Editor's Scientific Record.

SUMMARY OF SCIENTIFIC PROGRESS.

THE month of May has not passed without its contribution to the annals of *Astronomy*. The return of the second comet of 1867 has added another to the list of periodical bodies of this nature; and Professor Peters, of Hamilton College, announces the discovery, on the 20th, of the 131st asteroid. The valuable discussion of the respective merits of Halley's and of Delisle's methods of observing the approaching transit of Venus has been continued by Airy and Proctor, and is now probably definitively settled, since it seems that it is important to provide for putting both methods into execution. The extensive preparations being made by the Russian government for this great international work are suggested by the statement that twenty-four stations will be occupied by her astronomers, and her navy will carry out a special geographical expedition in connection with the work. In the matter of the improvement of our means of observation, it is worthy of note that Dr. Gould has succeeded in so repairing his photographic telescope that it is confidently hoped we may soon have valuable photographs of the stars of the southern hemisphere, such as Bond and Rutherford have given us for the northern skies. The laborious and thorough examination by Dembowski of the micrometer with which for twenty years his admirable double-star measurements have been made has shown the existence of errors in that refined instrument that have been hitherto unsuspected, and will serve to arouse attention to the necessity of improvement; at this juncture possibly some will turn to the very simple and quite different construction just proposed by Noel as an improvement on the double-image micrometer, in which the micrometer *screw* is quite dispensed with. As our instruments improve, our knowledge of the heavens keeps equal pace. After the first brilliant discovery of the companion of Sirius, made with the Chicago refractor before Mr. Clark had finished its construction, it was hoped that the new and far superior telescope now being made by him for the Washington Observatory would have already been distinguished by the discovery of the companion of Procyon, whose existence was theoretically demonstrated some years ago. In this, however, Americans have been, by a few months, anticipated by the activity of the eminent director of the Imperial Russian Observatory at Pultowa, who announces that after a long search the star has been found and observed by himself and his assistants during the month of March. This brilliant result of Struve's labors must be considered as one of the most gratifying indications of the value of the observations and calculations of the many astronomers who have busied themselves with this subject. It is noted with much satisfaction that in America an occasional amateur astronomer is found busy with his telescope, and the catalogue of eighty-one new double stars by Mr. Burnham, of Chicago, is a promise of still better things. A highly interesting contribution has been made by S. W. Williams, the secretary of the Royal Astronomical Society of London, and himself an able scholar of the Chinese language and literature, in that he has compiled a list of the sun-spots observed since the year 206 by the astronomers of that empire. The works from which Mr. Williams's list is compiled were published in China before the application by Galileo of the telescope to astronomy. Mr. Williams has also in his work on Chinese comets given many cases of their observations of meteors and other remarkable stars, so that the accumulating materials promise at no distant future to form a very complete history of astronomy. The application of the resources of astronomical observatories to the wide distribution of accurate standard public time continues to attract the general attention. Through the Western Union Telegraph Company the city of New York will soon be specially favored in this respect. At present the government buildings at Washington—that is, the War, Navy, and Treasury departments—as well as some others, are provided with Hamblett's electric clocks, which are controlled by continuous currents from the standard clock at the National Observatory. In the more difficult departments of astronomy we have a review by Wagner of Secchi's supposed discovery of a periodical variation in the diameter of the sun. Wagner shows that nearly twenty years of the most accurate modern observations do not justify Secchi's conclusions. Leverrier has presented to the Paris Academy of Sciences his complete mathematical formula for the motion of Jupiter about the sun. A theoretical investigation of the motion and nature of the rings of the planet Saturn has been published by Hirn, and is said to be a valuable work. His conclusion that the rings must be composed of small fragments in close juxtaposition does not seem to differ from the results of the studies of Pierce and Maxwell.

In *Terrestrial Physics and Meteorology* we chronicle the recent establishment by the Army Signal-office of an observing station on Mount Mitchell, in North Carolina, and the promise of another on the summit of Pike's Peak, Colorado. A new theory is proposed by Tarry, accounting for the sand-showers of Southern Europe by the action of oscillating cyclones. The annual report of the Canadian system of storm warnings shows that over a hundred observing stations are doing good work gratuitously in that Dominion. A tornado passed over Iowa on the 23d of the month which was one of the most destructive on record in that region; very many lives were lost. Brown continues his researches, and announces a twenty-six day period connecting the fluctuations of the barometer and the magnetic needle. A very unexpected announcement is made by Muhry that the researches of Meissner show that clouds would not be produced in our atmosphere were it not for the presence of oxygen. Jelinek has, like many others, given some time to the investigation of the solar-spot period in the rainfall which was recently announced by Lockyer, but can find no convincing proof of the existence of any connection of this sort. On the origin of atmospheric electricity Muhry has contributed somewhat by way of a paper on the geographical distribution of the electrical phenomena. Marchand has given the results of four years of observation with an actinometer of original con-

struction, by which he arrives at the power of the solar rays to effect the decomposition of carbon compounds.

In the department of *Electricity* we notice an excellent article by Boboulieff, giving as his results, after careful observation, that the dispersion of electricity depends on the temperature and pressure of the surrounding gas, as well as on its nature. The important question of the magnetism of iron ships has received a great addition in the elaborate memoir of Professor Harkness, just published by the Smithsonian Institution.

The death of Professor Hansteen on the 15th of April, in his eighty-ninth year, removes from us one of the founders of the modern science of terrestrial magnetism.

In *Chemistry* Violette announces that he has succeeded in fusing fifty grams of platinum in an ordinary wind furnace, though, as he used coke for fuel, it is suggested that the fusing-point of the metal may have been lowered by the formation of compounds of carbon, silicon, or even sulphur with the platinum. Debray shows that the purple of Cassius is only a lake formed by the mixture of finely divided gold with tin hydrate. He has succeeded in forming a similar color with alumina. The character of hydrogen when in a state of occlusion by palladium has been investigated by Roberts and Wright. They conclude from its specific heat that the compound body is not an alloy, as Graham had supposed, but that it is a chemical compound; that, moreover, since palladium and hydrogen may unite in any proportion, each several charge must be regarded as giving rise to a distinct compound. The atomic weight of thallium has been redetermined with great care by Crookes, and found to be 204.008. Berthelot has continued his valuable researches in thermo-chemistry, and has announced the following law concerning the mutual decomposition of salts in solution: That salt whose production evolves most heat is the salt which is formed in solution whenever the salts from which it can be formed are present in the state of partial decomposition in the liquid. This state of partial decomposition in presence of water, Berthelot shows to be the fact with most salts. The above law concerning salts in solution he generalizes as follows: Every chemical change effected without the agency of external energy tends to produce that body, or that group of bodies, in whose formation most heat is set free. Gautier has given some experiments to prove that elemental allotropism—a fact hitherto regarded as a consequence only of elemental molecular condition, and hence not capable of existing in combination—does actually exist in compound substances. His results were obtained with phosphorus, and he cites some of its compounds in which he believes allotropic phosphorus to exist.

In *Technical Chemistry* Crace Calvert has experimentally classified antiseptics. He finds cresol to be the only substance examined which destroys vibriones at once, and also prevents their reappearance. Phenol, which prevents their formation, does not destroy them completely after they are formed. Sulphuric acid, on the other hand, destroys them completely, but does not prevent their subsequent development. Zinc sulphophenate does both. Corrosive sublimate destroys them partially, but favors the development of the remainder; originally added, however, it prevents their formation. Jacquez has proposed borax as an antiseptic. A note sealed by him in 1857, and recently opened by the French Academy, contains experiments proving the efficiency of borax in preserving animal matters. Pieces of meat placed in a five per cent. solution of borax in August were withdrawn in a perfect state of preservation a month afterward. On exposure to the air, they dried without putrefying. The bodies of rabbits injected with a solution containing five per cent. of borax and ten per cent. of ammonium borate were perfectly preserved for months, the color and consistence of the tissues being unaltered. The author recommends borax as a preserving agent in taxidermy. It is proposed to render paper impermeable to water by a brief immersion in ammonio-cupric sulphate solution, and subsequent pressing and drying. By uniting several sheets while still wet by passing them between rollers, they form a hard, firm mass of great strength. The advantages of toilet soaps made by the cold process over those in which heat is used are fully recognized, and are due to the retention of the glycerine in the soap in the former process. But these cold soaps are objectionable because they contain an excess of caustic alkali. Mialhe proposes to make such soaps neutral by cutting them fine and exposing them to carbonic gas. A neutral, emollient soap is thus obtained of excellent quality. It is a common impression that coal exposed to the air immediately after mining loses essentially in valuable constituents, this loss having been stated as high as fifty per cent. of their combustible value. Kolb has tested the question by exposing four coals in this way for two months. In one of the coals the total loss was 4.8 per cent., but in the others it scarcely exceeded two per cent. of the combustible value. Exposed for a month to a stove heat of 90° C., one coal lost 5.5 per cent., another only 0.7 per cent. in value. A sample of coal mined at Nœux ten years previously was shown by analysis not to have deteriorated appreciably in value. White-lead made by the Dutch process has been found to have occasionally a red color, which has been attributed to the presence of foreign metals in the lead employed. Lorscheid, however, shows that this color is due to the presence of lead peroxide, and that it is produced when the carbonic gas is insufficient to convert the lead completely into carbonate. In proof of this he states that the red pigment submitted a second time to the action of the carbonic gas is converted into the white carbonate. Another common opinion in science, that animal or vegetable charcoal mixed with animal matters acted to facilitate their oxidation, has been rectified. Stanford has proved that lean beef mixed with an equal weight of wood, sea-weed, or bone charcoal, and freely exposed to the air for a period of twenty-one months, lost none of its nitrogen, and, moreover, that no nitrates were produced. The mixture was nearly inodorous, and he recommends it as a convenient one for utilizing animal offal as a fertilizer. In Le Blanc's process there is a loss of soda. This process, as is well known, consists in converting salt into sodium sulphate by sulphuric acid, and in heating this sodium

sulphate with limestone and coal to convert it into sodium carbonate. Scheurer-Kestner has shown that the loss in soda is due to the formation of insoluble sodium compounds which remain in the waste, and that this result depends on the excess of limestone which is employed. In the Bessemer steel process Kessler has proved by his analyses that the carbon of the cast iron does not burn until all the silicon has been removed. He also states that the combustion of the iron causes the percentage of the phosphorus in the metal continually to increase. Harcourt points out that carbon disulphide may be almost entirely removed from coal gas by passing it rapidly over red-hot iron, and this, too, without depositing any of its carbon or impairing its illuminating power. Indeed, in case the tube be heated to bright redness, an actual increase in illuminating power may be observed, owing to the production of more condensed hydrocarbons. Drinking-waters are generally filtered, if filtered at all, through carbon filters. Müller allowed some water to become stagnant, and then filtered it into a globe free from air through a carbon filter. In a few days the vegetable scum reappeared, though after boiling the water remained clear. It seems, therefore, that carbon filters can not remove vegetable germs from water, and that they are useful only to separate mechanical impurities, as sand, etc. Some experiments tried in Berlin prove that so small a quantity of coal gas as twenty-five cubic feet a day distributed in 144 square feet of soil four feet deep will kill all the trees in that area in a short time.

In *Botany* there has appeared a monograph of the *Ebenaceæ*, by W. P. Hiern, from the Transactions of the Cambridge Philosophical Society, England, giving in complete detail the relations and characteristics of the order, and including fossil as well as recent species. The five genera are represented by about 260 recent species, besides the forty reputed species which are extinct. The only known species of North America are a single *Maba* in Lower California, and our persimmons, *Diospyros texana* and *virginiana*, the latter very closely allied to *D. lotus* of Northern and Western Asia and *D. kaki* of Japan. Three fossil species are also reported from the miocene of Alaska and Nebraska.

A translation from the Danish into the German has been made by Grisebach and Reinke of the recent work by Oersted upon fungi, lichens, and algæ, the translators adding frequently to the original. It is well and largely illustrated, and gives in moderate compass, and in a quite popular though still scientific form, descriptions of the genera and of many of the more common species. A similar work in English would doubtless be appreciated.

An interesting contribution upon the relations of geography, climate, and vegetation has been made by Dr. F. C. Schübeler, Professor of Botany in the university at Christiania, in his *Vegetable Life in Norway* (*Die Pflanzenwelt Norwegens*), the introductory portion of which, with charts and illustrations, has just been issued. The physical characteristics of the region make his conclusions especially valuable.

Professor Müller, of Lippstadt, in a volume of no ordinary interest and value, upon the fertilization of the flower by insect agency, gives a compend of all the observations hitherto made within his knowledge upon the mutual adaptation of the structure of flowers and insects to secure the fertilization of the plant. He brings together the observations of Sprengel, Hildebrand, Darwin, Delpino, Axell, and others, and many made by the author himself, including not only the contrivances shown in the flower, but what has received much less attention, and has more of novelty, the special structural adaptations of insects for the same end—the whole illustrated with numerous well-executed drawings. The theories of Darwin as to the origin of species are fully adopted and enforced.

In our own journals Professor T. D. Biscoe gives in the *American Naturalist* for May a microscopic study of the winter state of the common duck-weed. The same journal contains descriptions of a score and more of new plants from the Arizona region, collected by the government expedition during the last season; and Professor D. C. Eaton describes in the Torrey Bulletin several new species of ferns.

In our last summary, under the head of *Geography*, we referred to the rescue of a portion of the crew of Captain Hall's steamer, the *Polaris*, by a vessel engaged in sealing on the coast of Labrador. Since then this party, nineteen in number, have reached Washington, the United States steamer *Frolic* having been dispatched to St. Johns by the Navy Department for that purpose. They arrived in good health, and have been subjected to a critical examination on the part of the Secretary of the Navy with a view of ascertaining as accurately as possible the events of the cruise. As the result, much important information has been gathered, tending to show that the steamer sailed as far north as 82° 16′, in what Captain Hall called Robeson Channel, and went into winter-quarters at the head of Polaris Bay, in what was called by him "Thank-God Harbor," in latitude 81° 38′, early in September. On the 8th of October Captain Hall started on a sledge journey to the northward, and returning on the 24th, after an absence of two weeks, he was almost immediately taken sick, and died on the 8th of November. The vessel remained in its winter-quarters until the 12th of August, 1872, when Captain Buddington started for home. On the 15th they encountered ice in latitude 80° 2′, and the vessel was fastened to a large floe by cables and ice-anchors, and drifted along with it as far south as Northumberland Island, in latitude 77° 35′, when, on the 15th of October, a heavy southwest gale came on. The impression that the vessel was in danger of being capsized or crushed caused her crew to throw overboard a large amount of provisions and supplies upon the ice; and while some of the men were engaged in removing these farther up on the floe, the *Polaris* broke away from her moorings in consequence of insecure fastening. For some reason the steamer could not, or at least did not, recover the portion of the crew thus cast away on the ice, and the floe drifted off with them. They thus remained, experiencing various adventures, from the 15th of October until the 30th of April, when they were picked up by the crew of the British steamer *Tigress* off the Labrador coast, as stated. When the result of the examination is published, we shall doubtless have occasion to recount some of the more interesting particulars.

Of the arctic expeditions for the present season, the only one recorded as under way is that of Mr. Leigh Smith to Spitzbergen. This gentleman started in Mr. Lamont's steam-yacht, the *Diana*, with the hope of reaching a high latitude, his own yacht also proceeding to Spitzbergen as a tender, or a relief vessel, if necessary.

All the government expeditions to the West are in the field, and are likely to do good service in the cause of science. The parties are those of Lieutenant Wheeler and Professor Hayden, already referred to; that of Major Powell, on the Colorado; that of Archibald Campbell, Esq., in the Northern Boundary Survey, with Dr. Coues as naturalist; and that of Mr. Dall, in the Aleutian Islands. In addition to these, another large expedition has started out for the protection of the constructors and surveyors of the Northern Pacific Railroad. This is accompanied by a number of scientific men, including Mr. J. A. Allen as naturalist; C. W. Bennett, assistant naturalist; Dr. L. R. Nettre as geologist and mineralogist; Mr. Konopicky, artist; and Mr. William Pywell as photographer. Much is hoped from this expedition, as it passes through a comparatively little known region of North America.

Commander Selfridge has returned from the Isthmus of Darien, bringing gratifying news in regard to the feasibility of an interoceanic ship-canal, the expense of its construction being now placed at a sum considerably less than the original estimate.

News has been received from Sir Samuel Baker, tending to prove his safety, in contradiction of the report of his death.

Dr. Nachtigal furnishes the results of an exploration to the northeast of Lake Tchad.

Mr. Smith, of the British Museum, who proceeded to Assyria, under the patronage of the London *Daily Telegraph*, to make ethnological explorations, has succeeded beyond his most sanguine expectations, and among other treasures has secured the portion of the deluge tablet which was missing from the one now in the Museum.

The *Challenger* has continued at work since our last, having carried a line of soundings and dredgings first from St. Thomas to Bermuda, then from Bermuda to Sandy Hook, thence to Halifax, and again from there to Bermuda. Her observations have, it is said, proved the entire practicability of laying a submarine cable between Bermuda and New York.

A French deep-sea expedition is now engaged in making explorations along the coast of the Mediterranean, and will be accompanied by M. Lacaze-Duthiers, an eminent French zoologist.

Under the head of *Ethnology* an interesting announcement is that of the discovery of stone implements and other prehistoric remains in Iceland, antedating certainly the period of its first discovery by Europeans. Among other facts brought to light by the voyage of the *Polaris* is the detection of the remains of at least sixteen Esquimaux huts on Newman's Bay, as far north as 81° 38′, right opposite the winter-quarters of the *Polaris*. In their vicinity were found spear-heads made of the teeth of the walrus, and other bone implements, but none of stone.

It is not within the province of the Record to chronicle the general progress of *Agriculture*; for this, reference must be made to the journals especially devoted to that subject. Among other points of general interest, however, we note the announcement of a method of greatly accelerating the ripening and of improving the quality of fruit, by removing a considerable portion of the superincumbent earth from over the roots of the tree to which this belongs. A German specialist maintains the failure of sewage irrigation as a matter of economy and of general expediency, the cost being much greater than the results will warrant, which in themselves are of very little moment.

We have from France the announcement of a new breed of ash-colored turkeys of remarkable excellence, far more prolific than the ordinary turkey, characterized, indeed, by a tendency to lay eggs throughout the year, like the domestic hen.

The record of *Pisciculture*, as might be expected, is very full. The States of Michigan, Pennsylvania, and Ohio have all passed more or less desirable laws regulating the subject of fisheries, and have appointed commissioners for their execution, as also to take measures for increasing the stock of useful food fishes within their limits.

The salmon eggs obtained at the hatching establishment of Mr. Atkins, of Bucksport, and distributed in part by the United States Commissioner, have all been hatched out with very little loss, and planted in a number of rivers and streams tributary to the Atlantic coast and the great lakes.

Shad planting has been conducted during the season by the United States Commissioner, under the general direction of Seth Green, in the Savannah River at Augusta, in the Neuse at Newbern, in the Roanoke at Weldon, the Potomac at Washington, and in the Susquehanna and Delaware; and numbers of young fish have been introduced into these waters respectively, as well as transported westward. The propriety of conducting such measures is well shown by the fact that young shad of two years old have recently been taken at the mouth of the Sacramento in California and near the mouth of the Genesee River in Lake Ontario—these being the results of experiments prosecuted by Seth Green in planting young shad in these localities in the spring of 1871.

Mr. Holton, a member of one of Seth Green's parties, succeeded in hatching out the eggs of the striped bass, or rock-fish, and, as a consequence, it is hoped that this species, one of the most valuable of those native to America, can be greatly multiplied in our rivers, and restored to those from which it has been for a long time absent.

The United States Signal-office has added to its other labors an inquiry which will be of great service to pisciculture—namely, that of determining the surface and bottom temperatures of the rivers and harbors of the United States. This will furnish the means, *a priori*, of determining whether it will be practicable to introduce particular species in a given locality.

Under the head of *Domestic Economy*, the most important announcement is that of the practicability and economy of the acetate of soda process of preserving meat and vegetables for a long time, as lately reported by Dr. Sacc, of Geneva. This substance, in his opinion, is

far superior to common salt, and will preserve the various objects in a condition much more akin to that of the fresh article.

An improved method of preparing glue from all kinds of refuse is also announced; while the startling intimation is given by a prominent chemist of the possibility of preparing alcohol from flint and quartz.

In the *Materia Medica*, trimethylamine, or propylamine, is presented and warmly indorsed as a remedy for acute articular rheumatism, the results of its application in numerous instances being quite extraordinary.

The use of large and continuous doses of chloral hydrate has also been strongly urged, as warranted by experiment, for a remedy in gout.

Our *Necrological* list for the month embraces some eminent names in science—the more prominent being those of Baron Justus von Liebig and Professor Christian Hansteen. To these are to be added Amédée Thierry, the historian; John Arrowsmith, the geographer; Dr. Henry Bence Jones, the physiologist and chemist; and the wives of Professor Lyell and Professor Owen.

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 that 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.

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, however, 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!'"

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.

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 temperatures 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.

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.

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 ex-

amines 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.

ARTIFICIAL RESPIRATION IN ASPHYXIA AND IN SNAKE BITE.

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.

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.

A NEW RELATION BETWEEN ELECTRICITY AND HEAT.

Dr. Guthrie, in a paper read before the Royal Society of London, gives the results 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.

RAIN-FALL IN JERUSALEM.

Dr. James Chaplin, who is at present residing in Jerusalem, corrects a statement that the rainfall 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 observation both of dry paper and that which had been moistened failing to indicate any discoloration of the ozone paper.

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 Pittsburg 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 Pittsburg 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.

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.

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.

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 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. Vögel 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.

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.

THE FRENCH ASTRONOMICAL COUNCIL.

Astronomical matters seem to be very systematically arranged in France, if we may judge from five decrees recently issued by the French government. According to these decrees, the government astronomers are divided into the three classes of "titular," "associate," and "assistant," the directors of the various observatories belonging, we presume, to the first of these classes, probably as the senior members of that rank. To each observatory will be assigned as many astronomers as the respective needs and resources demand. The directors and the titular astronomers are appointed by the President of the republic. To the Paris Observatory, as being the most important, is assigned the very handsome complement of twenty astronomers, including six titulars and ten associates, to whom must be added the director and various subordinates. This force is seen to be larger than that at any other existing observatory—as at Greenwich there are but eight, at Pultowa seven, and at Washington four astronomers.

As the new director of the reorganized observatory at Paris, Leverrier is reappointed to the position he formerly held. Marie Davy is director at Montsouris, and Stephan at Marseilles.

Editor's Historical Record.

POLITICAL.

OUR Record closes on the 24th of June.—The New York Legislature was adjourned on the 30th of May, after a session of 142 days. A new Local Option Prohibition bill, framed to obviate the objections made by the Governor to the former bill, was defeated in the Assembly, May 27, receiving only fifty votes. A Civil Damages bill (framed after the Ohio act), making liquor dealers and landlords responsible for damages committed by intoxicated persons, was passed by both Houses, and signed by the Governor. The bill in behalf of the Industrial Exhibition Company of New York city has been passed by the Legislature and signed by the Governor. It authorizes the issue by New York city of bonds to the extent of $2,500,000, to be secured by a first mortgage on the property of the company.

Some of the most important amendments reported by the New York Constitutional Commission have been rejected by the Legislature. The Commission limited special legislation by excluding laws regulating the internal affairs of towns and cities. This limitation the Legislature has abrogated. It also struck out the articles providing against hasty legislation and the introduction of bills of a private or local nature after sixty days from the beginning of a session. The new apportionment of Senatorial districts recommended by the Commission was rejected. The members did not, however, reject the amendment giving them a salary of $1500.

Among the important bills rejected by the last New York Legislature were the following: To exempt bonds and mortgages from taxation; to abolish the usury laws; to regulate the sale of gas, and to appoint inspectors; to provide for valuation of life-insurance policies; relative to forfeiture of life-insurance policies; to enable husband and wife to be a witness, either of them, for or against the other; for the protection of factory children; to regulate railway leases. The enumeration is a very suggestive one, since it includes some of the most popular and essentially important bills which were introduced during the session. But what was to be expected from a Legislature the Lower House of which on the last day of the session, while actually engaged in the passage of bills for the government of the State, could conduct itself after a fashion which would make the rudest of school-boys blush for shame?

The distribution of the $125,000 raised by the one-sixteenth of a mill tax for the benefit of sectarian institutions in the State of New York is very unequal. New York County pays one-half of the entire tax, but receives nothing in return; Albany County pays $3016, and receives only $103; Dutchess pays $2105, and receives nothing; Kings pays $12,196, and receives $4814; Westchester receives nothing, but pays $3748. More than three-fourths of the entire tax is a gratuitous contribution from a few counties for the benefit of all the others.

The Professional Thieves act recently passed by the New York Legislature has received judicial sanction, but is necessarily so interpreted as to be applicable only to such criminals as have been previously convicted of the crimes mentioned in the act. This latter provision is not included in the Pennsylvania statute of a similar import.

A few years since a commission was established in New York in imitation of the Massachusetts State Board of Charities. Until recently it has had simply an advisory power; but this board has been newly constituted, and its scope has been enlarged. Two acts of the last Legislature give this board extraordinary powers in reforming the poor-law administration of the State. One of these empowers the board to designate three or more persons in any county to act as "visitors" of the poor-houses and other public institutions. The other act empowers the secretary of the board to remove the insane paupers in the almshouses to the State asylums for the insane, and to reform the condition of the pauper children in the almshouses. Under the provisions of this act the pauper child may be transferred to an orphan asylum, or may be bound out during the remaining years of minority.

During the past two years the Prison Association of New York has organized a most practical method of dealing with convicts discharged or about to be released from the State and county prisons. The last annual report of the association shows that its officers have a good understanding with the State-prison inspectors and wardens, and that every convict has ample opportunity before release to confer with and be advised by the society's representative. By this means a large proportion of the younger convicts are provided with good employment, away from the cities, and with suitable employers, from the day of their discharge. The following facts relating to this subject have recently appeared in a memorandum issued by the Prison Association of New York:

"At each of the State-prisons, and at some of the penitentiaries, the association has established a definite system of personal effort to induce and prepare the convicts about to be liberated to enter upon a course of honest industry and prudent living; and to all such as will do so definite offers of employment and friendly protection, in suitable localities, are extended by the agents of this association. Upward of eighty convicts are liberated monthly from the three State-prisons, and of these *more than eighty per cent.* go directly to good employers, under direction of the association. Experience shows that the greater portion of these discharged prisoners try to do well. The penitentiaries discharge *upward of six hundred* prisoners monthly, and for many of them the association finds employment, and extends such aid and counsel as they need. In the sixty-seven county jails this system of duty has become in some measure established, and, by local agencies, each one is visited weekly.

"Upward of 300 employers of organized labor and trade industries are now aiding this effort for the benefit of discharged prisoners and for the repression of crime in all parts of the State. The known results of these efforts are remarkable. For example: at the Sing Sing prison these duties commenced on the 14th of August last, and from that date until May 1, a period of eight and a half months, out of the entire number (245) of prisoners discharged, *only three* have been resentenced to the prison; and at Auburn prison, out of 243 prisoners discharged during the nine months ending May 1, *only one* has been returned to the prison, and he was a man who persisted in his old habits of inebriety, and had not accepted the offer of employment. At Clinton prison *only one* of the discharged prisoners of the same nine months' period was returned to the prison during that time."

The Illinois farmers have succeeded in elect-