fact that in some recent experiments carried on for eight hours with one of the first machines constructed, the deviation of the needle of the galvanometer was absolutely invariable. The power of the current attained with a machine of a given size may be estimated from the following statements:

A machine containing two electro-magnets worked by hand decomposed water and fused a length of one inch of iron wire $\frac{4}{100}$ths of an inch in diameter. A large machine, driven by a two and a half horse-power engine, produced at a slow rate of revolution a light equal to eight thousand candles. A machine driven by a four horse-power engine, and itself four feet high, two feet long, and two feet wide, gave a light equal to nine thousand carcel lamps. In the galvano-plastic works, these and similar machines have been used for the electro-decomposition of metals; with the best machine hitherto known, moving with a velocity of twenty-four thousand revolutions per minute, one hundred and seventy grains of silver were deposited every hour; while with a small Gramme machine, moving with a velocity of three hundred revolutions, there were deposited two hundred grains of silver. The electric light generated by a Gramme machine has been exhibited on the tower of the Houses of Parliament. The machine is worked by a small engine in the basement of the building; from the machine two copper wires, half an inch in diameter, are led a distance of nearly nine hundred feet upward to the signal. The light passes through a lens twenty-one inches in diameter, and, by means of the proper machinery, is made to sweep the horizon as in the revolving lights of a light-house. These lights are exhibited during the sessions of Parliament.

These machines prove themselves to be valuable, not only for electric illumination, but also for chemical decomposition; for military signaling; for the exploding of gunpowder; for electro-plating; for telegraphy; and for medical purposes.—16 *A*.

NEW METHOD OF ILLUMINATION.

A uniform, brilliant, white, but mild and agreeable light, adapted to supplying the place of gas (in its mode of use, and otherwise), where the latter is not to be had, or is difficult to use, has recently been patented by Silber, and is in use on some of the steamers of the Cunard, Inman, and other lines, as well as on many of the English railroads. The peculiarity is in the burner, which converts the oil into gas, and regulates the access of air and gas so exactly that there is practically no consumption of wick, no accumulation of impurities, and no smoke. The apparatus varies in its details, according to the nature of the oil employed (as rape-seed oil, light hydrocarbons, etc.), but, in the main, consists of a series of concentric, vertical double cylinders, inclosing each other, with definite spaces between; the interior space of the first cylinder furnishing air; the first cylinder containing the wick; the second cylinder supplying air to the outside of the wick; the third containing oil, and being in communication with the reservoir as well as with the wick. The mouths of these chambers are all covered with a convex cap, through a suitable opening in which the gas flows out, in such a way as to obtain the supply of air necessary for complete combustion. —13 *C*, *June* 1, 1873, 721.

NEW PREPARATION OF MEAT.

Professor Leube, after numerous experiments, has concluded the following as the most suitable form of meat liquid for invalids, since it is more relished, and agrees with them better than other preparations. The same is also said to be true of it in a dry condition, in the form of powder or pastilles, which latter also keep well. In an earthen or porcelain vessel place one quart of water, and five and a half drachms of pure hydrochloric acid, with two and a quarter pounds of beef, freed from fat and bones, and chopped fine, and place the whole in a Papin's digester, with a tightly fitting cover. Boil from ten to fifteen hours, stirring occasionally the first few hours; then remove, and convert to an emulsion-like mass in a mortar; boil again from fifteen to twenty hours, without removing the cover of the digester; add pure carbonate of potash almost to neutralization, and finally evaporate to the consistency of jelly.—1 *C*, 1873, 144.

VALUE OF GELATINE AS FOOD.

The nutritive value of gelatine in these days of soups made from meat extracts, and of jellies served in all the forms which skillful cooks can devise, is a question of no small importance. Years ago it was decided, from French physiological experiments and hospital experience, that gelatine was of no use in nutrition. The subject has lately been more thoroughly investigated by Voit, who differs in some points from the conclusions of the French savans. His experiments were made on dogs fed either on gelatine alone or on gelatine mixed with flesh or fat, or both. By determining the amount of tissue transformed, as indicated by the nitrogen excreted, and the loss or gain in weight of the animal, the value of the gelatine could be ascertained. The results show that while gelatine has no nutritive value (if by this be meant the formation of tissues), yet, if the term be extended somewhat, that it does have an actual nutritive value in lessening the metamorphosis of albumen in the body. In a large dog, 168 parts of dry gelatine saved, in this way, 84 parts of dry albumen, this saving being much greater than that effected by the ingestion of fats or carbohydrates. Moreover, this saving can not be carried beyond a certain limit, some albumen being always decomposed, even when fat is given with the gelatine. No deposition of the gelatine takes place in the body: the whole of it is rapidly decomposed, all of its nitrogen being excreted within twenty-four hours after ingestion. Even the gelatigenous tissues themselves are not formed from this ingested gelatine, but from gelatine which is derived from albuminous bodies by retrograde metamorphosis. Voit explains this preserving action of gelatine by distinguishing two sorts of albumen in the organism—circulating or movable, and organ or fixed albumen. The former is capable of ready transformation, while the latter is not decomposed as such, but must first be transformed into the former. Gelatine acts to lessen the conversion of the organ albumen into circulating albumen, but not being able to replace the decomposed organ albumen, nor to construct new organs or tissues, it can not entirely prevent albumen transformation. When given in the food, therefore, along with albumen, it decreases the amount of this substance, which undergoes decomposition, and hence lessens the amount necessary to supply the needs of the body.—*Zeitschrift für Biologie*, and 21 *A*, *March* 24, 1873, 284.

IMPROVEMENT IN RIFLES.

The *English Mechanic*, in referring to the new method of making rifles lately described in its columns, in which the rifling is confined to about six inches of the barrel near the muzzle, informs us that this was tested lately at Wimbledon, with results which render further inquiry desirable. While the accuracy of the shooting is, if any thing, improved, the recoil appears to be reduced to a minimum.—18 *A*, *July* 25, 1873, 478.

L. MECHANICS AND ENGINEERING.

UNITED STATES COMMISSION ON IRRIGATION, IN CALIFORNIA.

Congress, at its last session, passed an act providing for a board of commissioners to report a system of irrigation for the San Joaquin, Sacramento, and Tulare valleys, in California. The board is to consist of two engineers of the army and one officer of the Coast Survey, who are authorized to associate with them the chief of the Geological Survey of California, and one other civilian distinguished for his knowledge of the subject; these five to constitute the board, whose duty it shall be to make a full report to the President on the best system of irrigation for said valleys, with all necessary plans and details, engineering, statistical, etc., to be transmitted to Congress at its next session. The Secretary of War is to furnish subsistence and transportation to the board while in the field, and the civilian members may receive a compensation not to exceed $2000 each.—*Acts of Congress, No.* 80.

MAREZZO MARBLE.

An article known as Marezzo marble, lately introduced into England, promises to be a valuable addition to the ornamental substances used in the arts, the appearance of true marble being very closely imitated, and the resulting material being very easily worked and very durable. The imitation of different colored veins in the marble is effected by taking skeins of silk, steeped in suitable colors, and laid in proper combinations upon a polished glass plate. Upon this is poured, to a depth of about one tenth of an inch, a quantity of fine cement, mixed with water, of a suitable body color, and the skeins of silk are removed before solidification ensues, leaving their representation in the colored mass. The thickness of the artificial marble is increased by backing it with a cement of a somewhat coarser quality, and a still coarser quality of cement is applied for the purpose of taking up the superfluous moisture. The whole will set in a very short time, and allow the glass slab to be raised on end, and the general effect to be exhibited. When completely dry, the slab is detached from the glass, and may be made of any desired thickness by a backing of coarse cement, and strengthened by the occasional interpolation of an intermediate backing of fibrous material, such as canvas, etc. The surface is afterward shaped and polished, so as to bring out the marbling; and a further process of enameling on this surface is sometimes gone through with, so as to secure special resistance to wear or exposure in the open air. This material has already been applied extensively in decorative work, such as columns, pilasters, cornices, statuary, etc.—3 *A*, *January* 8, 1872, 485.

BUILDING-STONE OF SLAG, COAL ASHES, ETC.

The advantage of the manufacture of the so-called "volcanic stone" out of ashes, slag, etc., lies not only in the utilization of waste material, but in economizing the valuable land near works generally covered by these substances. Although this refuse has been used as a substitute for sand in mortar, a suitable cement that would withstand the weather, and at the same time impart strength to these mortar masses, was still needed to convert them into building-stone. By the use of hydraulic lime, and other cementing materials, N. Schroeder, of Kreuznach, has succeeded in forming brick out of this refuse, of which large dwellings have been built, arches in churches, and cellars put up (some of twenty feet span), etc.; and it is claimed by Schroeder that there is no better nor cheaper material for ice-cellars, wells, etc.; and that it is especially adapted to laboratories and powder-magazines.—8 *C*, *January* 16, 1873, 1

IMITATION OF MARBLE.

Imitations of marble are in great demand for ornamentation, and many different compounds are used for the purpose. Mr. Pichler, a gilder in Vienna, from his own experience, recommends the following composition as being simple and satisfactory: Into one pound of best joiners' glue, boiled rather thick, half a pound of rosin (colophonium) is to be slowly stirred. (Instead of the rosin, the same quantity of Venetian turpentine may be used.) Into this plastic mass is worked a mixture of powdered chalk of any mineral color of the desired shade, and after the addition of a little olive-oil, it is ready for moulding. It is sometimes convenient to have the material in the shape of thin sheets to be cut as required; and in this case the mass is rolled out upon a slightly heated plate. Mr. Pichler asserts that this composition hardens rapidly, and can be easily polished. When kept for a length of time, it should be wrapped in a moist sheet, and exposed to gentle heat before using. The variegated marble-like veins can also be produced by kneading together differently colored portions of this mass.—8 *C*, 1872, xxx., 237.

PRODUCTION OF IRON RAIL IN THE UNITED STATES IN 1872.

The *Bulletin* of the American Iron and Steel Association publishes the following statistical account of the iron-rail production of the United States for the year 1872, the total yield footing up a considerable increase upon the figures of the preceding year. The aggregate (reported) manufacture amounted to 941,992 net tons, as compared with 775,733 tons produced in 1871. These figures include only rails made for freight and passenger railways, and exclude some 15,000 tons of street rails and mining rails, which as a rule are classified as bar-iron. The chief production is divided between Pennsylvania, Ohio, and Illinois—Pennsylvania, as usual, leading the list with 419,529 tons, or forty-four and a half per cent. of the whole.

SURFACE HARDENING OF CAST IRON.

The wearing of cast-iron surfaces exposed to sliding friction can be almost wholly prevented by tempering the surface with a mixture of $21\frac{1}{10}$ pints of water, $30\frac{3}{4}$ pounds of sulphuric acid, and 1003 grains of nitric acid. The article should be heated to a cherry-red, and protected from the oxidizing effect of currents of air by a sheet-iron box. The process is especially adapted to the hardening of bearings of axles, which, while much cheaper than those of the usual alloy, will, when regularly lubricated, last as long, even when there is great rapidity of motion.—5 *C*, 1872, LI., 408.

IMPROVEMENT IN PUDDLING IRON.

According to the *Journal of the Franklin Institute*, a successful experiment has been made in Germany in the direction of improving the qualities of pig-iron, by puddling in contact with a small percentage of fluor-spar. The object of this is to remove the phosphorus of the iron, to which its objectionable qualities are due; and the result, it is said, has been to produce a fibrous bar-iron, not at all cold-short, although the pig-iron employed was of poor quality, in consequence of containing a large proportion of phosphorus.—1 *D*, *March*, 1873, 152.

BAR-IRON FROM PHOSPHURETED CAST IRON.

The following are the essential features of the process for eliminating phosphorus from cast iron, devised by Professor Scheerer, of Freiberg; and which, it is claimed, yields superior bar-iron from phosphureted cast iron, at, practically, no increase of cost. Chloride of calcium and common salt, fused together in about equal proportions, are intimately mixed with the molten iron in the puddling furnace, either by adding gradually in two-pound water-tight paper packages, or placing the whole quantity required upon the bed of the puddling furnace at first, and, in either case, very thoroughly working it with the iron. The puddling process is generally so much shortened that the consequent diminution of the waste of iron almost offsets the cost of the material added. The quantity of the mixed chlorides required is about three times that of the phosphorus present in the cast iron. The presence of other chlorides, as of manganese, iron, and magnesium, interferes with the process, and renders a large excess of chloride of calcium necessary.—5 *C*, 1873, v., 35.

SIEMENS' REGENERATIVE GAS FURNACE.

The sudden and very material increase in the price of coal in Great Britain has naturally turned attention toward available methods for reducing the cost of fuel, and the subject of the use of peat has been again brought forward very prominently, with a probability of its extended employment. As the result of recent improvements by Siemens in his Regenerative Gas Furnace, he finds that rough, air-dried peat, even when containing twenty-five per cent. of water, may be burned to advantage in making gas; thus applied it appears more nearly equal to coal, as regards its heating power, than when used in any other way. It has been found that one ton of peat is equal, in heating power, to at least sixty-five per cent. of the same weight of Staffordshire coal. With this fuel Mr. Siemens' furnace has been successfully applied to the production of iron and steel, directly from the ore, and to potteries and zinc-works, as well as to other branches of manufacture.

In cases where the manufactories are situated in the vicinity of peat bogs, it is proposed to produce the gas from the peat directly on the spot, and to convey it in pipes to the places where it is needed. The essential principle of Siemens' furnace consists in first converting the fuel, peat, or whatever else it may be, into combustible gas, in a separate chamber of peculiar construction, and conducting it into the furnace containing the material to be heated, to be then burned with hot air. After use, the intensely heated products of combustion are made to pass through brick chambers called "regenerators," and the heat which would otherwise be wasted is caught, stored up in the bricks, and subsequently used to raise the air needed in the operation to a very high temperature.—3 *A*, *April* 5, 1873, 358.

NEW METHOD FOR TESTING THE QUALITY OF IRON.

Van Ruth, the inspector of mines, of Holland, examines the structure of iron by smoothing the surface at the desired point, and then treating it from six to twenty-four hours, according to temperature, etc., with hydrochloric acid, until the slaggy portions, which are more readily affected than the iron, are dissolved out and the fibres are left in relief, so that an impression may be taken from the surface with printers' ink, India ink, etc., which will exhibit the structure clearly, and serve for distinguishing and comparing the iron.—9 *C*, *December*, 1872, 182.

NEW PRESERVATIVE OF WOOD.

The application of paraffine to the preservation of railroad ties, by boiling them in it or coating them with it, according to Hock, of Mariabrunn, is not effective; but he suggests that impregnation of dried wood by paraffine in solution, draining off the excess of liquid, and distilling off the last portions of the solvent at a high temperature, would be efficacious, by leaving the paraffine in the pores of the wood in a finely divided condition, which, on fusion, would form a highly protective coating. Ties treated in this way would probably be perfectly protected from moisture; the paraffine would not be displaced by diffusion, in consequence of the moisture of the earth; the iron spikes would not become loose; the elasticity of the wood would not be impaired; the waste of the impregnating solution would be small, and any refuse of the finished ties thus treated would have increased value as fuel. The chief difficulty with the process lies in the thorough drying of the wood. By using crude paraffine the process would be cheap, and light hydrocarbons might be used as solvents. Apparatus adapted to the purpose might consist of a wrought-iron cylinder, to receive the wood, capable of resisting a pressure of fifteen atmospheres, and to be heated by passing high-pressure steam through a jacket around it. The drying of the wood could be completed in this way, and the impregnating solution be forced in by action of condensed air from a suitable reservoir, and then boiled by passing steam through the jacket until a gauge indicates a pressure of seven to eight atmospheres. The liquid, after cooling, may drain back into the reservoir, the residue be distilled off through a worm into the reservoir, air be forced into the impregnating cylinder, and the wood removed.—16 *C*, VI., 6 and 7, 90.

VALUE OF THE EUCALYPTUS.

Much attention has of late been given to the various species of *Eucalyptus*, on account of their value as timber, and as furnishing important vegetable products. Among the varieties one known in Western Australia as the jarrah is especially useful, on account of the resistance of its timber to the attacks of the white ant or the sea-worm. For this reason it has come greatly into use for railway purposes, ship-building, and dwelling-houses, especially in tropical countries. Companies have been formed in Victoria for the working of these trees, and arrangements are made for procuring the timber and shipping it to any desired extent.—17 *A*, *May* 1, 182, 262.

REPORT OF THE SUTRO TUNNEL COMMISSION.

The report of the Sutro Tunnel Commission is printed in detail, as an appendix to the report of the Chief Engineer of the army, just issued. The commission consisted of General H. G. Wright, General J. G. Foster, and Mr. Wesley Newcomb, civil engineer, who gave the subject a thorough examination.

The conclusions to which they came are that the tunnel is not a necessity for drainage, but that, in some cases, it promises increased economy in working mines, and in rendering available the now worthless ores in the Comstock lode, thus becoming of national importance. The feasibility of the tunnel, the commission think, is placed beyond a doubt, its cost being estimated at four and a half millions in gold, the work to be done in three and a half years; and this period may be considerably reduced if proper machinery be employed.

The value of the bullion heretofore extracted from the mines of the Comstock lode is estimated at $125,000,000, while the present annual yield is about $15,000,000. The commission believe that the lode is a true fissure vein; but whether it will continue to be ore-bearing can not be predicted with certainty. In deep mining the commission regard the experiment of the tunnel as of great importance.—*Report of the Chief of Engineers, U. S. A., for* 1871–2, 1127.

WATER-PROOF COATING FOR WALLS.

The following coating has proved very effective in preventing the penetration of moisture on the weather side of walls: Pitch, 50 lbs.; rosin, 30 lbs.; red ochre, 6 lbs.; fine brick-dust, 12 lbs.; all boiled together, with constant stirring, and then sufficient oil of turpentine—about one quarter the volume of the above—added to cause it to spread readily. It is to be laid on as thin as possible with a bristle brush.—12 *C, September*, 1872, 72.

TREATMENT OF NEW DWELLING-ROOMS.

The dampness of newly finished rooms is not due so much to the water used in mixing the plaster, as to the water of hydration of the lime liberated by the action of carbonic acid. The action of the small quantity present in the normal atmosphere would, however, be so slow, and the water be liberated so gradually, that no injurious effects could result. But as soon as the rooms become tenanted, the large amount of carbonic acid given off in respiration causes such rapid displacement of water, and with it other matters indicated by the peculiar odor, that unpleasant and injurious results may follow. Treatment of the rooms with carbonic acid, before occupying them, suggests itself at once as a means of rendering them rapidly tenantable. Although, by calculation, it would require the carbonic acid from the combustion of about three hundred and twenty pounds of coal to displace the hydrate in water in the walls of a room of about 1500 square feet of surface, in practice the consumption, in a suitable way, of about five pounds of charcoal per day, for five days, in the room, would answer, because the interior portions are protected from rapid action of carbonic acid as soon as a layer of about one tenth of an inch has been acted on. This is proved by the fact that Professor Fuchs has detected caustic lime in walls centuries old.—8 *C, September* 19, 1872, 306.

PROPER CONSTRUCTION OF CHIMNEYS.

Professor Meidinger earnestly advocates separate chimney flues for each story of a house, although they may not be as cheap nor as easily built as those which are common to several floors. In the latter case, according to his experience, it frequently happens that when fire is started on a lower story, smoke is thrown into an unheated room above, and may endanger life. In two instances he has himself been awakened by smoke entering the room in that way. More rarely smoke may be thrown into a lower room, when the fire is built on an upper story. There is frequently, also, a persistent lack of draft for the upper story, which can not be referred to want of altitude in the chimney, since with a separate chimney, or even a tube ten feet long, the draft on the same floor is all that could be desired. Narrowing the tops of the chimneys by setting smaller pipes on them does not remedy, but rather increases, the above defects. He illustrates and explains the above statements by a very simple apparatus, consisting essentially of a vertical tube, closed at the bottom and open at the top, made in two sections sliding on to each other, each surrounded by a jacket to contain the water, with three small horizontal tubes penetrating the jacket to the interior tube at such distances from each other as to represent the openings into a chimney common to the different stories. It is used by introducing hot water into the jackets, and placing lighted candles before the small tubes (which can be opened and closed at will by slides) to indicate the direction and intensity of the draft, etc. A smaller tube inserted in the top will show the effect of contraction of the top of a chimney.—16 *C*, VI., 66.

ACOUSTICS OF PUBLIC BUILDINGS.

The acoustics of public buildings has been lately studied very systematically by Orth, who, however, in general but confirms the results of the studies of Langhaus, whose work, "Ueber Theater," etc., published in 1810, seems as yet to have been but little improved upon. The investigations that these architects have made into the acoustic properties of rooms have led to the following conclusions:

1. The simple physical laws controlling the reflection and intensity of sound are alone necessary to be considered. The interference of sound-waves is a phenomenon of minor importance.

2. The concentration of the sound of the speaker's voice, within a small space, is of less importance than the suppression and diffusion of disturbing noises and reflections.

3. The chief cause of the poor acoustic properties of a large room is a reflection of sounds, such that they reach the hearer's ear, by a certain small interval of time, later than the direct voice of the speaker, and effect the ear as does an echo.

4. The acoustic properties of a room can be represented graphically, on a diagram, by tracing out the reflections, and entering for each point numbers showing the strength of the sounds, both direct and reflected, and lines showing the interval of time between them. For the time-scale may be substituted a scale of feet showing the difference in the lengths of the routes of the various sound-waves.

5. A difference of routes of fifteen to twenty-two feet not only exerts no disturbing influence, but may even be favorable, by strengthening the direct by the reflected sound; in feebler sounds the difference may be even somewhat greater; but a difference of thirty feet is, by all means, to be avoided. On the other hand, if the difference is 185 to 215 feet, the intensity of the reflected sound becomes so weak that it may be disregarded.

6. The ceiling which, in theatres, may be acoustically advantageous, is in lofty church edifices of much less importance, and may even be disadvantageous by producing audible echoes. It is, therefore, important to destroy the reflec-

tions from it, and this is best done by cylindrical surfaces. Plain arches are the worst form; flat ceilings are better, but far less effective than those that are indented or broken up by ornaments in relief; pointed arches, as in Gothic architecture, are less effective.

7. The walls are very frequently the cause of more disturbance than the ceilings; and, since these can seldom be built purely with reference to acoustic properties, it becomes necessary to ameliorate, as far as possible, the ill effects resulting from the adopted constructions. The portion of the walls above the plane of the speaker is of less importance; most attention should be bestowed on the zone between the level of the speaker and the hearer. This zone should be broken up by relief and profile ornamentations, etc., and by niches of small diameter. Casettes are to be avoided, as also plain surfaces on the pillars.

8. The material of which the surfaces should be made is still undecided. Wood, metal, or stone has each its disadvantage. The surfaces should probably be constructed to act as little as possible like sounding-boards; that is to say, the more important point to which attention should be given is the method of supporting the board or plaster, if these be introduced instead of stone or brick.—*Viert. Deutsche Polytech. Verein*, 1872, 187.

EXPERIMENTS ON STEAM-BOILER EXPLOSIONS.

Among other enactments by Congress, is one authorizing the President to cause such experiments to be made and such information to be collected as in his opinion will be useful and important in preventing the bursting of steam-boilers; and the sum of $100,000 is appropriated for the necessary experiments.—*Acts of Congress, No.* 80.

GLYCERINE AS AN ANTI-INCRUSTATOR IN STEAM-BOILERS.

According to the *Journal of the Franklin Institute*, glycerine is highly recommended as an anti-incrustator in steam-boilers. The effect of this addition is to increase the solubility of the lime salts, and to form with them a soluble compound. When the lime salts accumulate to such an extent as to be no longer soluble by glycerine, they are deposited in the form of a gelatinous sediment, which does not adhere to the boiler surface. The addition of one pound of glycerine to every three or four hundred pounds of coal burned is said to answer all necessary requirements.—1 *D, March*, 1873, 157.

VALUE OF THE STEAM-JACKET FOR ENGINES.

An animated discussion has lately taken place, before the Scientific and Mechanical Society of Manchester, as to the value of the steam-jacket around the cylinder of a steam-engine in aiding in the working of the engine by preventing the too rapid loss of heat. Mr. Hildebrand mentions, as among its advantages, that it slightly increases the power of the engine, and insures greater immunity from breakdowns caused by an accumulation of water in the cylinder; but that, on the other hand, it entails a positive waste of fuel, greater labor in attendance, and an increased outlay of capital to the amount of twenty per cent. For these reasons he concludes that the question as to economy must be answered in the negative. The case of hot-air jackets will form an exception, provided the hot air or other hot gas would otherwise be wasted. But here come in the objections—that the extent of superheating is not under as good control as with steam, and if carried too far impairs the durability of the cylinder, by depriving it of a moderate moisture necessary as a lubricant for the piston.—3 *A, March* 15, 1873, 262.

WENDT'S TORSION CAR-SPRING.

Wendt, the chief locomotive engineer of the Berlin and Görlitz Railroad, has obtained a patent for a car-spring which depends upon torsion instead of flexion, as in the ordinary plate springs, and which, it is claimed, is less liable to break, gives greater security, with twenty per cent. heavier load, is cheaper, and is easily attached to the car. Incomplete experiments on the above road indicate that the running is without danger, even after the accidental breaking of one spring.—13 *C, September* 15, 1872, 1224.

SCREW RAILWAY BRAKE.

Mr. William Kimball, of Woburn, Mass., has recently patented a brake, constructed on the principle of the screw, whose connections, it is claimed, can only with difficulty be put out of order or broken, whose motions are without loss of power, and which may be applied to the driving-wheels of the engine, and be under the control of the engineer. A shaft runs under the whole car, connecting with wheels at both ends by endless chains and slotted wheels, and also having screws which force the brakes against the wheels. A quarter turn sets the brake tight against the car-wheel, and a similar backward motion releases it. By a simple device all the cars in a train, as well as the engine, can be connected with it. The material is of wrought iron, and the inventor manifests his confidence in the apparatus by depositing $50,000 in the Woburn Bank, subject to the order of any railroad company that will try it, and not find it prove to be the most nearly perfect brake ever devised.

PROTECTION OF SHIPS AGAINST TORPEDOES.

The introduction of torpedoes into modern warfare has evoked much effort in the way of methods for counteracting their agency. It is suggested that the bottoms of vessels most exposed to torpedoes be constructed with double cells, the lower one being filled with water; this would act as a buffer, and would distribute the blow of concussion, and render it less injurious to the fabric of the vessel.—16 *A*, *July*, 1872, 392.

EXPLOSIVENESS OF WET GUN-COTTON.

The discovery by Professor Abel, of the Woolwich Observatory, made several years ago, that compressed gun-cotton fired by means of a detonating fuse exercised an extraordinary shattering power upon objects with which it was in contact, has been applied to a great many practical purposes, in consequence of the facility of manipulation. One special advantage claimed was the fact that the same cotton, when ignited by an ordinary match, would burn scarcely more rapidly than ordinary cotton, and with no explosive action. Several instances of disaster, however, have lately occurred in preparing and using this material, which tend to show that it is not quite so safe to handle as was originally anticipated.

Recent discoveries at Woolwich have somewhat restored confidence in this substance. Mr. E. O. Brown, of the arsenal, has found that compressed gun-cotton containing fifteen to twenty per cent. of water, and, consequently, incombustible under ordinary circumstances, can be exploded by detonating fuses almost as well as if perfectly dry, and it may be kept quite damp for an indefinite period of time without affecting its utility. In the course of his experiments, Mr. Brown placed disks of wet compressed gun-cotton upon a slab of iron an inch thick, without any covering, and on exploding them the iron was found deeply indented. A solid tamping of sand was then laid over the disks, and after the explosion the iron was shattered to fragments. By this new discovery the cotton may be kept wet in cylinders, and will be absolutely free from any dangerous results should it be exposed to any agency other than that of a percussion-cap or a detonating fuse.—*New York Herald, December* 30, 1872.

DIRECT METHODS FOR THE MANUFACTURE OF MALLEABLE IRON.

Von Tunner, in an article on the manufacture of malleable iron from the ore, remarks that the mechanical puddling method of Dank has given a fresh impetus to efforts in this direction, since by this process six to seven per cent. more iron is obtained than the amount of cast iron introduced, so that, allowing for waste, twelve to fourteen per cent. of iron must result from the ore added; or, according to Dank's statement, about one half of its iron. The reduction of the ore is doubtless mainly due to the carbon dissolved in the molten iron coming into most intimate contact with the ore, also for the most part in a fluid condition. The conversion of this secondary direct manufacture of malleable iron into the chief feature of the process, suggested itself very naturally, and has been much discussed. Siemens has stated that it would be difficult to obtain such a temperature, in a rotary hearth, as would fuse five to six tons of pure iron, and that it would be impossible to obtain fluid steel in it, since it would at once be deprived of its carbon by contact with the walls of ore of the furnace; but he remarked, at the same time, that he had directed his attention long ago to the use of rotary apparatus, not for puddling, but for the reduction of ores, and hoped soon to give an account of his experience. It was the opinion of Snelus, who has thoroughly investigated the chemistry of Dank's mechanical puddling, that it is impossible to do much more with that method, toward the direct manufacture of iron, than had been done as a secondary result, because it is impossible to bring more carbon into play in a liquid condition than is contained in the cast iron; and that the presence of carbon in a liquid state is necessary for the reduction of ores in a rotary hearth. There can be no doubt, however, that contact is more intimate and action consequently more energetic between the carbon and ore in a fluid condition than when solid. Indeed, the reducing action of gaseous carbon, as carbonic oxide, is not as energetic, since the temperature must be lower, or contact with the melted ore less perfect. Still it is indisputable that under conditions present in Dank's apparatus the reduction of ore may be aided by the addition of pure, finely divided vegetable or mineral carbon, since by rotation more intimate contact of the carbon and the more or less molten ore would take place, and consequently more energetic action. The treatment of pure iron ores in this manner, in common puddling furnaces in Styria and elsewhere, in the first part of the century—abandoned because not economical—supports this assumption. The old methods, as well as the recent experiments for the direct manufacture of malleable iron from unfused ore, made use of a temperature lower than that of the blast furnace, and were consequently very slow and variable. Elevation of the temperature to the fusion of the ore produced iron slag, reducible with difficulty for the want of free access of the reducing gases, and the molten portions rapidly escaped from the action of the solid and gaseous carbon. The behavior of a sample of slag in a carbon crucible, in a very fluid condition, shows, however, that the reduction of iron from slag by carbon may be very rapid when contact is intimate. In more recent experiments, in the direct manufacture, the reduction of the ore has either been a separate process, according to Gerstorf and Chenot, or, by a continuous process, the reduced ore, without cooling, has been carried on, in an apparatus consisting of different separate but connected hearths, to the finished bloom, as in Yates' method. In all these the reduction is accomplished by mixture with fine coal, and external heating, slowly, to be sure, but effectually, even to the formation of some cast iron, but the difficulties begin in the economical separation of the iron from the slag. It seems settled that only two methods are available for this, either the formation, at ordinary temperature of fusion, of a very fluid slag, rich in iron, in an apparatus similar to a finery or puddling hearth, or the employment of an unusually high temperature, at which even the slightly carbureted iron, in a suitably fluid condition, would separate from poor, very fluid slag. Such a temperature can only be produced by a Siemens' furnace, as he seems to realize; though whether he will also use a rotary apparatus in connection with it for separating the slag remains to be seen. In all recent processes, although various obstacles are encountered, the doubts of success turn mainly upon economical considerations, from the fact that in the Dank process, as well as the old Stückofen process, only one half of the iron in pure, rich ore could be calculated on—a fact that entirely forbids the use of poor ores; and it is only when cast iron is produced that the loss of the slag can be reduced to a small percentage. Under conditions present in the Bessemer operations alone is it possible to combine fluid bar-iron, containing little carbon, with slag containing a small percentage of iron. But, in addition to the loss of half the iron of the ore in rotary hearths, the consumption of fuel, amounting to two to three times that required for puddling the same amount of cast iron, renders their economical employment doubtful; and with the reduction of the quality of the ore the cost increases so rapidly that the use of ores of forty to fifty per cent. is out of the question, especially if the impurities are silica and alumina. After advising experiments in Austria, Tunner suggests that in order to lessen the loss in the slag, by the addition of a larger amount of carbon instead of soft iron, cast iron and a poor slag might first be formed in a rotary hearth, the latter be removed, and the iron puddled immediately by Dank's process, as is in fact done in the Yates plan and direct methods in common puddling furnaces. But it seems that with this treatment the time required, and consequent consumption of fuel, would be so great that favorable economical results could not be expected. Still it is more promising than the first, where poorer ores must be used. On the whole, the possibility of the direct manufacture of soft iron, in the way discussed, depends on the relation between the reduction of iron slag and its immediate carbureting at the high temperature, and the method of mixing with solid carbon; and more experiment is needed to decide the matter, since neither the present experience nor theory affords sufficient grounds for calculating the commercially practical character of it.—14 *C*, CCVII., 387.

SIGNIFICANCE OF EXPORTING IRON TO GREAT BRITAIN.

The alleged importation of one thousand tons of American iron by an English firm has given rise to a great amount of discussion both here and abroad; but while many of our home journals have been disposed to look upon the fact, if really true, as the forerunner of an almost immediate and increasing exporting trade in iron, the more thoughtful have taken a different view of it. According to the latter, the iron business of the country must first provide for its own necessities before it can think of exporting in any quantity; and to build works enough to cover the large margin between the demand and supply of iron in this country will require the investment of an amount of capital which will require years for its collection. These assertions are substantiated by a reference to the recent report of the Secretary of the Iron and Steel Association, in which it is shown that the consumption of iron, exclusive of American scrap, was 3,654,618 tons, of which no less than 1,254,618 were imported. He calculates, also, that the 109 new furnaces built last year could produce no more than 327,000 tons, and the 39 others already decided upon for 1873 might add 117,000 tons to the former figures. Thus, allowing an increase of 654,000 in the domestic production for 1872 and 1873, there is still left a margin of 600,000 tons, which must be imported. Before thinking to supply foreign nations, then, it behooves American capitalists to find the means for erecting the 200 furnaces and numerous rolling-mills needed to supply and work up the 600,000 tons which our home production fails to meet.

PRESERVATION OF RAILROAD TIES.

Treutlin, of Dresden, suggests the following plan for any kind of wood firm enough for ties. They are first to be air-dried as completely as possible, without consuming too much time, and then placed in a chamber gradually warmed until they become hot. They are then, while as hot as possible, placed in a suitable impregnating vessel, filled with thick, heated coal-tar, under pressure, until thoroughly saturated, and are placed upon and strewed with screened sand, coal-ashes, or the like, and dried. When perfectly dry, they are examined to see whether they are coated thickly enough, and every crack filled with the tar; if not, this is remedied by brushing with hot tar. The impregnating composition should be similar to that employed in the manufacture of roofing-paper—namely, condensed coal-tar, with the addition of natural asphaltum and some sulphur, the latter imparting a tendency to harden more rapidly. The spikes, when driven, should be dipped in hot coal-tar, and any split opened should be well coated with it.—14 *C*, CCVII., 514.

UTILIZATION OF FURNACE-SLAG.

Improvements continue to be made in the methods of utilizing furnace-slag, and in converting what was formerly a nuisance into a valuable article of commerce, and one profitable to its manufacturer. At the Tees Iron-works, in Great Britain, the slag, as it leaves the furnace, spreads itself over a revolving table, and water being poured over it, it is then pushed into the wagons beneath. When cold, it readily breaks into pieces, and forms a useful material for making concrete buildings. At the Tees Works some 7000 or 8000 tons have been made in a few months past, all of which has been employed in building and drainage works, and it has also been used as a top-dressing for roads over which there is a heavy traffic. By a special process the slag is converted into sand, from which bricks and cement of an excellent quality are made.—18 *A*, *May* 9, 1873, 191.

COMPARISON OF ANCIENT MORTARS.

Dr. Wallace, of Glasgow, has been paying some attention to the character of the mortars used in ancient buildings, and, among others, refers to specimens from the Great Pyramid, from the Island of Cyprus, from the ruins of Athens, and also from ancient ruins in Rome, and elsewhere in Italy. In a recent communication to the Philosophical Society of Glasgow, he mentions the remarkable differences between them. In some edifices, as at Baalbec, and some ruined cities in Turkey, buildings are met with constructed of immense blocks of stone, jointed with such nicety that even the blade of a penknife could not be pushed between them, but without any mortar whatever. On the other hand, the Egytians used mortar freely, as in the Great Pyramid. This, however, consisted almost wholly of gypsum, or sulphate of lime. A specimen of mortar from an ancient Phœnician temple was like that found in the baronial castles of England, having been made of burned lime, fine sand, coarse sand, and gravel. The lime in it had become completely carbonated, converting the mass into solid rock. The ancient Greek mortars, from ruins in the vicinity of Athens, contained more lime than that from Cyprus, and no gravel. That from Herculaneum, Rome, and its neighborhood, appeared to have been made from burned lime and volcanic ash, or puzzuolana. The mortar of the Great Pyramid consisted principally of hydrated sulphate of lime, to which were added traces of carbonate of lime, carbonate of magnesia, alumina, silica, and a very small per cent. of water.—3 *A*, *April* 26, 1873, 65.

ACOUSTICS OF LARGE ROOMS.

A recent study of this subject has been made by Orth, according to the method of graphic construction as detailed in the treatise of Langhaus, the law of reflection of sound, and that of intensity, as affected by varying distance, being mainly involved. The former consideration is easily introduced in graphic constructions; the latter necessitates calculations based upon the length of the path of the sound waves. By the employment of 0.01 of a square meter, at a distance of ten meters from the origin of sound, as a unit of intensity, Orth was also able to accomplish a graphic representation of intensity. The effect of intersecting waves upon each other he did not regard as demanding practical consideration; but, on the other hand, the diffusion of sound by reflection from rough surfaces proved to be of great importance, as furnishing, in some cases, the readiest remedy for acoustic annoyances. The only source of acoustical defects in a hall to be considered, according to these investigations, is the reflection of sound waves in such a way that they strike upon the ear of the hearer within a certain interval after the direct waves, and are recognized as an echo or resonance. For graphic determinations this interval of time is converted into difference between the lengths of the paths of the direct and reflected rays from the origin of sound, and the question of practical acoustics rests essentially on a knowledge of the limits within which this difference exerts a disturbing influence. The observations of Orth, which differ from those of Langhaus, show that a difference of from sixteen and a half to twenty-three feet not only causes no disturbance, but under some circumstances may produce favorable re-enforcement of the direct by the reflected sound, and that, with diminished intensity, the difference may be somewhat greater, but under no circumstances should it exceed thirty-three feet. On the other hand, the intensity at a difference of 196 to 230 feet may be regarded as too small to be noticed. From a discussion of the acoustic conditions of churches, in this way, he concludes, first, that the ceilings which, in theatres, help the effect in the upper tiers, in churches are too high for this, and may produce resonance or echo, and that it is therefore necessary to diffuse the sound reflected from them; and he gives the results of a comparison of different forms of ceilings obtained by graphic construction; second, that the walls require to be not less carefully investigated, since defects are often attributable to walls rather than ceilings; and, since they can not always be conformed to acoustical demands, the most practical question is frequently how to render the reflected rays without effect by suitable management of the surface; third, that surface and material, partially touched upon before, need scientific investigation to complete our knowledge in regard to the part they play; fourth, that sounding-boards, generally constructed empirically, ought to be regulated in size and form by suitable construction in each case, and that the material should be carefully selected.—*Technische Blätter*, 1872, III., 187.

INJURY TO ATLANTIC CABLES BY ANIMALS.

When submarine cables were first proposed, much trouble was anticipated from the boring of marine animals through their external envelopes, and thus allowing the salt-water to penetrate to the wires. A cable would also in time become covered with adherent mollusks and similar objects, which would be likely to attract fishes and other animals, the teeth of which might produce serious mechanical injuries. Although such results have not followed to so great an extent as was feared, experience has shown that these apprehensions were well founded. The Florida cable, for instance, is thought to have received serious injury from turtles nibbling at the sea-weeds, etc., incrusting it; and we now learn from *Land and Water* that on one occasion the cable between Penang and Singapore became defective, and, when taken up, was found to have been perforated by the teeth of a saw-fish, which tore away the coverings, and laid bare the conducting wire.—2 *A*, *June* 14, 1873, 430.

CASING FOR STEAM-BOILERS, PIPES, ETC.

The following composition has been patented in England for casing steam-pipes, etc.: Potter's clay, 1½ cwt.; sawdust, 24 pounds; fine shavings, 12 pounds; cow's hair, 2½ pounds; tar, 18 pounds; water-glass (specific gravity 1.7), 18 pounds; creosote, 5 pints. Another formula consists of clay, 1½ cwt.; cork dust, 24 pounds; cow's hair, 4 pounds; tar, 18 pounds; water-glass, 25 pounds; chalk, 10 pounds; coarse soap, 5 pounds; creosote, 7 pints.—5 *C*, 159.

CASING FOR STEAM-PIPES, ETC.

According to R. Weinlig, the following is a serviceable, extraordinarily cheap, and easily prepared substitute for the justly popular Leroy's composition. Very porous, thick paper is first wrapped around the pipes and fastened with wire, and then coated with dilute sugar sirup. A mixture of six bushels of clay, nine bushels of sand, or, better still, of very fine coke, is made, with as little water as possible, and three buckets of sirup and 30 pounds of fine graphite are added. This is laid on about three quarters of an inch thick, and covered once or twice with tar or linseed-oil varnish. For larger vessels, the composition should be mixed with hair enough to retain its plasticity, and be laid on from about one to one and a quarter inches.—14 *C*, 1873, CCVII., 508.

MOTOR FOR SMALL MACHINES.

Les Mondes asks its readers to examine a new motor constructed by Lambrigot, of Paris, which seems well adapted to small machinery (such as pumps, sewing-machines, organs, small screw vessels, etc.) by reason of its small size, peculiarity and ease of movement, with a small consumption of ether or alcohol.—9 *C, March*, 1873, 43.

THE GRAMME MAGNETO-ELECTRIC MACHINE.

The prize of 3000 francs offered by the Société d'Encouragement of Paris for an apparatus giving an electric current constant in direction and intensity, the electromotive force and the resistance of which should be comparable to that of a nitric-acid battery of sixty to eighty cells of the ordinary size, and which should be superior, both in economy and healthfulness, to any thus far produced, has just been awarded to the magneto-electric machine invented by M. Gramme. This apparatus, therefore, merits a brief description. It consists of a horseshoe magnet, between the poles of which revolves a ring of iron, lying in the same vertical plane with the magnet itself. This ring is entire, and is wound with covered wire in sections, the ends of which terminate in rods arranged about the transverse axis on which the ring turns. Upon the ends of these rods, as the ring rotates, press successively two copper disks, one on each side of the axle, which serve as the electrodes. The current developed by the rotation, due entirely, as Gangain has proved, to the motion of the helices, is continuous and uniform in direction. By using electro-magnets instead of permanent ones, and by adopting Ladd's principle of re-enforcement, the power of the machine has been vastly increased. A machine of this sort, in daily use for electro-plating in the establishment of M. Christolfe, in Paris, weighs 460 kilogrammes, of which 135 kilogrammes are the weight of wire on the permanent magnets, and 40 kilogrammes that on the movable ones. About one-horse power is required to give it its normal velocity of 300 turns a minute. With this velocity, the current is equal in intensity to that of two Bunsen cells of the ordinary size, and in quantity to 32 such cells. It will deposit 600 grammes of silver per hour. With this velocity, the temperature of the armature never exceeds 112° Fahr., and with 275 turns a minute, no heating takes place. A Wilde machine, much larger in size, and making 2400 revolutions per minute, deposited only 510 grammes of silver per hour. For the electric light, the Gramme machine is somewhat varied, so as to increase proportionately its intensity. The one tested by the committee was 1.25 meters in height, by 0.8 meters square, and weighed about a ton. In it three movable electro-magnets revolved between the poles of three fixed electro-magnets; one of these developed the magnetism of the fixed magnets, the other two furnished the light. The fixed magnets were wound with 250 kilogrammes of wire, the movable ones with 75 kilogrammes. With a velocity of 300 rotations per minute, requiring four-horse powers of force, this machine gave a tension equal to that of 105 ordinary Bunsen cells, and a quantity of five such cells; it gave a light equal to that of 900 Carcel gas-jets; and it ignited 12 meters of copper wire 0.7 of a millimeter in diameter, and five meters of iron wire 1.3 millimeters thick. It fused $2\frac{1}{2}$ meters of this latter wire.—*Annales de Chim. et de Phys.*, IV., 324.

RECENT EXPERIMENTS WITH THE WESTINGHOUSE AIR BRAKE.

A very thorough experimental trial of the Westinghouse Air Brake, as recently modified and improved, has lately been made by a scientific committee of the Franklin Institute, the record of which is worthy of being at least briefly alluded to. The experiments in question were made with a special train of seven cars upon that portion of the Pennsylvania Railroad which lies between Philadelphia and Paoli. The first signal to stop was given by the conductor by means of the bell-rope, while the train was going at the rate of thirty miles per hour, and the train was brought to a full stop in sixteen seconds, passing over 503 feet of rail.

Another stop was made by applying the brake from the interior of one of the cars by a cord passing over the windows and attached to valves of the apparatus. The train, making thirty-five miles per hour, was stopped in fifteen seconds, and passed over 514 feet of rail from the time of the signal to stop. In all cases the distance was determined from a flag thrown out when the brake was applied. Several interesting experiments were then made by severing the train, the act of uncoupling causing the brake to be applied. The five rear cars were separated while running at the rate of thirty-two miles per hour, and in fifteen seconds were brought to a full stop by the automatic action of the brake, passing over 367 feet of rail. Again, the engine was separated while the train was making forty-five miles per hour, and the train was stopped in ten seconds, passing over 318 feet of track.

Other equally satisfactory trials were made by applying the brake and stopping the train while the engine was still working, and by testing its automatic action by stopping the train whenever this meets with an obstruction of the track.

An iron rod connects with each brake, extending down to within four inches of the rail, and to this is attached a cross-bar. This device will apply the brake, whenever it comes in contact with an obstruction on the rail, or in case of the breaking of the wheels.

In the experimental trial referred to, the efficiency of this attachment was tried by means of a shovel while the train was traveling at moderate speed, and the train was speedily brought to rest.

The experimental tests were uniformly successful, and demonstrated most clearly the immense superiority of the automatic system over the old plan of braking by hand.

The official report of the Committee, which is at present in course of preparation, will doubtless do much toward drawing increased attention to the automatic system.

THE MECHANICAL PRINCIPLES OF FLYING.

L'Aéronaute, a journal devoted to the interests of aerial navigation, contains a valuable contribution to our knowledge of the mechanical principles of the flight of birds, in an article by M. A. Penaud. The elaborate experiments of Thibault on the resistances opposed by the air to motions of thin plates of metal form the basis of the mathematical studies of Penaud, as well as of those by Louvrié, published in 1868. Thibault's experiments showed that in moving a plane square surface the resistance normal to the surface remains very nearly constant so long as the angle between the normal and the direction of motion (the angle of incidence) is included between 90° and 45°; it then diminishes progressively to 20°, from which point up to 0° of incidence it is sensibly proportional to the sine of the angle. M. Penaud now demonstrates, first, that a bird sailing in the air falls as slowly as possible when he employs for his horizontal movement one fourth of the work of the fall; second, a bird in sailing with a uniform movement clears a given space with the least possible fall when the work of suspension is sensibly equal to the work of translation: the plane of the wings then bisects the angle formed by the horizon and the direction of movement, and the latter angle is itself a minimum.

From these principles (which apply to birds, and not necessarily to insects), Penaud deduces most of the known characteristics of the flight of birds. For insects, as well as for fishes, the modes of propulsion involve quite different principles of mechanics.—*L'Aéronaute, January*, 1873.

LONG BALLOON VOYAGES.

The proposal to build a large balloon, and start on a voyage from America to England, has called forth an excellent letter from the veteran balloonist, Samuel A. King, whose strenuous efforts and great personal sacrifice in the attempt to make the balloon the means of yielding reliable scientific results have placed him among the foremost of those who have devoted themselves to such work in this country.

In reference to crossing the Atlantic, Mr. King writes: "I do not know of a single scientific authority who indorses any theory of a direct current moving continually from west to east at any height. The probable direction of the upper current would be from Boston over New Brunswick and the southern coast of Greenland into the Arctic Ocean."

The longest voyages with the greatest balloons ever made have never been equal to one entire day. The balloon can not retain its gas a longer time because of the overflow at the neck. Even if it could be maintained in the high western current, the time required to reach Europe must far exceed the two or three days promised by the projectors of the enterprise, since the average velocity of all the very high ascents is not greater than twenty miles an hour, to say nothing of the fact that they move in every other direction than the one needed for a trip across the Atlantic. In reference to the uses of the balloon for meteorological and physical observations, it may be stated that Mr. King has made over one hundred and eighty balloon voyages, in several of which he has traveled remarkable distances. A brief synopsis of these, giving the direction of the upper and lower currents, with other data, was read by him before the Washington Philosophical Society in 1871. On all his ascensions in 1871 and subsequently he has freely invited competent meteorological observers to accompany him, his own time being required for the management of the aerial ship. Notwithstanding the losses during the great fire in Boston, Professor King has built, and very successfully used, a large balloon, designed specially for carrying delicate meteorological instruments. It would redound greatly to the credit of New York City could there be established a stationary balloon in the Central Park, as is described in Glaisher's *Travels in the Air*, that could be used not only for popular amusement, but for meteorological observations, in charge of the director of the Meteorological Observatory.

EXPLOSIVE PAPER CARTRIDGES.

Paper prepared in the following way explodes without foulness and only on contact with fire, and is said to be 30 per cent. cheaper than gunpowder: Add together 79 parts of water, 9 of chlorate of potash, $4\frac{1}{2}$ of nitrate of potash, $3\frac{7}{4}$ of yellow prussiate of potash, $3\frac{1}{4}$ of finely pulverized charcoal, $\frac{1}{21}$ of a part of starch, and $\frac{1}{16}$ of a part of chromate of potash; stir well, and boil for an hour. Soak paper cuttings in this liquid, and dry them and make into cartridges, in tubes of proper size, formed from sheets of paper saturated with the liquid, and dried at 167°. Protect the cartridges from moisture by a solution of xyloidin in acetic acid.—34 *C*, 1873, IX., 92.

ACTION OF DYNAMITE.

A series of experiments, by MM. Roux and Serrin, recently conducted for the French government, upon the effects of dynamite, have led them to conclude that this substance, accidentally inflamed (as when in the midst of a fire) will not detonate, but that it may produce an explosion of the second order, similiar to that of gunpowder. The maximum intensity of the explosion, obtained when the sides of the case present great resistance, would be such that one of nitro-glycerine represents two of powder. They state, also, that it is only by a percussion of sufficient intensity that detonation or explosion of the first order can be produced. Dynamite is more powerful, in proportion, than nitro-glycerine, as it is more easily inflamed by a shock. Where this takes place readily, the effect of the percussion is transmitted immediately through the whole mass. This is the case with quartzy sands. Whenever the dynamite is prepared with plastic matter, ochre, etc., only part of the mass detonates, the rest acting by simple explosion.—18 *A*, *May* 9, 1873, 192.

NEW FORM OF EXPLOSIVES.

Sir Charles W. Vincent makes a communication to *Iron* in reference to new explosives, the object being especially to call attention to a recent patent by Dr. Sprengel. The theory of explosions is based upon the rapid disengagement of an enormous volume of gas in a confined space; this being produced in such quantity as by its expansive pressure to accomplish the object of riving and bursting asunder the inclosure. As a general rule, these explosives, like fire and water, are very good servants, but very bad masters, and their tendency to go off when their services in this direction are not needed is the frequent cause of a great amount of mischief both to life and property. The object of Dr. Sprengel has been to devise some method by which the components of the explosive may be kept apart until the moment when needed for use, so that if either be subjected to the action of heat or percussion, no damage will be the result. The one being a combustible and the other an oxidizing agent, neither will act injuriously unless in combination with the other. These combustible and oxidizing agents, according to Dr. Sprengel, should be from different states of matter: thus, if the one be a solid, the other must be a liquid, and he proposes to place the solid but finely divided oxidizing substance in a vessel or chamber, and to add to it when needed for use the liquid combustible, and explode the two by means of a detonating fuse or percussion cap. The fluid oxidizing agent preferred by him is nitric acid, while the solid combustible will consist of such nitro-compounds as are not explosive, such as nitro-naphthaline and the nitrate of aniline. And again, the solid chlorates, perchlorates, or nitrates of potassium may be used to oxidize bisulphide of carbon, benzole, nitro-benzole, alcohol, ether, oils, etc. The best results were found from the oxidation of the hydrocarbons by nitric acid. A mixture of nitro-benzole with nitric acid (specific gravity, 1.5), when saturated, explodes with the violence of nitro-glycerine. Apart, the elements are harmless, and the miner may pour the proper proportion of each into a tube and place in position, adding the fuse when it is prepared. Up to the time of mixing he would be in no danger, and after that no more than he is liable to in treating nitro-glycerine, gun-cotton, or gunpowder. Sir Charles thinks Dr. Sprengel's methods are not entirely practical at present, but that there is in them the germ of an invention of very great value.—3 *A*, *May* 31, 1873, 612.

NEW METHOD OF IRON-MAKING.

According to *The English Mechanic*, a new process of iron-making, which dispenses with the blast furnace, has been practically tested, and specimens of its produce shown at Wolverhampton. The bloom is made direct from the ore, which is ground, mixed with lime and pitch, and baked in a coke oven. This is treated as pig-iron, and a furnace being charged with it, it is ready for the helve or the squeezers in half an hour. The inventors claim that by their process they can make a ton of finished iron from the ore at an expenditure of only two tons of coal; that they can make German steel as cheaply as cast iron, and that they can, furthermore, make the latter equal in purity to charcoal iron.—18 *A* *July* 18, 1873, 452.

ELECTRIC APPARATUS FOR INDICATING LEAKAGE IN SHIPS.

Sortais has devised an electrical apparatus to be placed in the hold of ships for the purpose of giving warning in case of a leakage. On the entrance of the water a current is established, and notice thus given to the officers.—15 *A*, *May* 31, 1873, 699.

NEW MOTOR FOR SEWING-MACHINES, ETC.

A decidedly novel steam-engine is said to have been invented by F. Siemens, of Dresden, which has neither cylinder, piston, guide-rods, cranks, nor valves, but apparently only a boiler, the interior arrangement of which for the present constitutes the secret of the patentee. The steam remains, as well as works, within it, not a drop of water being lost. It is only adapted to produce one-tenth horse-power; but it is always ready, and is perfectly safe, and when gas is employed for heating, requires only two feet per hour. Externally, it is cylindrical in form, widening at one end conically, and placed at an angle of forty-five degrees, and turns on supports, a conical toothed wheel on the top converting the motion into horizontal or vertical.—8 *C, May* 29, 1873, 173.

THE GUNPOWDER PILE-DRIVER.

The gunpowder pile-driver, with regard to its efficiency and economy as compared with the ordinary pile-driver, was recently the subject of a paper before the American Society of Civil Engineers. The apparatus had been employed on a line of sheet piles for a reservoir dam in the valley of Parsonage Creek, Long Island. The character of the work was, from the nature of the soil to be penetrated, very difficult. The opinion expressed by the engineer having the work in charge was to the effect that when the resistance is slight the machine may be economical, but when, as in this case, it required three hundred blows from cartridges costing two and a half cents each to force a pile down fifteen or sixteen feet, it can not be so considered. The gas from the explosions cuts passages in the ring at the end of the piston, thereby greatly lessening the power of the machine. Other difficulties exist, such as the heating of the gun and the enlargement of the bore; and finally, from the bending of the piston, the machine ceases to work.

There is great diversity of opinion among engineers concerning the economy of this highly ingenious apparatus, and reliable statistics, based upon the results of actual practice, such as those presented in the special case above named, will be very useful.

TURBINE WIND MOTOR.

Attention is called, in the German *Architectural Magazine*, to a so-called wind-turbine, or horizontal wind-wheel, near Riesa, moving about a vertical axis. It has a diameter of about 17 feet, height of 10.2 feet, six curved paddles, and eight movable guide curves, and makes ten revolutions per minute, even while running a saw, cutting a plank over three inches thick. It would probably make twenty revolutions without work, and with a good wind would furnish about six horse-power. Similar attempts, it seems, have previously been made, and careful experiments are needed to show whether they possess any advantage over the best constructed vertical wheels; especially as the comparative difficulty is the escape of the air that has operated on the paddles, and its reflex, by reason of elasticity in the wheel, may produce a sort of gyratory motion or current, sufficient to occasion a loss of power.—8 *C*, 1873, IX., 141.

DESULPHURIZING COKE.

Dr. Hoffmann communicates the fact that the sulphur may be completely removed from coke by addition, in quenching it, of acid chloride of manganese, sulphureted hydrogen being formed; manganese with some chloride remaining as a desirable addition to the coke. The solution of the acid chloride may be made in small leaden reservoirs, and allowed to flow into the water-tanks as needed.—6 *C*, *May* 22, 1873, 208.

CONVENTION OF RAILWAY MASTER MECHANICS' ASSOCIATION.

The American Railway Master Mechanics' Association recently held its sixth annual convention in the city of Baltimore. The attendance was somewhat larger than at the Boston meeting of last year, though it has been pronounced to have been less interesting. Many subjects of importance to the railroad engineer and to the public were discussed, among which may be named the investigation of boilers, the comparative value of fuels, the action of the sand-blast on copper, steel, and iron; the economy and efficiency of power-brakes, narrow-gauge railroads, the resistance of trains, etc.

With regard to the question of the merits of power-brakes, the opinion of the members was uniformly favorable. The Westinghouse, as the best-known apparatus of this class, came in for a good share of attention—the committee having the matter in charge expressing the opinion that the saving in expense with the air-brake, with regard to the wear and tear of the wheels and other machinery, is very great, and justifies its use from an economical stand-point. The safety of passengers also demands its use, in addition to which the committee deemed that much of the complaint against the complicated nature of the apparatus arises from the fact that it is yet a new thing. The air-brake was, on the whole, recommended as being the best brake in use.

ENTANGLEMENT OF A WHALE IN A SUBMARINE CABLE.

The instances of damage to submarine cables, resulting from intentional or accidental agencies of marine animals, are becoming by no means rare. We have lately mentioned the fact of the perforation of a cable and the laying bare of its conducting wire by the tooth of a saw-fish; but a still more remarkable instance is presented in connection with the cable at Kurrachee. This cable failed suddenly on the 4th of July, and the interruption was found to be about 160 miles off, where the cable rose over a very uneven and rocky bottom. A repairing steamer was sent out to that point, and on winding in the cable an unusual resistance was experienced. After some time the body of an immense whale was brought to the surface, two turns of the cable having passed around it immediately above the tail. It is thought that the whale had been endeavoring to rub its barnacles off against the cable, and in turning quickly had made a kink in the line, which held it fast, and was sufficiently strong to resist its efforts at release. The strain on the cable in hauling up the whale had caused it to cut through the body, and the carcass sank to the bottom, the tail being brought up.

COMPOSITION FOR SIGNAL LIGHTS.

The following mixtures, affording pure colored lights for signals, have been patented in England:—*White:* 100 parts of chlorate of potash, 10 of sulphide of antimony, 15 of boiled linseed-oil. *Red:* 50 parts of chlorate of potash, 50 of nitrate of strontia, 5 of charcoal, and enough linseed-oil to give a doughy consistency. *Green:* 50 parts of chlorate of potash, 50 of nitrate of baryta, 5 of charcoal, and linseed-oil, as in red. The peculiarity claimed is in the use of linseed-oil, which may be replaced by turpentine or a resin.—13 *C, June* 1, 1873, 727.

RECENT EXPERIMENTS ON THE STRENGTH OF STEEL.

It is now seventeen years since Mr. Bessemer introduced his methods of the manufacture of iron and steel to public attention, through the paper read before the British Association for the Advancement of Science. The present perfected methods of manufacturing iron and steel are due to the successive improvements of Dr. Siemens, Martin, and others. The total annual produce of steel in Great Britain, in 1852, was 50,000 tons; at present it is over 700,000, and, possibly, nearer 1,000,000 tons. In order to improve the quality of the steel manufactured in Great Britain, Mr. Barlow, president of the Mechanical section of the British Association, has, with others, made a series of experiments for the Institute of Civil Engineers, hoping by these to arrive at some standard of excellence, and some knowledge of the relative merits of different manufacturers, in order eventually to establish rules for the use of steel manufacturers, such as are now enforced by the Board of Trade government inspecting officers in regard to the manufacture of iron. The experiments made by the committee in question consisted of several series. In the first, twenty-nine bars fifteen feet long were subjected to tension, compression, and torsion, and the principle was established:

1. That in steel, as in iron, a bar whose tensile strength is fifty per cent. above that of iron will also exhibit about the same relative increase of strength under the other tests.

2. That the limit of elasticity in steel is, like that of wrought iron, rather more than half its ultimate resistance.

3. In reference to toughness and malleability of eighteen samples, each fifty feet long, it was found that when they were subjected to a breaking tension, the elongation at the moment of fracture was, in the most brittle example, $2\frac{3}{4}$ inches, but generally varied from $4\frac{1}{2}$ to $9\frac{1}{2}$ inches. In the experiments on transverse strain, bars two inches square were bent into a V shape, having an angle of 150 degrees, without any crack.

In the second series of experiments, a remarkable increase of strength is shown to have been obtained by tempering steel in oil and water, a property that has been for some time made use of in the manufacture of steel guns.

The third series of experiments was made upon seventeen steel bars, 14 feet long, and $1\frac{1}{2}$ inches in diameter, whose tensile strength varied from 32 to 53 tons per square section; and upon twenty-four iron bars, whose strength varied from 22 to 29 tons per inch. It was shown in these that the extension and compression of steel per ton per inch was little less than wrought iron, that the extension and compression were very nearly equal to each other, and that the modulus of elasticity of steel may be taken at 30,000,000, and, practically, equal to that of wrought iron.

The fourth series of experiments was made on riveted steel, and it was shown that the same rules which apply to the riveting of iron apply equally to steel.—12 *A*, 1873, 426.

DEFTY'S PUDDLING FURNACE.

In this newly devised arrangement, the fire-place is similar to that of a common puddling furnace, and furnished with blast and steam supply-pipes, as well as a pipe for carrying off the gas and heat in making repairs. The air is admitted through tubular grate bars, extending over the whole ash-pit, whereby the air is heated, the efficiency of the fuel thus increased, and the bars at the same time kept cool; the ash-pit being closed with tightly fitting doors. The molten iron is regularly admitted from a cupola to a peculiarly constructed movable chamber, beyond the fire-bridge, and subjected in regular order to the necessary decarbureting, desulphurizing, and dephosphorizing processes. The lining of the chamber is of a peculiar composition, and is continually renewed by the admission of the same material, as a powder, into the arch through a small funnel. The flame passes from this chamber through the blast-pipe, with the blast, into the cupola, which is charged at the top through self-regulating doors, and which, by means of a tube above it, furnishes steam for the whole establishment. All heat is thus utilized, while the puddling process is continuous, and the iron exposed to the action of the flame, as well as to the lining of the furnace, as long as may be necessary.—18 *C*, *June* 11, 1873, 376.

PNEUMATIC TUBES.

It has been proposed to improve upon the pneumatic telegraph system, by substituting in the tube through which the packages are conveyed by this system of conveyance ammoniacal gas instead of compressed or rarefied air. This gas is disengaged by a slight heat from its solution in water, and, on the other hand, when it is desired to absorb the gas filling the tube in front of the packet, it is again taken up by the water. By reason of its absorption and disengagement, it is always the same ammoniacal gas which is employed either to push or to draw the train of pneumatic boxes. It is maintained that the use of the gas is much cheaper than the use of a steam-engine to force air into or draw air out of the pneumatic tube.—6 *B*, 1873, LXXVII., 280.

IMPROVED GUN-COTTON.

According to Metchel, the best gun-cotton is that which is most explosible, and at the same time most soluble in alcoholic ether. For this purpose he boils for several hours (renewing the water that evaporates from time to time) two parts of cotton with one of carbonate of potash, and one hundred parts of water, after which the cotton is to be washed and then dried. He then treats seven parts of the cotton thus purified with a mixture of four parts, by weight, of nitric acid, and 1.42 density, charged with nitrous vapor; and with four parts of sulphuric acid of 1.84 density, after the mixture has been cooled to about 80°. The whole is then to be exposed to the air for four days; after which the cotton is to be removed, washed in warm water, then in cold distilled water, and finally squeezed out and dried. Eleven parts of gun-cotton will be thus obtained perfectly white, burning without any residue, and dissolving with great facility in sulphuric or nitric ether. The gun-cotton will be still better if submitted to a second treatment of the acid.—9 *B*, *August* 2, 1873 650.

EXPLOSION OF WET GUN-COTTON.

The discovery that finely divided gun-cotton, when suspended in water, can be exploded by detonation, but is not effected by exposure to fire of any kind, is considered of very great moment as regards the safe administration of this powerful substance, especially as it can be kept in this condition for an indefinite period without undergoing decomposition; when dried, resuming all its ordinary properties. To effect its explosion it is only necessary to introduce a little loose, dry gun-cotton to start the discharge; and, curiously enough, a small amount of water, instead of diminishing, has been found to actually add to the force of the discharge.

Professor Abel now proposes, instead of gunpowder, to make use of gun-cotton, steeped in water, for the bursting of shells. The shells are nearly filled with water, and then a few skeins of wet gun-cotton inserted. In this state it has been found impracticable to fire the explosive by any means yet tried, save detonation; so that there is little danger to be apprehended from the storage of shells thus loaded. When exploded, the shell breaks up into numerous pieces, which renders its discharge almost as effective as that of Shrapnel shot. Professor Abel thinks the best method is to keep the gun-cotton in the state of an impalpable pulp, with a sufficient quantity of water to form a sort of liquid gun-cotton mud. In this state it can be kept ready for use, with perfect safety, the shells being charged as they are required with even greater facility than they can be at present with gunpowder.—3 *A*, *June* 14, 1873, 691.

M. TECHNOLOGY.

IMPROVED TRACING-PAPER.

Puscher, of Nuremburg, has lately suggested a solution of castor-oil in absolute alcohol for the purpose of manufacturing a tracing-paper. The oil is to be diluted with one, two, or three times its bulk of alcohol, according to the thickness of the paper, and the amount consequently required for rendering it transparent. This can be laid on by means of a sponge; and in a very few minutes after the application the paper will be dry, transparent, and ready for use. It will readily receive the mark of a pencil or India ink, and as by immersion in absolute alcohol the oil can be removed, the paper can be restored to its original condition, if desired.—13 *C*, *Oct.* 15, 1872, 1363.

INERASIBLE STAMPING-INK FOR LINEN, ETC.

Professor Böttger gives the following formula of an ink for marking linen, etc., that he maintains to be entirely unaffected by chloride of lime, cyanide of potassium, caustic potash, or acids. Digest coarsely powdered cashew nuts, for some time, at a moderate temperature, in a closed flask, with petroleum naphtha; then allow the exceedingly volatile solvent to evaporate. After marking articles with the resulting sirupy liquid, moisten the place with aqua ammonia or lime-water, and the marks will instantly assume a deep, permanent black color.—13 *C*, *December* 15, 1872, 1627.

RED INDELIBLE INK.

According to Dr. Elsner, an indelible liquid preparation for marking clothing in red characters may be obtained by taking equal parts of green vitriol and cinnabar, finely powdered, sifting them, and rubbing them up very carefully with good linseed-oil. They are then to be passed through a strainer, and the thick fluid which is left is used for writing, with a quill pen. The preparation may be used both for writing and stamping on cotton fabrics. These may afterward be subjected to the operation of bleaching, it is said, without in the least affecting the ink.—6 *C*, *December* 19, 1872, 508.

IMPROVED DRAWING-INK.

The addition of one part of carbolic acid to eighty parts of the fluid India ink, while it does not impair its fluidity, causes it to dry rapidly, even in heavy lines, so that they can be varnished over. The proper amount of carbolic acid to be used in any case may be ascertained by adding, drop by drop, the ordinary apothecary's solution of it in alcohol, until varnishing does not affect the definition of a test line by causing it to run. The addition of too much carbolic acid is indicated by the transparency of the line and inability to draw fine lines, a condition easily remedied by the addition of more of the fluid ink.—6 *C, November* 7, 1872, 448.

PORTABLE INK.

Professor Böttger has lately recommended a new kind of ink especially adapted for the purposes of travelers. In its preparation some white blotting-paper is saturated with aniline black, and several sheets are placed together, so as to form a thick pad. When wanted for use, a small piece is torn off and moistened with a little water, the black liquid which dissolves out making a good writing-ink. A square inch of the paper will give enough ink for a considerable amount of writing, and a few pads would be sufficient for an exploring party; and as water can generally be obtained any where, the necessary amount of ink will always be readily available. —18 *A, March* 14, 1873, 625.

BLUE STAMPING-INK.

An excellent blue stamping ink, according to Böttger, is prepared by dissolving white glue in concentrated glycerine at a slight heat, adding a sufficient quantity of Thenard blue, and thickening the whole with enough finely powdered gum-arabic to bring it to the proper consistency.—13 *C, September* 19, 1872, 398.

INERASIBLE WRITING-INK AND BLACK ANILINE VARNISH.

An ink that is not affected by strong mineral acids nor alkalies, and at the same time will not corrode steel pens, may be made by triturating 60 grains of aniline black with a mixture of 60 drops of concentrated hydrochloric acid and

360 grains of alcohol, and diluting the deep blue solution obtained with a hot solution of 90 grains of gum-arabic in 1400 grains of water.

A very deep black varnish for wood stained black, brass, or leather, can be prepared by using a solution of 315 grains of shellac in 1440 grains of alcohol, instead of the solution of gum-arabic, to dilute the above-mentioned aniline-black solution.—15 *C*, 1872, XXIV., 382.

NICKEL-PLATED TYPE.

Type, electro-plated with nickel, are not only superior to copper-plated in their resistance to friction and pressure, being ten times as durable as ordinary type, on account of the almost steel-like hardness of their surface, but, by reason of the smoothness of the coating even when the nickel is deposited in a very thin film, they render the finest lines more perfectly, and possess the decided advantage of allowing the use of inks of all colors, while the copper-plated change some of these inks, and are acted upon by others, as vermilion, etc.—5 *C*, 1872, XLVII., 375.

MOULDS FOR ELECTROTYPES.

The employment of graphite with gypsum and gutta-percha moulds for electrotype purposes causes much trouble and loss of time, because the graphite must be rubbed till it assumes a metallic lustre, which, though a matter of no great difficulty with smooth, even surfaces, is very troublesome when irregularities occur. Better results are obtained when the gypsum mould, soaked in wax, is thickly covered over with a mixture of silver nitrate solution supersaturated with ammonia and alcohol, and is then exposed to the action of sulphureted hydrogen, whereby sulphide of silver is formed, which is a good conductor. The free ammonia in the solution causes it to adhere more readily to the wax, leaving, on drying, a uniform, unbroken covering of the silver compound.

When a somewhat powerful battery of from four or five Daniell's elements is used, the layer of copper quickly diffuses itself over the whole surface, whereas, by employing a feebler current, a softer and less friable copper is obtained.

A good method of preparing the solution is as follows: Dissolve fifteen grains of lunar caustic in thirty of water, to which forty-two grains of ammonia of specific gravity 0.960 are to be added, and then forty-five grains of absolute alcohol.—21 *A*, *December*, 1872, 1133.

IMPROVED LIQUID FOR ETCHING COPPER.

According to Erckmann, the etching of copper and silver by means of nitric acid has the inconvenience of disengaging nitrous vapors. This, in addition to the injury to the health and comfort of the operators, often penetrates under the protecting layer of wax or paraffine, and thus produces an undesired action. He therefore recommends the use of chromic acid as not being liable to this inconvenience. The action, indeed, is much slower, but the engraver is not rendered uncomfortable, and the engraving is much more clear and sharp. Gold and platinum are not thus acted upon by the acid, but silver becomes covered with a red chromate of silver, which shows that it is attacked. To prepare the chromic acid, 150 parts of bichromate of potash are dissolved in 800 parts of warm water, and 200 parts of sulphuric acid are added. This forms a solution which may be used for the purpose in question.—9 *B*, 1872, XLIII., 552.

FORMATION OF ANTIQUE PATINA ON BRONZES.

A commission appointed in 1864, at the suggestion of the late Professor Magnus, has been investigating the conditions favorable to the formation of patina (or green incrustation) on bronzes, in Berlin and its vicinity. Analysis of a collection of antique bronzes showed that while the composition of the bronze does not affect the beauty of the patina, it may influence the rapidity of its formation, although the latter is also dependent on atmospheric conditions. More recent analyses of patina, as well as of bronze, reveal the presence of earths, etc., in the former which are not found in the latter; a difference due, in the judgment of the committee, to the accumulation of dust, etc., rather than to artificial treatment of the antique, as has been suggested. A modern bust, simply exposed in the air for seven years, was covered with dust and vegetation, preventing the recognition of the metal beneath; while another, which had been daily sprinkled with water, and gently rubbed monthly with olive-oil, acquired a patina, noticeable for its beautiful dark greenish-brown tint, as well as its transparency. Of two others, subsequently exposed, one, treated twice a year with olive-oil, in addition to daily sprinkling with water, was greatly superior in brilliancy and clearness to the other, which had been simply sprinkled; so that mere cleansing in the way indicated seems highly beneficial. Two bronzes that had been artificially coated with patina, and subjected to similar treatment for several years, presented so satisfactory an appearance as to incline the committee to recommend the use of artificial patina.—14 *C*, 1872, CCVI., 200.

WATER-PROOF PASTEBOARD.

One of the cheapest and most effectual coverings to render wood perfectly water-proof and increase its durability, and which will impart to pasteboard the appearance and strength of wood, is that employed in many ways by the Chinese, according to tests made with a sample sent from Pekin by Dr. Scherzer. It may be prepared, as a slightly viscid fluid fit for immediate use, by stirring into three parts of fresh serum of blood (or defibrinated blood) four parts of dry-slaked lime and some alum. It should be laid on twice, or at most three times, in order to render articles perfectly water-proof.—10 *C*, *September*, 1872, 138.

TREATMENT OF HAIR FOR FELTING.

Nitrate of mercury has for a long time been used in preparing hair for felting, in the manufacture of felt hats, etc.; and numerous cases of poisoning are on record among the twenty to thirty thousand Europeans engaged in this business. According to M. Hilairet, if the skins be impregnated with a neutral substance, such as molasses, dextrine, or sugar, and then placed in nitric acid, the hair undergoes a change of structure by the action of the nitrous and hyponitric acids thus developed, corresponding exactly to that obtained by means of a solution of mercury in nitric acid.—15 *A*, *April*, 1873, 281.

REMOVAL OF OILY MATTER FROM WOOL, ETC., BY HYDROCARBON VAPOR.

According to Simonin and Coffin, by passing vapor of any of the light hydrocarbons produced in the rectification of petroleum (as naphtha, etc.) through wool, horse-hair, feathers, etc., placed on suitable open frames, it will take up the oily matter, and retain it in solution after condensation. By distilling this solution, and either passing the vapor through fresh portions of wool, etc., or condensing it, the oily matter is left as a residue, which can be purified and utilized. Treatment with vapor is more effective than with liquid hydrocarbon, since it comes into more intimate contact with the substance to be purified.—13 *C, September* 1, 1872, 1163.

REMOVAL OF GUM FROM SILK.

Formerly raw silk was boiled in bags in a solution of soap, whereby its gloss was frequently injured. Afterward this process was modified by exposing the silk to the action of steam, after having been impregnated with Marseilles soap. The removal of the gum from raw silk has since then been still further simplified, and requires neither boiling nor steaming. The silk, suspended upon sticks, is moved about for a quarter of an hour in a hot bath, containing a quarter of a pound of soap for every pound of silk, and then treated in the same way in a second bath containing only one fifth of a pound of soap for a pound of silk. Simple as this proceeding is, it has, nevertheless, been found successful in rendering the silk soft, smooth, and of higher gloss.—18 *C*, 1872, xx., 409.

IMPROVED FLOUR PASTE.

Paste which will keep unchanged in warm or damp weather may be made in the following manner: Put a teaspoonful of powdered alum in two quarts of water, and let it boil. Mix a pint of flour smoothly into a pint of cold water, and stir it into the boiling alum water, continuing the boiling and stirring until the flour is cooked, and the whole is clear, like starch. Add to this about half a teaspoonful of essential oil of cloves or cinnamon, strain through a wire gauze or perforated tin strainer, and bottle in wide-mouthed jars, which should be corked to keep out dust.

PROCESS FOR BLEACHING RAPE, POPPY, AND LINSEED OILS.

Puscher states that by mixing 220 pounds of these oils intimately with 4½ pounds of a mixture containing equal parts, by weight, of 96 per cent. alcohol and oil of vitriol, they do not become partially resinous, as when oil of vitriol alone is used, but the sulphethylic acid mixes perfectly uniformly with them. The green turbidity that soon appears after a while becomes black, and, after standing twenty-four to forty-eight hours, forms a slight black sediment. Poppy and rape oils become perfectly clear; linseed-oil in thick layers retains a trace of yellow. The oils, after being drawn off from the sediment, must be thoroughly shaken with several quarts of hot water, to free them from traces of sulphuric acid, and then be allowed to settle.—9 *C*, *December*, 1871, 186.

SIDERIN-YELLOW.

The addition of a hot, saturated solution of bichromate of potash to a neutral solution of sesquichloride of iron produces, after heating for some time, a fine yellow precipitate of a basic chromate of sesquioxide of iron of definite constitution, which, when washed and dried, may be used, under the name of siderin-yellow, as a pigment, free from lead, and unaffected by light and the atmosphere. This is not only suitable for an aquarelle and rapidly drying oil color, but, when intimately ground with water-glass, it forms a coating that dries rapidly, and hardens like cement into a stony incrustation, which running water does not affect. With ultramarine it gives a green pigment of similar properties. The following proportions are based upon the chemical reactions which take place in the preparation: Crystallized sesquichloride of iron, 433 parts, and bichromate of potash, 1473 parts. After a long boiling of these constituents together in water, 378 parts of the basic chromate of the sesquioxide of iron, or siderin-yellow, separate, while 90 parts of water of crystallization are liberated from the sesquichloride of iron, and 1049 parts of chromochloride of potassium remain in the aqueous solution, with 389 parts of chromate of potash.—13 *C*, *November* 1, 1872, 1432.

GRENADE, A NEW DYE-STUFF.

A secondary product of the manufacture of fuchsine, employed for some time in dyeing woolen goods, under the names of cerise, aniline, orseille, etc., has of late contained impurities in the form of insoluble foreign substances, which has suggested the effort to render it sufficiently pure to warrant its use with the finer fabrics. A dye-stuff, named grenade, has been produced at the factory of Knosp, in Stuttgart, which is said to give a pure garnet-brown, free from the dirty bluish-red tint of cerise and other substances substituted for archil, and which, by combination with picric acid, turmeric, etc., can be made to give any shade of brown. The brilliancy of the color surpasses that of genuine archil. It is applicable to woolen, cotton, silk, leather, and wooden articles, by use of different mordants, and is practically cheaper than cerise, by reason of low first cost, and absence of insoluble residue. Dr. Reimann predicts for it a permanent place among dye-stuffs.—5 *C*, 1872, XXXVII., 294.

NEW DYES.

Reimann, in his color journal, *Färber-Zeitung*, makes mention of several new colors invented by Schlumberger, of Brussels. He calls attention to the fact that this establishment was the first to introduce xanthine, which has recently come so much into vogue. It is especially applicable for coloring leather, for which it is greatly used. Other colors for dyeing leather are what he calls Russian red and pomegranate red. Another color from the same house is known as Tournay red. The latest invention is an alkaline blue, of which a specimen is given in the journal referred to.—24 *C*, 1872, XXXIX., 306.

ACTION OF APPLE-JUICE IN FIXING COLORS.

A cotton-dyer and printer in Manchester claims to have made the discovery that apple-juice has the valuable property of perfectly fixing the colors of printed cotton fabrics. —21 *C*, 1872, VII., 111.

ALUM IN MORDANTING WOOLENS.

According to Harvey, the successful use of alum for mordanting woolens depends upon the employment of a weak solution and a small quantity of alum; since, with a large quantity, the alumina hydrate deposited in the fibres is redissolved, and the woolen is not so easily nor so deeply colored as when small quantities are employed. The amount of alum recommended by Harvey is one tenth of that of the woolen to be colored. Even after washing the woolen with weak nitric acid solution, to remove from the water any alkali derived from the soap or lime, a decomposition of the alum sometimes takes place, and alumina hydrate is deposited in the fibre of the material, this decomposition evidently having been caused by the fibre of the woolen itself.—21 *A*, *February*, 1873, 206.

AN EBONY STAIN FOR WOOD.

Apple, pear, and walnut wood, especially of fine grain, give perfect imitations of ebony under the following treatment: Boil in a glazed vessel, with water, four ounces of gall-nuts, one ounce of logwood chips, half an ounce of vitriol, and half an ounce of crystallized verdigris; filter while warm, and brush the wood with the hot solution a number of times. The wood, thus stained black, is then to be coated two or three times (being allowed to dry completely after each coating) with a solution of one ounce of pure iron filings in a quart of good wine vinegar. This is to be prepared hot, and allowed to cool before use.—16 *C*, VI., 6 and 7, 104.

SPECKS IN COCHINEAL DYES.

It has long been noticed that fabrics colored with cochineal are apt to exhibit black specks, which have been ascribed to the presence of iron. According to Guignet, however, these are due to the formation of a carminate of lime, which occurs in the form of black powder, insoluble in water. This salt, of a red color, is soluble in acetic acid, without decomposition; and appears, on the drying of the solution, as a black residuum.—3 *C*, *November* 25, 1872, 1152.

EXTRACTION OF RAPE-SEED OIL BY BISULPHIDE OF CARBON.

The removal of the oil from rape seed by means of bisulphide of carbon, according to Fischer, of Riesa, depends materially on several conditions to produce satisfactory results. If the seeds are not properly crushed, the bisulphide can not act; and, if powdered, they stop up the tubes, stop-cocks, etc., of the apparatus. Old seeds require more power in crushing than fresh ones, and in all cases it is advantageous to employ heavy rollers. The extraction is most complete from dry, fresh seeds; less so from moist, unripe, or very old seeds. According as the time employed in extracting varies from one to ten hours, the amount left in the meal may vary from one to three per cent. Temperature also demands attention, since the bisulphide, at 43° Fahr. and under, has little solvent power, and at and above 68° Fahr. may produce a tension that would seriously interfere with the operation. Finally, the degree of freedom of the bisulphide from water is of importance, since moisture imparted to the seed hinders the penetration of the bisulphide itself.—13 *C*, *Dec.*, 1872, 1567.

PREVENTING EXPLOSIVENESS OF PETROLEUM.

The great extent to which various mineral oils are used for purposes of illumination or lubrication, and the consequent increase of accidents from their employment, has made it very desirable to devise some method by which they can be made more or less innocuous, and Mr. Jordery suggests a method which he maintains to be satisfactory, and applicable in many cases. He claims to have ascertained that a small quantity of soap-wort powder (*Saponaria*), when mixed with petroleum, will produce an emulsion resembling thick glue, which flows with great difficulty, and will not penetrate through the cracks of badly joined vessels. Although it may ignite on contact with flame, this is only the case with the lighter and more volatile oils, and the flame is then feeble and easily extinguished, and there is no tendency to explode.

To secure this result, Mr. Jordery takes a given bulk of an aqueous extract of soap-wort powder, and adds it, little by little, to the petroleum oil, stirring it continually. The operation is entirely similar to that used in producing any kind of emulsion, or in making mayonnaise for salad dressing, which, as is well known, solidifies large quantities of olive-oil. A quantity of oil equal to thirty times the volume of the extract of soap-wort employed can thus be used in the emulsion. The product obtained is consistent and stable, and is not disturbed by the ordinary motion to which oil is subjected in transportation or in warehouses, and is said not to be altered in the least by the amount of water combined with it. In the case of the crude oils, the powder itself, without the aqueous extract, is sufficient to produce the desired emulsion. Nothing is easier, according to Mr. Jordery, than to restore the oil, thus prepared, to all its limpidity and its primitive qualities. For this purpose it is only necessary to allow a few drops of carbolic acid to fall upon the surface, or a still larger amount of crystallizable acetic acid. The separation commences immediately; and, without the necessity of interfering with it at all, the petroleum, with all its original properties, very soon re-appears, clear and limpid, floating above the watery extract which occupies the bottom of the vessel. It is calculated that at the expense of about $3 per 100 pounds, for which sum the soap-wort can be purchased, the increase in the price of the petroleum consequent upon the employment of this process will be almost inappreciable. —9 *B*, *July* 25, 1872, 598.

PETROLEUM OILS AND CARBOLIC ACIDS.

Petroleum and the many products derived from it are at present so extensively used that it is of great importance to have a fixed standard by which to judge their money value, as well as their applicability to the intended purpose. The light oils, or so-called naphthas, greatly differ in their degree of volatility; while safety and efficiency in their manifold applications frequently depend on this quality. In order to secure consumers against deception, a large chemical establishment, in Brunswick, has divided these naphthas into five classes, ranging from a specific gravity of 0.65 to 0.75, and a boiling-point from 104° to 338° Fahr. The quality in every case is guaranteed, and the price conforms to it. The value of carbolic acid — now so much in demand as a disinfectant —depends on the amount of phenol contained in it, which is very variable in different specimens. The same manufacturers accurately ascertain the percentage of phenol in their products, and regulate the price absolutely in proportion, so that a hundred-weight of carbolic acid with 100 per cent. of phenol costs about $12; while the same quantity, containing only twenty per cent. of phenol, is sold for about $2 50. By thus giving definitely the amount of the active principle, the economical and successful use of the article is greatly facilitated, and the practice of demanding a certain price for the mere name of a thing—irrespective of its intrinsic value—is done away with.—8 *C*, 1872, XXIX., 232.

AQUEOUS SOLUTIONS OF SHELLAC.

According to Walzan, an aqueous solution of shellac may be made by breaking it up and covering it with a concentrated solution of carbonate of ammonia, boiling it upon a water-bath until the ammoniacal smell has entirely disappeared. More of the solution is then added, and the boiling continued until the shellac forms a coherent, sponge-like mass. The carbonate of ammonia is then expelled by further boiling, and the mass will readily dissolve by pouring boiling water upon it. A kind of soap will be found floating upon the surface, which may readily be removed by straining. The solution spread on paper, etc., dries rapidly, and leaves a thin, lustrous, adherent film of shellac.—3 *A*, *October* 5, 1872, 282.

RUBBER-GRAPHITE PAINT.

A so-called rubber-graphite paint has recently been patented, said to be water-proof, and to present another advantage in reducing the corrosive influence of exposure to the atmosphere, etc. It is a solution of pure India rubber in linseed-oil, which is ground with graphite into a thick, elastic, smoothly flowing paint. Compositions of which India rubber forms a part possess in a very high degree the quality of resisting the action of moisture and of corrosive gases. The graphite is a pure form of carbon, and it is well known that paints containing carbon last longer than other kinds, holding their body and color when other paints are totally destroyed. Hence the combination may, as suggested, form a paint of great durability and highly protective qualities. Cream-color or drab paints can be obtained by this method. —16 *A*, *October*, 1872, 538.

UTILIZING WASTE RUBBER.

By melting down the waste clippings, etc., of hard rubber, and dissolving the mass, when cold, in benzole or spirits of turpentine, an excellent varnish may be made, which dries rapidly, adheres firmly to metals, and is well adapted for electrical apparatus.—15 *C*, 1872, xix., 300.

VARNISH FOR BASKET-WARE.

The following varnish for basket-work is said to dry rapidly, to possess sufficient elasticity, and to be applicable with or without admixture of color: Heat 375 grains of good linseed-oil on a sand-bath until it becomes stringy, and a drop placed upon a cold, inclined surface does not run; then add gradually 7500 grains of copal oil varnish, or any other oil varnish. As considerable effervescence takes place, a large vessel is necessary. The desired consistency is given to it, when cold, by addition of oil of turpentine.—15 *C*, 1872, XVIII., 287.

CEMENT OF CHALK AND SOLUBLE GLASS.

If fine chalk be well stirred in soluble glass, a cement may be produced which will harden in the course of six or eight hours. The additions of powdered sulphuret of antimony will give rise to a black mass, susceptible of a high polish, and capable of receiving a fine lustre. Fine iron-dust gives a gray-black mass of great hardness. Zinc castings can, it is said, be readily repaired by a paste of soluble glass and zinc dust.—1 *D*, *March*, 1873, 156.

FUCHSIN FOR PREVENTING PUTREFACTION.

According to Lanjorrois, one of the best methods for preventing the putrefaction or decomposition of animal substances, even when exposed to the air and to a high temperature, consists in the addition of one-hundredth part either of fuchsin or of aniline violet. Among the numerous specimens submitted by him to the Academy of Sciences was a solution of gelatine which had been kept for eleven months, and was still fresh. The author remarks that flesh preserved in this manner has no waste, and when cooked is without odor, and has the taste of fresh meat. Nevertheless, as aniline is believed to be quite poisonous in its character, it would be hardly safe to use it for any thing intended to be subsequently eaten. And, again, the coloring effect of the material would doubtless constitute an objection to its use in the arts; and it is a question, after all, whether carbolic acid in an equal amount will not have the same result in a still more decided degree.—3 *B*, *March* 13, 1873, 445.

ANTIPUTRESCENT QUALITIES OF SILICATE OF SODA.

In a communication by Champouillon to the French Academy, upon the therapeutical and antiputrescent properties of silicate of soda, it is stated that fœtid pus, coming from an ulcer of the thigh, and treated by silicate, became coagulated, and lost its odor to a very great extent. A concentrated solution of the silicate was found to destroy all the microscopical bodies in animals or vegetables, which seem to be associated with the propagation of infectious diseases. It takes hold of and solidifies the mucilage, gum, mucus, and albumen of the organic liquids. It also protects the surfaces against the absorption of poisonous external agents, renders suppurations wholesome, and neutralizes the infectious elements of cutaneous diphtheritis, so apt to follow the application of blisters in crowded hospitals. It also has a very happy effect in the treatment of ulcerous chronic diarrhœa.—6 *B*, *February* 10, 1873, 343.

ADULTERATION OF BONE-DUST BY VEGETABLE IVORY.

It has been ascertained that the powder of the vegetable ivory-nut is used very largely for the adulteration of bone-dust, being so similar as to be very difficult of distinction. Even the microscope scarcely furnishes a satisfactory means of determining the facts in the case, especially if the external envelope of the fruit has been carefully removed. The best method, however, short of chemical analysis, is said to consist in throwing the suspected substance upon hot coals. If vegetable ivory be present, a pleasant odor, like that of roasted coffee, will be immediately diffused, while bone-dust yields a disagreeable animal odor. The precise proportion of the two substances can only be determined by chemical analysis.

ELECTRO-STANNUS METHOD OF PLATING.

A recently invented mode of plating, known as the electro-stannus process, consists in the use of a cheap white metal, of which tin is the principal ingredient, and which can be readily deposited galvanically upon all metals excepting zinc. The articles to be plated are first thrown into a bath of weak sulphuric acid and water, and then into a second strong bath of boiling potash lye, when a complete chemical cleanness is effected. They are then suspended in a vat containing a solution of metal, and, having remained there a sufficient length of time, they are "scratched" by a rapidly revolving wire brush, when they are ready to return to the customer.

In emerging from the vat, the articles are of a dull leaden color; but they are susceptible of a high polish, very little short of that of polished silver. One of the chief advantages of the new method is that it obviates the liability of iron and steel goods to rust, and it is proposed that where articles are to be silver-plated, a white under-coat shall be first given by means of this new material, so that when the silver wears off it will show the silver-white appearance beneath.

The process is now being applied to coating various substances, such as harness-fittings, spurs, bedstead-springs, sewing-machines, gas-fittings, locks, keys, etc.—8 *A, December* 2, 1872, 185.

HOT-GILDING OF IRON.

The process of hot-gilding of iron, and similar metals, has been lately much simplified by Kirchmann, who produces gilt designs which are very uniform, and which bear polishing. This is done by rubbing the surface with soda-amalgam (which amalgamates it immediately, even if the surface be oxidized), and then quickly applying a concentrated solution of chloride of gold, and expelling the mercury by the heat of a lamp or furnace. Similar results may be obtained with platinum and silver salts.—13 *C, December* 15, 1872, 1624.

PYRO-PLATING.

The term pyro-plating has been applied to a method of coating one metal with another by the action of heat, to distinguish it from the electro-plating, close-plating, and amalgamation processes; the peculiarity being that the coating, after deposition, is driven into the surface of the metal by the aid of heat and atmospheric pressure. It is used, therefore, wherever the other processes indicated are unsuited or impracticable, and is applicable not only for coating with silver, but also with gold, platinum, aluminium, copper, aluminium-bronze, etc.

The object to be coated must be rendered chemically clean, this being effected in various ways, according to the metal to be operated upon. Thus articles of iron or steel are first boiled in caustic alkali, and then cleaned, under water, with emery and wire brushes, and finally by generating nascent hydrogen upon the surface, the articles being suspended in a hot alkaline solution, and made the negative pole of a somewhat powerful battery. When perfectly clean, they are transferred to the plating bath, and the proper amount of metal is deposited upon them in the usual way.

The peculiar stage of the process consists in submitting the articles to the operation of firing. For this a bright red heat is commonly employed, at least for articles that do not require tempering. For cutting instruments the heat is more carefully watched, and not allowed to rise above 450° or 500° Fahr. When the articles have attained a proper temperature, they are withdrawn, and instantly quenched in cold water.—21 *A*, *November*, 1872, 1045.

TESTS FOR GILDING.

According to P. Geyot, if a gilt surface be touched with a drop of chloride of gold or nitrate of silver solution, the former will produce a brown, the latter a gray spot, if the coating be an alloy, but will have no effect upon pure gold. For gilt paper, moisten with a drop of chloride of sulphur, which will immediately produce a dark-brown margin, if the covering is not pure gold. Metallic spangles, shaken in closed flasks with chloride of sulphur, suffer no change, if gold, otherwise they gradually darken; while under a slight pressure, as in hermetically sealed tubes, gold spangles disappear in a short time by conversion into chloride of gold.—13 *C*, *December* 15, 1872, 1624.

COATING FIBRES WITH SILVER.

A new industry has lately sprung up in England, which has already attained considerable development, namely, the silvering of any given animal, vegetable, or mineral substance for ornamental purposes. For this purpose two solutions are necessary: the first, composed of quicklime, two parts; grape-sugar or honey, five parts; tartaric acid (or, for want of this, gallic acid), two parts; and water, 650 parts. This is to be filtered, and the solution placed in bottles, to be entirely filled and thoroughly sealed, so as to prevent any action of the air. For the second solution, twenty parts of nitrate of silver are to be dissolved in twenty parts of ammonia, and the solution diluted with 650 parts of distilled water. At the moment of using, the two liquids are to be mixed in equal parts, and shaken carefully together, and then filtered. To silver wood, silk, hair, wool, or flax, or other fibres, they are first carefully washed, and immersed for a moment in a saturated solution of gallic acid, and then in a solution of twenty parts of nitrate of silver in 1000 parts of distilled water. This double immersion is to be repeated until the appearance of the fibre is of a fine silvery color. It is next to be immediately placed in the mixture of the two first-named solutions until it is perfectly silvered, and then in a solution of carbonate of lime, washed, and allowed to dry.

In the case of bones, leather, and other similar substances, the solution may be applied with a brush, instead of immersing the article in it. Earthenware, etc., must be coated with stearine or varnish before the application of the silver solution; and when the articles are porous, even a coating of soluble glass should be first applied. Ordinary glass or porcelain is to be carefully cleaned with distilled water or alcohol, and then treated with a mixture of the first-mentioned solution, which is to be kept in a dish of earthenware or gutta-percha. The deposit of silver begins after a quarter of an hour, and continues for several hours. The object is then to be washed with distilled water, allowed to dry, and covered with a protecting varnish. If the object be slightly heated, it will accelerate the deposit of the silver.

Metallic articles should be first cleaned with nitric acid, and afterward rubbed with a mixture of cyanide of potassium and silver powder, then washed with water, and immersed in the above-mentioned solutions, Nos. 1 and 2, until they are sufficiently silvered. Iron, however, must previously be immersed in a solution of sulphate of copper.—5 *C*, 1872, XLIII., 344.

PROCESS OF SILVERING GLASS VESSELS.

Dissolve 61¾ grains of nitrate of silver and 38½ grains of aldehyde-ammonia in separate parts of 1¾ pints of distilled water, mix the solutions, and filter. Cleanse the article to be silvered from every trace of grease by washing with a solution of carbonate of potash, rinse with alcohol and with water in succession, fill it with the silvering solution as high as it is to be silvered, and hang it in a water-bath. The latter must be heated very gradually. When the temperature of the water reaches 122° Fahr., the silver begins to separate, and little time is then required to complete the deposit. At first, while thin, the film appears dark, but increases in brilliancy until a beautiful silvered surface is produced, when the object must be removed, emptied, and washed with distilled water, or its brilliancy may be impaired. The aldehyde-ammonia may be prepared by passing dry ammonia gas through aldehyde.—1 *C*, 1872, XXI., 336.

METHOD OF GILDING GLASS.

The following simplification of Wernicke's process for gilding glass has been suggested by Professor Böttger, as exceedingly rapid, besides being economical, and adapted to ordinary temperatures. Dissolve the chloride of gold, obtained by solution of 1 gramme of pure gold in aqua regia, as nearly neutral as possible, in 120 cubic centimeters of pure water, and 6 grammes of caustic soda in 100 cubic centimeters of water. Prepare, as needed, a reducing solution of 2 grammes of glucose, 24 cubic centimeters of water, 24 cubic centimeters of 80 per cent. alcohol, and 24 cubic centimeters of commercial aldehyde (specific gravity, 0.870). To cover the interior of a tumbler, for example, with a brilliant film of gold, put into a separate glass four volumes of gold solution, add one volume of soda solution, and then one-sixteenth volume of reducing solution, and pour quickly into the tumbler to be gilded enough of the mixture to half fill it. Keep it in motion for several minutes, so that every part may be continually moistened.—5 *C*, 1872, XXXVI., 286.

COATING COPPER WITH IRON.

Professor Böttger states that ammonia-sulphate of iron, with suitable batteries, gives beautiful results in the electrical deposition of iron into thin films or thick plates, according to the process with double salts of iron described by him about twenty-six years ago. This has proved of great practical value in the preservation of engraved copper-plates from wear in printing, by covering them with a thin film of this peculiarly hard, steel-like iron.—15 *C*, 1872, XVIII., 274.

TEMPERING STEEL GRAVERS, DRILLS, ETC.

According to Schützleder, of Gösling, watch-makers temper the points of drills, etc., so that they can be used upon steel tempered in the ordinary way, by heating them to a white heat, and inserting them into hard sealing-wax, allowing them to remain but a second, then pushing them again into another part of the wax, and again quickly withdrawing, to repeat the operation in a fresh spot, until they are too cold to penetrate the wax. The tool is to be moistened with turpentine when used.—14 *C*, 1872, CCVI., 419.

WHITE METAL ALLOYS FOR MACHINERY.

An alloy of 90 per cent. of tin, 8 per cent. of antimony, and 2 per cent. of copper, has been found excellent for crank and connecting-rod bearings on the Moscow and Nishni railroad. On the Kursk-Charcow-Asow railroad an alloy of 78.5 per cent. of tin, 11.5 per cent. of antimony, and 10 per cent. of copper has been found very superior for pivots of all kinds, slide-valves, eccentrics, stuffing-boxes, etc. The Swiss Nordöstbahn Company, in ordering locomotives recently, required the following preparation as a composition for axle-journals: 10 parts of antimony added to 10 parts of melted copper, with 80 parts of tin added, and the alloy run into bars, to be remelted for use.—6 *C*, *November* 21, 1872, 468.

PURIFICATION OF CAUSTIC SODA.

The sulphur compounds present in caustic soda, prepared by lime on a commercial scale, are entirely removed by the simple and effective process of Helbig, of Gera, who uses a blast of air, instead of simply converting them into less objectionable sulphate of soda by the employment of saltpeter. The lye is evaporated as usual in iron kettles. When a certain degree of concentration is reached, the cyanogen compounds are decomposed, with effervescence and development of ammonia, as well as the separation of graphite. The scum then settles, and the mass becomes semi-fluid. The heat is increased until the mass is red-hot and liquid; air is then forced in through an iron tube passing through the cover and reaching to the bottom, with such violence as to keep the mass in agitation, and is continued until most or all of the sulphur is oxidized. Portions are withdrawn and examined during the operation. After settling, the caustic soda is removed as usual. The graphite that settles during the operation floats on the top, and may be removed; but since it is useless for pencils, paint, etc., it is generally allowed to consume.—14 *C*, 1872, CCVI., 375.

A NEW APPLICATION OF CENTRIFUGAL ACTION IN THE MANUFACTURE OF SUGAR.

It is claimed that Weinreich & Schröder have succeeded in the application of centrifugal action in the production of common sugar and purified loaf-sugar without the usual method of liquoring. In case of the loaf-sugar, a current of air, drawn in by the centrifugal action, and with which steam is mixed, is employed to aid in the removal of the last traces of sirup. The amount of sugar obtained is said to be larger, and ten hours to be sufficient, after concentration, to produce a marketable article. Time, labor, and storage-room are thereby greatly economized.—8 *C*, *September* 19, 1872, 303.

COATING PAPER WITH GRAPHITE, ETC.

The following process for coating paper with graphite has been patented by W. N. Lake, of London. Unsized paper, as in parchmentizing, is best treated with a mixture of two volumes of fuming sulphuric acid and one volume of water. As soon as the surface seems gelatinized, it is quickly removed, and sprinkled with graphite or other mineral substance, as emery, etc., on one or both sides; and then immediately immersed in water containing a little soda, and finally carefully dried. This process is also adapted to fabrics of vegetable fibre.—15 *C*, 1873, 14.

REMOVING ODOR OF SULPHIDE OF CARBON.

Sulphide of carbon is an important substance for many industrial purposes, but its disagreeable odor is very much in the way of its extensive employment. Quite lately a method has been devised for removing the odor, which is said to accomplish its object. To effect this, it is first to be shaken up with one per cent. of corrosive sublimate, this operation being repeated several times, after longer or shorter intervals. In this way certain sulphurets are produced, which cause the salt of the mercury to turn black. The liquid is then to be distilled, and that which passes over will have a much less disagreeable smell. If one third of its bulk of the oil of almonds be added, the result is very satisfactory. The sulphide, under these circumstances, emits a pleasant odor, somewhat like that of ether.—9 *B*, *August*, 1872, 621.

SEPARATING BRASS FROM FOUNDERS' SLAG.

An improved method of separating the brass from the slags of brass-founders consists in mixing the substance with limestone, coal dust, and oxide of iron, and subjecting the whole to a melting heat. The brass settles at the bottom of the melted slag, and can be drawn off in moulds.—6 *C*, *September* 19, 1872, 378.

REVIVIFICATION OF BONE-BLACK WITHOUT IGNITION.

Bone-black used in the manufacture of sugar may be restored to its original powers without the trouble and waste of re-ignition as generally practiced. For this purpose a two per cent. ammonia is employed, as suggested by Eisfeldt. The bone-black is subjected to the usual fermentation, or boiling with caustic soda, and washing, and placed on perforated bottoms in suitable iron vessels, and boiled with ammonia, by aid of steam. The ammonia vapor given off is condensed in worms, and used again. The boiling lasts about an hour, and is repeated, generally three times, until a test portion of the ammonia, evaporated almost to dryness, and heated with a few drops of caustic soda, does not turn brown—an indication that no more organic matter is dissolved by the ammonia. In avoiding the usual ignition, by this process, there is not only economy of fuel, but of the carbon of the bone-black, its active constituent, consumed in ignition. Besides, no reduction of sulphate of lime to sulphide of calcium takes place, to be taken up by the sirup, and produce dark-colored sulphides in contact with metals. Most of the muriatic acid is also saved, and all of the soda, in case of fermentation, at the cost of but little ammonia; and, since the bone-black is not acted on by ammonia, the waste is fifty to sixty per cent. less. The cost by this process, on the whole, is only about two thirds of that by the old one, while the purification may be made so thorough that the filtration of the sirup is far better.—14 *C*, 1872, CCVI., 405.

IMPROVEMENTS IN GLASS-SPINNING.

Recent improvements in glass-spinning by Brunfaut, as set forth in a communication of Professor Herrmann, promise to develop a new branch of industry. Prolonged experiments led to the discovery of a compound which affords threads surpassing in fineness even the single cocoon fibres, and apparently as soft and elastic as silk. This substance has been applied to a variety of uses; but on account of the skill required in the workman, and the fatiguing character of the labor, especially to the eyes, the articles may as yet be classed as curiosities. When felted, it forms excellent material for chemical filters. It is adapted to figures for brocades, etc., and to the manufacture of clothing, ornaments, furniture covers, curtains, carpets, lace, collars, etc., and can be used in knitting and embroidering. In softness, the articles approach silk, and in the feel, the finest woolen, while they are warmer than the latter and exceedingly light. They are comparatively free from mechanical wear, and are not affected by light, heat, moisture, nor acids, and, by reason of their incombustibility, are peculiarly adapted to ladies' garments. The annexed prices of a few articles will indicate the present stage of the manufacture: Cuffs, \$1 15; collars, 50 cents to \$2 50; watch-chains, 25 cents to \$1; ladies' hats, complete, \$4 75 to \$26.—15 *C*, 1873, 9.

OIL FROM BIRDS.

Few persons realize the extent to which the oil obtained from birds enters into trade, or are aware of the amount of destruction of life caused by this business, threatening the extermination of some, at least, of the species. Among these we may mention the Fulmar (*Fulmarus glacialis*), which breeds in the Hebrides, on St. Kilda, and in various other portions of the northern hemisphere. The inhabitants of these islands, during the season when this bird can be most readily obtained, devote much of their time to its capture, using the flesh as food, and preparing the fat for its oil.

This is of a bright red color, with a penetrating odor, and has many of the physiological and chemical properties of cod-liver oil. It has a specific gravity of 0.992, is soluble in ether, and slightly so in boiling alcohol, but much less in cold alcohol. It contains a trace of iodine, and, with sulphuric acid, gives the color-test of cod-liver oil. Soap made from it has a peculiar smell.

It is from the Penguins, however, that the largest supply of oil is obtained, especially in the Falkland Islands; numerous vessels, manned by from ten to fifteen persons each, being occupied during the season in capturing the birds and securing the oil. A single schooner has been known to procure 25,000 to 30,000 gallons in the course of from four to six weeks. Eleven birds furnish about a gallon of oil, so that the cargo of this vessel involved the destruction of more than 275,000 birds. The oil is sent to London, and used solely for dressing leather.

The Dusky Petrel (*Puffinus obscurus*), sometimes called the Mutton Bird, from its great fatness, is also hunted in New Zealand, and other localities in the Pacific, on account of its fat. The oil will run out of the mouth of the young birds when squeezed. This oil has been used as a liniment for rheumatism, and answers well for illuminating purposes. It is said to be very similar to goose fat. Other species of the petrel family, as also the Frigate Pelican (*Tachypetes aquilus*), are hunted for the same purpose. The fat of the Ostrich (*Struthio camelus*) is likewise saved by the hunters, and eaten on bread, as a substitute for butter. It also has a local reputation as a remedy for rheumatism and in bilious affections. The Cassowary is prized for the same purpose. A peculiar kind of goat-sucker found in Trinidad and Venezuela (the *Steatornis caripensis*, or Fat Bird) derives its generic name from its immense accumulation of fat under the skin, for which it is hunted by the Indians.—2 *A, Feb.* 1, 1873, 95.

IMPROVEMENT IN MANUFACTURE OF PAPER PULP FROM WOOD.

In the chemical methods (especially those of Sinclair and Tessie de Motay) for converting wood into pulp for paper (admitted to be superior to the mechanical methods on account of the economy of power, and the non-requirement of a prolonged beating so injurious to toughness of the stuff), high pressure, up to fourteen atmospheres, and a strong soda solution are required, together with subsequent beating, and consequent reduction of tenacity below that of rag stuff. Ungerer now claims from experiments in his laboratory (to be followed up by tests in a mill, in course of construction, and intended to turn out 50 cwt. daily), that it is possible to dispense with the costly process of mechanical comminution of the wood, and to get along with a steam pressure of but five to six atmospheres, as well as with half the amount of soda, and one fifth the chlorine required by Sinclair's process. The conversion of the wood is so complete that subsequent beating is unnecessary, and not only is mechanical power economized, but a reduction in tenacity of the stuff avoided, and the addition of rag stuff rendered unnecessary. It is also claimed that twenty-eight per cent. more of the soda can be recovered. In addition to simplicity, avoidance of high pressure, and cheapness, it is stated that the process is not confined to the manufacture of paper, but that it is adapted for preparing hemp, flax, etc., without the preliminary operations of rotting, breaking, etc.—16 *C*, 1872, VI., 8 and 9, 137.

CERESINE.

Among other substances recently introduced to notice is one called ceresine, which is obtained near Vienna and elsewhere, in combination with ozokerite or fossil wax. By heating the latter to 572° Fahr. in a distilling apparatus, a viscid oil, which becomes condensed, is driven off. After cooling the oily mass to about 158° Fahr., sulphuric acid is to be added, and the mixture digested until the carbonaceous matters are separated. By a succession of manipulations unnecessary to mention, the last of which consists in filtering it hot through animal charcoal, ceresine is obtained—white, semi-transparent, or opaline, and strongly resembling ordinary white wax or paraffine; without odor or taste, melting at about 140° Fahr., with a specific gravity of 0.88, insoluble in water, but soluble in alcohol. Candles can be made from this of a hardness equal to that of stearin, burning with a beautiful white light, very lustrous, and having twenty per cent. more illuminating power than stearin. It will not form a soap with alkalies, but may be mixed in all proportions with wax, and, when the two are melted together, it is impossible to separate or distinguish them. It is now used for various pharmaceutical purposes in Vienna for which wax would be employed, among them unguents of all kinds. Indeed, for any purpose it is fully equal to wax or stearin. Notwithstanding its valuable qualities, the price, by the present mode of manufacture, is much less than that of wax, stearin, or paraffine, being scarcely more than one fifth that of the first-mentioned substance.—9 *B*, *November* 19, 1872, 37.

LEATHER GLUE.

A substance known as "leather glue" is prepared by mixing ten parts of sulphide of carbon with one of oil of turpentine, and adding enough gutta-percha to thicken the mass. The leather surfaces to be united must be freed from oil, which is accomplished by subjecting them to pressure by laying the leather upon blotting-paper and applying a hot iron. After tacking together the edges to be joined with the cement, they are to be kept under pressure until the glue is entirely dry.—15 *C*, 1872, XXII., 352.

IMPROVED ELASTIC BANDS.

The ordinary elastic bands, with rubber threads woven into them, lose their elasticity in a short time by action of the atmosphere; but bands free from this defect, and at the same time more elegant and stronger, are made at no greater cost by causing two strips of cloth, previously coated on the inner surfaces with a solution of India rubber in benzine, and with a band of stretched gum threads or a gum band inserted between them, to pass through rollers, compacting the three by this pressure into a firm fabric.—25 *C*, XLV., 362.

THE SPONGE TRADE.

According to the "Report on Commercial Relations for 1871," sponge is exported from Nassau to the United States, England, and France. Within the last two years the greater portion has come to the United States.

About 500 vessels are engaged in "sponging," and 4000 men find employment. The several qualities are shipped under the names of sheep-wool, glove, fine reef, velvet, yellow, and grass sponge. The grounds from which the sponge is taken are east, west, and south of Nassau; the finest being taken from William's Cay, Andros Island. These last are used for surgical purposes, and are exported to the United States, as Europe is supplied from the Mediterranean.

The sponge obtained at Abaco is exported to France; the same quality being found at Key West, the American market is supplied from the latter place.—*Commercial Relations*, 1871.

PREPARATION OF FRENCH CHALK.

The substance generally known as French chalk, used by tailors for making marks upon cloth, is manufactured by rubbing up ultramarine, ochre, etc. (according to the color desired), with pipe-clay softened with water. The mixture is then poured into moulds, and dried in a slightly heated room. —21 *A*, *December*, 1872, 1142.

YELLOW COLOR OF SILK.

Pfeiffer informs us that the yellow color of silk is a more or less altered chlorophyl, which has been deprived of its blue color. He succeeded in extracting uncolored chlorophyl from the raw silk, which, when heated with ether containing hydrochloric acid, could be again divided into the blue and yellow constituents.—13 *A*, *February* 15, 1873, 70.

SILK WITHOUT THE SILK-WORM.

It is said that the Italian manufacturer, Marasi, has patented a very simple process for the production of silk from the bark of the mulberry-tree, in which chemical agents previously unsuccessfully employed, such as soda, lime, etc., are dispensed with. Fibres are said to be obtained entirely free from parenchyma, and resembling in color, appearance, fineness, and strength a specimen of Moorish silk. Similar statements have, however, heretofore proved unfounded. — 8 *C*, *January* 16, 1873, 22.

IMPROVEMENTS IN THE MANUFACTURE OF SILK.

In an account of the progress of silk manufacture, by Alcan, the two following items seem of particular interest:

It occurred to Alcan to simplify the process for killing the worms in the silk cocoons, by employing a volatile substance (camphor) instead of steam, which is generally employed in European countries, at a risk of loss by subsequent rotting, etc., unless the cocoons are carefully and thoroughly dried.

About 40 pounds of cocoons were transported from Southern France to Paris, in a box in which a small quantity of camphor had been placed, and on the crevices of which paper had been pasted. Although the transportation, with the greatest dispatch, occurred at a season of the year when the temperature was favorable to the metamorphosis, upon opening the box, several weeks after its arrival at its destination, not a single butterfly was found; all the cocoons were perfectly sound, and the worms had assumed mummy-like properties, were black and hardened, and occasioned no stain of any kind. Practically, no appreciable amount of camphor had been volatilized. This experiment certainly shows that this method of transporting cocoons merits consideration.

The great defect in the processes for unwinding the cocoons, which in so many ways affect the quality and quantity of the product, lay in the necessity of employing water of a high and uniform temperature, originally maintained by direct application of fire, but since 1810, indirectly, by use of steam. In the last two or three years, Limet, a manufacturer of Cosne, introduced a new process, involving the alternate and also combined use of steam and water. By one stop-cock steam is first admitted, in order to soften the cocoons; by opening another, they are then saturated with water; in this condition they would sink; but, by opening a third stop-cock, the water is forced out by the pressure of the steam, the cocoons swell and float again, and the unwinding is accomplished with the greatest ease. The quality of the silk is improved in many respects, the amount of waste diminished, and labor economized.—6 *C*, *September* 5, 1872, 353.

PRESERVATION OF HAIRS FOR THE HATTER.

A method of treating animal hair for the uses of the hatter, which has been kept secret for a long time, is now known to consist in the application of a solution of the nitrate of mercury for the purpose of preventing the putrefaction of the fibre. This substance, however, is known to be very deleterious both to the health of the workmen and to the implements of the trade; and, quite recently, carbolic acid or creosote has been used to great advantage as a substitute. This has the property not only of preserving the animal matter, but of causing the hairs to contract, thus rendering them more apt to felt. The subsequent treatment of the fibre is according to the usual process, and the carbolic acid (or the carbolates, if preferred) may be added to the oleaginous or astringent elements used by hatters.—9 *B*, *July* 25, 1872, 607.

MATERIAL FOR MOULDINGS.

According to Mr. C. Muratori, of London, a compound of alum, glue, and sawdust offers a convenient material for ornamenting furniture or other wood-work. It is easily moulded, and by drying becomes so hard that it readily takes a high polish.—15 *C*, 1872, XIII., 208.

MICRO-CHEMICAL INVESTIGATION OF FIBRES.

A valuable contribution to the methods for determining the character of different fibres, animal and vegetable, has lately appeared in an inaugural dissertation presented to the University of Zurich by Albert Schleseniger, upon what he calls microscopical and micro-chemical methods of investigation. After mentioning the peculiarities of fibres, he gives tables of the reactions of the different coloring matters; for instance, dividing the vegetable fibres into three groups, namely, those which are colored yellow, brownish-yellow, or reddish-yellow, by iodine and sulphuric acid; those which are colored green; and, third, those which are colored blue by the same chemicals.

A similar arrangement is followed in regard to the animal fibres. The whole memoir is full of important suggestions, which can doubtless be readily turned to practical account. —*Inaugural Dissertation of Albert Schleseniger.*

PEH-LAH WAX OF THE CHINESE.

One of the most interesting articles of commerce in China consists of what is called peh-lah wax, or insect wax, an exudation from certain trees, particularly a species of *Rhus* and *Ligustrum*, formed in consequence of the puncture of the branches by a species of *Coccus*. These insects are white when first developed, but when they yield their wax are red, and attached closely to the branches of the trees. At first they are about the size of a grain of rice; but after the wax is produced, the accumulation is as large as a hen's egg. The insect commences to secrete the viscous substance in the spring, this taking the form of a silky down, which thickens and hardens. In August or September the balls hang like grapes, which are gathered by detaching them with the fingers, and after being dried in the sun they are purified and refined. This wax is in general use in China and Japan, where large tracts of land are planted with the trees referred to, upon which the insects are reared. The insect is propagated by means of its eggs, which are collected in clusters in the shells of the balls. As met with in commerce, the peh-lah wax is nearly pure, and melts at 190° Fahr. It is sold in cakes of a circular form, and of different sizes. It dissolves easily in naphtha, and contains eighty-two per cent. of carbon, fourteen of hydrogen, and four of oxygen. It is used like bees-wax in making candles, and for other similar purposes, where its high melting temperature is an advantage. The light of these candles is of great brilliancy, and, if a little oil be mixed with the wax, they do not gutter. It has been known in Europe about twenty years; but, so far, its importation has not been as great as the value of the material would seem to warrant.—17 *A*, *May* 1, 1872, 262.

DETECTION OF ADULTERATIONS OF MADDER.

A simple method, quoted from Pernod, is given in *Iron*, for detecting the more probable adulterations of madder. These he divides into two classes: those which give colored compounds with oxide of tin, etc., such as logwood, peachwood, burwood, etc.; and those which contain tannin, with little or no coloring matter, such as oak-bark, extract of chestnut, etc. These latter substances produce a black or brown color with solutions of iron. To detect adulterations of the first class, take a piece of white paper of four inches square, dip it into a solution of tin crystals, lay it on a white earthenware plate, and sprinkle a little of the finely powdered sample upon it. If logwood be present, purple spots will appear in about half an hour. Peach and barwood will be betrayed by red spots, and fustic by yellow; while pure madder gives merely a faint yellow color. A piece of paper, similarly steeped in sulphate of iron, will serve for the detection of the second class of impurities, every particle of which will be indicated by a fine black spot. An adulteration amounting only to one part in a thousand parts of madder may thus be detected.—2 *A*, *February* 1, 1873, 83.

REDUCING THE INTENSITY OF A NEGATIVE.

According to Letalle, a negative can be diminished in intensity by first washing it and then covering it with a solution containing fifteen grains of chloride of gold and 0.53 of a quart of water. The operation is to be repeated until the plate has obtained a proper tone. A quantity of nitric acid is then to be poured on one corner, enough to cover the whole plate, when the silver is immediately dissolved and almost disappears. It is then to be re-enforced with sulphate of iron, and then re-appears with a great degree of transparency. Pyrogallic acid may be made use of to bring it up both to the desired degree of intensity and to that of transparency. The image which remains after the application of the nitric acid, on account of its great transparency, is well adapted for taking large pictures.—3 *B*, *April* 24, 1873, 720.

GUMMATE OF IRON PHOTOGRAPHIC PAPER.

The *British Journal of Photography* announces a remarkable compound of gummic acid and sesquioxide of iron which renders paper coated with it sensitive to light. To prepare it we are directed to add ammonia carbonate, carefully and with continual stirring, to a solution of sesquichloride of iron, until the mixture effervesces violently. Filter the liquid, saturate the paper with it, dry in the dark, and then cover it with a tolerably thick film of gum-arabic, and a layer of gummate of iron will immediately form upon it. Paper thus prepared does not become deep yellow for some time, and, if perfectly dry, remains very flexible for a long period, and retains a fine gloss.—8 *C*, *May* 1, 1873, 150.

PREPARATION OF COTTON FOR COLLODION.

M. Adolph Martin, of Paris, has lately suggested a new mode of preparing cotton for collodion, which is extremely soluble and well adapted for many purposes of photography. For this purpose he takes two parts of sulphuric acid of 66° Fahr., to which he adds one part of dry nitrate of potash. When the mixture reaches the temperature of 130° Fahr., the cotton is introduced in small bunches, taking care to allow it to become moistened as rapidly as possible. After seven or eight minutes, the whole is turned into a large quantity of water and repeatedly washed. These washings are continued until the cotton becomes completely neutral, and it is then carded with copper cards to remove all its pulverulent matter. The proper proportions are eight grammes of cotton to 300 grammes of the mixture above mentioned.—3 *B*, *April* 24, 1873, 718.

PERSISTENT ACTINISM OF A BICHROMATE IMAGE.

According to Marion, of Paris, as announced in *Nature*, if a bichromate photographic image, printed in the sun, be brought into contact with another bichromate surface in the dark, a similar impression will be made upon the latter. In fact, a carbon picture fresh from the frame can be employed as a printing-block, from which any number of impressions can be obtained, as if a sufficient quantity of sunlight had been stored up in the original impression to produce an active effect by merely bringing the surface in contact.

This discovery, if verified, is considered of very great importance, since it is alleged that if a single photograph be printed in the sun, we can from this procure a large number of copies, all of which will be as delicate and vigorous as the original. For this purpose a sheet of gelatine, sensitized with bichromate of potash, is put under a negative and printed; it is withdrawn from the printing-frame, and immersed in a weak solution of bichromate of potash, which swells up those portions of the surface that have not been attacked by light, and thus produces a picture in relief. The sheet of gelatine is then put into a press, and impressions from it taken on sensitive carbon tissue, the block being moistened, from time to time, with bichromate solution. The copies thus produced upon the tissue are not fully printed, and can not be developed at once; they are simply incipient, or nascent pictures, and require preservation in the dark for some hours, to allow the action of the light to continue, exactly in the same way as if the carbon tissue had been exposed to sunlight for a few minutes. When the prints have been kept sufficiently long, they are developed in warm water, and fine, vigorous copies are the result.—12 *A*, *May* 22, 1873, 67.

SZEKELY'S BRILLIANT PHOTOGRAPHS.

In order to avoid the usual strengthening of the negative, and any consequent necessity for retouching, the requisite intensity is obtained by accurately superposing two simply developed negatives, after having varnished them, and fastening them in position by means of paper strips pasted on the edges. The combination is printed from in diffused daylight as an ordinary negative, and the pictures are said to have a strength and softness unattainable by a single negative.—15 *C*, 1873, VI., 86.

COATING FOR PLASTER CASTS, ETC.

Articles of glass and plaster are frequently covered of late with mica powder, instead of bronze, and the following process is recommended by Schelhass, of Munich, as affording a cheap, durable, and beautiful coating for such articles, superior to metallic bronze in being unaffected by sulphurous vapors, and capable of being freed from dust and dirt, without injury, by washing. Mica scales, perfectly whitened by boiling with hydrochloric acid, or by calcination, are washed and dried, and finely pulverized by grinding, sifting, and elutriation, then stirred into thinned collodion, and laid on, a number of times, like a color, with a soft brush.—6 *C*, *May* 15, 1873, 199.

RENDERING FABRICS WATER-PROOF.

Dissolve one part by weight of caoutchouc, and one of paraffine or stearine, in two of benzine; dilute as much as necessary, and either saturate the fabric with it, or lay it on with a brush.—14 *C*, CCVIII., 1873, 159.

IMPROVED CARDING-MACHINE.

An important improvement in carding-machines has recently been made in England by the substitution of flat for round wires. The former have greater resistance, when worked edgewise, and are consequently less liable to break or become impaired; and, since they require less and lighter grinding, they also last longer. Their points being sharper and longer, also render the cards more effective. The material is also worked better, because the spaces between the wires, on account of their diminished thickness, are greater, and impurities collect in them, and can readily be removed.—9 *C*, *March*, 1873, 40.

IMPROVED METHOD OF DRYING CLOTH FABRICS.

An improved method of drying cloth textures, devised by Bastaert, and one that probably may be applied advantageously on a large scale in the laundry, consists in passing them over several rows of apertures in iron pipes, out of which superheated steam issues. This penetrates the cloth, and dries it, in virtue of the tendency of the steam to absorb water, and to its high temperature. The steam is drawn into a flue above, in which there is a strong current of air. One advantage of the process is that the original surface of the web is not exposed, thus avoiding the injury it is apt to sustain from contact with heated drums or plates in the ordinary process.—18 *A*, *May* 30, 1873, 272.

ANTHRAPURPURINE, A NEW ALIZARINE DYE.

Mr. William H. Perkin, to whom we owe so much for his researches among the aniline colors, has lately communicated a paper to the Chemical Society of London upon Anthrapurpurine, in which he remarks that his attention has for some time been directed to artificial alizarine, with a view of eliminating certain associated colors and utilizing them in the arts. He has now succeeded in separating one of these, and making and introducing it to notice, under the name of Anthrapurpurine. His method consists in dissolving the crude coloring matter in dilute carbonate of soda, and then agitating the resulting solution with freshly precipitated alumina, which combines with the alizarine, leaving the anthrapurpurine in solution. This is filtered from the alizarine liquid, heated to boiling, and acidified with hydrochloric acid. The coloring matter which is present is collected on a filter, washed and dried. The Anthrapurpurine thus obtained is very impure, being associated with a substance which dyes alumina mordant of an orange color (and which is now under investigation), as well as with anthrafluvric acid, etc. Perkin gives a method for obtaining a pure anthrapurpurine, and, as the result of numerous inquiries, he finds that it has about the same affinity for mordants as alizarine, and that the colors it produces are analogous to some extent, as it produces red with alumina, purple and black with iron mordants. It is, however, in many respects superior to alizarine, as the reds are much purer and less blue than those of alizarine, while the purples are bluer and the blacks more intense. The fastness of the colors, against soap and light, is equal to that of alizarine. When used to dye turkey-red it produces very brilliant colors of a scarlet shade, which are of remarkable permanence. Specimens presented in connection with the communication of Mr. Perkin show a decided superiority over alizarine in the purity and brightness of the proper color.—21 *A*, *May*, 1873, 425.

USES OF PURPURINE.

Purpurine can be employed for dyeing cotton, wool, or silk of a black, red, rose, or lilac color. Cotton is printed with the usual madder mordant, colored, and soaped at 122° to 144° to restore the whites and clear the colors. Passing through bran improves the whites. Wool is mordanted in alum and tartar, or bichloride of tin and tartar, and dyed by boiling half an hour in a purpurine-bath. A little tannin may be added with advantage to the mordant. For printing wool, about 300 grains of purpurine and 60 grains of carbonate of soda are dissolved in hot water, thickened with starch, and increased to about one quart, then printed and steamed. For crimson, alum and tartar are used as mordants. Silk takes colors beautifully, especially reds, by mordanting with acetate of alumina and chalk, drying, gumming slightly with tragacanth solution (100 to 200), printing with a solution of 480 grains of purpurine and 180 grains of crystallized carbonate of soda in water, filtered, and thickened with 3000 grains of roasted starch, then steamed and soaped at 144°.—13 *C*, *March* 15, 1873, 403.

DYEING SILK.

The practice of boiling with soap in the process of scouring silk has recently been abandoned; and it is, instead, simply plunged into a boiling soap-bath containing one-quarter pound of Marseilles soap to each pound of silk, until it is entirely ungummed, when it is turned, and the portions of the skeins on the rods scoured. It is then placed in a second bath containing three ounces of soap to the pound of silk, and turned every quarter of an hour several times. The second bath, with the addition of ten per cent. of soap, may be used as the first bath for the next lot. The silk, by this treatment, retains more of its gloss and smoothness, and does not become woolly, as is frequently the case on boiling. To dye it brown, soap it and ground it without washing in the clear liquid obtained by boiling four to five ounces of turmeric, and allowing it to settle. Then wash twice, place from ten to twelve hours in an alum-bath, wash twice again, and dye at 113° with fustic, archil, brazil-wood, logwood, and some soap, according to the tint desired. After dyeing, it is cleansed with fuller's earth, well rinsed, and cleared with a little oil dissolved in a solution of potash.—24 *C*, 1873, 99.

COLORING KID GLOVES.

According to Reimann's *Journal of Dyeing*, the gloves are to be smoothly fitted on a wooden form, and the coloring solution is to be brushed on; the different colors being produced as follows: *Black:* The glove is washed or brushed with alcohol, dried, and then brushed with a decoction of logwood, and after ten minutes the logwood liquid again applied; after ten minutes more, dipped into a solution of green vitriol, and then brushed off with warm water. If the color is not as dark as desired, some decoction of fustic or quercitron may be added to the logwood liquid. Nitrate of iron may also be substituted with advantage for the green vitriol. When the glove begins to dry, it is rubbed with some fine olive-oil and French chalk, and then placed between flannel; and then pressed, again well rubbed with olive-oil and the chalk, and drawn upon the wooden form. None of the coloring solution must reach the interior during the operation. *Brown:* A decoction of fustic, brazil-wood, and logwood, with some alum, is brushed on. The shade desired must regulate the proportions of these ingredients. To darken the color, a small quantity of green vitriol may be used. *Morocco-red:* A decoction of cochineal with the addition of a little chloride of tin and oxalic acid. The shade may be readily deepened by the addition of a little logwood. *Gray:* A decoction of sumac, and subsequent treatment with weak solution of green vitriol; greenish gray being obtained by addition of fustic and logwood, or fustic and precipitated indigo to the sumac liquid. Any of the aniline colors, in solution, may be employed by simply brushing them on without further treatment. In place of a brush, a sponge may be employed when more suitable. The favorite bluish cast may be imparted to the black gloves by washing them off with ammonia after coloring. The stitching may be preserved white, if desirable, by coating with flour paste with some fat in it. — 15 *C*, 1873, IV., 52.

FIXING ANILINE COLORS ON COTTON BY TANNIN AND GELATINE.

It is suggested by Austerlitz that passing a piece of cotton mordanted with tannin through a weak solution of glue or gelatine, before dyeing, renders much less tannin necessary for a given shade in fixing aniline colors, such as fuchsin, iodine green, etc., than when, as usual, tannin alone is employed. Owing to the variableness of quality of tannin, he was unable to give a numerical statement of his comparative tests; but any one can make them by using tannin and tannin and gelatine, in the latter case gradually weakening the tannin until precisely the same tint is obtained, and then comparing the concentration of the two tannin-baths.—13 *C*, *April* 1, 1873, 469.

A NEW ANILINE RED.

According to F. Hamel, the addition of a few drops of chloride of sulphur to 375 grains of aniline, in a flask, with continued, careful stirring, produces, in from five to ten minutes, sometimes immediately, a red solid, which, when treated with acetic acid and filtered, gives a red liquid that yields on evaporation a brilliant black substance, soluble in acetic acid, ether, and alcohol. Addition of water to its solution in any of these produces a gray precipitate.—25 *C*, 1873, 90.

MORDANT FOR ANILINE COLORS ON COTTON.

Until recently aniline colors have been fixed on cotton by treatment with animal matter, as albumen, caseine, gelatine, or with galls, sumac, tannin, as well as by the use of mordants of acetate of alumina, soap, and oil. Dr. Reimann, however, directs attention to the peculiar power possessed by starch of abstracting aniline colors from solutions, this not being due to the gluten it contains, since this property is shared equally by wheat and potato starch; and he founds upon this a beautiful method for fixing aniline colors on cotton. It is immaterial whether the color is attracted by the starch suspended in the liquid or attached to the fibre. If the cotton is saturated with a thin paste of potato or wheat starch, and then steeped in a dye-bath of aniline color, it will receive the corresponding shade.—24 *C*, 1873, VIII., 60.

ANILINE GREEN WITH STRAW.

Straw, in a manufactured or unmanufactured condition, immortelles, grasses, etc., may be very easily colored with iodine green, as follows: Place the articles in boiling water for from ten to fifteen minutes, and allow the whole to cool; in the mean time mix together ten quarts of water and 450 grains of chloride of lime, and add 450 grains of crystallized carbonate of soda, and then immerse the straw half an hour in the clear liquid obtained by allowing it to settle. Move about the articles thus bleached in a bath of 450 grains of hydrochloric acid in ten quarts of water for from five to ten minutes, and color the well-rinsed straw by agitating it in a bath of a clear solution of iodine green, at about 100°, in a wooden vessel, adding a little picric acid for dyeing yellow.—13 *C*, *March* 15, 1873, 403.

BEAUTIFUL BROWN FOR WOOLEN.

According to the *Muster-Zeitung*, the following method affords the most serviceable brown for woolen and half-woolen goods: After dry removal of all spots with hard soap (for tar stains, butter and soap may be used), the pieces are washed well by hand, and then drawn through a weak, lukewarm soda-bath, rinsed, and passed through a warm acid-bath. For a 20-pound dyeing-bath, 1 pound of Roman alum, 8 ounces of sulphuric acid, and 4 to 8 pounds of archil are boiled for forty minutes, and the shade regulated with turmeric, sulphate of indigo, and archil. For yellowish brown, add 1 pound of common alum, 8 ounces of sulphuric acid, 2 pounds of turmeric, 4 to 6 pounds of archil, and some sulphate of indigo.

The pieces desired of the darkest shade should be dyed first. —5 *C*, 1873, x., 80.

ARTIFICIAL ALIZARINE.

It is but three years since the German chemists, Graebe and Liebermann, announced that they had succeeded in producing alizarine—the coloring matter of the madder root—in the laboratory, a discovery which, though at the time it had very distant possibility of attaining practical importance, was yet hailed by the chemical world as a noteworthy triumph of science. Since that time great advances, the result of much and laborious experiment, have been made in the direction of giving a practical and commercial value to this important discovery, the consequences of which are to be estimated from the fact that to-day the artificial material can be supplied to the market at prices below those asked for the natural madder. In the city of New York there were recently purchased several tons of the artificial alizarine at a price twenty-five per cent. cheaper than it could be manufactured from the madder.

It is said that the rapid growth of the manufacture has already caused distress among the producers of madder in those regions of France and Germany where the cultivation of the madder forms almost the entire means of subsistence of the inhabitants.

DYEING FEATHERS.

Feathers color almost precisely like silk, but special care must be taken to free them from fatty matter, and also that they retain their form and brilliancy. For this reason, lye or any caustic material can not be employed to remove the grease; but carbonate of ammonia, or at most very diluted solutions of soda, may be used. The feathers must be carefully laid in the bath, without breaking or bending, and kept in constant motion while drying, after being dyed, so that the down may stand out and the natural form be restored. Black is the most important color, and at the same time the most difficult to produce. The following processes (each for half a pound of feathers), according to *Reimann's Journal*, give most excellent results: 1. *Black:* Prepare a bath of one pound of calcined carbonate of soda in fifty quarts of water, at a temperature of 100°. Rub the shafts of the feathers with a piece of carbonate of ammonia, and place the feathers a quarter of an hour in the soda solution, or, instead of it, in a solution of twice the amount of carbonate of ammonia over night. Rinse them with warm water on removal from this bath, and lay them for five or six hours in a bath of nitrate of iron, of 7° Baumé; remove, rinse with cold water, and work them in a lukewarm bath of a decoction of two pounds of logwood and two pounds of quercitron, heating it gradually, but not allowing it to boil, and let them remain in it until they are perfectly black; then remove, and rinse with lukewarm water. Dissolve three ounces of potash in six quarts of water, and stir half a pound of oil into the solution until it is completely disseminated. Pass the feathers singly through this bath, allow them to drain, without squeezing them, and keeping them in motion until dry by fastening their shafts to a long cord stretched in a well-heated drying-room, a number of such cords being kept in motion by connecting them with one at right angles, which can be pulled slowly back and forth. The feathers thus recover their natural lustre. If but few are treated, they may be dried by holding singly in the hand, and moving before a fire. Many dyers dispense with the oil-bath by placing the feathers, after drying and rinsing, lengthwise, in layers, in a box, powdering each layer with gypsum, removing them while moist, and swinging them dry; the last portions of gypsum being removed with a soft brush. The shafts are then polished, and the veins curled with suitably shaped hot irons. 2. *Another Black:* The feathers are cleaned as in the previous case, and laid from one to two hours in a bath prepared by boiling two pounds of prepared catechu, allowing it to settle, carefully decanting the clear liquid, and bringing it to a temperature of 122° before using. They are then placed in a cold bath of acetate of iron, of 3° to 4° Baumé, rinsed, and dyed with logwood and quercitron as before, the subsequent treatment being the same as in the first process given. 3. *Brown:* The feathers are prepared as for black, and treated in a similar manner in a decoction of two pounds of catechu, and the dyeing then completed by working them in a bath of a quarter of a pound of bichromate of potash at a temperature of 144° to 167°. If not brown enough, they may be dipped again, and for very dark brown they may be placed in a cold bath of acetate of iron, of 2° Baumé, before the chrome-bath.—24 *C*, 1873, 114, 121.

ANILINE BLACK WITH TUNGSTATE OF COPPER.

The following method, according to the *Muster-Zeitung*, affords a fine aniline black for printing on fabrics; and although the high price or other obstacles may prevent its use on a large scale, it has been found to give almost equally satisfactory results, at a less cost, when in combination with other blacks. Tungstate of copper is to be prepared from tungstate of potash and chloride or sulphate of copper, and stirred with starch and water, and while warm a mixture added, composed of 180 grains of chlorate of potash, 120 grains of chloride of ammonium, and 600 grains of chloride of aniline. Other tungstates instead of that of copper can be employed, but soluble ones seem most suitable.—25 *C*, 1873, 107.

CHINESE WATER-PROOF VARNISH FROM BLOOD.

Dr. Scherzer, an eminent Austrian naturalist, during a recent visit to China, learned the mode of preparing a water-proof varnish very extensively used in that country for coating boxes and other packages which it is desired to protect against moisture. For this purpose four parts of blood, fresh drawn, are mixed in four parts of powdered slaked lime and a small quantity of alum. One, two, or three coats of this mass, which is slightly viscid, will impart so great a degree of impermeability to wood to which it has been applied that it is said to be unnecessary to use the interior tin or lead lining to boxes for transporting delicate articles through the tropics. Owing to its cheapness, it can be used for coating boxes containing sugar, coffee, tea, and other substances.—3 *B*, *May* 22, 1873, 142.

QUICK-DRYING OIL COLOR AND VARNISH.

According to the *Muster-Zeitung*, the following affords an excellent varnish, imparting a beautiful and durable gloss, which is a protection from the action of moisture and of the atmosphere, and also causes oil colors to dry more quickly: Heat twelve parts of shellac and four parts of borax, under constant stirring, in a copper kettle, with eighty to one hundred parts of water, until a uniform mass results. Then cover the kettle well, and, after cooling, pour the liquid into bottles, which are to be well corked. Its color depends on the use of bleached or unbleached shellac. To impart the property of drying quickly to oil colors for printing or painting, mix an equal weight of the shellac solution with the color, rubbed up thickly, using bleached shellac with light colors. To prevent too rapid drying in printing, some linseed-oil varnish should be added; but for painting, oil of turpentine will answer. Care must be taken to have a perfectly uniform mixture with the coloring matter, and only to prepare as much of it as may be needed at a time, as it will become worthless by hardening, while the shellac solution can be preserved indefinitely in tightly corked bottles. By mixing the varnish with yellow ochre, an excellent paint for floors may be made, the brilliancy of which will be heightened by coating the floor, after drying, with the simple varnish. The drying of other slow varnishes can be hastened by mixing this shellac preparation with them as needed.—8 *C*, *May* 15, 1873, 163.

PREVENTION OF MOULD ON GUM MUCILAGE.

The addition of a few drops of concentrated sulphuric acid to gum mucilage, and then allowing the precipitated sulphate of lime to subside, will, according to Hirschberg's experience, prevent formation of mould or deterioration of adhesiveness for at least a year and a half; while sulphate of quinine, as recommended, will not prove effective, at least in the proportion of one to twenty of the solution.—5 *C*, 1873, x., 80.

EXPLOSIVE OILS.

Professor Attfield, in a lecture upon the relation of animal and vegetable oils to fire, remarks that, in themselves, they are much safer than mineral oils, since they do not ignite at low temperatures, nor give off vapor which, when mixed with a certain portion of air, explodes in contact with flame. On the other hand, in their liability to spontaneous ignition, when freely exposed to the air, under certain conditions, they possess a dangerous property from which the mineral oils are free. The animal and vegetable oils differ considerably among themselves in the rate with which they cause the generation of heat on being exposed to air upon the surface of fabrics, shavings, or other materials; but all are more or less liable to this result when spread out in thin films, or in any other minute state of division. The so-called "drying oils" are particularly susceptible to such atmospheric influences; the drying itself consisting in the conversion of the oil into a kind of rosin by the action of the air. A greater or less amount of heat is evolved by the process, which, under favorable circumstances, may produce spontaneous combustion. Such "drying" is not similar to that where cloth, removed from water, is said to dry; since, in this case, it is merely the evaporation of the liquid portion, instead of the conversion of it into a different substance, by the absorption of oxygen. The emission of heat from a painted surface is not generally noticed, since it is comparatively slight in quantity, and is carried away by the atmosphere as fast as formed; but accumulated in any way it becomes very evident. Thus a heap of old greasy rags soon becomes so hot in the central part that the temperature can not be borne by the hand.

A number of experiments were made by the use of paper, cotton, and wool slightly impregnated with different kinds of oil and exposed to the air under similar conditions; and, as a result, it was found that the temperature rises from 25° to 200°, according to the variety of the oil, the amount of surface in contact with the air, and the duration of the exposure. In one experiment with an initial temperature of 80°, the material of the mass soon rose to 275°, and in another, where it was 70°, it rose to 223°. The escape of heat in these experiments was purposely prevented, a condition that might ensue naturally, by the compression of pliable substances, or covering them with some non-conductor. Even in cases where an actual spontaneous ignition did not take place, the presence of a highly volatile, inflammable oily vapor was developed, which at once ignited at a considerable distance from the oiled substances on the approach of a flame.

Great care, therefore, is urged in reference to the accumulation of any oiled substances (either refuse or manufactured articles), and every precaution should be taken where the rooms in which such articles are contained are exposed, in any way, to heat from a stove, a furnace, or any other form of heating.

As the result of the same experiments, Professor Attfield concludes that, although mineral oils are especially liable to combustion, in consequence of their vaporization, yet they never act as those of animal and vegetable origin do, when applied to fibrous or other substances, in producing spontaneous combustion.—14 *A*, *March* 22, 1873, 745.

ZINCING IRON.

The following is an excellent and cheap method for protecting iron articles exposed to the atmosphere, such as cramp-irons for stone, etc., from rust: They are to be first cleansed by placing them in open wooden vessels, in water, containing three quarters to one per cent. of common sulphuric acid, and allowed to remain in it until the surface appears clean, or may be rendered so by scouring with a rag and wet sand. According to the amount of acid, this may require from six to twenty-four hours. Fresh acid must be added according to the extent of use and of the liquid, and when this is saturated with sulphate of iron, it must be renewed. After removal from this bath, the articles are rinsed in fresh water, and scoured until they acquire a clean metallic surface, and then kept in water in which a little slaked lime has been stirred until the next operation. When thus freed from rust they are to be coated with a thin film of zinc, while cold, by means of chloride of zinc, which may be made by filling a glazed earthen vessel, of about two to three gallons' capacity, three fourths full of muriatic acid, and adding zinc clippings until effervescence ceases. The liquid is then to be turned off from the undissolved zinc, and preserved in glass vessels. For use, it is poured into a sheet-zinc vessel, of suitable size and shape for the objects, and about one thirtieth per cent. of its weight of finely powdered sal ammoniac added. The articles are then immersed in it, a scum of fine bubbles forming on the surface, in from one to two minutes, indicative of the completion of the operation. The articles are next drained, so that the excess may flow back into the vessel. The iron articles thus coated with a fine film of zinc are placed on clean sheet-iron, heated from beneath, and perfectly dried, and then dipped, piece by piece, by means of tongs, into very hot, though not glowing, molten zinc, for a short time, until they acquire the temperature of the zinc, the surface of the zinc having been cleaned with an iron spoon. They are then removed and beaten, to cause the excess of zinc to fall off.—12 *C, February*, 1873, 12.

COATING CAST AND WROUGHT IRON AND STEEL WITH COPPER.

For this purpose the three following methods are given by Gaudoin: 1. Dry method: To coat wrought or cast iron with a heavy film of copper, brass, or bronze, when it is not necessary that it should be perfectly uniform (as in printing rollers, sockets, etc.), the object, after having been heated to the same temperature, is dipped into a bath formed of the necessary quantity of metal, melted in a crucible of suitable shape, and covered with a layer of pulverized cryolite and phosphoric acid. 2. A second dry method, with or without an electric current, applicable with advantage to fancy articles requiring only a slight coating: A mixture of one part dry subchloride or subfluoride of copper and five to six parts of cryolite is fused in a crucible, to which a certain amount of chloride of barium may be added to increase its fusibility. The articles, previously cleansed by dipping in acid solution, when immersed in the perfectly fluid mass, become coated with an adhesive layer of copper (displaced from its combination), of a thickness dependent upon the length of the immersion and the concentration of the bath. Employing an electric current has the advantage of maintaining the strength of the bath constant, as well as facilitating the deposition of copper. 3. The wet process: The cause of the failure to produce heavy, adhesive, tough films of copper on wrought or cast iron and steel by any of the numerous alkaline and neutral solutions of salts of copper proposed for this purpose, lies in the fact that such baths have not the property of completing the cleansing of the surface of the iron, only partially brought about, especially with cast iron, by the previous dipping. Investigations on copper-coating, on a large scale, indicate that decidedly acid coppering solutions must be employed, which may cleanse the oxidized portions unaffected by the dipping, without, however, attacking the underlying metal, thus acting continually upon the parts not coated with copper, and finally removing the oxide which prevents its deposition. Many organic acids are adapted to this purpose. Oxalates of copper, combined with a very large excess of binoxalate of quadroxalate of potash, equivalent to free acid, the whole dissolved in ten to fifteen times as much water, affords a most excellent solution. To produce a very heavy deposit, an electrical current must be employed with it.—14 *C*, 1873, CCVIII., 50.

TINNING, COPPERING, AND SILVERING BRASS, IRON, ZINC, ETC., BY THE WET METHOD.

In a memoir by C. Paul, on the best method of depositing one metal on another, we are informed that the operation of tinning brass, copper, and German-silver articles, by boiling in a tin solution, succeeds best with a solution of cream of tartar in an enameled iron vessel, to which pure granulated tin has been added. If sufficient tin be employed, and the liquid frequently stirred, the coating will be heavy enough after boiling two hours. It is best to place the articles in the vessel first, and to scatter the tin over them. Iron articles, as buckles, nails, etc, may also be tinned in the wet way, by a method less generally known. It is, however, essential that they be first thoroughly cleansed, by dipping in a mixture of one part of nitric acid and ten parts of water; then lightly coated with copper, by adding, gradually (in more than an hour), to this liquid only so much of a solution of sulphate or acetate of copper as may be necessary slowly to produce a very slight covering of copper. They must then be rinsed, and more heavily coppered by wetting them uniformly with a solution of one part of proto-salt of tin, two parts of water, and the addition of two parts of muriatic acid, allowing the excess to drain off, and then shaking, rubbing, or scouring them with a solution of ammonio-sulphate of copper. This is a deep-blue liquid, obtained by dissolving one part of sulphate of copper in sixteen parts of water, and adding first ammonia, until the precipitate formed at first is redissolved, and then powdered chalk. The copper deposits rapidly on the iron, and is very adherent. The same process answers for zinc, with the omission of the treatment with the tin-salt solution. The iron and zinc articles thus copper-coated can then be tinned by the usual process, or, still better, in a solution of three parts of cream of tartar and one part of salt of tin in water, by first sprinkling them thinly with zinc filings, and then pouring the warmed tin solution over them. The latter liquid must not be too strong, and it is therefore best to add the concentrated solution of tin salt and cream of tartar, gradually, drop by drop, so that the tin coating may form slowly. This should appear of a beautiful bluish, dead white. The articles must remain an hour longer in the liquid, and then be rinsed and dried (the smaller in sawdust). Brass, copper, or German-silver articles, polished, or freshly cleansed in an acid bath, and also copper-coated iron and zinc ones, may be silvered as follows: Dissolve 210 grains of silver in 390 grains of nitric acid, and 1800 grains of cyanide of potassium in one quart of water; mix the solutions, and add 420 grains of powdered chalk. Smooth objects may be silvered by being rubbed with this, with the addition of some Spanish white. Chains and small articles may be placed in an unglazed earthen vessel and strewed with whiting, which is then moistened, and the objects are shaken about with it, and then as much of the silvering liquid gradually added as may be necessary, until the coating seems uniform and sufficiently heavy. Brass which is to present both dead and polished surfaces must first be deadened as follows: Saturate one quart of nitric acid with zinc, mix sulphuric acid with hydrochloric until effervescence ceases, and add one third as much of nitric acid to the mixture, and then as much of the zinc solution as may be necessary to produce a deadening liquid of the desired quality. The articles, after being dipped in this, are to be rinsed, and then brightened by covering with snuff and dipping in pure nitric acid, withdrawing quickly, and immediately rinsing in plenty of water, to the last portions of which it is well to add a solution of cream of tartar; they are then dried with linen or sawdust. The polished parts must afterward be burnished with blood-stone. To impart the dark gray color, and form the so-called oxide, the portions to remain uncolored are first protected with a coating of wax, and the parts to be colored then penciled with sulphide of ammonium. Moderate warming hastens the coloring. A bronze tint may also be imparted to other metals in this way. The finest effect is produced with gold; and silvered articles may be first gilded for this purpose, by immersing them in a bath of one hundred and eighty grains of sulphocyanide of potassium, forty-five grains of chloride of gold, and one quart of water, slightly acidified with hydrochloric acid. It should be slightly warmed. The deposit of gold immediately formed answers the purpose of producing the bluish tint with sulphide of ammonium. A heavier film can be obtained by this bath with a galvanic current.—14 *C*, 1873, CCVIII., 47.

MANGANESE A SUBSTITUTE FOR NICKEL IN THE ARTS.

In view of the present high price of nickel, Dr. Percy, the eminent metallurgist, proposes to substitute manganese for it in the preparation of German silver, and maintains that it is impossible for the most experienced manipulator to determine the difference, except chemically. A further article on this subject in the *Chemical News*, indicates the best method of obtaining manganese sufficiently pure for the purpose, as also for refining it; and it is here suggested that there is nothing to prevent pure metal being obtained in large quantity, and at a comparatively low price.—1 *A*, *May* 23, 1873, 249.

CASTING METAL IN A VACUUM.

In order to avoid the difficulties and defects occasioned by the air inclosed in moulds in casting, especially with works of art, Cumin and Martel have devised the plan of producing a vacuum in the mould, at the instant of casting, by connecting it with an air-pump, which removes the air. The interior is faced with a sufficiently porous and refractory material, varying with the nature of the metal to be cast; dried plaster-mortar answering for such as are readily fusible, such as type-metal; plaster-mortar, mixed with graphite, alum, or other materials, well ground together and thoroughly dried, for the less fusible, such as bronze; and graphite alone for the most refractory, such as iron and steel.—5 *C*, 1873, 119.

UNION OF IRON AND STEEL.

For many purposes it is frequently desirable to unite iron and steel, the advantages of such a combination being very great. There are, however, a number of difficulties in the way of accomplishing this result. With edge-tools, for example, the tedious hand labor required makes the product very costly, while with large masses the employment of fluxes has not served to shield the steel from being burned. A plan is proposed by Mr. Charles Wheeler, of Philadelphia, of attaining the desired end very simply and efficiently. The essential feature of this process lies in bringing the iron and steel to a welding heat in one "pile," and simultaneously, and then manipulating them by rotary motion. In order to avoid the danger of burning the steel, this is protected from the *modifying* effects of the furnace gases by being inclosed in an iron case made as nearly air-tight as possible. This is brought to a welding heat, and the mass thus rolled. According as the material is piled in the case, the inventor produces an iron-coated steel slab, plate, or bar, in which steel preponderates, steel-centred iron, in which iron preponderates, and a combination in which the materials are so disposed as to be best able to endure wear and support strain. Upon the same general plan a tubular combined iron and steel axle is produced, for which many advantages are claimed. The process is extremely simple, and has received much attention from practical workers in metal.

BLOW-PIPE FURNACE.

A simple and convenient arrangement for the purpose of producing heat more than equal to the melting of cast iron by means of the gas blow-pipe consists of a furnace composed of two parts—an interior envelope and a movable covering. The latter, which completely surrounds the internal portion, rests upon a flange adapted to the outside and lower extremity of the interior envelope. Its walls are very thick, the better to retain the heat, and upon its lower edge eight holes are symmetrically placed, to allow an outward passage to the heated gases. A knob or ring of iron at the top serves to remove and replace the covering. The crucible to be heated is held in the centre of the interior portion by a platinum support, which rests upon a small ledge. The source of heat (an ordinary gas blow-pipe) is arranged beneath so that the nozzle shall be only an inch or so below the inferior circular orifice; the flame will therefore circulate, in the first instance, round the crucible, then in the annular space between the interior envelope and the covering, and the products of combustion will finally pass out through the eight openings at the base. The progress of the heating may be noticed by holding a small mirror beneath. With a furnace arranged in this manner persons have succeeded in melting six hundred grains of cast iron in a small porcelain crucible in less than a quarter of an hour.—21 *A*, *May*, 1873, 471.

MIRRORS FOR REFLECTING TELESCOPES.

Professor H. L. Smith, of Hobart College, Geneva, N. Y., makes the following communication regarding an improvement in the manner of making very large mirrors for reflecting telescopes. He says: "I ground and prepared a bell-metal speculum, which I coated with nickel, and this, when polished, proved to be more reflective (at least I thought so) than speculum metal. The two objects which I sought were—first, to have a polished surface unattackable by sulphureted hydrogen (this, for example, is not injured by packing with lucifer matches), and, secondly, for large specula, doing most of the work by the turning-tool and lathe. I really think a large (say three-feet) mirror, coated with nickel, but cast of iron, and finished mostly in the lathe, while it would not cost the tenth of a similar-sized speculum metal, would be almost equal to silvered glass of the same size, and vastly more enduring as to polish."—12 *A*, *April* 17, 1873, 475.

ARTIFICIAL GRASS FROM PARCHMENT PAPER.

A step toward the fabrication of artificial flowers from parchment paper has been made in the successful manufacture of artificial grass, which has the advantage of being much tougher than that from common and oiled paper, and in no way inferior to it.

VEGETABLE PARCHMENT.

The employment of vegetable parchment seems capable of great expansion by adaptation of its character and price to different purposes; and it may be expected that increased consumption will cheapen its production and lead to still further uses. In many cases it already replaces waxed cloth, mole-skin, etc. As a water-proof wrapping it is serviceable in the form of envelopes for valuable papers, and for inclosing small samples, especially of moist colors and dye-stuffs. It may also prove desirable for artificial flowers, if suitably colored. But attention is particularly called to its substitution for tin for boxes for packing aniline colors, it being far less expensive when manufactured from a cheap paper adapted to this use, and easily made into box-like pouches accurately fitted into light wooden boxes with smooth interiors, the parchment box lid being fastened by a tin hoop, and the wooden one nailed. Such boxes are not only perfectly tight, but not liable to be cracked or burst open by rough handling in carrying, as experience shows to occur with tin boxes. —25 *C*, 1873, 98.

PREPARATION OF GELATINE.

The high price of fine gelatine induced Hewze to attempt the preparation of a cheaper and equally good article. He began with a brown, almost black, glue, of poor quality, obtained as a secondary product in the manufacture of neat's-foot oil, and made by digesting feet with steam, with adhering hair, after removal of the hoofs and leg bones, under the pressure of three atmospheres, for three hours; then allowing the liquid to stand for half an hour, in order that the fat might collect on the top, and next drawing off the strongly ammoniacal solution of glue, straining, and evaporating in a steam-bath to a friable, black mass. Attempts to bleach this with sulphurous acid, and sulphite of soda and hydrochloride acid, were entirely unsuccessful, and would have been impracticable on a large scale. Investigations of the cause of the dark color were next made. The presence of sulphur and considerable quantity of ammonia salts, indicated that the energetic and prolonged action of the steam had affected both the cartilaginous matter and the hair, and had been the cause of the darkening. In order to reduce the decomposition of the glue and the formation of ammonia to a minimum, the process was so modified as to draw off the liquid accumulated in the digester every hour, instead of every third hour; and after it had remained at rest until all the fat had collected, and had been removed, a mixture of fresh charcoal and twenty-five per cent. of bone-black (about equal to four per cent. of glue in solution) was added, and the whole allowed to remain over night, to free it completely from ammonia. Next morning it was warmed to about 68° to 78°, until the gelatine was melted, strained, and evaporated to the proper consistency. The odor during evaporation was not unpleasant; the glue proved to be clear, elastic, and adhesive, without odor or taste, and capable of being used as gelatine.—14 *C*, 1873, CCVII., 500.

PREPARATION OF CHROME ALUM.

In the use of alcohol, sulphurous acid, or sulphureted hydrogen, as reducing agents, in the preparation of chrome alum (now so much used in photography) from bichromate of potash and sulphuric acid, the end of the reaction is obscure, and, according to the concentration, a greater or less elevation of temperature occurs, which requires careful attention, lest a green uncrystallizable solution be formed. By the employment of oxalic acid as the reducing agent, Professor Lielegg simplifies the process, avoids heating in the reduction, and all uncertainty as to the quantity of the reducing agent necessary without requiring any special apparatus. To make 100 parts of chrome alum, 29.5 parts of the bichromate of potash, 38 of crystallized oxalic acid, and 39 of concentrated sulphuric acid are weighed out, and the last is diluted with water enough to cause it to dissolve the bichromate, which is added to the acid, still warm from dilution. When the solution is complete and the liquid cool, the oxalic acid is stirred in, in small portions, the evolution of carbonic acid indicating the commencement of the reaction. Crystals of chrome alum separate from the filtered liquid left to spontaneous evaporation.—14 *C*, 1873, CCVII., 321.

PRODUCTION OF COAL-TAR, ETC.

Dr. Behrens gives, in detail, results of experiments with reference to the effect of temperature in gas manufacture upon the tar formed. The tar from earthen retorts, requiring a higher temperature, was much richer in benzole and toluol than that from the Pauwel system in a coke furnace, and also contained a large quantity of naphthaline and other solid matters; while that from the Pauwel arrangement, with more volatile oils, also contained a considerable amount of substances soluble in alkalies, the carbolic acid being little more than a trace. By introducing a stream of heavy oils, as used in the preservation of wood on a large scale, into a suitable gas manufacturing retort, two per cent. of benzole and toluol, some xylol, and only traces of cumol and cymol, were obtained at a proper temperature, from which pure benzole was more easily prepared than from the light oils. By using earthen retorts, at higher than the usual temperature, with increase of charge, the quantity of gas was increased, its quality unimpaired, and the solid constituents of the tar increased. Behrens then gives the methods for separating the constituents by fractional distillation, as well as some of their uses.—13 *C, March* 1, 1873, 322.

PURIFICATION OF TALLOW.

Treutlen states that tallow treated in the following way is almost odorless, can be preserved in this condition in earthen vessels covered with bladder, paper, or tight covers for a long time, and can be used for cooking, for pomade, salves, etc. The fresh tallow, thoroughly melted in boiling water, is pressed with it while hot through a linen strainer, boiled again, and carefully skimmed, then cooled to solidification, washed with water, and finally carefully freed from water by pressure, then fused at a moderate temperature, and put in earthen vessels.—14 *C*, 1873, CCVII., 516.

APPLICATION OF BISULPHIDE OF CARBON.

The employment of bisulphide of carbon has of late become greatly extended, and the substance is now manufactured on a very large scale in various establishments, and employed in many branches of the arts. Until 1850 its only technical application was to the vulcanizing and dissolving of India rubber, but it is now, according to Dr. Wagner, put to the following uses, among others, which he mentions: 1. For the complete extraction of fat from bones for the preparation of bone-black. Ten or twelve per cent. of fat can be obtained. 2. For the extraction of oil from seeds and olives. Large quantities of olive-oil, rape-oil, linseed-oil, hemp-seed-oil, palm-oil, and cotton-seed-oil are obtained in this manner. 3. For the extraction of sulphur from sulphurous earth (according to Mossu), and of bitumen from bituminous rocks. 4. For separating fat from wool, woolen tissues, and rags from machine shops, by Seyferth's patent. 5. For the extraction of the soluble principles of spices, according to the process of Boniere, of Rouen, France. 6. For the manufacture of yellow prussiate of potash, according to Gelis, and of sulphocyanide of ammonium for the fabrication of the toys called Pharaoh's serpents. 7. For the preparation of the Fenian or liquid fire—a solution of phosphorus in bisulphide of carbon, with which projectiles for rifled guns are filled. 8. In silver-plating, a small quantity of bisulphide of carbon is added to the silver-bath, so that a brilliant deposit may at once be effected. 9. For killing rats, mice, moths, ground worms, and other vermin. 10. As a motor for steam-engines. All systems of engines, with or without expansion, can be run with bisulphide of carbon, which, as is well known, boils at 115° Fahr. The construction requires no essential alteration; but, since bisulphide of carbon dissolves fat and oil with ease, water must be used for lubricating.

One real objection to the use of bisulphide of carbon is its extremely disagreeable odor. This, however, can be removed in a great measure by certain forms of treatment; although involving a considerable increase of the cost, it is less desirable in many cases. Dr. Vohl, of Cologne, maintains that gasoline is applicable to nearly all the purposes for which bisulphide of carbon is used; and, besides being much cheaper, is free from many of its defects and dangers.—17 *A*, *May* 1, 1873, 67.

BISULPHIDE OF CARBON FOR SCOURING WOOL.

According to Jean de Hall, bisulphide of carbon presents no special advantages for freeing wool from grease. It has no injurious effect on the wool at from 50° to 59°, and if it is removed after extraction of the grease by a current of cold air, the wool will be soft, and not distinguishable from that scoured by benzole. But the separation of the bisulphide of carbon by a current of cold air is too slow, and too wasteful of that substance to be practicable on a large scale; and if steam or warm dry air be employed for the purpose, the increased temperature renders the wool containing bisulphide less soft and pliable, as clearly manifest in its feel. Furthermore, although it preserves its color during the operation, it becomes yellow shortly afterward in comparison with a sample treated by benzole—a change that can not be explained, except as indicating a chemical decomposition in the wool fibres, since the color can not be removed by any solvent of sulphur nor by boiling water. — 5 *C*, 1873, xv., 120.

KEEPING WOOL IN A MOIST CONDITION.

The theory of many wool-dyers that stowing away washed wool in a moist condition before dyeing is in many cases advantageous, or even necessary, and never injurious, seems contrary to the facts, no attention being paid to the disagreeable odor or other changes produced in it, which in many cases are not only injurious, but dangerous. Spontaneous combustion may occur, especially with greasy wool, and therefore no more wool of this kind should be washed than can be dyed in three to four days; and even with common wool a tendency to decomposition is produced in that time, and the unpleasant odor acquired is not easily removed by simple washing. Chrome-dyed wool may even be injured by unequal penetration of air into heaps or basketfuls, unless it is well cooled, and turned after a short time. For the most part, however, lying for twelve hours is not injurious to mordanted wool, but rather beneficial; and when alum and tartar have been used for madder-dyeing, a period of three days is advisable, if it has been well cooled. Brown and olive darken by lying in heaps. Wool treated with sulphuric acid, unless washed very soon, becomes brittle, and loses in color. —25 *C*, *March*, 1873, 89.

TREATMENT OF WOOL BY GLYCERINE.

According to Asselin, glycerine has hitherto failed to answer its expected part in the treatment of the fibre of wool for dyeing in consequence of a want of knowledge of its actual properties as a solvent, and he has been engaged in determining the degree of solubility in glycerine—first, of the metallic soaps, and those of magnesia and of lime; second, of the sub-soaps, or soaps with an excess of base; third, of the sulphate of lime of calcareous waters. As the result of his labors, he comes to the conclusion that a rational and moderate use of glycerine in the treatment of wool will aid in the manufacture of certain tissues of uniform tints and of bright colors, which has been considered impossible by some. Fabrics worked from wool so treated always possess great superiority in their soft and pleasant feel, quite different from that where glycerine has not been employed. The calcareous waters which are so constantly met with in manufacturing regions will be no longer an objection when glycerine is employed. Should the glycerine occur in any excess in the wool, it can be easily removed by washing in distilled water. —6 *B*, *April* 7, 1873, 884.

WASHING WOOL AND UTILIZING THE REFUSE.

The custom of shearing sheep without previous washing, and sending the wool directly to establishments that wash it on a large scale, has lately become so prevalent that a consideration of the methods employed and the refuse obtained is worthy of attention. The usual scouring-machines were necessarily unsuited for the treatment of such wool, as giving results unsatisfactory in quality and quantity; and the so-called Leviathan, or a machine similar in character, was adopted. This consists, in the main, of two steeping-tubs and two scouring-tubs, each tub having a pair of iron pressing-rollers, the upper one in each case being wrapped with hempen cord and covered with cloth, the wool being brought to and taken from the rollers on an endless cloth. The stirring apparatus of the scouring-vats also delivers the wool to elevating forks, which place it upon the feeding-cloth. The scoured wool is rinsed in a tub having a similar stirring apparatus and an abundant water supply. All the tubs have stop-cocks in the bottom, and perforated false bottoms to retain the wool when they are emptied. The first three tubs can be warmed by steam-pipes. The wool is placed in a steeping-tub in warm water, whereby the adhering excrement and dirt are for the most part removed; and since two such tubs are employed in turn, there is ample time for dissolving the dirt, any undissolved particles being rendered more readily soluble by passing through the first pair of rollers. The wool is then carried in succession through the two scouring baths, prepared from calcined carbonate of soda, on account of the energetic action of the small amount of caustic soda it contains, and warmed to 112°. The strength of the bath varies in the two vessels, as well as with the quality of the wool; and it is best, although not most economical of soda, to place the wool in the stronger bath first, since the grease itself will, to begin with, in a measure protect the wool from any decomposing effect of the stronger soda. Weaker alkaline substances, as crystallized carbonate of soda, trona, etc., will not answer for scouring dirty, freshly clipped wool. After passing through the rollers of the last scouring-vat, the wool is placed by basketfuls in the rinsing-machine, thoroughly rinsed, spread, and dried.

Of the impurities removed in the washing, the grease and potash salts deserve attention. The latter amount to eight per cent., and, in Belgium, are converted into potash. The wool, before washing, is soaked in vessels, and the pasty residue resulting from the evaporation of the liquid obtained calcined in a furnace, whereby the organic acids are decomposed, and the potash left as crude carbonate of potash, to the amount of five per cent. of the unwashed wool. The grease is found in the soda solution used in scouring, that has become too dirty for use, partially saponified with soda, and partially as an emulsion, together with undecomposed carbonate of soda and soda combined with acids in the perspiration. Its amount varies, with the quality of the wool, between five and fifteen per cent. It has hitherto been separated, either by supersaturation of the liquid with hydrochloric or sulphuric acid, or by precipitation by means of lime salts; in both cases the soda being sacrificed. The first method was only applicable when ammonia and urine had been employed in washing, and the fat was of inferior quality, while the process was as tedious as unpleasant. It could only be partially freed from its impurities; was not valuable for stearine, as it only contained twelve per cent. of it, and only one third of it was saponifiable, an amount too small to render it valuable for soap, but large enough to impair the valuable applications that could be made of the other two thirds in a pure condition. A German writer, however, claims to have succeeded in devising a method, according to which the scouring liquid, no longer fit for use, is decomposed, so that it immediately separates into three layers, the top one containing the fat, the middle one the impurities, and the lower one the soda. In the subsequent treatment the two kinds of fat separate, so that each may be obtained by itself. The impurities form a valuable fertilizer. The soda solution can either be used over again, or the soda can be obtained pure, by evaporation and calcination, and amounts to forty-five per cent. of that employed in washing. The process is also adapted to the separation of the oil from the fulling wash-water, and is superior to previous methods in which acids are used in rapidity, ease, and neatness, as well as in the quantity obtained. The refuse from 10,000 cwt. of unwashed wool would contain the following ingredients, having about the annexed values:

500 cwt. crude potash, at $4 26	$2130 00
160 cwt. saponifiable fat, at $5 68, at least	908 80
340 cwt. unsaponifiable fat, at $4 26, at least	1448 40
225 cwt. soda (being 45 per cent. of 500)	798 75
Total	$5285 95
Cost of recovery, about	$2130 00

—23 *C*, *March* 16, 1873, 102.

INERASIBLE INK.

According to Nissen, when a solution of the yellow prussiate of potash is added to any kind of ink, attempts to erase it by means of oxalic acid or other chemical substances simply convert the characters into Prussian blue. This method is therefore believed to be well adapted for the treatment of inks to be used in banking and other operations.—1 *C*, 1873, XII., 188.

NEW MODE OF COPYING DESIGNS.

Renault has communicated to the Academy of Sciences in Paris an ingenious process for copying designs, based upon the reduction of salts of silver, on paper or other organic material, by copper, hydrogen, or vapor of phosphorus. To effect this the sheet of paper on which the drawing is made is placed on the top of a sheet of card-board, which has previously been exposed to vapor of hydrochloric acid, and above the drawing is laid a sheet of paper sensitized with an oxygen salt of silver; the double nitrate of iron and silver is one of the best for this purpose. The vapors of the hydrochloric acid rising from the pasteboard beneath pass through the paper at all points except those at which the lines of the picture are found. The oxy-salt in the sensitized paper quickly becomes converted into chloride of silver; but those points at which the hydrochloric acid has not penetrated remain in their old condition. When the paper thus treated is laid on a plate of copper, or exposed to hydrogen or vapor of phosphorus, the unchloridized parts blacken, and a perfect copy of the design is obtained, which may afterward be fixed in the regular way.—21 *A*, *May*, 1878, 538.

SULPHATES OF SODA AND POTASSA IN BLEACHING ANIMAL FABRICS.

A patent has lately been obtained by Samal & Beronson, for the use of feeble solutions of the sulphates of soda and of potassa, in bleaching animal textile fabrics; their special object being to remove the gum in preparing silk and in scouring wool. For the first-mentioned object the bath must be boiling; while for the second, the temperature of the alkaline sulphuret should not exceed 120°. Where it is especially difficult to remove the gum and prepare the silk, the proto-sulphuret may be employed. The aluminates of soda and of potash have also been used for the same purpose.—18 *A*, 1873, 402.

WHITENING WOOL.

The sulphurizing of wool can, to a certain extent, be avoided by placing it, after scouring, in a bluing bath at 122°, composed (for fifty pounds of wool) of alum, 2 pounds; tartar, 9 ounces; sulphuric acid, 1 pound; starch, 9 ounces; sulphate of indigo, 3 ounces; archil, $1\frac{1}{2}$ ounces, and working at that temperature for three quarters of an hour. The white thus obtained, though generally satisfactory, can be much improved by squeezing out the wool, without washing it, and dipping it in a lukewarm solution of one pound of chloride of barium. The sulphate of baryta, or permanent white, deposited in the fibres, adds to the weight as well as the whiteness of the wool.—26 *C*, 1873, 108.

BLEACHING DISCOLORED FLANNEL.

It was found by Professor Artus that flannel which had become yellow by lying for some time, when treated with a solution of one and a half pounds of Marseilles soap in fifty pounds of soft water, with the addition of one eighth of an ounce of ammonia, and subsequently rinsed, was much improved in appearance. The bleaching was more quickly accomplished by soaking the articles for an hour in a dilute solution of acid sulphite of soda, then stirring in dilute hydrochloric acid (fifty parts of water to one of acid), covering the vessel, allowing it to remain a quarter of an hour, and afterward thoroughly rinsing the articles.—26 *C*, 1873, 166.

PRESERVATION OF TEASEL-CARDS.

Teasel-cards, for dressing cloth, may not only be rendered tougher, more elastic and durable, but adapted to working under water, by impregnating them with a solution of about six pounds of sulphate of copper in two hundred and fifty pounds of water. Sulphate of zinc may replace sulphate of copper.—5 *C*, 1873, 224.

CANNELLE, A NEW BROWN ANILINE DYE.

An aniline, called cannelle-brown, suitable for replacing dye-woods in producing, on silk, wool, or cotton, a beautiful, bright wood-brown, and all shades of brown, with less trouble, and not too great expense, has been prepared for some time by Knosp, of Stuttgart. For silk and wool no mordant is necessary, the dye being simply dissolved in hot water, and filtered through flannel, when cold. Silk is dyed in a lukewarm bath with which this solution is mixed, and slightly acidified with tartaric acid. The color can be deepened and tinted by the addition of a solution of patent or methyl violet, or precipitated indigo. Wool is dyed in a boiling bath, with the addition of half a pound of Glauber's salt, and one eighth of a pound of sulphuric acid to ten pounds of wool; for shading and tinting, the same dyes may be used as for silk, the cheaper precipitated indigo being preferable. Cotton must be mordanted (best with tannin), by using three pounds of sumach, or a quarter of a pound of good tannin, to ten pounds of cotton. It is then dyed in the usual way in a cold bath of pure cannelle.—5 *C*, 1873, XXVI., 206.

A NEW DYE-STUFF.

Now that all possible shades of color have been produced from aniline, chemists have turned their attention to anthracene and alizarine; and Springmühl obtains an accessory product in the artificial manufacture of alizarine out of anthracene, from which a beautiful blue can be made, superior in many respects to all aniline blues. Dried in a vacuum, it forms a blue powder, with a few small crystals, and differs from aniline color in having the same color in solution. It dissolves with but little residue in water. An alkali destroys its color, but an acid restores it; and the strongest acids improve, instead of attacking its tint. Unlike aniline, it is not soluble in ether nor alcohol; and it resists the action of light better than aniline. Unfortunately, its preparation is as yet extravagantly expensive: a pound would cost about $15,000. The process is a secret, and it is to be hoped will be so improved as to cheapen the product.—5 *C*, 1873, XXIV., 191.

FASHIONABLE GREEN FOR SILK.

This new green is produced by aniline iodine-green, with the addition of a little water-glass. The dyeing must be carefully done, and the silk added very gradually, to keep it uniform. Since iodine-green is not uniform in quality, if the shade is wanting in yellow, it may be brought to that of the sample by the addition of picric acid, the article then being passed through a diluted acetic-acid bath.—26 *C*, 1873, 107.

USE OF HYDROSULPHITE OF SODA IN DYEING WITH INDIGO.

Messrs. Schutzenberger and Lalande announce a new method of dyeing and printing fabrics by means of indigo, in regard to which they remark that, in consequence of its insolubility in neutral dissolvents, whether acid or alkaline, the coloring matter of indigo can only be fixed upon the textile fibre after being previously reduced—that is, converted into white indigo, soluble in alkalies and alkaline earths.

They find, however, that the very strongly reducing properties of the hydrosulphite of soda, in its almost instantaneous action upon indigo, changing it in the cold state to an alkaline liquid or white indigo, suggests the practical use of this salt in the various applications of indigo in dyeing and printing. The memoir, which is contained in the *Moniteur Scientifique*, gives first the details of the manipulation for dyeing, and then for printing, and is accompanied by specimens of the general effect produced.

The colors obtained, according to these gentlemen, are very beautiful, and possess a very distinctive outline. The new blue which they produce requires no treatment, after printing, for fixing it thoroughly; and it may, indeed, be printed at the same time with most of the other colors, such as aniline blacks, etc. Its preparation consists in thickening with gum, or other thickener, a sufficiently concentrated solution of white indigo in an alkali or alkaline body, and then adding to the mixture the proper quantity of hydrosulphite of soda.

TO COLOR CHAMOIS ON HALF-WOOL GARMENTS.

For ten pounds of material prepare, in a perfectly clean kettle, with soft water, a bath of about one fourth of a pound of annatto; heat, add the garments, heat to boiling, and boil for half an hour; then rinse well, pass through a weak warm sulphuric acid bath, and again rinse well.—26 *C*, 1873, 167.

IMPROVED GUM-ARABIC MUCILAGE.

A serious objection to the use of gum-arabic, as an adhesive, is found in its showing through unsized paper, and thus producing a semi-transparent blot. This is also attended with the still greater inconvenience that the two layers do not stick together satisfactorily. On this account gum-arabic mucilage can not be used for attaching paper to pasteboard, nor wood to wood, nor one metallic substance to another, since the gum soon peels off. All this inconvenience may be remedied, it is said, by adding to the gum a solution of sulphate of alumina; two parts of crystallized sulphate of alumina answering for one hundred and twenty-five parts of the concentrated solution of gum-arabic, in the proportion of two parts of gum to five of water. The salt is to be dissolved in ten times its weight of water, and the solution mixed direct with that of the gum solution, which in this condition well deserves its name of vegetable glue. A solution of alum replaces the sulphate of alumina, but to a much less satisfactory degree.—18 *C*, *July* 2, 1873, 428.

CEMENT FOR FASTENING METALS ON GLASS.

The following cement, recommended by Franke, for fastening prize-medals, electrotypes of badges of honor, etc., upon the show-cases in the Vienna Exposition, instead of the tedious and defective method of boring the glass, with its liability to fracture, may be found generally useful in fastening metal on glass securely and rapidly. To an intimate mixture of two parts of finely powdered silver-litharge, and one part of dry white lead, add as much of a mixture of three parts of boiled linseed-oil and one of copal varnish as will form a doughy mass. It is only necessary to cover the lower face of the medal with this cement, press it upon the glass, and remove the excess of cement.—13 *C*, *May* 15, 1873, 655.

A PERMANENT PASTE.

The following process will, it is said, afford an unusually adhesive paste, adapted to fastening leather, paper, etc., without the defects of glue; and, if preserved from evaporation in closed bottles, will keep for years. Cover four parts, by weight, of glue, with fifteen parts of cold water, and allow it to soak for several hours; then warm moderately till the solution is perfectly clear, and dilute it with sixty-five parts of boiling water, intimately stirred in. Next prepare a solution of thirty parts of starch in two hundred parts of cold water, so as to form a thin, homogeneous liquid, free from lumps, and pour the boiling glue solution into it with thorough stirring, and at the same time keeping the mass boiling.—8 *C*, 1873, LX., 144.

LIQUID PARCHMENT.

According to Dr. Hoffmann, a fluid by this name, consisting of gutta-percha softened and soaked in ether, is especially adapted for forming a coating for pictures and cards, which permits the removal of dirt with a moist rag. Pencil and crayon drawings may be rendered ineffaceable by sprinkling with this liquid by means of an atomizer, an exceedingly delicate film remaining on the evaporation of the ether.—14 *C*, 1873, CCVIII., 235.

HOW TO VARNISH.

It is essential to the brilliancy and adhesiveness of varnish that the temperature of the atmosphere in which it is put on should be as high as can conveniently be borne, since, at a lower degree of heat, a deposit of the invisible moisture in the atmosphere takes place before the solvent in the varnish has sufficiently evaporated. This may occur even on fine summer days, giving a milky, turbid appearance to the varnish, which can only be avoided by bringing the temperature artificially up to about 79°. The article should acquire this temperature by several hours' previous exposure to it in the shop, and should then be smoothed, washed, and rubbed dry with chamois leather or silk. All dust, dirt, and moisture are to be removed by means of a brush of suitable size with pure, soft, firm bristles, the use of any form of oil or grease being avoided. The varnish must be laid on with exceeding care, dipping the brush lightly into it, and beginning a short distance from the edge, and working by direct, long, rapid, uniform sweeps of the brush, of even pressure, to the edges and corners, at each side alternately, until the film has the thickness of paper. The article should then be exposed to the sun, or artificial heat, protected from draft and dust; since cold or draft would darken the varnish. In this latter case the brilliancy and clearness can only be restored by thinly recoating the surface with the varnish and exposing it directly to the fire, that the spoiled part may be redissolved, taking care not to put it so near that it will scale off.—5 *C*, 1873, 230.

NEW METHOD OF SILVERING GLASS.

An improved method of silvering glass and other substances, devised by Mr. Siemens, consists in the use of aldehyde of ammonia, obtained by passing a current of dry ammonia through aldehyde. He makes two solutions of four grammes of nitrate of silver and two and a half grammes of aldehyde of ammonia, and then mixes the solutions and filters them. The object to be silvered is first washed with a solution of carbonate of potassa, then with alcohol, and finally with water. It is then brought in contact with the silvering solution, and subjected to the heat of a sand-bath. A deposit of metallic silver immediately takes place, and the temperature is carried up to 130° or 140° Fahr. When the deposit is sufficiently formed, the article is to be removed and rinsed with distilled water.—3 *B*, *June* 26, 1873, 329.

TINNING LINEN AND COTTON FABRICS.

The following process is given by R. Jacobsen for coating linen and cotton fabrics with a heavy, flexible, brilliant film of tin. A thin paste, formed by stirring commercial zinc dust into a solution of egg-albumen, is laid on the fabric by brushing or pressure. This coating is fixed, after drying, by coagulating the albumen by heated steam, the fabric being then placed in a bath of perchloride of tin. The metal precipitates upon the zinc in a finely divided condition, and the article, after being well rinsed with water and dried, is put through a glazing machine, which imparts brilliancy to the tin coating. Beautiful results can be obtained for decorative purposes by printing or tracing designs, and linen cloth thus tinned could be employed in many cases as a substitute for tin-foil, as an elegant, tenacious water-proof wrapping.—6 *C*, *May* 22, 1873, 209.

HARDENING STEEL TOOLS, ETC.

The following secret, unpatented composition, suggested by the chemist Kulicke, has been employed with success at Saarbrücken for restoring burned steel to its primitive condition; and as it affords a peculiarly hard metal, it is also used for tempering steel tools that are too soft, or may have become so by use, as chisels, saw-blades, etc. Although rather expensive, it is really an economical treatment where large numbers of steel tools are used. Burned steel heated to a cherry red, and forged somewhat on an anvil, is plunged into a well-mixed, doughy mass (in a box near by) composed of tartaric acid, six ounces; cod-oil, thirty ounces; charcoal powder, two ounces; bone black, eight ounces; beef tallow, ten ounces; yellow prussiate of potash, five ounces, and burned hartshorn, three ounces, and is then completely cooled in water. Steel tools are similarly treated. Small articles of cast iron, such as wheel-boxes, axle-bearings, etc., may be successfully case-hardened by being plunged red-hot into a mixture of ten buckets of urine, five pounds of whitening, and four pounds of salt.—18 *C*, *June* 4, 1873, 368.

ARTIFICIAL PRODUCTION OF FLUORIDE OF CALCIUM.

Among other mineral substances which the chemist has succeeded in producing artificially in his laboratory may now be mentioned fluoride of calcium, in crystallized forms, identical with those of the native compound. A combination of fluor-spar and barytes, identical with a native one, well known to mineralogists, has also been manufactured.—14 *A*, *July* 19, 1873, 81.

EXPLOSION IN A FLOUR MILL NEAR GLASGOW.

A recent explosion at the Tradeston Flour Mills in Glasgow was explained on the theory that minute particles floating in the atmosphere became so mixed with oxygen as to form an explosive gas, and this conclusion has been corroborated by a similar explosion at the Park Brewery during the grinding of a quantity of malt. A small flint was introduced into the malt between the iron rollers of the mill, and a spark being struck, the floating dust immediately exploded with a loud report.—18 *August* 1, 1873, 604.

SPONTANEOUS COMBUSTION OF OILY COTTON WASTE.

Experiments by Galletly show how dangerous it is to allow greasy refuse to lie, even in small quantities, in warm places. He found that such waste, dipped in boiled linseed-oil, and wrung out, required, at a temperature of 170°, only one hundred and five minutes at the most to take fire, and that the bulk need not be very great, as a match-boxful, at 167°, took fire in one hour. With raw linseed-oil it required four to five hours; with rape-oil at 170°, over six hours; with castor-oil at 185°, over a day; with olive-oil, one and two-third hours; and with sperm-oil it would not take fire at all. The heavy coal and petroleum oils were found to retard oxidation by excluding the air. Silk waste did not take fire, but gunpowder placed in it was fired in an hour; and in cotton, under similar circumstances, only after one hour and a half.—6 *C*, *April* 10, 1873, 140.

PHOSPHORUS BRONZE.

The result of three years' experiment, on the part of certain manufacturers in Europe, of the use of the phosphorus bronze, tends to affix a high value to this alloy. In the instances referred to it has been used to much advantage for the great bearings of the plates in general rolling-mills, and for conical gearing in universal rolling-mills, in cases where the rollers weighed five tons. It was found that the gear, when made of hard cast iron, broke frequently; this was replaced by wheels of ordinary bronze, and then by those of phosphorus bronze. The duration of ordinary bronze wheels did not exceed, on an average, five months, while those made of phosphorus bronze wore for about nine months. This material has also been applied with great advantage not only in the making of pinions, but in the driving axes of mills; in the latter case the superiority seeming to depend not on the hardness, but on the very great resistance of the alloy, the arbors in the phosphorus bronze twisting much less than those made of forged iron, and not being liable to break like those of cast iron.—3 *A*, *July* 26, 1873, 101.

MACHINE FOR MAKING SMALL WOODEN BOXES.

A machine has lately been invented in England for facilitating the manufacture of small wooden boxes, varying from nine to twenty-four inches in length, and of a corresponding depth. The machine is capable of being adjusted so as to cut simultaneously three V-shaped grooves in a board, and to bevel the edge so that it can be readily bent round at these joints until the groove is closed, when the sides are fastened by glue or by a few nails, thus producing the four sides of a box, which is completed by nailing on the bottom and top. This machine and its mode of working were exhibited at the Vienna Exposition.—*Jour. Soc. Arts, June* 27, 1873, 630.

CONVERSION OF YOUNG HORN INTO GELATINE.

According to a contemporary, the soft, spongy horns of the deer, when they have sprouted about a foot or more from the skull, are collected, in Alaska, and when thoroughly dried are exported to China, where they are made into a highly prized jelly. The deer referred to are probably the reindeer, as it would be extremely difficult to obtain a sufficient number from the wild species in Alaska to serve the purpose of a regular trade.—2 *A*, *July* 5, 1873, 11.

FIRE-PROOF POWDER-CHESTS.

Tests have recently been made by the English government in regard to a new construction of powder-chests, with such a satisfactory result as to render it not impossible that they may be adopted at least for the retail trade. These chests are apparently similar to the ordinary fire and burglar proof safes, with unusually thick walls, composed of four-inch chambers filled with sawdust and alum. On exposure to heat the alum melts, and the 52 per cent. of water it contains escapes into the powder-chest, through small openings, and prevents the explosion of the powder. The safes were placed in separate furnaces, and after being heated intensely for six hours, the powder in two of them, on examination, was found unaffected, the chests themselves appearing in good condition, and a registering thermometer indicating a maximum of 210°. The two remaining chests were heated still further without damage.—14 *C*, 1873, CCVIII., 234.

IMPROVEMENT IN PHOTOLITHOGRAPHY.

In the ordinary process, paper coated with a mixture of bichromate of potash and gelatine, and exposed under a suitable negative, is covered with fatty ink, and immersed in hot water, which dissolves the unchanged gelatine, and leaves the picture coated with fatty ink, which is then transferred to a suitably prepared stone. By this method fine lines are not faithfully reproduced, since the hot water swells the insoluble gelatine, and softens the fatty ink. Paul avoids this defect by dispensing with heat in removing the unchanged portion, substituting albumen for gelatine. The roughening, of even the finest quality of paper, on being moistened, is prevented by employing the ivory-surfaced transferring paper of the Autotype Company, prepared with a mixture of equal parts of beaten albumen and a saturated solution of bichromate of potash. After proper exposure under a negative, it is placed on a lithographic stone, which has been covered with ink, and passed through the press several times, changing its position each time. On soaking it in a vessel of cold water for some time, the unchanged albumen dissolves, and can be removed by brushing lightly with a sponge, affording a very fine, sharp picture, ready for transfer to the stone by simple pressure, the cold water having no injurious effect upon the picture or the ink, while the paper retains its fineness of texture.—15 *C*, XII., 1873, 189.

MACHINE FOR REPRODUCING ALL KINDS OF ART-MODELS.

A machine, that may prove of value to founders, etc., has been devised by G. Mathis, of Villingen, which is said to be capable of producing a perfect copy of a piece of sculpture of any size or shape, with great rapidity and precision, and so completely that only the finest touches require the hand of an artist. The essential part of the apparatus is claimed to involve an entirely new mechanical contrivance.—9 *C*, *June*, 1873, 88.

AMSLER'S PLANIMETER.

The planimeter of Professor Amsler, of Schaffhausen, ordinarily called the polar planimeter, is, of all the instruments of this class at present known, by far the most simple, the most commodious, and least expensive, and is deserving of a wide introduction among American draughtsmen. It is composed of two metallic rules joined together at a pivot, and, connected at right angles to them at each end, a metallic point. In the prolongation of one of these rules there is found upon an axis parallel to its direction a wheel whose edge is graduated. In order to measure any plane area, one fastens the extremity of one of the arms upon the paper outside of the perimeter of the figure, in such a way that the end of the other arm can be made to follow this perimeter around its whole length. When this end has returned to its point of departure, the divided wheel has undergone a displacement which is easily measured, and is proportional to the area of the figure that was to be measured.—6 *B*, 1873, 509.

RENDERING LAMP-BLACK MISCIBLE WITH WATER.

According to Köchlin, lamp-black acquires all the properties of India ink, and admits of being incorporated with printing colors, after mixing it with ten times its weight of sulphuric acid, of 66° Baumé, and washing after twenty-four hours.—9 *C*, *June*, 1873, 92.

THE INFLUENCE OF THE SUNLIGHT ON OLIVE-OIL.

Among the results of the studies of Morchini on the mechanical influence of sunlight upon olive-oil, we may mention the following items that will be of interest to commercial as well as scientific men. 1. In one month the sunlight will entirely bleach the oil without changing its specific gravity. 2. Oil that has been exposed a month to the sunlight has still the property of thickening under the influence of nitrous vapors; but if the exposure last two or three months, it continues fluid under the influence that would otherwise thicken it. 3. The oil that has been bleached by sunlight has a decided acid reaction, and a slight rancid odor and taste, and dissolves the aniline red easily whereby it is itself intensely colored, a principle that is of importance only when we would test the purity of the oil by the method proposed by Jacobsen.—1 *C*, 1873, 176.

EXTRACTION OF WOOL FROM HALF-WOOL RAGS, ETC.

According to Dr. Wagner, the present method of removing cotton and linen from half-wool material by means of sulphuric acid of five per cent. is not as cheap, effective, or quick as is desirable; and his investigations show that a complete destruction of the linen fibre combined with wool requires sulphuric acid of eight to ten per cent., as well as prolonged boiling, and even with the utmost care, too, the wool fibre will be somewhat affected. A comparatively large quantity of liquid is required, which consequently renders the process expensive, and with colored materials the same liquid answers only twice, or at most three times, while the consumption of fuel is considerable. A new process, devised by Dr. Wagner, but not yet published, based on very different chemical reactions, is claimed by him to obviate all these objections, and to be very cheap, and to demand little care, while at the same time it does not affect the character of the wool fibres.—13 *C*, *July* 1, 1873, 854.

ALLOYS OF MANGANESE.

At the meeting of the British Association in 1870, Mr. J. F. Allen, F.C.S., described several manganese alloys in a paper read before it. An alloy of copper, with from five to thirty per cent. of manganese, he found to be ductile, malleable, and considerably more tenacious than copper. With zinc, copper, and manganese, an alloy was obtained resembling in some of its qualities German silver. Besides these, other alloys were made and experimented upon.

INTERNATIONAL STANDARD FOR NUMBERING YARN.

The international congress, held at Vienna in July, to establish a uniform standard for assorting yarns, after considerable discussion of a variety of propositions, came to the following conclusions: That the present occasion was most opportune for the introduction of the metrical system; that all spun material should, if possible, be numbered on the same principle; that this should be metrical, and the number of the yarn should express the number of meters in a gramme, and that the minimum for inspection should be 1000 meters. The establishment of a uniform reel was passed over for the present. A standing committee of delegates from the countries represented was selected, to publish the results in their respective countries, and impart strength to the new movement. The meeting next year was fixed at Brussels.—32 *C, July* 19, 1873, 351.

PREPARATION OF CARBONATE OF MAGNESIA.

The fact that, in the treatment of dolomite with carbonic acid under pressure, the carbonate of magnesia dissolves more readily than the carbonate of lime, is employed on a large scale in Pattinson's process at Newcastle, England. The finely powdered dolomite is stirred with cold water, in a cylinder revolving on a horizontal axis; and carbonic acid, obtained by the action of hydrochloric acid on carbonate of lime, is forced in, under a pressure of five to six atmospheres. The solution of bicarbonate of magnesia, thus obtained, is treated with steam in a vertical cylinder; and the neutral carbonate formed is allowed to deposit in channels, and is then cut out in rectangular blocks, dried, and brought into the market, affording caustic magnesia by ignition in muffles. —6 *C, July* 10, 1873, 276.

N. MATERIA MEDICA, THERAPEUTICS, AND HYGIENE.

SIGNS OF DEATH.

Dr. Hugo Magnus, assistant physician to the hospital at Breslau, suggests that the tying of a tight ligature around one of the fingers will determine whether a person supposed to be dead is so in reality. If life be not extinct the extremity of the finger soon becomes red, the depth of the color increasing to dark red and violet, while the skin above the ligature remains white. This is easily understood, as, if there be any circulation of the blood, the ligature prevents the return of the venous blood, while the arteries still continue to convey it to the capillaries. A test so simple can be applied without difficulty, and seems to be quite decisive.—13 *A*, *December* 1, 1872, 451.

CURE FOR CATARRH.

Although a catarrh of itself is not to be classed with the dangerous diseases, it is always troublesome, and if the bronchiæ become affected, a favorable termination, especially with aged persons, is not always certain. A remedy for this affection, as suggested by Dr. Hagar, is as follows: Five parts of carbolic acid, six of aqua ammoniæ (specific gravity 0.960), ten of distilled water, and fifteen of alcohol are to be mixed together in a wide-mouthed bottle, half filled with cotton or asbestos, and snuffed up from time to time from the bottle. After a thorough trial of this prescription, Dr. Brand states that it shortens the first stage of the disease, prevents the second, and alleviates all the symptoms. He prefers, however, to apply it by inhalation through the mouth as well as the nose, by pouring a few drops on porous paper, and holding it in the hollow of the hand before the face, with the eyes closed. —9 *C*, 1872, VI., 87.

THEORY OF "TAKING COLD."

Professor Rosenthal gives the following explanation of the pathogenic action of exposure to cold. Suppose an individual to have been subjected to an elevated temperature, such as that of a ball-room or a theatre, or to have engaged in violent muscular exercise: the cutaneous vessels are dilated, and in a state more or less akin to paralysis, and in all cases more slow to contract than usual. If at this moment the same person be exposed abruptly and without any intermediate transition to a low temperature, especially to a current of cold air, a considerable loss of heat will be observed upon the surface of the body. The blood which has been thus cooled externally comes back into the internal organs and cools them suddenly; which circumstance alone may, in an organ predisposed to disease, become the active cause of some severe malady. The cutaneous vessels, on their part, become contracted, driving out the blood which they contained, and thus produce a kind of hyperæmia, which in itself may exercise a morbific action. This cause, however, is usually only an accessory one, at least in cases where the temperature has been much elevated. The vessels have lost their tonicity, and do not contract suddenly. But if the danger from collateral hyperæmia is thus diminished, that from refrigeration is increased.—8 *B*, *Dec.* 21, 1872, 592.

CURE FOR CORNS.

According to the *Union Medicale*, corns may be cured, with greater certainty and rapidity than in any other way, by simply applying, morning and evening, a drop of perchloride of iron by means of a bit of straw. This treatment, continued for fifteen days, will, in most cases, effect a cure without involving any pain.—3 *B*, *September* 26, 1872, 106.

BENEFITS OF VACCINATION.

The small-pox epidemic has been very prevalent for some time past in Vienna, and numerous cases are constantly occurring, taxing the abilities of the medical profession and the capacity of the various hospitals to the utmost. The benefit of vaccination, however, is shown by the unanimous testimony of those who have been most concerned in the treatment of the disease. The general result is summed up as follows: 1. The mortality has been ten times greater in the unvaccinated than in the vaccinated. 2. The intensity of the disease has also, as the general rule, been very much greater in them. 3. Cases of hemorrhagic small-pox occurred much more frequently in the unvaccinated. 4. In the Children's Hospital, where the mortality has been so enormous, and has specially prevailed in the hemorrhagic form, its fatal course has chiefly been among the unvaccinated. These facts will, at a later period, be demonstrated by the publication of the full statistical data, and it is hoped they will teach the opponents of vaccination a much-needed lesson.—20 *A*, *Nov.* 30, 1872, 617.

ACTIVE PRINCIPLE OF VACCINE VIRUS.

The vaccine matter, or virus, contains, in an albuminous fluid, different formations, among which very small microscopic grains are conspicuous. Messrs. Chauveau and Keber consider these as the very carriers of the vaccine matter. Mr. Ferdinand Cohn was offered an opportunity to examine the subject more closely, and makes the following report:

At first he raises the question, Are these grains, perceived by all observers, constituent parts of the virus, or accidental admixtures? Experiments instituted with all possible precautions led to the conclusion that they exist in the freshest virus, and have to be considered as constituents. These globular corpuscles fill the vaccine matter quite equally. They are without spontaneous motion, but show molecular motion. Their size could not be ascertained accurately, being beyond our present means of microscopical measurement, but is certainly less than 0.001 of a millimeter—perhaps one half or three quarters of it. At first they are mostly single, rarely in pairs, but increase rapidly in number when the observation is continued for some time with proper precautions. They form entire rows, and, after some hours, irregularly connected groups. This extremely rapid and uninterrupted augmentation proceeds from cross-division of the cells. From these observations Mr. Cohn considers the corpuscles of the virus as living, independent organisms, belonging to the class of schizomycetæ, which, as the smallest and simplest of all organisms, multiply only by the division of cells.

In conclusion, Mr. Cohn discusses the question whether these corpuscles are in fact the carriers of the contagion, and comes to the conclusion that this is highly probable, yet not definitely decided. He inclines, however, to a modification of this statement, viz., he would consider them rather as originators than carriers, in so far as he believes them to act as ferment upon the liquid constituents of the virus, which, becoming decomposed, show their poisonous effect when received into the circulation of the blood. Mr. Cohn promises to test this hypothesis experimentally, and to communicate the results.—19 *C*, 1872, xxix., 231.

TREATMENT OF INTERMITTENT FEVER BY CARBOLIC ACID.

Dr. Déclat announces to the Academy of Sciences of Paris a new method of treatment of intermittent fever, the success of which has been tested upon cases conducted in France, Hungary, Algeria, Senegal, India, etc., and which, after a few days of trial, sometimes with a single application, has succeeded in causing a disappearance of the fever. The advantages of the treatment are that it may be applied at any time, and that there are no counter-indications on the part of the nervous system, the intestinal apparatus, etc. The brain and the stomach, so frequently affected by the use of quinine, are not interfered with by the new medicine.

The method in question consists in the hypodermic injection of carbolic acid, introduced under the skin of the chest, the belly, the inside of the thighs, etc. The first day of the treatment four injections are to be used of one hundred drops of carbolic acid of one per cent., the next day three injections, and two the day after.

The author states that the first operation always diminishes the fever, and frequently cures it entirely; the second is sometimes merely a precautionary measure, and the third is even less necessary. As an additional precaution in some cases, especially if there are indications of cachexy and decided visceral engorgement, Dr. Déclat prescribes the use every day of twenty to twenty-five centigrammes of pure carbolic acid, either in sweetened water or in the form of a special sirup.—6 *D*, *December* 2, 1872, 1489.

ORIGIN OF GOITRE.

The commonly accepted hypothesis in regard to the origin of goitre and the reason of its special development in certain districts of England (namely, the hard-water or limestone regions) is not considered satisfactory by Mr. Lebour, as his own researches have shown that, while at points in certain limestone districts it is entirely wanting, in others it is very common. The true cause, according to this writer, consists of metallic impurities in the water; and he thinks he can show that goitre occurs most where the water is ferruginous, especially where the iron is derived from the decomposition of iron pyrites.—15 *A*, *August* 24, 1872, 240.

LINDEMAN ON GREGARINA IN CHIGNONS.

The *British Medical Journal* publishes an abstract of an article by Dr. Lindeman upon the parasite bodies (*Gregarinidæ*) found in the false hair and chignons usually worn by ladies. These grow at the extremities of the hair, and form little lumps, visible to the naked eye. Each of these lumps represents a colony of about fifty psorasperms, which are originally spherical, but become flattened and discoid by reciprocal pressure. Under the influence of heat and moisture these swell, and the granular contents are converted into little spheres, and then into pseudonavicellæ, which are little corpuscles having a persistent external membrane, and inclosing one or two nuclei. These become free, and float in the air, and penetrate into the interior of the human organism, reaching the circulatory apparatus, and, according to the doctor, producing various maladies, not the least of which are affections of the heart, Bright's disease, and pulmonary complaints. Dr. Lindeman remarks, with the exactness of the mathematician, that in a ball-room containing fifty ladies forty-five millions of navicellæ are set free, and he urges the propriety of abolishing false hair on this account. —18 *A*, *September* 6, 1872, 645.

METHYLENE ETHER AS AN ANÆSTHETIC.

Dr. Richardson, who is indefatigable in the introduction of new remedies, especially those having anæsthesia for their object, furnishes an account of some recent experiments with methylene ether, or ethyl, from which he concludes that this substance bids fair, on the whole, to hold a permanent place in surgery. He says that it is rapid in producing its effects, and that the sleep induced is gentle, rarely attended with convulsive movements, and easily recovered from. He thinks that fewer deaths will occur from its use than from chloroform, or even methylene bichloride, and that it may prove equally safe with common ether, over which it possesses, as a practical agent, all the advantages of the substances first named.—20 *A*, *February* 15, 1873, 164.

OZONE WATER AS A REMEDY.

In a unanimous petition of a German medica. society to the Prussian government in December, 1872, for further opportunity to test the effects of ozone water, it is stated that this preparation (of which the quantitative analysis and electrolytic method of manufacture were given by Professor Carus in the German Chemical Society, June, 1872), has proved so decidedly efficacious in malignant diphtheritis, typhus, acute rheumatism of the joints, and against the consequences of chronic affections of the heart, that its disinfecting and tonic properties deserve to be more widely recognized, especially as oxygen has already been placed in the French pharmacopœia, and English observers announce a decidedly beneficial action of peroxide of hydrogen in whooping-cough, although it is entirely inferior to ozone water in oxidizing power.—8 *C*, *January* 23, 1873, 30.

PRESERVATION OF UNSTABLE REMEDIES IN COMBINATION WITH EACH OTHER.

Certain substances used in the *materia medica* are extremely unstable in their combinations, and can not be kept for any length of time, either dry or in solution, without becoming entirely changed, and consequently more or less unfit for therapeutical purposes. Among these are the proto-carbonate and proto-iodide of iron, much used for certain affections. According to Tisy, a Parisian pharmaceutist, this difficulty may be remedied by mixing together powdered protoxide of iron, some carbonate or alkaline iodide, and an inert powder, the object of which is purely mechanical, and which serves to separate the molecules, and prevent their chemical reaction. These are to be inclosed in hermetically sealed capsules, such as are commonly used in medicine, and may thus be kept indefinitely. When swallowed, however, the capsule is immediately dissolved, and the liquids in the stomach, mixing with the powdered ingredients, cause their combination and consequent action.

The advantages of this mode of preparation are three: first, it replaces a very insoluble pill by a soluble capsule;

second, the salt of iron does not exist in the capsule, and oxidation is therefore not possible; third, the salt of iron is presented to the stomach in a nascent state—that is to say, in the best condition for absorption and assimilation.

The same pharmaceutist prepares the iodo-bromide of iron in capsules, representing the natural association of bromine and iodine in marine productions and mineral waters. According to his statement, the bromide of iron can be taken with perfect convenience by persons who can not use the other salts of iron.—9 *B*, *January* 9, 1873, 112.

BROMIDE OF CALCIUM IN MEDICINE.

The application of the bromides in medicine has within late years increased to an enormous extent, the bromide of potassium alone being manufactured by tons and furnished at a low price, whereas years ago it was only the more wealthy who could afford to use it. The combinations of bromine usually employed are those of potassium, sodium, and ammonium, and their virtues depend principally upon the extent to which the bromine is taken into the system. This substance can not be employed by itself on account of its very acrid properties.

Quite lately Dr. William A. Hammond, the eminent specialist in diseases of the nervous system, introduced the use of the bromide of calcium, to which he was led by noticing the much greater readiness with which it was decomposed; in fact, for this reason a solution can not be kept any length of time without becoming unserviceable. It is therefore best kept in a dry state, the solution being made from time to time as needed for administration. The dose is fifteen to thirty grains, according to the age or condition of the patient. As a hypnotic, it is much preferable to the other remedies, and it has even been available in checking a powerful attack of delirium tremens. It has also been used to advantage in epilepsy, in which it has a very decided effect.—*Amer. Jour. of Med. Science, October*, 1871.

NITRITE OF AMYL.

Among the recent additions to the *materia medica* which promise to be of value in the treatment of disease, one of the most interesting is the nitrite of amyl, one of the numerous products of coal-tar. If four or five drops of this substance be sprinkled on a handkerchief and inhaled, a sensation of great fullness of the head is experienced, accompanied by a pricking of the skin and redness of the face and ears, and, if continued for any considerable time, consciousness is lost for a season. It is said, however, that this application will prevent a threatened attack of an epileptic fit, if the patient is sufficiently aware of its approach to apply the remedy in time. It is also asserted to be very serviceable in preventing attacks of asthma consequent upon heart-disease, and even of angina pectoris, stopping both at once, and possibly tending to reduce the violence and frequency of the attacks.

Its secondary effects are considered not at all injurious, and the dose of four drops is said to be perfectly safe.—*Amer. Jour. of Med. Science, October*, 1871.

PRODUCTION OF OPIUM IN GERMANY.

The production of opium has greatly increased in Würtemberg, Germany, during the last year, and it is remarked that the juice is even richer in morphia than the best brought from India. Seeds of the most valued species of poppy from Asia Minor were in no respect superior to the indigenous.—14 *C*, vol. cciv.

THERAPEUTIC QUALITIES OF HYOSCYAMUS.

In an article by M. Oulmont upon the therapeutical action of hyoscyamine in convulsive and spasmodic affections, being a continuation of a former paper by him, published two years since, on the physiological action of this substance, the following conclusions are presented: 1. Hyoscyamine represents all the active principles of henbane, and the fixity of its composition allows its being employed with a precision that is not attainable with henbane in substance. 2. It should be given at first in small doses (two milligrammes per diem), whether in the form of pills or hypodermic injections, but the dose may ultimately be increased to ten or even twelve milligrammes per diem. 3. It should be continued even after the supervention of slight symptoms of intoxication (as dryness of the throat, and dilatation of the pupils); but if these become more serious, and cerebral symptoms are produced, it should be suspended. Such symptoms, however, soon disappear. 4. Its action is narcotic, and it is efficacious against pain, and especially in neuralgia, but its efficacy is less marked than that of opium and belladonna. 5. It exerts a favorable action in spasmodic and convulsive neurosis. It has cured mercurial tremor when all other means have failed, and in senile trembling and *paralysis agitans* it has produced an amelioration procurable by no other means. 6. In *locomotor ataxy* it is of no use, but in *traumatic tetanus* it has produced an amount of relief that encourages further trial.—20 *A, November* 30, 1872, 605.

OZONIZED WATER.

Ozonized water has lately been profusely advertised by several chemical establishments. Competent chemists assert that water is not a solvent for ozone, otherwise rain-water from thunder-clouds would contain it. Professor Böttger, in Frankfort, has examined specimens of such ozone water, and found an acid reaction, but no trace of ozone. The acid was recognized as nitrous acid. Mr. Carus, on the contrary, positively states that ozone is present in considerable quantity, without any free acid.—1 *C*, 1872, xv., 240.

PRUNUS BOLDUS, A NEW ARTICLE OF THE MATERIA MEDICA.

The *materia medica* has quite lately been enlarged by the addition of a Chilian tree, there called the Boldo (*Prunus boldus, Prunus fragrans*), the leaves of which have an aromatic taste, and contain an essential oil and an alkaloid which has been termed Boldine. This substance crystallizes, and is soluble in alcohol, ether, chloroform, and benzine. It has been recently introduced to a considerable extent into the United States for the purpose of experiment by pharmacists.—1 *A, October* 4, 1872, 168.

ACTION OF COD-LIVER OIL.

Dr. Decaisne, who has been investigating the therapeutic action of cod-liver oil, reports as the result of nearly one hundred observations that it is in rickety patients, as previously shown by various writers, that cod-liver oil has its most positive and curative action, but that it cures neither scrofula nor consumption. In these three affections, as in all others in which it has been tried, it acts as a restorative and reconstituent, and may be applied to the treatment of all such conditions of the system as exhibit a general cachexia, without being addressed to any particular malady.

Wishing to verify as much as possible the conclusions of Dr. Pollock in reference to the fattening of calves, pigs, and sheep with cod-liver oil, Dr. Decaisne weighed a number of children slightly affected with scrofula and rickets, before, during, and after treatment, and ascertained that whenever the dose exceeded a certain limit, variable with the individual, the growth ceases, and that the cessation of growth is attended with loss of appetite and a reduction of nutriment. He has been enabled to verify the experience of Greenhow, who maintains that the increase of weight always ceases in individuals attacked with consumption whenever by the use of the cod-liver oil they have attained their normal weight.

He furthermore maintains, contrary to the views of other writers, that the oil treatment is only useful in the first stages of consumption, and when there is little or no fever. On the principle, now perfectly admitted, that the digestion and minute subdivision of fatty matter is one of the functions of the pancreas, the functional activity of that organ is always connected with that of gastric digestion, and he therefore always administers the oil with the food, and not in the intervals between meals.—6 *B*, *December* 16, 1872, 1714.

MEDICAL USE OF KUMISS.

In a paper by Professor Richter, on the medicinal use of milk and whey, it is stated that kumiss, a substance prepared in Northern Asia by the fermentation of mare's milk (according to an analysis, in June, by Hartier, an apothecary), contains, in 100 parts, 2.05 of fat, 2.20 of milk sugar, 1.15 of lactic acid, 1.12 of casein, 28 of salts, as solid constituents, 1.65 of alcohol, and 0.758 of carbonic acid. Compared with an analysis of the milk, this shows loss of nutritious matter (cheese, fat, sugar), but gain of lactic acid, carbonic acid, and alcohol. To these, then, must be ascribed the peculiar effect of kumiss; and they increase in amount if it is subjected, like wine, to a subsequent fermentation. It has a pungent, pleasantly acid taste, with an after-taste of almonds, and an acid odor, somewhat similar to that of the horse. The effect upon healthy individuals is that of a pleasant, cooling, thirst-allaying beverage. It does not injure the stomach or bowels, has no laxative effect, except when either too fresh or deteriorated, and is especially wholesome in warm weather. Somewhat like beer, it produces a slight intoxication, or rather exhilaration, without loss of consciousness, and with subsequent inclination to sleep; it causes no unpleasant after-effects, as headache, etc. When it has been used for several weeks, the body increases in size and weight, the skin becomes moist, and the countenance acquires a peculiar fresh complexion. Young subjects, who do not improve on the most nutritious diet, seem gifted with new life after the use of kumiss. Dr. Von Maydell, Medical Inspector, says that it combines the effect of animal food with the stimulating effect of carbonic acid on the vascular system. It has acquired a great reputation in Russia as a specific for consumption. Ucke and Stahlberg ascribe remarkable curative properties to it, in cases of chronic, not acute, catarrh of the respiratory organs, especially when accompanied by free expectoration. This effect, in case of chronic bronchial catarrh, manifests itself almost on the first day of the use of kumiss; and it is highly probable that it owes its reputation, as a cure of consumption, to this fact. The use of kumiss is not desirable in the case of plethoric persons, or a predisposition to apoplexy, congestion, or hemorrhage, sluggishness of the liver or spleen, pregnancy, organic disease of the kidneys, bladder, heart, or vascular system, or hectic. Blood-spitting is not a contra-indication, and the cause of some cases of blood-spitting, attributed to the use of kumiss, was the excessive summer heat of the Steppes.

Contrary to the opinion of many, that it is necessary to use kumiss in the Steppes, where it is prepared, in order to enjoy its full effect, the resorts recently established elsewhere (first by Russian physicians) have met with success. Among these are those of Drs. Witskof in St. Petersburg and Stahlberg in Moscow, the latter of whom earnestly disputes the opinion that kumiss is only effective in the Steppes. Out of Russia, goats' and even cows' milk is employed, with the addition of the sugar necessary for fermentation, and, in order to imitate old kumiss, a little wine is added. From Ottenstein one kind is sent out for women, children, and feeble persons, and another to men accustomed to spirituous beverages. The latter evidently contains wine, and the former reminds one of seltzer water and milk. Although doubt has been expressed as to its transportability, it seems that it has long been forwarded from the Steppes to the interior of Russia, and at present different manufactories send out large quantities of milk-wine that will not deteriorate for several months; while Gross states that the Americans ship a milk-wine prepared on their Western prairies to Eastern Siberia. —8 *C*, *September* 19, 1872, 313.

PREPARATION OF KUMISS FROM CONDENSED MILK.

According to Carl Schwalke, this is accomplished by dissolving six cubic inches of condensed milk in a little cold water, to which add fifteen grains of lactic acid, eight grains of citric acid dissolved in water, two hundred and twenty-five grains of rum, and dilute with water to from one to two quarts. Put the mixture in a Liebig's bottle, impregnate with carbonic acid, and place it in a warm room. If in from two to four days it is sparkling, and fermentation has commenced, it is in good condition, and will remain so for about a week.—13 *C*, *September* 15, 1872, 1236.

ACTION OF THE BLOOD ON CHLORAL.

Personne has recently been endeavoring to ascertain whether, as Liebreich maintains, the hydrate of chloral is actually transformed in the system so as to produce chloroform. Various opinions have been held on this point, some experimenters denying that the effects observed could be referred to chloroform, especially for the reason that there is no characteristic odor of chloroform to be observed in the blood of animals treated with chloral, even when drawn from the veins and heated to almost 122° Fahr. The result of the experiments was a decided confirmation of Liebreich's views, as shown by certain delicate chemical tests; and Personne is of the opinion that, as the chloroform is at best but slight in quantity, and its odor very feeble, this is masked by the characteristic odor of the blood itself.

The same investigator has discovered a combination of chloral with alcohol, and has also suggested that there is a very intimate connection between chloral and aldehyde, showing that by substituting hydrogen for the chlorine in the chloral we can produce aldehyde. The transformation of the chloral into chloroform in the blood is due to the alkalinity of the latter.—6 *B*, *November* 25, 1872, 1317.

TURPENTINE AS AN ANTIDOTE TO PHOSPHORUS POISONING.

For some time it has been well known that oil of turpentine constitutes an antidote to phosphorus in cases of poison, although the precise philosophy of the action was not well understood. It has now been ascertained that a chemical combination takes place, with the formation of what is called *turpentine phosphoric acid*, in which form it is discharged in the urine of a poisoned patient treated with turpentine, and can be found in the alkaline distillate when the urine is distilled.—21 *D*, *February*, 1873, 179.

PREVENTION OF MERCURIAL POISONING.

Jules Meyer, an employé in a French mirror factory, has lately ascertained that by scattering through the working-rooms a pint or half a pint of aqua ammonia every evening all danger from the absorption of mercurial vapors will be in a measure prevented. This practice has now been in use for several years in his establishment without the occurrence of any new attack of mercurial intoxication, while no further difficulty has been experienced by persons who had been previously affected. No explanation has been offered as to the theory of the action of the ammonia.—3 *B*, *March* 13, 1873, 445.

CHLOROFORM AS A SOLVENT IN EXAMINATION FOR VEGETABLE POISONS.

According to experiments by J. Nowak, chloroform will rapidly and completely take up from an alkaline solution, on being shaken with it, even when cold, strychnine, quinine, quinidine, cinchonine, caffeine, theobromine, emetine, atropine, hyoscyamine, aconitine, veratrine, physostigmine, narcotine, codeine, thebaine, nicotine, and coniine; somewhat more slowly, brucine, colchicine, and papaverine; and when warm, sabadilline, and some narceine. Picrotoxin is taken up much more readily from acid than from alkaline solutions, while morphine and solanine are taken up from neither. Further experiments showed that all these substances absorbed from alkaline-aqueous solutions by chloroform, are given up again upon agitating it several times with acidified water, while the fats and other foreign matters are retained. A systematic plan for the detection of these vegetable poisons, based upon the above facts, was tested by mixing weighed quantities of them with suitably selected portions of a human subject. In many cases the whole of the poisonous matter was recovered, in most cases the greater part; and it was a peculiarly satisfactory feature of the process that the substances were obtained from the chloroform in such a state of purity that immediate tests for their identification could be made.—14 *C*, 1872, CCVI., 422.

NICOTINE IN TOBACCO SMOKE.

Experiments, by Dr. Heubel, do not confirm the alleged absence of nicotine from tobacco smoke; on the contrary, by condensing smoke from cigars, and washing it in water and alcohol, he obtained a solution which was capable of producing the effects of nicotine; and he also detected its presence, chemically, in the form of the salts more permanent at high temperatures. The injurious effect of smoking, he concludes, must therefore be ascribed, in part, at least, to the absorption of nicotine, though other substances may act with this poison.—13 *C, December* 15, 1872, 1630.

BRÉANT PRIZE FOR 1872.

The Bréant Prize has been adjudged to M. Chauveau by the Academy of Sciences of Paris for his researches upon virus and virulent maladies. This gentleman has, for many years, been engaged in experiments upon the subject, and has already reached results of very great scientific and practical importance. In his investigations upon vaccine virus, he was able to strain out certain granulations from the serosity forming the contents of the vaccine pustule; and he ascertained that the liquid itself was inert, and that the action is due entirely to the solid granulations.

Again, when water was added, these granulations were found to settle at the bottom, leaving an inactive layer above; but when the liquid was disturbed, and these granulations stirred about, the vaccine properties were imparted to the whole mass. He thus found that the virus diluted with fifty times its weight of water is as decided in its action as when concentrated; indeed, he has been successful with vaccine when diluted with one hundred and fifty times its weight of water; but in this case with less certainty.

Professor Chauveau next took up the determination of the action of virulent and morbid pus, and found here, as before, that the specific action rests entirely in the elementary corpuscles held in suspension in these humors. He ascertained that they could be washed without losing their specific properties, and that a continued retention in the water had no other effect than to communicate the virulence to this liquid itself.

Another point in his investigation was the refutation of the common impression that virulent substances introduced into the stomach are harmless, from being digested and rendered inactive after entering the alimentary canal. The contrary was proved to be the case, especially in regard to matter of a tubercular nature.—6 *B*, *November* 25, 1872, 1327.

ARTIFICIAL RESPIRATION IN ASPHYXIA AND IN SNAKE BITES.

According to Gréhaut, carbonic acid which has entered the lungs from without may be eliminated again by means of artificial respiration without having been changed or undergone any combustion. In cases of apparent death from asphyxia caused by charcoal vapors, the employment of artificial respiration has, it is said, resulted in finally restoring the patient to life. According to Dr. Fayrer, artificial respiration is the best method of counteracting the effect of snake bites, and in his opinion it is the only method that gives the slightest promise of enabling a patient to overcome the effect of the poison. A bitten rabbit has been kept alive for several hours by artificial respiration, whereas under the usual operation of the poison it would have survived but a few minutes.—18 *A*, *February* 21, 1873, 551.

HEATED IRON IN RESUSCITATING THE DROWNED.

A case of restoration from apparent drowning has lately taken place in the city of Brussels, where a man had fallen into the water, and was only recovered after a considerable time. Dr. Joux, an eminent physician in the city, immediately initiated the necessary measures toward his restoration, and for three hours applied all the remedies that could be thought of. No evidence of life manifesting itself in this interval, Dr. Joux proceeded to apply plates of iron, heated to a white heat, to the upper parts of the body, near the more vital organs. After a short time, to the astonishment of the assistants, faint signs of breathing were observed, and in the course of half an hour the man came to life, and was finally fully restored, the only inconvenience sustained being the result of the severe cauterization which his skin necessarily underwent.—18 *A*, *February* 14, 1873, 527.

CURING PHOSPHORUS BURNS.

As a preventive of evil consequences from burns by phosphorus, it has been suggested to place the part affected as soon as possible in a concentrated solution of carbonate of soda, perfectly harmless phosphate of soda being thereby formed.—12 *C*, *September*, 1872, 71.

LAUGHTER AS A REMEDIAL OPERATION.

At a recent meeting of the German Scientific Association, at Leipsic, Dr. Hecker made some remarks upon laughter. He stated that tickling, which he styled a variable, intermittent excitement of the nerves of the skin, produced irritation of the sympathetic nerves, with the result of an expansion of the pupil and a contraction of the blood-vessels, and that the consequent diminution of pressure on the brain, permeated with blood-vessels, is so considerable as not to be without danger. Powerful expiration operates against such a diminution of pressure, and therefore laughter, which consists simply in intermittent forced movements of expiration, must be recognized as a decided remedy for the effects of tickling.

Laughter due to a sense of the ludicrous, according to his experiments, is also to be accounted for as the result of an intermittent cheerful excitement, accompanied by similar bodily manifestations, which may be referred to stimulation of the sympathetic nerves. Laughter thus seems to have a remedial office.—19 *C*, *October* 26, 1872, 352.

A CHINESE REMEDY FOR SNAKE BITES.

Among the most esteemed drugs used by the Chinese is one known as "ch'ing muh hsiang," the root of a species of

Aristolochia, cultivated and growing wild in the region about Ningpo. It is said to be a powerful purgative, emetic, and anthelminthic, and is the principal remedy for the bites of snakes. Dr. H. F. Hance reports the exports of this drug from Ningpo as very large, amounting in 1868 to six or seven hundred tons, and valued at over £26,000.

No other genus of plants has had such a reputation in these cases as *Aristolochia*, through all ages, in every condition of society, and in all quarters of the globe. Greeks, Romans, and Arabs, the Indians of North America, the West Indies, and throughout South America, as well as the inhabitants of Eastern Asia, testify to the virtues of different species. Yet modern physicians agree in regarding them as simple diaphoretics, stimulant tonics, and emmenagogues. The fact of this so general but apparently unfounded belief is a curious one.—*Trimens' Jour. Bot., March*, 1873, 72.

RELATION OF ENTOZOA TO THE GROUSE DISEASE.

This disease has been a subject of great interest to the sportsmen of Great Britain, the zest of the shooter's season depending very much upon the presence or absence of this affection. Some years ago it was extremely virulent, and threatened an almost entire extermination of the birds. Of late years the disease has been less troublesome. The precise cause has not yet been ascertained, although frequent surmises have been expressed as to a dependence upon the presence of entozoa. Dr. Cobbold, a very high authority upon this subject, gives the details of an examination of diseased grouse made by him, and he found that the intestinal cæca were occupied by an undescribed species of strongylus, about one third to one half an inch in length. The same animal was found in healthy birds, but in much less quantity, and Dr. Cobbold was prepared to admit that the health of the grouse was probably affected by the presence of these parasites, and that the disease might result in great part, if not entirely, from the presence of the entozoa.—19 *A, November* 9, 1872, 450.

ANTAGONISM OF BELLADONNA AND PHYSOSTIGMA.

According to Dr. Frazer, the active principle of belladonna (atropia) has a remarkable counteracting influence upon the poisonous action of the Calabar bean (physostigma). When doses of atropia were given a few minutes before or after taking the bean, animals recovered from the effects, which would otherwise have proved fatal, the most successful result being when the atropia was given before taking the bean.—15 *A, August* 31, 1873, 276.

COMPARATIVE POISONOUS QUALITIES OF METALS.

In 1849 Rabuteau announced as a law that metals are poisonous in proportion to the elevation of their atomic weight, or the low degree of their specific heat. Thus, in comparing cadmium and zinc, it was found that the former was much more active than zinc, the two having the relations indicated. Barium, again, was more poisonous than strontium, and the latter than calcium. This law has been verified by comparison of the groups of tellurites. Thus tellurites and selenites are extremely poisonous, much more so than the sulphides, which are scarcely dangerous. Finally, oxygen, which belongs to the group of sulphur, selenium, and tellurium, according to Dumas, is only poisonous, as shown by the recent researches of Bert, when animals are exposed to the compressed gas, so that their blood shall be made to contain about double the quantity which it has in the normal condition.—6 *B, February* 10, 1873, 349.

INJURIOUS EMANATIONS FROM MANUFACTORIES.

The necessity of legislative action for the protection of the health of the community in the vicinity of certain manufacturing establishments is shown by the experience with the Freiberg lead-smelting works. All vegetation has been destroyed in the vicinity, and a pine forest at a distance of four miles has been considerably injured. Cattle feeding on the fodder of the district experience peculiar attacks of sickness. Analysis of the affected plants exhibits traces of arsenic and lead, and an abnormal quantity of sulphuric acid. In view of the variety of substances involved in the supposed agencies, experiments were made to determine to which the result was especially to be ascribed, and it was found that arsenic was not at all injurious, successive fumigations of arsenious vapor producing no effect on the trees; nor was vegetation destroyed in the neighborhood of arsenic factories. When arsenic was applied in solution to the roots of plants, it was found to be more prejudicial. In continuing the experiment, finely powdered lead carbonate was applied from time to time for one year to a young fir. During that year there was no growth; but the next season it proved to be healthy and vigorous. The most destructive results were found to be due to sulphurous oxide. Five fumigations, with air impregnated with $\frac{1}{18000}$ of this gas in volume, caused all the leaves to fall, and killed the upper part of the tree. A still more excessive dilution produced similar evils, but required a longer time. Trees fumigated for a period of three months were killed, even when treated with a mixture of one millionth of the gas by volume, the moist trees being first affected. Soot appeared to have no injurious effects; benzine was burned under a case surrounding a young fir till the tree became quite black; but the tree produced its annual shoots notwithstanding, and remained quite healthy.

The general result is that sulphurous oxide is the especially poisonous ingredient of the smoke from smelting-works. A curious fact has been noticed in Germany in reference to the action of sulphurous oxide—namely, that an atmosphere of $\frac{1}{55000}$ of sulphurous oxide destroys the chlorophyl grains in wheat, oats, and pease in a few hours; but, curiously enough, a proportion of one in 74,000 produces no injury. Cabbages, and all plants having large, strong leaves, appear to be but slightly affected. Wood smoke does not injure vegetation; but that of coal and of some kinds of turf is very prejudicial, owing to the sulphurous oxide produced in combustion.—21 *A*, *December*, 1872, 1109.

HYPODERMIC ADMINISTRATION OF QUININE.

According to Limousin, the best method for the hypodermic injection of quinine is to use it in the form of a sulphovinate. He has also used the sulphate of quinine acidulated by tartaric acid in the proportion of twenty parts of water, one part of sulphate, and of tartaric acid half a part, which he finds to answer a very good purpose, as it does not irritate, and produces the same effect as doses of twice the strength taken by the mouth. If the sulpho-vinate prove to possess these advantages, it will be preferable, as much less water need be injected. The hypodermic injection is indicated where great promptness of action is required, or where there is much irritability of the stomach or bowels. This is said to have proved efficacious, not only in cases of fever, but also in acute rheumatism.—20 *A*, *March* 8, 1873, 256.

STANFORD PROCESS OF TREATING EXCRETA.

Some years ago, Mr. Edward C. Stanford presented to the British Association a new method of dealing with excretal matters—fish offal, and other offensive nitrogenous substances—so as to secure the whole of their value as manures in an inoffensive form. The process simply consists in combining the material with charcoal, which at once removes all odor. The mixture may be stored, and gradually becomes quite dry. It is then passed through re-burning retorts, when the whole of the nitrogen comes off as ammonia. This is neutralized with an acid, and can then be evaporated with the residual charcoal from the retorts, thus forming a general process free from offense.

Dr. Williamson, however, dissented from the reasoning, and insisted that the process must fail, because, according to Stenhouse, such nitrogenous matters in contact with charcoal become oxidized to nitric or nitrous acids, which, of course, would entirely vitiate the results. With a view, therefore, of testing this point, Mr. Stanford has prosecuted a series of experiments, the results of which he sums up by stating—first, that charcoal mixed in equal weights with nitrogenous matter acts simply as a drier; second, it does not act as an oxidizing agent when thus applied, and does not conduce to the formation of nitrates; third, it is probable that after the lapse of some time, and if the mixture be artificially dried, a small proportion of nitrogen may be eliminated in the form of ammonia; fourth, that, for all practical manufacturing or manurial purposes, there is but little loss of nitrogen in such mixtures.—21 *A*, *January*, 1873, 14.

ANTIPUTRESCENT PROPERTIES OF SILICATE OF SODA.

Much attention has been directed of late to the antiputrescent properties of silicate of soda, and the elaborate memoirs of Rabuteau and Papillon have been succeeded by papers of Picot and other writers. In whatever proportion this substance was added to glucose, grape-sugar, etc., there was the same effect produced—that is, in proportion to the percentage, even so small a quantity as one part in a hundred being sufficient to produce a decided effect. In one experiment five vials were filled, each with fifty cubic centimeters of milk, and while one was left unaffected, the others had respectively five, ten, fifteen, and twenty centigrammes of the silicate of soda added. In three days the first gave an acid reaction not shared by the rest. After a little time, however, the rest exhibited the same reaction; but the vial containing twenty centigrammes experienced no change. A similar experiment was made with a solution of fresh meat, where, with larger percentages of the silicate, no traces of animalcules developed themselves after the lapse of many days. —6 *B*, *November* 4, 1872, 1125.

HOSPITAL BUILDINGS.

Dr. J. M. Woodworth, supervising surgeon of the United States Marine Hospital Service, in his first annual report, just issued, opposes the present course of the Government in regard to the building of hospitals, and recommends that hereafter they shall be built of wood, to be destroyed after being in use ten or fifteen years, on the ground that hospital buildings become poisoned after several years' use, and cause unfavorable results in the treatment of injuries and diseases by engendering erysipelas and its cognates. He claims that his plan will not be as expensive as that now pursued by the Government, as the wooden hospitals will not cost more than a third as much as those of stone or iron.

It will be observed that Dr. Woodworth does not advise the Government to sell the wooden structures after they have been used sufficiently long for hospital purposes, but to *destroy* them. The sale of such buildings, as heretofore authorized, is highly reprehensible. In many cases they are bought up by speculating builders, who use the infected timber in erecting houses for the poorer and middle classes.

CHLORAL IN GOUT.

A correspondent of the *Medical Times and Gazette* writes ecstatically in regard to his experience of the use of chloral as a remedy for gout, having been cured in four days of what had been a very severe attack, and one which, according to previous experiences, should have lasted a fortnight. His first dose, taken at bed-time, was between seventy and eighty grains, and threw him into a profound sleep, interrupted by only occasional awakenings, during which the pains were sufficiently intense to draw tears, but the continued effects of the chloral soon brought on sleep again. A second, third, and fourth dose of equal amount was taken on successive nights, and, as the result, the pain and the gout had disappeared, having been slept off in the interval. The writer remarks that the experience was so astonishing to himself that he hardly expects his assertion to be believed, as he had previously tried every known form of opiate without success.—20 *A, May* 17, 1873, 529.

PROPYLAMINE AND TRIMETHYLAMINE IN ACUTE RHEUMATISM.

A French writer, Dujardin-Beaumetz, has recently prepared an elaborate essay upon the medical properties of propylamine and of trimethylamine in the treatment of acute articular rheumatism; remarking that it is to Professor Awenarius, of St. Petersburg, that we owe the first application of propylamine for the purpose referred to, and that the same remedy was brought to notice, in America, by Dr. John M. Gaston, who has for several years treated numerous cases with a remarkable degree of success. He thinks, however, that the curative action in the practice of this gentleman is somewhat modified by his concurrent employment of sulphate of quinine, so that it is difficult to define the precise functions of either agent. He also makes proper mention of Mr. William Proctor, of Philadelphia, as having, as early as 1859, described all the different methods of preparation of the drug.

The substance in question is readily obtained from animal matter in a state of decomposition, especially that of fish, and old pickled herrings furnish a ready means of securing it in sufficient quantity. It is also found in certain plants, particularly in the pig-weed (*Chenopodium vulvaria*), likewise in various rosaceous plants, such as *Pyrus communis*, the *Sorbus aucuparia*, *Cratægus oxyacantha*, etc.

To obtain the trimethylamine from herring brine it is only necessary to distill a certain quantity with potash, and then treat the distillate, which contains ammonia and the trimethylamine with hydrochloric acid. It is then to be evaporated to dryness, and absolute alcohol applied, which dissolves out the organic alkali, to which hydrate of lime is subsequently added. It is from this source that the material used in the experiments of the writer was derived, and presents itself in the form of a limpid, colorless, very volatile liquid, of an extremely strong odor of rotten fish. The present price of the drug in France is about twenty-five dollars per pound; but this can be readily reduced, should there be a sufficient demand for it.

As the result of numerous experiments, Dujardin-Beaumetz expresses his great confidence in the remedy for the cases referred to, stating that it may be administered without inconvenience in doses of from half a dram to a dram and a half. He finds that it exercises a more powerful effect in cases of acute rheumatism of the joints than any other substance hitherto employed, and hopes, as the result of experiments he is about making, to present a fuller report on the subject hereafter.—11 *B*, *March* 15, 1873, 151.

TRIMETHYLAMINE IN RHEUMATISM.

The application of trimethylamine in cases of acute articular rheumatism seems to commend itself more and more to those who have made use of it, and its virtues have lately been especially detailed by Dr. Dujardin-Beaumetz, of Paris. In a recent article he takes occasion to say that propylamine, which has usually been considered as identical with trimethylamine, is in reality a very different substance, being, in fact, a more or less complex solution of ammonia and trymethylamine, and consequently not a chemically definable substance, but a mixture of variable composition. Trimethylamine itself is most conveniently obtained from old herring brine by a chemical process (and also from several other substances), and is open to the great objection of possessing a disagreeable odor, resembling that of putrid fish. The difficulty of obtaining it pure, and the disadvantage of its smell, have suggested the employment of its compounds, and the hydrochlorate has been proposed as eminently suited for all medicinal purposes. It is a fixed salt, composed of needle-shaped crystals, without any odor excepting when in solution, and even then this is not very objectionable. It is very deliquescent, and acts like a caustic upon the skin.

Dr. Dujardin-Beaumetz has treated some recent cases of articular rheumatism with this preparation instead of trimethylamine, and he finds it to be greatly preferable in every respect. The usual dose is from half a gramme to a gramme every twenty-four hours, taken in considerable dilution, a teaspoonful at a time, from hour to hour. The effect upon a healthy individual is first seen in a depression of the pulse and of the temperature, this being decidedly marked in almost every instance. In one case the pulse was reduced in two hours from eighty-eight to seventy-six. It will of course be proper to decide by experiment how far this action upon the heart may be of service in certain diseases of that organ, and the extent to which its use may actually be allowed.

The testimony of those who have recently reported on this remedy is quite concurrent as to its specific action on articular rheumatism. In one instance a complete cure was said to have been obtained in two days after the administration of fifty centigrammes of the hydrochlorate.—12 *B*, *April* 30, 1873, 337.

PRECAUTIONS AGAINST CHOLERA.

In a lecture on this subject, Professor Förster calls particular attention to the effect of wells in spreading cholera, and gives numerous instances, not only of different cities, but of different parts of the same city, in which cholera was epidemic, where the water supply was from surface wells, while it did not prevail where water was obtained from other sources, or from deep rock wells. He states that in Dresden the water in one well sank when seven feet were pumped out of another 120 feet distant; that carcasses contaminated the water 160 feet off, and that the ammoniacal liquor of the gas-works at Munich was detected in wells 700 feet distant. In short, wells, generally, seem to collect fluid matter from a space of at least 200 feet radius; and, since very few are removed that distance from privies, they are liable to be contaminated by them. Indeed, chemical analysis shows that well-water is rich in nitrates which could only have such a source. It is plain, therefore, why rocky or impenetrable clay soils are not favorable to the appearance of cholera, while the rapid sinking of surface water and a porous soil involves a contrary tendency; so that cholera may continue epidemic even in winter. Cholera is not only produced by drinking such water, but milk, beer, meat, etc., treated with it, become similar sources of the disease.—8 *C*, *April* 17, 1873, 125.

POISONOUS WOOLEN GOODS.

Dr. Hagar states that a number of cases have occurred in Berlin where colored woolen garments, worn next the skin, have produced a peculiar kind of poisoning. Violet-gray woolen stockings, after having been worn less than six hours, caused redness of the skin and permanent pustules, in connection with feverish symptoms and constipation. The same results followed after the stockings had been treated with boiling water. Similar symptoms were produced by gray woolen shirts, next the skin, and by the red binding of others. He considers the aniline colors as a rule poisonous in their action upon the skin, as has been established in regard to coralline, in spite of all denials; the exceptional character of a few in this respect being difficult to establish. He recommends, therefore, that woolen garments colored with aniline colors should not be worn next the skin, and suggests, as a test for these colors, that a portion of the wool be heated to boiling, in a test tube, with 90 per cent. of alcohol, and if the latter acquire a red, violet, or violet-blue tint, the coloring matter is suspicious.—1 *C*, 1873, 64.

PUTREFIERS AND ANTISEPTICS.

Dr. Dougall, of Glasgow, has lately published a pamphlet on putrefiers and antiseptics, the result of an examination of the principal substances that have been presented for consideration in such a connection. His experiments were made to ascertain (1) whether putrefaction can be accelerated by adding certain chemicals to fresh organic fluids; (2) the relative antiseptic powers of different bodies, as shown by their preventing the appearance of fungi and animalcules in organic fluids with which they are mixed; and (3) the relative aerial antiseptic powers of different volatile bodies, as evinced by their preventing the appearance of fungi and animalcules in organic fluids exposed to their vapors, and by their action on vaccine lymph.

Under the first head it was ascertained that the alkalies and alkaline earths and their salts (with a few exceptions) hasten decomposition when present in small proportion in fluids containing organic matter. This is the case with domestic soap-suds, spent lye, and all more or less alkaline liquids. Ammonia, permanganate of potash, biborate of sodium, among chemical waste substances, do not accelerate putrefaction, but, at the same time, they do not retard it. Soda, potash, nitrate and chlorate of potassium, and lime, are especially vigorous as purifiers. Salt, saltpeter, and sugar, all substances which preserve meat when used in large quantities, act as putrefiers when added in small percentage.

Under the second head, Dr. Dougall came to the conclusion, as the result of his experiments with solutions containing organic matter, that putrefaction and fermentation are not identical processes; that the former is more difficult to prevent than the latter, which sometimes subsides into putrefaction, though putrefaction rarely becomes intensified into fermentation. The best antiseptics, in his opinion, are the acids, since it is apparently impossible for marked putridity and acidity to go together. Among these he especially mentions chromic acid and benzoic acid, carbolic acid, indeed, only retarding the appearance of the animalcules and fungi for a time.

The most important portion of Dr. Dougall's investigations related to the relative antiseptic powers of different volatile bodies, and here the chloride of lime appeared to be efficient in nearly all cases. It was ascertained that nitrous acid, glacial acetic acid, and hydrochloric acid are the most perfect in their action; and that next come carbolic acid, sulphurous acid, and chloride of lime, the last being the best of the three. But as the application of these substances was made under very favorable circumstances, and much more concentrated than it is possible to use them in practice, he concludes that aerial antiseption is in most cases fallacious. A very curious fact was developed in regard to the action of various substances upon vaccine lymph in preventing its activity—carbolic acid, both in vapor and solution, as well as chloroform, camphor, sulphuric ether, and iodine, not interfering with this activity. Lymph, exposed to the action of vapor of chloride of lime, sulphurous, nitrous, glacial acetic, and hydrochloric acids, was found incapable of producing its characteristic effect, however, from which Dr. Dougall concludes that these are the best destructives of the active properties of vaccine lymph, and therefore are more likely to act upon variolous matter and other zymotic substances.—18 *A*, *May* 16, 1873, 209.

POISONOUS CHARACTER OF METHYLAMMONIUM COMPOUNDS.

Rabuteau has ascertained that the iodide of methylammonium and the iodide of tetramylammonium act upon animals precisely like the curare poison, by destroying motions without affecting the sensibility, and with precisely the same subtility and energy. A few centigrammes will kill a dog in a few minutes.—3 *B*, *April* 10, 1873, 621.

ACTION OF WATER ON LEAD PIPES.

Sir Robert Christison, who has devoted much attention to the influence of water upon lead in passing through pipes, etc., has ascertained that the purest waters are those which act most powerfully upon lead, corroding it, and forming a carbonate of a peculiar and uniform composition, and that all salts impede this action, many preventing it altogether, some of them doing so when in extremely minute proportions.—3 *A*, *May* 31, 1873, 615.

DETECTION OF ARSENICAL COLORS IN PAPER, ETC.

H. Hagar gives the following process for detecting arsenical color in paper. A piece of the paper is soaked in a concentrated solution of nitrate of soda in a mixture of equal volumes of alcohol and water, and allowed to dry, and then burned in a flat porcelain capsule. The ashes are covered with water, several drops of caustic potash solution are added, so as to produce a strong alkaline reaction, then heated to boiling, and filtered. Permanganate of potash is gradually added to the warmed filtrate, previously acidified with dilute sulphuric acid, as long as decoloration, or conversion of the red to a yellowish-brown color, takes place; and finally a slight excess of the permanganate is introduced. If the liquid become turbid in the operation, it must be filtered. After cooling, and the addition of more dilute sulphuric acid, a piece of pure zinc is added, and the flask closed with a cork with two splits in it, in one of which a strip of parchment paper moistened with nitrate of silver is fastened, and in the other a strip moistened with acetate of lead. If arsenic be present, the silver paper soon darkens. The lead paper is simply intended to indicate the presence of sulphureted hydrogen. The treatment with the permanganate is absolutely necessary, otherwise a blackening of the silver paper and a slight browning of the lead paper will invariably take place, though perhaps only after some time, even in the absence of arsenic.—14 *C*, 1873, CCVII., 511.

GIRARD'S PREPARATION OF THE PROTOXIDE OF IRON.

Dr. Girard, of Paris, has presented to the consideration of the Academy of Sciences a preparation of the protoxide of iron, which he recommends to the Academy as possessing the tonic properties of the salts of iron, and as not producing constipation, but, on the contrary, having a slightly purgative action.—3 *B*, *May* 22, 1873, 139.

GOUBLER ON PROPYLAMINE.

Professor Goubler does not agree entirely with those who recommend propylamine as a valuable specific in articular rheumatism, remarking that this, as well as methylamine and their combinations, act much like ammonia and ammoniacal salts, constituting diffusible and fluidifying stimulants. On this account he thinks them capable of rendering good service in cold rheumatism (or that in which there is little fever), and especially when there is a tendency to interstitial exudation and a thickening of the fibro-synovial tissues, but that they are very apt to exasperate rather than alleviate the inflammatory and febrile phenomena of intense acute articular rheumatism.—18 *A*, *July* 4, 1873, 40.

ARTIFICIAL FIBRINE FROM THE WHITE OF EGG.

Dr. John Goodman, in a series of articles in the London journals, warmly commends what he calls artificial fibrine as a very nutritious substance, capable of being administered to invalids under circumstances where other food is not acceptable. It is formed by emptying the albumen or white of the egg into cold water, and allowing it to remain there for twelve or more hours. In this time it undergoes a chemical molecular change, becoming solid and insoluble, assuming an opaque and snowy white appearance. This and the fluid in which it was immersed only require to be heated to the boiling-point to render the fibrine ready for use. It is easy to digest and very palatable, and is considered as a great culinary delicacy. It is said that the stomach will retain this in many cases where any thing else is promptly rejected, its presence creating a craving for more food, and thus promoting instead of decreasing the appetite.—1 *A*, *May* 23, 1873, 255.

THE SENSATION OF COLD NOT IMPARTED BY COLD ALCOHOL.

An interesting discovery, which may prove to be of considerable importance in its practical applications, has lately been made by Horvath, who announces that, in the course of experiments on the effect of cold on frogs, he has ascertained that the immersion of the finger in alcohol at a temperature of 25° Fahr. produces no pain, but that contact with a solid body under such circumstances is distinctly appreciated. Hence he concludes that tactile perception remains, though the sensation of cold is not experienced.

Still further, Horvath found that in the case of wounds and burns, if the part affected be immersed in alcohol, the pain immediately ceases, and the subsequent progress of a cure is greatly accelerated. If, therefore, the excessive and continuous pain which usually accompanies extensive burns be one cause of death, it is suggested that life may often be saved by the alleviation of the pain resulting from the application of glycerine or alcohol, and that possibly tetanus may also be prevented. The severe pain produced by immersing the hand in cold water is well known, while in ether and quicksilver it is still more intense.—13 *A*, *June* 15, 1873, 213.

POISONING OF THE ATMOSPHERE BY ARSENIC IN WALL-PAPERS.

The poisonous effects upon the air of rooms of arsenical pigments on wall-paper have been generally ascribed to the inhalation of the dust, which was found to contain arsenic and copper, but cases of arsenical poisoning of this kind have occurred in which, on account of the moisture still present in the wall and the effectual fixing of the colors, this explanation will not answer. Upon these a recent series of experiments by Fleck throws some light. Air in glass receivers was subjected to the action of Schweinfürth green and arsenious acid by simply placing these substances beneath some bodies in a moist condition, and by applying them as a coating to others, with and without paper, potato and wheat starch being employed as pastes. After from eight days to three weeks, in different cases, the presence of arseniureted hydrogen in the air was unmistakably revealed by tests, and left no doubt that cases of chronic arsenical poisoning must be attributed not only to the mechanical mixture of arsenical compounds with the air of rooms in the form of dust, but also to the presence of this gas, resulting from the decomposition of free arsenious acid in Schweinfürth green. It was also found that the development of the gas is favored by moisture in the air and the presence of organic matter, especially that in the paste. Mould appeared on the paper in some cases, showing that arsenic is not a preventive of its formation, as often stated.—19 *C, January* 25, 1873, 35.

NEW MODE OF TAKING COD-LIVER OIL.

A novel method of administering cod-liver oil, announced by Carré and Lemoine, consists in introducing it into bread, each pound containing seventy-five grammes (or five teaspoonfuls) of the oil, and about ninety grammes of milk. This bread is said to be in every respect sweet and palatable, without the least smell or taste of the oil.—12 *B, July* 15, 1873, 26.

ELECTRICITY FOR CURING TOOTHACHE.

Dr. Bouchaud, of Paris, strongly recommends the use of electricity in cases of severe toothache, and maintains that not unfrequently a perfect cure will be effected, even where the teeth are greatly decayed. He has seldom failed to secure at least a temporary relief, this frequently lasting for days, and often continuing indefinitely. In numerous instances where alleviation after the first application was of brief duration, the effect became more and more marked, and lasted longer as the treatment was repeated. The method adopted for applying the electricity is to place the positive pole of the current on the cheek opposite the diseased tooth, and the negative upon the antero-lateral portion of the neck; and, to avoid ulcerations, he makes the electrodes very large, and changes their place frequently. He continues the application for about half an hour, although relief is frequently experienced in the course of ten or fifteen minutes. He uses a battery of about ten elements.—12 *B*, *July* 15, 1873, 1.

PUTRID INFECTION.

Original investigations upon this subject, by Ravitsch, show essentially the following results in transferring a putrifying liquid obtained by long maceration of meat and hay, to rabbits, sheep, dogs, etc., allowance being made for the differences of the animals: 1. The local effect consists in the production of diphtheritis at the point of contact, often with little influence upon the general condition—according to experiments with rabbits. 2. The constant anatomical changes are increased, and granular degeneracy of the colorless blood corpuscles, solution of the red corpuscles, with rapid separation of crystals of hæmoglobin, granular degeneracy of the muscles of the heart, liver-cells, and epithelium of the kidneys. 3. The usual symptoms of disease, viz., elevation of temperature, and diminution of consciousness and sensibility; vomiting and purging, on account of irritation of the mucous membrane, are frequently, but not invariably present; cramps seldom occur. 4. No bacteria or other foreign bodies can be found in the blood of infected living animals, and the putrid infection, therefore, can not consist in the development and multiplication of bacteria. 5. After death an exceedingly rapid decomposition of the blood takes place, and an unusual development of bacteria, and small bodies (microzymes) which develop into bacteria. It also appears, from inoculation and injection with putrifying blood, that it is more active than the liquid from macerated flesh; and that its energy depends on the amount of it in the body, and whether it is introduced immediately into the circulation or beneath the skin. Neither does the infection in this case consist in the production or development of bacterides, which always first appear after death, and invariably precede the formation of movable bacteria. Dried matter is less active than fluid, and putrid matter is not entirely deprived of its activity by boiling, but produces a feverish condition with local irritation. The disease produced by putrid infection can not be transferred by inoculation; but the blood of animals that have reached the condition of blood poisoning acts upon sound animals, just as inoculation with putrid blood and other putrid matter. Since the effect, however, is always dependent on the amount of matter introduced, which is never the case with contagion, putrid infection can not be classed with contagious diseases. From these and numerous other careful experiments involving the use of sulphureted hydrogen, sulphide of ammonium, etc., the author concludes that this infection is not due to living bacteria, vibriones, or other microscopic objects in the putrid matter, even though they may take part in the formation of the virus.—28 *C*, *April*, 1873, 250.

DETERMINATION OF ORGANIC IMPURITIES IN WATER.

Water, even though free from color and an appreciable odor and taste, and at the same time furnishing a proper lather with a small proportion of soap, may yet have sewage impurities sufficient to render its use extremely dangerous. The *Pharmaceutical Journal* quotes from Heisch a very simple and important test for determining the quality of drinking water, and especially as to its freedom from sewage contamination. This consists in placing a few grains of the best white lump-sugar in half a pint of the water in a perfectly clean, colorless, glass-stoppered bottle, freely exposed to daylight in the window of a warm room. If the water be perfectly free from sewage contamination, it should not become turbid, even after an exposure of a week or ten days, in which case it is almost certainly safe, otherwise not.—*Jour. Soc. Arts, June* 27, 1873, 633.

DRINKING WATER.

According to Dr. Gautier, a suitable drinking water should be destitute of any particular taste, and must be positively rejected should it contain any odor whatever. Its temperature should be comprised between 42° and 60° Fahr. As the water introduces not only oxygen and hydrogen into the system in the proportions necessary to form water, but also such mineral substances, in solution, as are indispensable to life, it will be readily understood that absolutely pure water is not suited for the sustenance of life. There must, however, be a limit to the quantity of such foreign ingredients, under the penalty of injury to health. Of these ingredients, carbonate of lime is the most common, and of this there may be, without inconvenience, $\frac{10}{100}$ths to $\frac{20}{100}$ths of a gramme to the litre. An appreciable percentage of phosphate of lime renders the water unfit for domestic and industrial uses; and for general purposes there should not be a greater percentage than $\frac{2}{100}$ths to $\frac{5}{100}$ths of a gramme to the litre. Small percentages of the chlorides generally affect water disadvantageously for drinking purposes. The maximum, however, should be $\frac{8}{100}$ths to $\frac{10}{100}$ths of a gramme to the litre. The presence of organic matter in waters has been considered one of the principal causes of any injurious qualities they may possess; to their presence being attributed the development of such diseases as diarrhœa, dysentery, intermittent fever, typhoid fever, etc. The organic residue should never amount to more than $\frac{2}{100}$ths to $\frac{5}{100}$ths of a gramme to the litre.—1 *B*, *July* 6, 1878, 270.

ARSENIC IN THE AIR OF ROOMS.

The deleterious effects produced by the use of arsenical green in paper-hangings, which have long been known, are commonly attributed to the inhalation of the dust mechanically detached from the walls. The occurrence, however, of cases of arsenical poisoning in rooms where no such mechanical abrasion was possible has led Dr. Fleck, of Dresden, to submit the question to the test of experiment. Four glass jars were employed for this purpose. The interior of the first was lined with paper covered with Schweinfürth green, a paste of potato starch being used as the adhesive material, every square centimeter of surface having upon it fifteen milligrammes of white arsenic combined in the copper salt. The second jar was covered on its interior with a thick layer of gelatine mixed with Schweinfürth green, applied while warm. Under the third jar was placed a capsule containing Schweinfürth green mixed with water to a thick paste. The fourth was similarly prepared, except that white arsenic was used instead of Schweinfürth green. Each jar was closed at the bottom by a glass plate, and at the top by a cork carrying two glass tubes, one of which extended to the bottom of the jar. Blue litmus papers were attached to the corks, and the temperature was maintained at about 64° Fahr. At the end of six hours the litmus paper in the fourth jar had become red, that in the third jar at the end of twenty-four hours, and those in the first and second jars after the lapse of three days. Moreover, in the first jar mould soon formed between the paper and the glass. The air in the interior of these jars was subsequently tested for arsenic. That in jar 3 showed a trace in eight days, that in jars 1 and 2 gave the reaction distinctly in three weeks, while none could be detected in that of the fourth jar. Upon investigation, the arsenic in jars 1, 2, and 3 was found to exist there as hydrogen arsenide, or arseniureted hydrogen, mixed in the third jar with acetic acid. The reddening of the litmus in the fourth jar was due to sulphurous oxide contained in the arsenic employed. As a confirmatory experiment, white arsenic was mixed with flour paste and placed under a glass bell-jar. Four weeks afterward the mixture was covered with a thick mould, and a dark band of crystalline metallic arsenic, reduced by the process of vegetation, surrounded the jar near the upper edge of the mould. The air of the jar contained hydrogen arsenide. A mixture of starch paste and white arsenic gave the same results. It appears certain, therefore, that the air of a room whose walls are papered with arsenic green may contain arsenic proceeding not from mechanical abrasion, but in the form of hydrogen arsenide, produced by the action of the moist organic matter, particularly the paste, upon the Schweinfürth green. To this exceedingly poisonous gas, therefore, chronic arsenical poisoning is doubtless due in many cases.—14 *C*, 1873, CCVII., 146.

STRICKER ON SEPTICÆMIA.

Professor Stricker, of Vienna, has lately been renewing the experiments of Davaine, of Paris, in reference to the injection of septicæmic or putrid blood. This latter author has ascertained that if a drop of putrid blood be injected under the skin of the neck of a rabbit, it induces an extensive infiltration and septicæmia, and that the poisonous properties of the injected blood are communicated to the whole of the blood of the dead animal; also that each successive transfer of blood from one animal to another causes a greater and greater degree of virulence in the poisonous properties, until, on the twenty-fourth, a very minute part of a drop produced fatal symptoms.

Stricker, however, was unable to find any of the microscopic organisms in the poisoned blood noticed by Davaine, as he only met with small, colorless protoplasmic bodies, which could hardly be considered as organisms. He, however, thinks that the increase of intensity in the poison, by transmission, favors the view of its being a living contagium, as he was unable to conceive that a material could propagate so rapidly unless organized. At the same time he found that boiling does not destroy the poisonous quality of the fluid.—20 *A*, *June* 14, 1873, 628.

CHLORIDE OF LIME AS A DISINFECTANT.

Eckstein, a technical chemist of Vienna, after comparative tests with the other disinfecting agents, recommends chloride of lime as decidedly the best for water-closets, cesspools, etc., and attributes its efficacy to its rapid action in decomposing hydrogen compounds, such as ammonia, sulphureted hydrogen, etc. He regards as the chief objection to its general use its unpleasant effect on the organs of respiration, and states that this can be remedied, and its action regulated, by enveloping it in a bag of parchment paper, which acts osmotically, and is decomposed slowly by it.—28 *C*, *March*, 1873, 184.

ON THE RELATION OF THE WINDS AND HEALTH.

Dr. Prestel, of Emden, who for over thirty years has observed and discussed meteorological phenomena, has lately collated the results of his own observations with the sanitary statistics of Friesland. He maintains—1. That it is possible to discover the original cause of diseases that are dependent upon climate and the weather, by a proper study of the winds as observed at that place. 2. That the climatic character of any region is exactly represented by the nature of the winds. 3. That from the nature of the winds at various places we can determine with much safety their relative salubrity. The winds and the character of the weather are identical with each other for any given month. The sickness, however, depends rather upon the climate of the preceding month, evidently because in it began the sickness which appears recorded, perhaps, in the statistical tables of the succeeding weeks or month. The ventilation produced by the winds gives a general measure of the salubrity of various regions on the earth's surface, and, therefore, a measure of the sanitary value of the places of summer resort, water cures, etc. The most unfavorable condition of the atmosphere for the earth is a long period of prevailing calm, or very slight breezes. In many climatic sicknesses, as malaria, yellow fever, etc., it appears that when they become epidemic, there has preceded that time, a long period of calm weather, in which the lowest stratum of air rested quietly upon the earth. Hence arises the Spanish motto: "In Madrid the air kills men, but never blows out the light." The salubrity of the air over any region, therefore, depends upon its renewal by the winds, quite as much as the salubrity of the air in a room depends upon proper ventilation. It follows that, in considering the influence of climate on health, we must observe both the strength and the direction of the wind, and especially the calms. For this purpose Prestel has constructed a peculiar instrument, which he calls the pendulum anemometer, which records automatically both the direction and the pressure of the wind.—*Die Winde, Prestel,* 1872.

THE INFLUENCE OF CLIMATE ON MORTALITY.

The report of the Board of Health for the City of Philadelphia, for the year 1872, contains some graphic illustrations of the intimate connection between the vicissitudes of climate and the mortality from various classes of disease; and if the facts therein discussed are not entirely new, it is at least important that they should be demonstrated so clearly as is done in this work. The curves indicating the course of the mortality from pneumonia and bronchitis rise rapidly in cold weather, and rapidly decline as the temperature of the year rises; while consumption pursues a more equitable course, being only slightly modified by the variations in temperature. The heaviest mortality from small-pox usually occurs in March; but in 1872 the greater number of deaths took place in January, and the smallest in December, a departure from the general rule. A very remarkable connection is apparent between the extreme hot weather of the first week in July, with its enervating moist atmosphere, and the mortality from cholera infantum and the zymotic diseases, both which classes of disease swept away during that week one third of those who died from all causes whatever; and in general the total mortality from all causes during this hot period of nearly two weeks was more than twice as great as the normal value for that month.—*Report of Board of Health, Philadelphia*, 1872.

NEW TREATMENT OF CONSTIPATION.

The *Medical Times and Gazette* contains an abstract of a paper by Dr. Macario, of Nice, upon a new treatment for constipation, which he has employed during twelve years with such success that he can not but consider it as infallible. He remarks that this affection may be produced either by intestinal excitement with deficiency of secretion (nervous constipation), or in consequence of deficient contraction of the muscular coat of the intestine. In nervous constipation he prescribes the following pill: Pure sulphate of iron, ten centigrammes; socotrine aloes, five centigrammes; atropine, from one third to one half of a milligramme. In the atonic form of the disease, one centigramme of the powder of nux vomica may be substituted for atropine. By the use of one to three of these pills, immediately after dinner, in the manner referred to by Dr. Macario, he promises that the evil will be entirely overcome, the number of pills being graduated to produce a moderate effect.

Their use is not to be continued indefinitely, a longer interval being allowed to elapse between their administration in proportion as the constipation diminishes, ceasing altogether after a time, to be again resorted to with a return of the affection.—20 *A*, *June* 21, 1873, 659.

CLIMATE AND DISEASE.

Herr J. Molner, of Pesth, who has for many years conducted meteorological observations in connection with health at the Hospital of St. Roche in that city, has published some conclusions, as follows: He is convinced that meteorological changes reflect themselves in the number of the sick. It is not, however, on the next day, but, according to the extent and duration of the meteorological oscillations, on the second and following days, that the results of the changes find their expression in an increased number of sick. From this he has been led to the conclusion that the main influence of the meteorological elements on the human organism is produced by their changes. Hence a comparison of the true means and the number of attacks of disease for a definite time will not easily throw light on the subject. He gives instances to show how widely different observations may yet give the same means.—*Quarterly Jour. Meteor. Soc., January* 7, 1873.

PAHONIM, A POISON FROM THE GABOON.

A poison from a substance known as pahonim, obtained in the Gaboon district, acts with great energy upon the heart, producing death by arresting the action of that organ—primarily in consequence of the abolition of the contractility of the cardiac muscles, and subsequently of the others. When introduced into the pericardium, it stops the action of the heart more rapidly than when the same quantity is injected, but the excitability of the nerves is not affected. Death is produced without apparently affecting either the great sympathetic, the encephalon, the spinal cord, or the pneumogastric. It acts less swiftly when taken into the stomach than by cutaneous absorption. The oily extract of the poison acts more rapidly than the same weight of the crystallized principles of digitalis and of the upas, but the marked effects are later in appearing. Five milligrammes of the impure alcoholic extract have been known to kill a dog weighing fifty-four pounds.—13 *A, April* 1, 1873, 136.

O. MISCELLANEOUS.

EXTENSION OF FREE TELEGRAPHIC COMMUNICATION.

Some months ago, at the instance of eminent astronomers in America and Europe, Professor Henry secured the privilege of free exchange over the Atlantic cable of information in reference to astronomical discoveries (as of comets or new planets, etc.), and the Western Union Telegraph Company also agreed to carry such dispatches in the United States without expense. The arrangement was started on this basis, and soon after the French telegraph authorities granted the same privilege. We now learn that during the month of September a letter was received by the Smithsonian Institution from Mr. A. Wagner, vice-director of the Observatory of Poulkova, announcing that the director of the Imperial Russian Telegraph has also given his consent to the transmission, free of cost, within the boundaries of the Russian empire, of messages announcing new astronomical discoveries.

FOURTH CIRCULAR OF THE BUREAU OF EDUCATION FOR 1873.

The fourth number of the circulars of the Bureau of Education for 1873 contains a list of publications by the members of certain college faculties and institutions of learning in the United States from 1867 to 1873, and constitutes quite a valuable record of scientific activity during that time. If the bureau would publish each year such a list, of all American scientific papers for the country at large, it would meet a want that has been long felt.

BUFFALO SOCIETY OF NATURAL HISTORY.

The Buffalo Society of Natural Sciences bids fair to become prominent among American institutions for the magnitude and value of its publications. The second number of the first volume of the *Bulletin* has just appeared, and embraces descriptions of new species of fungi by Mr. Charles H. Peck; contributions to a knowledge of North American moths, by Grote; and a study of North American Noctuidæ, also by Grote. One hundred and forty-two new species are described in the first paper, of which fifty-four belong to the extensive genus *Agaricus*. The papers of Mr. Grote likewise include a very large number of new genera and species, his most interesting announcement being the occurrence in North America of the genus *Oncocnemis*, which, according to Mr. Grote, has hitherto only been known from the Ural Mountains. The discovery of three species in Colorado is, therefore, a fact of much interest in connection with the geographical distribution of animals.

THE TORREY BOTANICAL CLUB.

The Torrey Botanical Club, which has been in active existence for a number of years, was recently reorganized by the election of George Thurber, as president; T. F. Allen, as vice-president; James Hogg, corresponding secretary; William H. Leggett, editor of the *Bulletin;* and P. V. Leroy, as curator. Up to the time of his death this club had been under the presidency of Dr. Torrey, and the seventh number of Volume IV. of the *Bulletin* contains a sketch by the present president of the history which led to the organization of the club, and a eulogium upon the eminent botanist whose name it bears.

The meetings of the club are held at the Herbarium in Columbia College on the last Tuesday of every month, and many interesting communications are frequently presented, as shown by the record in the *Bulletin*. An appeal is made to the friends of science to establish a fund of about three thousand dollars for the permanent endowment of the official organ. This is the only periodical in the country devoted exclusively to botany, and is now in its fourth year of publication.

It may not be generally known that the Herbarium of Columbia College, in connection with which this club was started, is one of the finest in the country. It contains all the immense collections gathered by Dr. Torrey during the many years of his life, including the exchanges which he was enabled to make with herbaria at home and abroad. For a long time Dr. Torrey was the recognized head in American botany, and then shared the position, up to the time of his death, with Dr. Gray. On this account the greater number of the collections made by all the government exploring parties were placed in his hands for determination, with the privilege of retaining a series of specimens for himself. All these, of course, now form part of the Columbia College Herbarium, and tend to give it its great value.

A special object of the Torrey Botanical Club is to prepare a catalogue of the flora of New York and its vicinity to the distance of thirty miles, an undertaking initiated in 1817 by Dr. Torrey.

In 1871 a charter was granted by the Legislature of the state, incorporating the club; and as an interesting illustration of the extent to which the Ring influence formerly pervaded every interest in New York, we are informed by Professor Thurber that, among the names of the club, two were introduced, of leading politicians who had no interest whatever in science, and who were unknown to the other members. The charter thus granted allowed the club to hold property to the amount of fifty thousand dollars; and it is supposed that the two extra names were inserted for the purpose of securing the chance, should any be offered, of making money. The club refused to accept the charter, and it was not until the next year that the names of these objectionable individuals were removed by an amendment. The present charter was first accepted by the club on the 7th of January last.—*Bulletin Torrey Bot. Club,* IV., No. 7.

MINNESOTA ACADEMY OF NATURAL SCIENCES.

A society has lately been organized at Minneapolis, under the title of the Minnesota Academy of Natural Sciences, which makes its bow to the public in the form of a pamphlet containing its constitution and by-laws, and the address of its president, Mr. A. E. Johnson. The objects of the society are to investigate natural phenomena, and make and preserve collections of specimens of various objects, and to discuss scientific subjects at its meetings.

AGASSIZ NATURAL-HISTORY CLUB AT PENIKESE.

An Agassiz Natural-History Club was organized at Penikese Island among the students of the summer school of natural history during its session, of which Mr. Solon F. Whitney was chosen president, and Miss A. E. Johnson and Professor J. Tingley vice-presidents.

THE SIXTH ANNUAL REPORT OF THE PEABODY MUSEUM, CAMBRIDGE.

The sixth annual report of the trustees of the Peabody Museum of American Archæology and Ethnology, presented by Professor Wyman, has lately been published, and we learn from it that the addition of a story to the Boylston Hall of Harvard College has permitted the exhibition of a portion of the rich treasures of the museum, leaving, however, to the erection of a special building, soon to be commenced, the final display of what, in regard to Old World archæology, is by far the richest collection in the country. This series, illustrating the stone age of Scandinavia, Great Britain, France, Switzerland, Germany, Italy, and other portions of Europe, is surpassed, if at all, by very few museums in the Old World.

The principal addition during the year, in the way of Old World archæology consisted of the Nicolucci collection, composed principally of stone implements and crania, purchased and presented by Colonel Theodore Lyman. Some specimens were obtained by Mr. Henry Gilman in the course of explorations on the Detroit and St. Clair rivers, while a very large series was supplied from the researches of Professor C. F. Hartt in Brazil.

The funds of the museum appear to be in a satisfactory condition. The total endowment is given as $183,133.

CONDITION OF THE BOSTON NATURAL-HISTORY SOCIETY, 1871–72.

The Report of the Proceedings of the Boston Society of Natural History for the year ending April 30, 1872, has recently been published, from which we learn that the total value of the property of the society is $342,792, of which the building is valued at $133,989. The receipts for the year mentioned amounted to $19,841, with a balance left over from the expenditures of $3649. The principal sources of income are the dividends and interest of the general fund, the Walker fund income, the Bulfinch Street estate fund income, and the annual assessment—the latter amounting to $1325. The admission fees during the year brought in the sum of $125.

In this estimate of the property the museum and library are not included. Their value, of course, is very great, and would carry the aggregate up to a very large sum.

BUILDING OF THE NEW YORK MUSEUM OF NATURAL HISTORY.

Contracts have finally been made for the erection of the building of the New York Museum of Natural History in Manhattan Square, the foundation for a portion of which has been dug for some time. Bids were originally opened in March last, but under the new charter, and in the organization of the Park Department, various questions arose which prevented further progress in the work. It is now stated that the mason-work for the first section has been let for $127,900, the granite for $123,000, and the iron for $168,000, being an aggregate of $418,900.

APPROPRIATIONS FOR THE NEW YORK STATE CABINET OF NATURAL HISTORY.

Among the appropriations made by the State of New York for the State Cabinet of Natural History, we find the following enumerations: Hall of Natural History, cleaning, repairs, etc., $3000; for the increase of the zoological collection, $1000; assisting in arranging duplicate fossils and minerals for distribution, $1500; salary of botanist, $1500; for the use of the Cabinet of Natural History, $10,000—making an aggregate of $17,000. The Board of Regents of the University receive $6500.

REPORT OF THE NATIONAL ACADEMY OF SCIENCES FOR 1872.

In compliance with the act of incorporation, the report of the National Academy of Sciences for the year 1872 was presented by Professor Henry, the president, to Congress, and lately printed. It is occupied principally by a statement of the original law organizing the Academy, and the steps taken under the recent act of Congress as to the number of members, and includes also the amended constitution of 1872, and the list of papers presented at the Washington meetings of April, 1871, and April, 1872, and of those at the meeting of November 21 at Cambridge. — *Senate Misc., Forty-second Congress*, No. 10.

NOURSE'S HISTORY OF THE U. S. NAVAL OBSERVATORY.

The volume of the observations at the Naval Observatory in 1871, about to be published, will contain, as its fourth appendix, a detailed sketch of the origin and development of that institution. By full quotations from rare documents, Professor Nourse gives the present generation an impressive view of the difficulties our fathers experienced in introducing pure science to government patronage. At present the American government is certainly as discreet in its encouragement of science and art as is any state of Europe, in obedience to the general conviction that knowledge is power, wealth, and happiness. It is highly instructive to follow Professor Nourse in his narrative of the repeated failures to secure an appropriation for a national observatory. The official Congressional agitation of this question began in 1810, with the resolution of Mr. Pitkin to employ Mr. Lambert to determine the longitude of Washington as the prime meridian of the United States. Bills to effect this object were introduced at each successive session of Congress; but the burning of the Capitol, and the confusion incident to the war of 1812, annually defeated the project, and it was not until 1821 that Mr. Lambert was appointed to this work. Lambert's report on his results was printed in 1822, and was followed by supplementary reports in 1822 and 1823. The long and eloquent address of President Adams urging the establishment of a national observatory is familiar to all. He gave expression to his convictions not only in his inaugural address, in 1825, but subsequently, as a senator, in 1836, 1838, 1840, and 1842. Professor Nourse gives full extracts from the bill reported in 1826, advising the establishment of the observatory as recommended by Adams. The official correspondence that was thus called out shows that from 1825 to 1842 a steadily increasing pressure was brought to bear upon Congress, which at last, overpowering personal and party considerations, was finally sufficient to effect the transformation of the modest dépôt of charts and instruments into a well-equipped observatory. The "dépôt," as such, had been established in 1830, and its field of operations had much extended during the celebrated Wilkes Exploring Expedition. As auxiliary to the latter, a small observatory was connected with the dépôt from 1833 to 1842, in which Gilliss made those observations that constituted his excellent catalogue of 1100 stars; magnetic and meteorological observations were also conducted by him with equal assiduity. To Gilliss is generally credited "the honor of being the first in the United States who conducted a working observatory." To this, however, we may add that the first observatory established by the United States government was erected, in 1806, at Cincinnati, by Colonel Jared Mansfield, the first surveyor-general, and at this were made from 1806 to 1813 numerous observations, both astronomical and meteorological. The bill establishing a permanent dépôt was passed in March, 1842, and its success was owing apparently in no small degree to the interest excited by the appearance of Encke's comet. It is interesting to note the exact coincidence of this date with that of the beginning of the course of astronomical lectures of Professor O. M. Mitchell, who, in May of the same year, secured the funds for the purchase of the fine equatorial of the Cincinnati Observatory, whose corner-stone was laid in November, 1843, by President Adams in person. The buildings of the Naval Observatory were erected on the site chosen long before by Washington as the location of the proposed National University, and according to the plans furnished by Gilliss in November, 1843, after consultation with the best American astronomers, and were completed by September, 1844, which is the date of the report of Lieutenant Gilliss to the Secretary of the Navy. With the completion and equipment of the building we may close our extracts from Professor Nourse's interesting memoir. The subsequent history of the institution is so well given in the annual reports that it must be familiar to all.

TWENTY-SECOND MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The twenty-second annual meeting of the American Association for the Advancement of Science, which was held in Portland, Maine, from the 20th to the 26th of August, inclusive, was one of the most successful of the series, whether we consider the number of specialists in attendance or the character of the papers presented. For two years past the meetings have been held in the West, that of 1871 at Indianapolis, and that of 1872 at Dubuque; and the long interval that had elapsed since the association was convened in the eastern portion of the country had its natural effect in increasing the size of the recent meeting at Portland. Comparatively few of the specialists of the country who were at all able to attend failed to report themselves, although the Exposition at Vienna involved the absence of some eminent names that had heretofore been prominent at the meetings.

The local committee of arrangements discharged their functions in a very satisfactory manner, the city having proffered the use of the magnificent City Hall, in which all the accommodations that could possibly be desired were found under one roof. The officers of the Portland Natural-History Society extended a welcome to the association, and freely threw open its museum and other apartments. Among the entertainments provided by the committee may be mentioned a public reception on the evening of the first day of the meeting; a lunch on Friday, which afforded a convenient opportunity for meeting the citizens socially; an excursion in Casco Bay and among the islands in the revenue cutter on Saturday; a general reception and clam-bake at Old Orchard Beach on the following Tuesday; an excursion to the White Mountains and back on Wednesday, after the regular exercises of the association had closed; an outside dredging excursion on the revenue cutter *M'Cullough* on Friday; and an excursion to St. John and back on one of the boats of the International Steam-ship Line for such as chose to avail themselves of it.

The more special business of the meeting was well relieved by these pleasant features, which tended better than any thing else to promote the formation and renewal of acquaintances among the members themselves as well as with the citizens of Portland.

The total number of members present was large, amounting to very nearly three hundred. One hundred and ten names were added to the list, bringing up the total membership at present to about seven hundred. A pleasant feature in the meeting was the presence of many naturalists actively employed in the vicinity in connection with the labors of the United States Fish Commission under Professor Baird and his associate, Professor Verrill, which had its head-quarters on Peak's Island, in Casco Bay, about three miles from the city, as also of many members of the Anderson School of Natural History under Professor Agassiz, which had been in operation during the summer at Penikese.

The total number of papers amounted to one hundred and fifty-six, of course varying in value, and while perhaps embodying nothing of very striking importance, contributing in a greater or less degree toward the sum of our knowledge. It is hardly to be expected that great discoveries in science should be reserved for presentation at such meetings, the desire for priority inducing their announcement, sometimes even by telegraph, as soon as made.

Reporters were present in full force, including not only those of the Portland press, but of the leading New York papers, especially of the *Tribune*, *World*, and *Times*. The *Tribune* reports, made under the immediate direction of one of its editors, Mr. W. C. Wyckoff, were extremely full and satisfactory, and will very largely anticipate the official publication by the permanent secretary. It is understood that the daily reports and abstracts of this paper will be reproduced in a corrected and otherwise improved form, and embodied in one of the famous lecture or scientific extras that have given the *Tribune* so much reputation.

THE CENTENNIAL EXHIBITION.

On the Fourth of July, 1873, the grounds set apart by the city of Philadelphia for the purposes of the International Exposition of 1876 were formally transferred by the Park Commission to the Centennial Commission of the United States. The transfer took place on the grounds in the park in the presence of an immense gathering of citizens, and was conducted with due regard for the grandeur and importance of the great event of which it forms the first public inauguration.

One of the features of the occasion was the reading of a proclamation by his Excellency the President of the United States, fixing upon the 19th of April, 1876, as the time for the opening of the Exhibition, and the 19th of October of the same year for its close, and inviting the co-operation of the United States, as well as that of foreign nations. Though it may seem somewhat premature, the following form of application for space in the coming Exhibition has been adopted by the Centennial Commission, to be sent to manufacturers throughout the world. It will, no doubt, have the advantage of advising the managers of the great event to make appropriate provision for abundant space. It is said that this policy has met with much success, and that even at this stage of the undertaking the applications for space are both numerous and from distant quarters.

UNITED STATES

1776. INTERNATIONAL EXHIBITION. 1876.

UNITED STATES CENTENNIAL COMMISSION,
904 WALNUT STREET, PHILADELPHIA, ——, 187–.

M. ——: For the purpose of facilitating the progress of the necessary preparation in connection with the *International Exhibition* of 1876, your co-operation is requested. Have the kindness to forward a list of such products or manufactures as you desire to have on exhibition at that time, with amount of space required, so far as it is possible to prepare it. This list will not interfere with any future entries that you may desire to add, the object being simply to form some practical idea as to the total amount of space required, and to aid in the prompt production of the catalogue. A form is inclosed which you will please fill up and send, addressed to,

Yours respectfully, ALFRED T. GOSHORN, Director-General.

AMERICAN DEPARTMENT OF THE VIENNA EXPOSITION.

The American department of the Vienna Exposition was by no means so indifferently represented as has been currently reported—though in view of the unfortunate complications which arose about the time of the opening of the display, a somewhat inferior representation of American industries was generally anticipated.

The department, though in very bad order about the time of the opening of the Exposition, was brought into creditable shape, and was tolerably well filled.

The space allotted to American exhibitors amounted to some 70,000 square feet, divided as follows:

In Industry Palace	13,450	square feet.
" Covered Court	27,000	" "
" Machinery Hall	14,550	" "
" Agricultural Hall	10,000	" "
" Additional halls	5,000	" "
	70,000	" "

THE BACHE FUND.

The late distinguished chief of the Coast Survey, by his will, established a fund to be placed in the hands of executors, by whom the income is to be expended, under the direction of a committee of the National Academy of Science, for the advancement of some branch of physical research. The first report of results achieved through this bequest was recently made to the Academy by its President, Professor Joseph Henry. The committee had decided that in view of the great interest that Professor Bache had throughout his life manifested in terrestrial magnetism, it would be highly proper to further this science by gradually extending over the country the magnetic survey which, during his own lifetime, he had carried out in the Middle States. In the execution of this design they had been so fortunate as to secure, at small expense, the services of Dr. Hilgard, of St. Louis, by whom, in 1872, chiefly in the season most favorable for traveling, quite a large number of stations were occupied for the determination of the magnetic elements. These stations are mostly in the Southern States; and it is the intention of the committee to extend the work annually, northward and westward, as the income from the fund may allow.

GIFT OF LAND TO THE CALIFORNIA ACADEMY OF SCIENCES.

The Academy of Sciences of San Francisco has lately been the recipient of a donation from Mr. James Lick, of that city, which may or may not be of future moment. This consists of a lot of land on Market Street, east of St. Ignatius College, measuring 80 by 275 feet. The present is, however, coupled with the condition that the Academy shall within three years secure the funds necessary to erect thereon a substantial three-story building, faced with granite, without encumbrance of debt, and to be devoted exclusively to the objects for which the societies were organized. This is to be of classical architecture, and decorated with emblems of science. No part of the building is to be in any way used for political or religious purposes.

The plan of the building contemplates a library, museum, and lecture-room. The value of the lot is estimated at $150,000. It is stated that this same lot was previously presented to a beneficent institution with similar conditions, which it was unable to comply with, and the gift lapsed to the owner. We hope the Academy of Sciences may obtain the means of securing this property, although it is to be regretted that they will not be permitted, as was the case with the Academy of Sciences of Chicago, to devote the lower story of the building to stores, the rents of which would furnish a certain amount of endowment for the establishment.—*San Francisco Weekly Bulletin*, *February* 21, 1873.

THE JAMES LICK DONATION TO THE CALIFORNIA ACADEMY OF SCIENCES.

We have already mentioned the provisional donation to the California Academy of Sciences, by Mr. James Lick, of a valuable lot in San Francisco, and the conditions under which it was to be transferred. The lot, which is 80 by 275 feet, is situated at the corner of Fourth and Market Streets, and is extremely valuable; but the condition that, unless a very expensive building be erected upon it within a very limited period, the lot is to revert to its owner, detracts very much from the positive value of the gift, as it has been considered impossible to secure the necessary means within the time mentioned. More recently, however, a new deed has been issued by Mr. Lick, by which ten years are allowed to the Academy, after taking possession, for the erection of the building. This must be of brick, at least three stories high, suitably ornamented, and to contain rooms for a library, a museum, and a lecture-hall. The deed further stipulates that the property must not be encumbered nor allowed to be sold for taxes, that the property shall not be alienated during the lifetime of any of the existing members, and shall never be leased nor occupied for any religious or political purpose, though this restriction is not to be applied to subjects of a scientific, artistic, or literary nature. Should these provisions be violated, the property reverts to the state, which is an additional security that it will be maintained perpetually in the Academy.

WOODWARD'S GARDENS IN SAN FRANCISCO.

Among the various public gardens and museums in the United States, that of R. B. Woodward, in San Francisco, known as "Woodward's Gardens," occupies a very prominent position, being familiar to all the inhabitants of the Pacific States, as well as to visitors from the East. This was established some years ago by Mr. Woodward, the founder of the What Cheer House of San Francisco, and has rapidly grown to be really a very meritorious and admirable establishment.

A catalogue of its collections, occupying sixty-two pages, has lately been published, in which a list of the principal objects is presented, with some illustrative remarks. The museum proper consists of a large number of cases filled with natural-history objects, among which is a very complete collection of the birds of the Pacific coast of the United States. In the menagerie are numerous living animals, among them the sea-lion, the leopard-seal, the fur-seal, etc. Grizzlies, black bears, tigers, monkeys, kangaroos, camels, llamas, buffaloes, etc., are to be met with in considerable number. The aquaria recently erected and placed on exhibition are said to contain a very interesting series of marine animals of the coast.

"FOREST AND STREAM," A NEW WEEKLY JOURNAL.

We welcome to the ranks of natural-history journals in the United States a new weekly periodical, edited by Mr. Charles Hallock, entitled *Forest and Stream*. The first number of this handsomely printed quarto contains several interesting communications from officers of the United States army and navy, and numerous suggestions in connection with practical natural history. It is intended to be more especially the organ of the sportsman, whether hunter or fisherman, and will, to a certain extent, occupy a portion of the ground of the famed *Spirit of the Times*, especially as it was under the editorship of Colonel Porter.

There has long been a need of precisely such a journal as this in the United States, and we trust that it will meet with such a measure of support as to secure its permanency. It will contain a special column of military and naval news, which, of course, will give it an additional interest to officers in these branches of the service.

CATALOGUE OF THE ARMY MEDICAL MUSEUM.

A bill is now before Congress providing an appropriation of $20,000, or as much thereof as may be necessary, for the purpose of having printed, at the government printing-office, one thousand copies of the "Descriptive Anatomical Catalogue of the Army Medical Museum." Should this sum be granted, the rich treasures of this great collection can be made as well known to the world at large as they are to those who have the privilege of visiting the historical locality in which they are at present displayed.—*House Bill*, 3453.

NATIONAL PHOTOGRAPHIC INSTITUTE.

Among other bills lately presented to Congress was one for the establishment of a National Photographic Institute, which provides for the establishment of such an organization in Philadelphia, where the entire theory and practice of the photographic art is to be taught by competent professors, under the direction of the National Photographic Association of the United States. The bill also provides that the sum of $30,000 shall be appropriated for the purchase of a suitable building and apparatus, but that the institution shall be self-supporting, and only such fees shall be paid by the students as shall meet the actual expenses.—*House Bill*, 3752.

NATIONAL INVITATION TO THE INTERNATIONAL STATISTICAL CONGRESS.

Among the resolutions adopted by Congress at its last session was one authorizing the President to invite the International Statistical Congress to hold its next, or ninth, session in the United States. The invitation is to be formal and cordial, and it is provided that, should this be accepted, the President is authorized to appoint the usual organization commission, and to take the other preliminary and necessary steps for the meeting of this body, and for holding its session at such time as may be deemed expedient by the Statistical Congress. We believe these sessions are biennial, the last having been held during the summer of 1872 at St. Petersburg.

BENEVOLENT ENDOWMENT IN THE UNITED STATES TREASURY.

For the purpose of aiding in the permanent investment of funds destined for scientific, educational, and charitable purposes, Senator Sherman has lately introduced a bill into the Senate authorizing the Treasurer of the United States to receive sums of money, not less than five hundred dollars at a time, to be placed to the credit of any orphan asylum, hospital, or other institution for charitable purposes, or for the encouragement of learning, mechanics, or the fine arts. A certificate is to be issued for this sum, and interest to be paid upon it semi-annually. It is further provided that such deposit shall be forever held inviolable and irrevocable, and that the rate of interest—five per cent.—shall not be reduced nor increased. The original deposit may be increased by additional deposits of not less than five hundred dollars at each donation.

A subsequent clause of the bill provides that all moneys received under this act shall be applied from time to time by the United States Treasurer in the purchase and cancellation of the interest-bearing debt of the United States. The fund thus received is to be entitled "The United States Five per Centum Annuity Fund of Charitable Donations and Bequests."

Should this movement become a law, it will furnish a long-desired opportunity for investing sums of money for the purposes mentioned, with the assurance that the principal can never be embezzled or wasted, the government of the United States being responsible for its safe keeping.—*Senate Bill*, 1554.

CUSTOM-HOUSE VALUE OF THE POUND.

Congress at its last session passed an act to establish the custom-house value of the pound sterling at four dollars eighty-six cents and six and a half mills, in all payments to the Treasury, whether made here or in foreign countries, and provided that all acts or parts of acts inconsistent with this should be repealed.

MERCHANT MARINE OF THE UNITED STATES IN 1872.

The annual report of the Chief of the Bureau of Statistics of the Treasury Department for the year ending June 30, 1872, gives the following recapitulation of the merchant marine of the United States:

	No.	Tons.
Sailing-vessels	17,049	2,146,585
Steam vessels	3,625	1,048,205
Unrigged vessels	9,174	955,242
Grand total	29,848	4,150,032

PHYSICAL SOCIETY OF PARIS.

According to *Nature*, the physicists of Paris have lately met and established a society which proposes to commence the publication of transactions and proceedings of its meetings. The organization was effected on the 17th of January last, and consists of M. Fizeau as president, M. Bertin as vice-president, and M. d'Almeida as general secretary.—12 *A, May* 22, 1873, 73.

"LA NATURE," A NEW FRENCH JOURNAL.

A new weekly scientific journal has lately been started in Paris under the direction of M. Tissandier. This bears the name *La Nature,* a somewhat unfortunate designation, as it is in danger of being confounded with its older and well-established contemporary of the same name in London. Each number embraces sixteen pages, and is illustrated with engravings. The subscription price is twenty francs in Paris, and thirty when mailed to foreign countries.—3 *B, June* 12, 1873, 233.

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The meeting of the French Association for the Advancement of Science opened on the 21st of August at Lyons, under the presidency of M. de Quatrefages. The only American scientist present was Dr. H. C. Yarrow, Acting Assistant Surgeon, U. S. A.—12 *A, August* 14, 1873, 333.

LYONS INSTITUTION FOR THE ADVANCEMENT OF EXPERIMENTAL SCIENCE.

An important enterprise has lately been initiated by the municipal administration of Lyons, in France, in the form of an establishment entitled the Lyons Institution for the Advancement of Experimental Science, and intended to be a worthy rival of the richest establishments in Germany, France, or England. The report of the committee appointed to prepare a plan for this enterprise has recently appeared, and contemplates, among other provisions, for biological science, first, a large central laboratory, in which investigations of any kind can be prosecuted; second, a central apparatus room; third, a laboratory of biological chemistry; fourth, one of biological physics; fifth, one of osteology; sixth, a room for investigations into the disease caused by parasitic animals, including that of the silk-worm; seventh, a post-mortem room; eighth, a room for delicate dissections and the mounting of specimens; ninth, a work and tool shop; tenth, a cabinet of collections; eleventh and twelfth, a drawing-room and photographic establishment; thirteenth, a library; fourteenth, a lecture-room; fifteenth, apartments for lodging animals; sixteenth, a greenhouse and inclosure for researches in vegetable physiology. In addition to these, there is a provision for general office rooms, the residences of the director and assistants of the director, the librarian and three aids—one for operations and autopsies, another for biology, physics, and chemistry, and a third for microscopical investigations and labors in zoology. It is also thought probable that to these will be added a physical and chemical establishment on an equally large scale. According to the plans submitted, the buildings will cost $190,000, of which over one third will be expended during the present year. An annual allowance of $6000 will be made for the biological work.—8 *B*, *April* 12, 1873, 957.

GEOGRAPHICAL SOCIETY OF THE NETHERLANDS.

A new geographical society has recently been organized at Amsterdam under the title of the Geographical Society of the Netherlands. The names of the gentlemen concerned in this movement are a sufficient guarantee that the new institution will be one of the first class.—8 *C*, *March* 24, 1873, 240.

COLLEGE OF ENGINEERING IN JAPAN.

The recent foundation of a College of Engineering in Japan in the city of Jeddo, in which the youth of that country may obtain thorough instruction at home in the science of engineering, civil and mechanical, is perhaps the most striking indication of the radical advances in introducing modern ideas which has been thus far afforded. The new establishment is placed under the directorship of Mr. Henry Dyer, formerly of Glasgow, Scotland.

INTERNATIONAL CONGRESS OF ORIENTALISTS.

An international congress of those interested in Oriental literature, as announced by Mr. Leon de Rosny, took place at Paris on the 10th of July, 1873, numerous invitations to attend it having been sent out to the learned of all parts of the world, including several Americans, whose participation was especially desired. For the sum of twelve francs annually members are to be admitted to all its privileges, including a copy of the proceedings. The first sessions of the congress were especially devoted to Japanese studies, while the others were occupied with questions of interest to Orientalists in general, and the selection of some point outside of France for the meeting of the next year's congress.—*Circular of Leon de Rosny.*

FUND FOR SCIENTIFIC RESEARCH.

A very important movement has been set on foot in England to promote the application of a portion of the vast income at the disposal of the old universities of Oxford and Cambridge to the promotion of scientific research, rather than, as it is now, in the form of fellowships given as a reward for literary or scientific excellence already attained, and involving no duties nor need for further work. It is maintained that the promotion of original research was one of the objects for which the universities were originally founded, but which has so long been almost entirely lost sight of. Among the prominent supporters of the movement are Sir B. C. Brodie, Bart.; Professor Rolleston; Professor Seeley; the Rev. Mark Pattison, rector of Lincoln College, Oxford; Dr. Carpenter; Dr. Burdon Sanderson, etc.

SOCIETY OF TELEGRAPHIC ENGINEERS.

A new society has lately been established in London—"The Society of Telegraph Engineers"—which promises to occupy in science, to some extent, the place that was at one time held by the London Electrical Society, but, of course, with the wider range of labors imposed by the vast extension and social importance of electric science. The society numbers among its members all the prominent electricians of Great Britain, and its publications are of high scientific and practical importance. The discussions that are held at its meetings are partaken in by such men as Siemens, Latimer Clark, Culley, Varley, Preece, Sabine, Walker, Webber, Wheatstone, Winter, and others. The extensive and thorough scientific knowledge thus brought to bear upon the most difficult problems in electrical science gives great value and interest to the meetings of the society.

MEETING OF THE BRITISH ARCHÆOLOGICAL ASSOCIATION.

The British Archæological Association held its annual meeting at Sheffield on the 18th of August last, under the presidency of the Duke of Norfolk. The papers read were of local antiquarian interest, and were listened to by large audiences.—12 *A*, *August* 14, 1873, 333.

AWARD OF MEDALS BY THE ROYAL SOCIETY OF LONDON IN 1872.

Of the medals in the gift of the Royal Society of London during the year, the Copley Medal has been awarded to Professor Wöhler, of Göttingen, for his contributions to the science of chemistry. Another medal has been given to Professor Thomas Anderson, M.D., also for chemical investigations, and for papers in physiological and agricultural chemistry. Mr. Henry John Carter has received a medal for long-continued and valuable researches in zoology, and especially into the natural history of the sponges. The Rumford medal, awarded biennially, has been given to A. J. Angström for his researches in spectral analysis.—12 *A*, *November* 28, 1872.

BRITISH NAVAL COLLEGE FOR OFFICERS.

An important movement has lately been started in Great Britain in the shape of a naval college, the object of which is to impart instruction in all the higher branches pertaining to the nautical profession to such as require it, and to be especially open to captains and commanders, lieutenants and navigating officers, naval instructors, officers of the marine artillery, and of the marine and engineer branches of the navy. Instruction will also be given to a limited number of persons in naval architecture and marine engineering; officers of the mercantile marine will also be received.

This does not cover the ground of the naval college at Greenwich, where graduates are instructed in the primary branches of their profession; but it is intended for posting officers of the higher grades in those subjects with which they are not familiar, and to enable them to take worthy parts in the scientific movements of the day. The course includes pure mathematics, co-ordinate and higher pure geometry, differential calculus, etc., as well as the modern languages, drawing, etc. A naval officer is president of the college, assisted by a captain in the navy in matters of discipline, and by an extensive corps of professors, who may be selected from civil life.—12 *A, January* 16, 1873, 218.

MEETING OF THE IRON AND STEEL ASSOCIATION AT LIEGE.

The annual meeting of the Iron and Steel Institute took place at Liege on the 18th of August, and numerous papers of much technical interest were presented. The members were invited to hold their next meeting in the United States, though it was not stated whether this was actually decided upon.—12 *A, August* 14, 1873, 333.

BRADFORD MEETING OF THE BRITISH ASSOCIATION.

The recent meeting of the British Association, held at the manufacturing town of Bradford, in Yorkshire, and presided over by Professor A. W. Williamson (in consequence of the illness of Dr. Joule, the president appointed last year), was not a very brilliant one, nor very largely attended. Many of the papers were of great scientific value; but there was no one incident of surpassing interest, like the appearance of Mr. Stanley, the discoverer of Dr. Livingstone, at the Brighton meeting last year. The next meeting is to be held at Belfast, Ireland, under the presidency of Dr. Tyndall.

PROFESSOR CARUS AND PROFESSOR WYVILLE THOMSON.

Professor Carus, the eminent German naturalist, long connected with the University of Leipsic, has been selected to fill the chair of Wyville Thomson during the period of his absence with the *Challenger*, which will probably continue for several years. He entered upon his duties on the 2d of May by an address on the study of zoology; and, according to *Nature*, he is fully convinced that "the final form of our zoological system will be a pedigree."

REPORT ON SCIENTIFIC INSTRUCTION IN ENGLAND.

The statement recently presented by the royal commission appointed to report on the state of scientific instruction in England contains a very large amount of testimony presented by scientific men of eminence. The tendency of the great mass of the evidence is in favor of the more direct encouragement of science by the state, especially in those researches the remuneration of which comes only after the lapse of a long time, but which may nevertheless ultimately be of great economical importance. The increase of the number of professorships, and rendering the emoluments independent of the number of pupils, are strongly urged by some. An unfavorable contrast is drawn by some of the witnesses between the encouragement afforded to science by the English government and that extended by the governments of France and the United States.

MEETING OF THE BRITISH MEDICAL ASSOCIATION.

Among the more important meetings of men of science held during the year 1873, we may mention that of the British Medical Association of London, which took place on the 5th of August last, and was attended by a very large number of representatives and visitors, including many of the most prominent members of the faculty on the continent of Europe, and several from the United States. The routine consisted of an anniversary and valedictory address, and proceedings in general council and special session, attended by various entertainments and other lighter features. The medical journals contain very full abstracts of the proceedings; and we doubt not that the result of this interchange of views, and the announcements of discoveries, will result in an appreciable advancement in medical science.—20 *A*, *August* 9, 1873, 148.

PROTECTION OF ANTIQUITIES.

The administration of the Royal Museum in Berlin has issued a circular intended to prevent the unnecessary destruction of coins and other valuable antiquities. In consequence of the impression that all such objects belong to the state, and would be seized upon if found, the discoverers have been in the habit of melting up silver articles for the sake of the bullion, or disposing of them furtively to the first comer, this resulting in the loss to the state of many important objects of antiquity.

The administration now gives notice that these objects are not claimed by the state, and that the full value will be paid, on information being rendered; and that if the offer is not satisfactory, the holder is at liberty to reject it. In the same connection we learn that an order has been issued to the naval officers of the German government instructing them to pay some attention to such scientific subjects, particularly anthropological, as may come within their notice, and that the facts and collections thus secured may be transmitted to any scientific body in Germany.—18 *A*, *November* 9, 1872, 605.

NEW CORRESPONDING MEMBERS OF THE ACADEMY OF SCIENCES OF PARIS.

At a recent election held by the Academy of Sciences of Paris for three correspondents in the section of zoology, Professor Steenstrup, of Copenhagen, Professor Dana, of New Haven, and Dr. William B. Carpenter, of London, were chosen.—4 *D*, *August*, 1873, 159.

HONORS TO AMERICAN SCIENTISTS.

Among the many instances in which American scientists have received appreciative honors from Europeans, perhaps none is more remarkable than the recent election, by the Royal Society of London, of four Americans to its list of foreign associates. This honor, which is perhaps the most distinguished that is known in the scientific world, has fallen simultaneously to Professor Newcomb, of Washington Observatory; Professor Newton, of Yale College; Mr. Rutherford, of New York; and Professor Young, of Dartmouth College. It has been happily said that "we have here a remarkable quartet of astronomers, each distinguished in an entirely different department of research—an encouraging symptom of the healthy condition of science in America."

AMERICAN AND FOREIGN TECHNICAL SCHOOLS.

An admiring notice is given by the editor of the *Chemical News* of the reports of two technical schools—namely, the Royal Rhenish Westphalian Polytechnic School at Aix-la-Chapelle, and the Stevens Institute of Technology at Hoboken. Both are equally prominent as to the scale upon which they are carried on, although the first is conducted directly under the authority of the Prussian government, with a staff of forty teachers and four hundred students, and the other founded by the munificence of a private individual, Mr. E. A. Stevens. While noticing these institutions, regret is expressed by the editor that there is nothing whatever in Great Britain which even approaches either of the establishments referred to.—1 *A*, *August* 29, 1873, 106.

APPOINTMENT OF PROFESSOR C. A. WHITE TO BOWDOIN COLLEGE.

Professor Charles A. White, State Geologist of Iowa, and late professor in the Iowa State University, has been appointed a professor in the new department of geology and mineralogy of Bowdoin College.—5 *D*, *August*, 1873, 511.

RAILROAD IN NICARAGUA.

According to the Panama *Star and Herald*, Mr. Henry Meiggs Keith has just executed a contract with the government of Nicaragua for the construction of a railroad which is to put Leon in connection with the port of Corinto. This, it is understood, will not interfere with the work on the Costa Rica railroad, commenced some time ago under his direction.—*Panama Star and Herald*, *May* 9, 1873.

DESTITUTE CONDITION OF LOUIS FRASER.

Our English readers will regret to learn that Mr. Louis Fraser, at one time prominently connected with the Zoological Society of London, author of the "Zoologia Typica," and a professional taxidermist of high repute, is suffering from destitution, in his old age, in British Columbia. On the 7th of April last a communication was presented before the meeting of the Academy of Sciences of San Francisco on this subject by Mr. Henry Edwards, one of the members, and an appeal for assistance was made to the friends of science. This was answered by contributions on the part of several members, but it is not stated to what extent.—*San Francisco Bulletin*.

RESEARCHES OF PAUL BERT.

For several years past M. Paul Bert, of Paris, Professor of Physics in the Faculty of Science, has been making very extensive and laborious investigations upon respiration in compressed atmospheres, and on other points of great physiological interest. It is stated in *Les Mondes* that this has been done at the expense of Dr. Jourdonet, who makes a specialty of treating diseases in rarefied or condensed atmospheres.—3 *B*, *March* 20, 1873, 481.

TYNDALL ENDOWMENT.

For some time before his departure from this country the friends and associates of Professor Tyndall had been aware that he contemplated leaving in the United States whatever proceeds of his lectures might remain after his necessary expenses were met, with a view of applying them in some manner that should tend to the advantage of science; and in the lectures on light, lately issued by the Appletons, the details are for the first time officially made public. The amount available for the object in question is about $13,000, his total receipts in this country, from thirty-five lectures, being $23,100. This balance has been placed in charge of a committee consisting of Professor Henry, General Hector Tyndale (his cousin), of Philadelphia, and Professor Youmans, of New York, and these gentlemen are authorized to expend it in aid of students who devote themselves to original investigation. A suggestion has been made, and one worthy of encouragement, that efforts be initiated to secure an increase of this fund to at least $50,000, the whole to bear the name of the Tyndall Fund, so that the objects of the Professor may be carried out to a fuller extent.

AID TO SCIENTIFIC RESEARCH.

Mr. William K. Parker, the eminent English comparative anatomist, well known by his researches upon the skull and shoulder girdle of the vertebrate animals, has lately received assistance from a quite unexpected quarter. The London Fishmonger's Company has presented to him fifty pounds sterling, and made him an allowance of twenty pounds annually for three years to aid him in still further prosecuting his inquiries into the anatomy of fishes. *Nature*, in referring to this action, commends it as a precedent, and hopes that some of the other united companies, many of which possess enormous wealth, will take pains to subsidize in a suitable manner some specialist whose scientific researches may illustrate the objects of the company. It is thought, however, that quite an inadequate appreciation is shown of the value of the time of men of science like Mr. Parker in the amount of the subsidy.—12 *A*, *May* 22, 1873, 74.

HONORS TO PROFESSOR HUXLEY.

Professor Huxley has been elected Lord Rector of the University of Aberdeen by a considerable majority over the Marquis of Huntly, a satisfactory evidence of the estimation in which eminence in science is held by the younger minds in Scotland.

RETIREMENT OF BARON VON MÜLLER FROM THE BOTANICAL GARDEN AT MELBOURNE.

It is stated that, in accordance with intimations made for some time past, Baron Von Müller will leave the directorship of the Botanical Garden at Melbourne. This gentleman, by his unwearied efforts in behalf of the garden, and by his high accomplishments as a botanist and general naturalist, has given lustre to the establishment with which he has been connected; and if, as is suggested, his retirement is brought about by the disinclination of the government to support his plans of improvement (preferring to make the garden merely a place for growing ornamental plants for the vice-regal residence), it is a fact certainly much to the discredit of our antipodean neighbors.—12 *A*, *August* 14, 1873, 334.

TERCENTENARY OF THE BIRTH OF COPERNICUS.

The original manuscript of the great work, "De Revolutionibus Orbium Cœlestium," of the immortal Pole, Copernicus, has been safely preserved in Prague for three hundred years, and is now being published as a part of the collection of writings issued to commemorate the third centennial anniversary of his birth. It will be remembered that this most interesting work, which has virtually been the foundation of modern astronomy, was originally printed during the latter years of his life, but not altogether under the personal supervision of the author, and was immediately proscribed by the Romish Church, so that few if any copies of the original edition are now extant. The numerous subsequent editions have given the original text in a more or less mutilated state, and it is as a welcome contribution to astronomical literature that we are now to have a faithful copy of the work as it still exists in the handwriting of Copernicus. This book will form one of the four subdivisions of the "Spicilegium Copernicanum," the other divisions being composed of the lesser works, correspondence, etc., of the great astronomer. The original manuscript of the "De Revolutionibus" forms a volume of 217 leaves of small folio, one foot high and eight inches broad, quite clearly written, in uniform small letters, with black ink, the titles and initials of the separate books and chapters being colored red. It has been in the possession of the Nostitz family since the year 1600.—*Heis, Wochenschrift*, 1873, 3.

APPOINTMENT OF MR. ADAMS IN LONDON.

Great satisfaction is expressed in scientific circles in England at the appointment of Mr. Adams as Chief Commissioner of the Board of Works in the place of Mr. Ayrton, whose interference with Dr. Hooker in the management of the Kew Botanic Gardens excited so much indignation in 1872.

MEMORIAL TO GALILEO.

The citizens of Florence have set a worthy example to the world in having recently erected a durable memento of the immortal Galileo. Galileo stands out pre-eminently as one of the fathers of experimental philosophy. He did not create it, but he introduced a taste for it and enlarged it; and he possessed in an unusual degree the true spirit of philosophical inquiry, the ardent love of research, through which all progress is made in knowledge. The Tuscan memorial to Galileo is entirely the work of Tuscans, and is said to have been constructed at the cost of nearly $200,000. It is erected in Florence, and consists simply of a vestibule, from which opens a small rectangular hall with a semicircular tribune, in which is placed the statue of Galileo by Costoli. The interior of the hall is entirely lined with white marble, and with frescos, in admirable taste. The vestibule is also lined with frescos, representing, among other things, Leonardo da Vinci in the presence of the Duke of Milan, and also Volta explaining his inventions to the members of the French Institute, in the presence of Napoleon and La Grange. In the hall is a fresco representing Galileo lecturing in Pisa, which is spoken of as a striking and well-conceived painting, the whole conception being noble and spirited. There is also a fresco representing a meeting of the Academy of Sciences. In the tribune, immediately around the statue of Galileo, three frescos represent three notable events of his life. In the first he is seen intently watching the swinging of a lamp in the cathedral of Pisa; in the second we see him in the act of presenting his telescope to the Venetian Senate; in the third he appears as an old man in his house at Arcetri, dictating the geometrical demonstration of the laws of falling bodies to his disciples. On the arch above the statue, on a blue ground, are very effectively represented the astronomical discoveries of Galileo, while on the pillars of the arch bass-reliefs represent his terrestrial discoveries. Beneath the frescos and around the statue are niches containing some of Galileo's instruments. Immediately around the statue are the busts of his most celebrated followers. There are also in the hall six cases containing old apparatus belonging to the latter part of the fifteenth century and the beginning of the sixteenth century.

The memorial is altogether worthy of the man and of the fine taste of the Florentines. It is perhaps the only scientific sanctuary that exists.—12 *A*, 1873, 329.

INFLUENCING THE ADVANCEMENT OF SCIENCE.

Professor De Candolle has lately published a work relating to the statistics of men of science, in which he takes into consideration those who have been not merely learned, but who have given a powerful impulse to the advancement of science, limiting his attention, however, to those whose labors have been in the line of mathematical, physical, and natural sciences. He takes for the basis of his inquiry the three great academies of Europe, namely, the Royal Society of London and the Academies of Science of Paris and Berlin, and makes a comparison between the number of scientific leaders developed in the several countries in connection with these institutions, and inquires into the causes which may have produced the differences which he narrates. The influences which he finds to be most powerful in advancing science, by increasing the number of those who prosecute it in a proper spirit, are, first, a well-organized system of instruction, independent of parties, tending to awaken research and to assist young persons devoting themselves to science; second, abundant and well-organized material means for scientific work—libraries, observatories, laboratories, collections, etc.; third, freedom of utterance and publication of any opinion on scientific subjects without grave inconvenience; fourth, the habitual use of one of the three principal languages, English, German, or French, and the extensive knowledge of these languages among the educated classes.—18 *A*, *February* 14, 1873, 519.

P. NECROLOGY.

THE following list embraces the principal losses by death, during the year 1873, in the ranks of men of science.

Agassiz, Professor Louis. Born at Moltier, Switzerland, May 28th, 1807. Died at Cambridge, Massachusetts, December 14th, in the 67th year of his age, universally lamented.

Arrowsmith, John. Died May 3d, in his 84th year. A collector and publisher of geographical works relating to almost every part of the world.

Babinet, Louis. Born at Lusignan in 1794. Died in Paris, October 20th, 1872. Author of various works on meteorology; made a member of the Academy of Sciences of Paris in 1840, in the section of physics.

Blyth, Dr. Edward. An eminent zoologist, and for twenty years curator of the Museum of the Royal Asiatic Society of Calcutta. A specialist and an extensive writer on the mammals and birds of Asia. Died in London, December 27th, 1873, aged 62.

Boeck, Dr. Axel John. Born in 1833. Died on the 6th of May. A member of the faculty of the University of Christiania; distinguished as an ardent investigator of the minute crustaceans of the Northern seas; and more recently, while in the employ of the Norwegian government, for his inquiries into the habits of the herring and other economical food fishes. Author of an elaborate work on the Northern amphipods.

Branchley, Julius. Died in February. A traveler in the South Pacific, on the geography and natural history of which region he had prepared an elaborate work, with numerous plates.

Breithaupt, Professor, of Freiberg. Died October 22d, in his 84th year. For sixty years connected with the Mining Academy of Freiberg. Author of a "Hand-Book of Mineralogy," in three volumes, and also of numerous special papers.

Burdine, M. Eminent as a mathematician, and as the first constructor of turbine water-wheels. A member of the Academy of Sciences of Paris. Died at Clermont-Ferrand, November 22d, at the age of 85.

Butler, Thomas Belden. Died June 8th. At his death he was chief justice of the Supreme Court of Connecticut; was the author of several papers upon the "Atmospheric System," the "Philosophy of the Weather," etc.

Calvert, Dr. Crace. Died at Manchester, October 24th. An eminent English chemist; appointed professor of chemistry to the Royal Institution at Manchester in 1846. Received patents for the preparation of carbolic acid, and for a process of desulphurizing coke by means of the chloride of lime. A juror in the International Exhibition at Vienna.

Chacornac, Jean. Died in September, in the 51st year of his age. Distinguished as an astronomer.

Chatelier, M. Well known as an engineer, having been the inspector-general of Mines in France, and for his investigations in chemistry, which had special reference to the regenerative gas-furnace for the manufacture of steel, and to the effect of saline manures in the cultivation of the land. Died November 16th.

Chevallier, Rev. Temple. Professor of astronomy in the University of Durham. Died November 4th, aged 80.

Clark, Professor Henry James. An accomplished naturalist; author of a work entitled "Mind in Nature," as also of a paper on "Lucernaria and its Allies"—the latter yet to be published by the Smithsonian Institution. Member of the National Academy of Sciences. Died July 1st, at the age of 47.

Coffin, Professor James Henry. Born in 1806. Died February 6th, in his 67th year. As a member of the faculty of Lafayette College, he filled the chair of mathematics and astronomy; best known from his treatise on the "Winds of the Northern Hemisphere," although many other papers have appeared from his pen, and an extensive work on the "Winds of the Globe" was nearly completed at his death. He was a member of the National Academy of Sciences.

Coste, Professor. Born in 1807. Died at the age of 66. Made a member of the Academy of Sciences of France in 1851; zealously devoted to pisciculture, erecting and superintending for some time the great establishment at Hüningen; the author of several treatises on fish-culture.

Czermak, Professor. Distinguished for his physiological researches; the inventor of the laryngoscope. Died at Leipsic, September 18th.

De la Rive, Professor August, of Geneva. Distinguished as a scientist, and especially for his researches in regard to electricity. Died at Marseilles, November 27th, at the age of 72.

De Smet, Rev. Peter John. A worthy ecclesiastic who rendered great service among the North American Indians, both to them and to travelers and agents of the government. Aided in making numerous collections in natural history and other branches of science, for museums at home and abroad. Died at St. Louis, May 23d.

Donati, Professor. Director of the Astronomical Observatory at Florence. Died at Vienna, September 20th.

Dupin, Baron P. C. F. Born October 6th, 1784. Member of the Academy of Sciences of Paris. Author of various statistical and mathematical works. Died January 19th.

Duppa, B. T. Specialist in the department of organic chemistry. Died November 10th.

Durand, Elias. A native of France. Author of various botanical works. By his will presented to the Jardin des Plantes a collection of American plants, and his botanical library to the Philadelphia Academy of Sciences. Died at Philadelphia, August 15th, at the age of 80.

Fedchenko, Alexis. An eminent traveler in Central Asia. Died of exposure on the Col de Géant, Switzerland, August 12th.

Foster, Colonel John W. Aided in the geological survey of Ohio; with Professor J. D. Whitney surveyed the iron and copper regions of Lake Superior; president of the Chicago Academy of Sciences. Author of a work on the physical geography of the Mississippi Valley, and one on the prehistoric races of the United States, as well as of numerous reports and papers on geology and ethnology. Died on the 29th of June, at the age of 58.

Gay, Claude. A member of the Academy of Sciences of Paris. A specialist in botany. Died at Deffends, November 29th, probably over eighty.

Gibbs, George. An eminent specialist in ethnology and philology. Born July 9th, 1815. Author of a "Life of Oliver Wolcott." In 1854 was appointed collector of the port of Astoria, Oregon; was geologist to the survey of a Pacific Railroad route under Major Stevens; a member of the Northern Boundary Survey in 1857. At the time of his death, on the 9th of April, was superintending the printing, on the part of the Smithsonian Institution, of vocabularies of the American Indians.

Gordon, J. A. Superintendent of the Crystal Palace Gardens; assistant of Sir Joseph Paxton.

Hancock, Albany. An eminent anatomist. Died October 24th.

Hansteen, Professor Christian. In 1816 was made director of the Astronomical and Physical Observatory of Christiania; among the highest of authorities in terrestrial magnetism. Author of a large number of scientific papers, but his most valuable work was "Magnetismus der Erde." Died April 15th, in his 89th year.

Hoeck, Professor M. Director of the Astronomical Observatory of Utrecht. Died September 4th, aged about forty.

Holland, Sir Henry. Died October 28th, at the age of 85.

Irvine, James. Author of the "London Flora."

Jameson, Dr. William. An eminent botanist and naturalist; contributed largely to public institutions in Europe and America of specimens in botany and zoology. Died at Quito, Ecuador, in June.

Jones, Dr. Henry Bence. Author of several special treatises upon various branches of science. Died in London, April 20th, at the age of 60.

Jourdan, M. Formerly director of the Natural-History Museum of Lyons.

Kaup, Dr. J. J. Grand-ducal inspector of the Museum of Darmstadt. Died in October.

Landseer, Sir Edwin. Born in 1802; elected an associate of the Royal Academy in 1827, and a royal academician in 1831. Distinguished for his skill as an artist in the delineation of animal life. Died October 1st, aged 71.

Liebig, Baron Justus. Born May 12th, 1803, in Darmstadt. Distinguished especially as an agricultural chemist, as well as for researches upon chemistry as applied to physiology and pathology. Died at Munich, April 18th, at the age of 70.

Livingstone, Dr. David. A distinguished explorer of the interior of Africa. Born at Blantyre, Lanarkshire, 1817. Died in Lobiser, Central Africa, August 15th.

Lyell, Lady. Wife of Sir Charles Lyell. Accomplished as a geologist and naturalist. Died April 24th, in the 65th year of her age.

Maack, Dr. G. A. A geological explorer on the Isthmus of Darien and in Brazil; author of various zoological treatises, and an assistant in the Museum of Comparative Zoology, Cambridge. Died August 6th, aged 33.

Madden, Sir Frederick. Well known as an antiquarian. Died in March, at the age of 72, being, at the time, head of the manuscript department of the British Museum.

Maury, Captain Matthew F. Distinguished for his attainments in mathematics and astronomy. Author of many works, the most important being "The Physical Geography of the Sea." For many years superintendent of the Washington Observatory. Died at Lexington, Virginia, in February.

M'Clure, Vice-Admiral Sir Robert. Eminent as an Arctic explorer, and well known in connection with the search for Sir John Franklin, for his success in which he received £5000 as a reward. Died in London, October 18th, at the age of 66.

Melsheimer, Dr. Friedrich E. The oldest of American entomologists, his most important work as an author being a catalogue of the described coleoptera of the United States. Died in Pennsylvania, March 10th, at the age of 91.

Naumann, Professor C. F. A member of the Academy of Sciences of Paris; a correspondent in the section on mineralogy. Died at Dresden, December 4th, at an advanced age.

Norris, Dr. Edwin. Author of several works on the cuneiform language of Assyria, and of a partially completed Assyrian dictionary. Died December 10th, at the age of 77.

Nott, Dr. J. C. Well known as an archæologist, and as a critical writer on ethnological subjects. Died at Mobile, March 31st, on his 69th birthday.

Obermeier, Dr. Otto. Having great confidence in his ability to prevent infection from cholera, his investigations and exposure, in his devotion to science, were the immediate cause of his death by that disease, August 20th, at the age of 31.

Ormerod, George. A well-known antiquary of Sedbury Park. Died in October, at the age of 87.

Owen, Mrs. Wife of Professor Owen, and only daughter of William Clift, the first curator of the Hunterian Museum.

Paschen, Dr. F. Astronomer. Died at Schwerin, Mechlenburg, August 24th.

Pentland, Joseph Barclay. Born in 1792. Well known for his explorations in Peru and Bolivia, and his determination of the elevation of several peaks of the Andes. Died July 12th, in his 82d year.

Rankine, Professor J. W. Macquorn. Born at Edinburgh in 1820. Distinguished as a civil engineer, and the author of valuable works in mechanics. Died December 25th, 1872, at the age of 52.

Ronalds, Sir Francis. Well known, many years ago, for his experiments in electricity. Died at Battle, in Sussex, in his 86th year.

Rose, Gustave. An eminent chemist and mineralogist, and author of various works on these sciences. Died in July, at Berlin, in the 76th year of his age.

Russell, Professor John Lewis. An ardent student of botany, and a recognized authority on the cryptogams of New England. Died at Salem, June 7th, in the 65th year of his age.

Saxton, Joseph. Celebrated for mechanical ability, and as the first inventor of the electro-magnetic machine producing an electric spark, and many useful machines, such as the medal-ruler, etc. Was a member of the National Academy of Sciences. Died at Washington, October 26th, in the 75th year of his age.

Schaeffer, George C. Librarian of the United States Patent Office; an ardent cultivator of natural and physical science, and especially interested in studying the microscopical structure of fossil plants. Died at Washington, October 4th, in the 59th year of his age.

Schweizer, Professor C. G. Director of the Observatory of Moscow. Born February 10th, 1816. Died July 6th.

Sedgwick, Professor. Author of many memoirs upon geological subjects, in the "Transactions of the Philosophical Society of Cambridge" and elsewhere. Occupied the Woodwardian chair in the University of Cambridge at the time of his death, in the 88th year of his age.

Smallwood, Dr. Charles. Specially known as interested in meteorology, having had charge for some time of the Montreal Observatory. Died at Montreal, December 22d, aged 66.

Stewart, Dr. J. Lindsay. Conservator of forests in the Punjaub, in India, and a writer on the botany of that country.

Sullivant, William S. An accomplished botanist, and a recognized authority in the department of the mosses for many years. Author of several valuable works on this branch of science. Born in 1803. Died at Columbus, Ohio, April 30th, at the age of 70.

Sydow, Count Emil von. Member of the general staff of the Prussian army; an eminent geographer. Died of cholera at Berlin, October 14th, aged 62.

Thierry, Simon Dominique Amedée. A member of the Institute of

France and various other learned societies in Europe. Died at Paris, March 26th, in the 76th year of his age.

Torrey, Professor John. Born in New York in 1798. The Nestor of botanical science in America. Author of numerous important works in this department, and distinguished as well for his attainments in chemistry and mineralogy. Filled many important professorships, as that of chemistry at West Point from 1824 to 1827, and that of chemistry and botany in the College of Physicians and Surgeons in New York, from 1827 to 1854; and at the same time exercising the function of professor of chemistry at Princeton College, from 1828 to 1851. At the establishment of the Assay Office in New York in 1853 he was appointed assayer, which office he held during the remainder of his life. Died in New York, March 10th, aged 75.

Varley, Cornelius. An early and active member of the London Society of Arts, the meetings of which he attended for nearly sixty years, and for whose "Transactions" he prepared the drawings. Made various improvements in scientific optical instruments. Died October 2d, in the 92d year of his age.

Verneuil, M. de. Eminent as a geologist. An explorer, with Sir Roderick Murchison, of the Russian Ural. Member of the Geographical Society of France. Died May 29th.

Verreaux, Jules. An accomplished ornithologist. Assistant naturalist in the National Museum of France, and a coadjutor of Charles Bonaparte in the preparation of ornithological works. An explorer in Africa and elsewhere. Died at the age of 66.

Wucherer, Dr. Otto. A German naturalist, long resident in South America, and author of several papers on the reptiles and birds of Brazil.

Young, James Wallace. An ardent student in the field of chemical geology, and author of valuable papers on this subject. Died at Portobello, May 12th, in the 30th year of his age.

Q. INDEX TO THE REFERENCES.

In the large number of serial works received regularly for use in the preparation of material for the *Record*, it has been found expedient to adopt some mode of abbreviating the titles, so as to save both time and space in writing and printing them. For this purpose the different countries have been represented by letters, and the journals numbered as in the following table. Publications referred to only occasionally are indicated by abbreviations of their titles at the end of the articles. Where no references are made, it is to be understood that the article is partially or entirely original, and prepared by the editor or his collaborators; in some cases, however, that the quotation has been mislaid or overlooked.

The list of works here mentioned relates simply to those most frequently consulted—especially those coming direct through the post-office—and forms but a small portion of those passed regularly in review. The unrivaled scientific library of the Smithsonian Institution is in regular and constant receipt of the latest publications from at least one thousand societies and establishments, public and private, in different parts of the world, all of which are used to a greater or less extent by the editor and his collaborators in the preparation of the *Annual Record.*

A. *Great Britain.*

1. The Chemical News and Journal of Physical Science. Weekly. London.

2. Land and Water. Hunting, Shooting, Fishing, practical Natural History. Weekly. London.

3. Iron: the Journal of Science, Metals, and Manufactures: with which is incorporated the Mechanics' Magazine, established 1823. Weekly. London.

4. Hardwicke's Science Gossip. Monthly. London.

5. The Popular Science Review. Quarterly. London.

6. Ocean Highways: The Geographical Record. Monthly. London.

7. London, Edinburgh, and Dublin Philosophical Magazine. Monthly. London.

8. Scientific Review: Record of progress in Arts, Industry, and Manufactures; and Journal of the Inventors' Institute. Monthly. London.

9. The Student and Intellectual Observer of Science, Literature, and Art. Quarterly. London.

10. The Annals and Magazine of Natural History. Monthly. London.

11. Proceedings of the Scientific Meetings of the Zoological Society of London. London.

12. Nature: a weekly illustrated Journal of Science. London.

13. The Academy: a Record of Literature, Learning, Science, and Art. Semi-monthly. London.

14. The Pharmaceutical Journal and Transactions of the Pharmaceutical Society. Weekly. London.

15. The Athenæum: Journal of English and Foreign Literature, Science, and Fine Arts, Music, and the Drama. Weekly. London.

16. The Quarterly Journal of Science, and Annals of Mining, Metallurgy, Engineering, Industrial Arts, Manufactures, and Technology. London.

17. The Journal of Applied Science: a monthly record of progress in the Industrial Arts. London.

18. English Mechanic and World of Science. With which are incorporated "The Mechanic," "Scientific Opinion," and the "British and Foreign Mechanic." Weekly. London.

19. The Field, the Farm, the Garden: the Country Gentleman's Newspaper. Folio. Weekly. London.

20. Medical Times and Gazette. Weekly. London.

21. Journal of the Chemical Society, containing the papers read before the Society, and abstracts of chemical papers published in other journals. Monthly. London.

22. Illustrated London News. Weekly. London.

23. Journal of the Society of Arts. Weekly. London.

B. *France.*

1. Bulletin hebdomadaire de l'Association Scientifique de France. Weekly. Paris.

3. Les Mondes: revue hebdomadaire des Sciences et de leurs applications aux Arts et a l'Industrie. Weekly. Paris.

4. Le Moniteur Scientifique du Dr. Quesneville. Journal des Sciences pures et appliquées. Bi-monthly. Paris.

5. Le Technologiste, ou Archives des progrés de l'industrie française et étrangère. Monthly. Paris.

6. Comptes rendus hebdomadaires des séances de l'Académie des Sciences. Weekly. Paris.

7. Science pour tous. Weekly. Paris.

8. Revue Scientifique. Weekly. Paris.

9. Revue hebdomadaire de Chimie scientifique et industrielle publiée sous la direction M. Ch. Mène. Weekly. Paris.

10. Bulletin Mensuel de la Société d'Acclimatation. 8vo. Monthly. Paris.

11. Revue de Therapeutique Medico-chirurgicale. Bi-monthly. Paris.

12. Bulletin général de Therapeutique médicale et chirurgicale. Bi-monthly. Paris.

13. La Nature. Weekly. Paris.

C. *Germany and Austria.*

1. Aus der Natur. Die neuesten Entdeckungen auf dem Gebiete der Naturwissenschaften. Weekly. Leipsic.
2. Archiv der Pharmacie. Monthly. Halle.
3. Das Ausland. Ueberschau der neuesten Forschungen auf dem Gebiete der Natur- Erd- und Volkerkunde. Weekly. Augsburg.
4. Badische Gewerbezeitung für Haus und Familie. Monthly. Karlsruhe.
5. Deutsche illustrirte Gewerbezeitung. Weekly. Berlin.
6. Deutsche Industrie-Zeitung: Organ der Handels- und Gewerbekammern zu Chemnitz, etc. Weekly. Dresden.
7. Gaea. Natur und Leben. Zeitschrift zur Verbreitung und Hebung naturwissenschaftlicher, geographischer, und technischer Kenntnisse. Monthly. Köln and Leipsic.
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