cally by the two poles, and returns to its path, the line of least resistance, through the molecules, whereas the stream of molecules at the higher exhaustion, carrying their electricity with them, are carried away by the electric charge upon them, and get utterly lost and scattered on striking the side of the tube, yielding up a great deal of energy in the form of heat to the tube or to the glowing platinum or other substance in the tube.

I must now show you the beautiful aurora tube which has been seen once in this theatre, and for which I am indebted to the kindness of Dr. De La Rue. It has been brought to the right state of exhaustion to show just those effects which will help better than any description of mine to give you an idea of the character of the aurora discharge in the middle regions of the atmosphere.

By bringing a magnet to bear upon this discharge we may see the effect of terrestial magnetism on the aurora discharges in the atmosphere.

Aurora Borealis.—The aurora as seen in the north-eastern parts of Siberia, where it is often very brilliant, is described as consisting of single bright pillars rising in the north and in the north-east, gradually covering a large space of the heavens; these rush about from place to place, and reaching up to the zenith, produce an appearance as if a vast tent was spread in the heavens, glittering with gold, rubies, and sapphires.

More exact attempts have been made to describe the aurora, and perhaps I may be allowed to quote Dalton's description of an aurora as seen by him.

A remarkable red appearance of clouds was noticed in the southern horizon, which afforded light enough to read by, and a remarkable effect was expected. He says, "There was a large luminous horizontal arch to the southward, and one or more concentric arches northward. All the arches seemed exactly bisected by the plane of the magnetic meridian. At 10.30 streamers appeared in the S.E. running to and fro from W. to E.; they increased in number, and approached the zenith, when all of a sudden the whole hemisphere was covered with them, and exhibited such an appearance as baffles all description. The intensity of the light, the prodigious number and volatility of the beams, the grand intermixture of all the primitive colours in their utmost splendour, variegating the glowing canopy with the most luxuriant and enchanting scenery, afforded an awful, but at the same time a most pleasing and sublime spectacle. But," he adds, "the uncommon grandeur of the scene only lasted one minute. The variety of colours disappeared, and the beams lost their lateral motion, and were converted, as usual, into the flashing radiations; but even then it surpassed all other appearances of the aurora, in that the whole hemisphere was covered with it."

In his address before the British Association in 1863, Sir William Armstrong speaks of the sympathy between forces operating in the sun and magnetic forces on the earth, and notices a remarkable phenomenon seen by independent observers on September 1, 1859.

"A sudden outburst of light, far exceeding the brightness of the sun's surface, was seen to take place, and sweep like a drifting cloud over a portion of the solar surface. This was attended with magnetic disturbances of unusual intensity, and with exhibitions of aurora of extraordinary brilliancy. The identical instant at which the effusion of light was observed was recorded by an abrupt and strongly-marked deflection in the self-registering instruments at Kew. The magnetic storm commenced before and continued after the event."

The daily and yearly periods of the magnetic changes, the change in the horizontal force depending on the sun's rotation on his axis, the agreement of the eleven-year period of magnetic disturbances, sun-spots, and auroras, show that the sun plays a very important part in causing or governing both the regular and irregular magnetic changes.

If the sun be assumed to be a very powerful magnet, then changes in his magnetism might be expected to affect the magnetism of the earth, although the effect could not be very large, unless the sun is magnetised to an intensity much greater even, compared to his mass, than the earth is magnetised. Then as there are tides in the sea around us and probably in the earth's crust, so there are certainly very large tides in the ocean of air above us: and may not the sun and moon, by dragging this air towards them as the earth revolves, cause that friction between air and earth, and also that evaporation, which together may account for the presence of, and keep up the supply of, positive electricity in the air and negative electricity in the earth? Again, these tides in the atmosphere will cause the mass of it to lag behind the revolving solid earth, and at a height of thirty or forty miles we have a layer of air which, for air, is a comparatively good conductor of electricity. Here then we have not a lagging of the magnet behind the conductor, but a lagging of the conductor behind the magnet, and hence, according to the laws of Faraday, we may expect a current or a gradual heaping up of electricity in the air in the opposite direction to the current in the earth's crust. Thus the regular tidal waves in the atmosphere would cause the gradual transfer of positive electricity from the poles towards the equator. This transfer may be of the nature of a current of electricity or of a mass of air carrying a static charge of electricity with it, for as Prof. Rowland has shown that the motion of a static charge will produce magnetism, so we may expect from the principles of conservation of electricity that a change in the position of a magnet will under such circumstances produce motion of the static charge of electricity. When the air becomes charged up to discharging point, then we may get the sudden discharges such as the aurora in the air and the earth current in the earth; and since the conducting layer of air approaches nearer to the earth in the colder polar regions, possibly within less than twenty miles of the earth's surface, it may be found that the discharge of the aurora may even take place from earth to air by gradual slow discharge, aided as it may be by the state of moisture of the air and by change of temperature and other causes.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—W. H. Caldwell, B.A., of Caius College, has been nominated to study at the Zoological Station at Naples.

Mr. F. M. Balfour, F.R.S., has been elected President of the Cambridge Philosophical Society. Prof. Newton in laying down the office referred with pleasure to the removal and the change in the management of the Society's library. Since the transfer to the new room about 500 volumes have been presented to the library by Professors Humphry and Newton, Mr. J. W. Clark, Mr. F. M. Balfour, and Mr. Horace Darwin.

Open Scholarships for Natural Science have been offered by Trinity College (date of examination, March 22 next); subjects those of the Natural Science Tripos; by St. John's College, subjects, Chemistry, Physics, Physiology, with Geology, Comparative Anatomy, and Botany (the last three only if notice be given beforehand), date, March 22; by Caius College, date March 28, subjects, Chemistry, and either Biology or Physics; by Christ's, Emmanuel, and Sidney Sussex Colleges, at a common examination; subjects, Physics, Chemistry, Biology, and Geology; date March 28.

UNIVERSITY COLLEGE, LIVERPOOL.—The Council of the College have appointed Dr. W. A. Herdman to the professorship of natural history, founded by Lord Derby in connection with University College. Dr. Herdman is a graduate of the University of Edinburgh. He took the degree of Bachelor of Science in 1879 in the department of Natural Science, and in the same year was intrusted by Sir Wyville Thomson with the preparation of the report on the collection of Tunicula obtained during the *Challenger* Expedition. The Council have also appointed Dr. J. Campbell Brown to the professorship of chemistry in the same college. Dr. Campbell Brown has for several years held the office of borough and county analyst, and of lecturer upon chemistry at the Royal Infirmary School of Medicine.

DR. ALEXANDER BAIN, lately Professor of Logic at Aberdeen, has been elected Lord Rector of that University.

SOCIETIES AND ACADEMIES

LONDON

Anthropological Institute, November 8.—Prof. W. H. Flower, F.R.S., vice-president, in the chair.—The following new Members were announced:—Miss Becker, Mrs. R. Crawshay, Mrs. Lloyd, Miss Mary Sheldon, Miss Eleanor E. Smith, Miss Wolfe, Prof. Acland, F.R.S., James Backhouse, William Bowman, F.R.S., Alfred T. Brett, M.D., Rev. H. Canham, John G. Garson, M.D., Hugh T. Hall, F.G.S., Capt. Hozier, W. J. Knowles, E. Llanfair Lewes, Alfred Lingard, M.B., G. D. Longstaff, M.D., William Parkin, H. Seebohm, F.L.S., Mark Stirrup, F.G.S., H. Stopes, F.G.S., Richard Thompson, Prof. E. Perceval Wright, F.L.S.; also Dr. Josef Majer of Cracow as a Corresponding Member.—Dr. J. G. Garson exhibited some improved forms of anthropometric instruments.—Mr. Everard

F. im Thurn read a paper on the animism of the Indians of British Guiana. After defining animism as belief in the existence of spirit in any form, the author stated that the animism of the Indians of Guiana, in common probably with that of many other American tribes, is not only of an exceedingly pure and rudimentary kind, but is much more primitive than has yet been recognised by students of religious evolution. The Indian belief is that each object and phenomenon of the visible world consists of body and spirit; and these countless dual beings differ from each other only in bodily form and in the degree of brute force or cunning which they possess, but are none of them distinguished by the possession of any sort of divine character. There is no belief, of genuine Indian origin, in gods or a God, in heaven or hell, or in reward or punishment after death; nor is any form of worship practised. The author also indicated how in this belief may be found the germs from which all the features of the higher religions have arisen by modification.

PARIS

Academy of Sciences, November 7.—M. Wurtz in the chair.—The following papers were read: On the limits of electrolysis, by M. Berthelot. In the electrolysis of sulphate of potash (as also of haloid salts), the smallest sum of energies capable of working the decomposition is far below that which would be required for the previous setting at liberty of the alkaline metal. It is equivalent to the separation of the acid and the base, plus either the separation of the oxygen and the metal at expense of the base, or the decomposition of the acidulated water.—On the combustions effected by bioxide of nitrogen, by M. Berthelot. The property of burning at expense of bioxide of nitrogen under influence of a flame or electric spark, depends mainly (the author shows) on the temperature developed. Of the mixtures tabulated, none that develop a temperature theoretically under 7000° are inflamed; while those developing a higher temperature burn or detonate.—Synthetic experiments in artificial reproduction of meteorites, by MM. Fouqué and Lévy. By igneous fusion they have obtained bodies closely resembling some oligosideric meteorites; one type containing felspathic products, and another not. The former contains anorthite associated with pyroxyene and enstatite (eukrite) or peridote (howardite); the latter peridote, enstatite, oxydulated iron, and a pyroxene exclusively magnesian.—Solution of two questions of maritime hydraulics, by M. Cialdi. One refers to the force governing the sand of banks and harbours; (Cialdi's theory that the undulatory motion is the prime force is now accepted, as against that which puts the littoral current first). The other refers to the method of construction of moles for harbours by the Romans; (they did not make these with apertures where there was exposure to the open sea).—On the comparison of the waters of the Isère and those of the Durance in their hydrographic and agronomic relations, by M. de Gasparin. He controverts some views of M. Dumont.—Report on a memoir of M. Leauté on teledynamic transmissions. The author's solution of the problem is pronounced complete, theoretically and practically.—On silica and silicates of lithine, by MM. Hautefeuille and Margottet. *Inter alia*, three new crystallised silicates of lithine have been obtained (by means of chloride of lithium in fusion), and it is proved that silica may take the form of quartz in presence of a fused chloride.—On the means to employ for destroying the winter-egg of phylloxera, by M. Mayet. He considers it best to operate where the vines have every year galls on the leaves, and to treat (with insecticide) only the wood of two or three years.—A work by M. du Bocage (Lisbon) on the "Ornithology of Angola" was presented.—Elements of Denning's comet (1881 *f*), by M. Schulhof.—On a general formula for development of the principal part of the perturbative function, by M. Baillaud.—On the reduction of Abelian integrals, by M. Picard.—On linear differential equations, the integrals of which verify relations of the form $F[\phi(x)] = \psi(x)F(x)$, by M. Appell.—On the integration of an equation with partial derivatives of the second order, by M. Teixeira.—Mode of transmission, in an isotropic solid (in equilibrium) of the pressure exerted on a very small part of its surface, by M. Boussinesq.—On the possibility of electric equilibrium, by M. Lévy.—On the product and the limit of operation of the transport of force by electricity, by M. Lévy.—Articulated systems, giving rectilinear motion or circular curvature, by Prince Gazarine.—Experimental method of determination of the ohm, by M. Lippmann.—Action of cold on the voltaic arc, by M. Tommasi. He used as rheophores, copper U-tubes (placed *vis-à-vis* horizontally), through which ran cold water. The luminous power is considerably weakened; the arc is very unstable; it does not ignite paper held 0·004m. above it; it is very mobile, and its form is like that of a drop of liquid in the spheroidal state; it is attracted and put out by a magnet; and there seemed to be more ozone than when the arc is not cooled. The flame was slightly green.—On an electric method for determining, with a needle, the position and depth of a projectile, or other metallic substance, in the human body, by Prof. Bell. A fine needle, connected by wire with a telephone, is inserted; and a metallic plate, similarly connected, is applied to the skin. A sound is heard when the ball is reached. A trembler may be introduced into the circuit giving a musical note in the telephone on contact of needle and ball; a battery may also be included.—New demonstration of Riemann's theorem, by M. Croullebois.—The direct-vision spectroscope with calcareous spar, by M. Zenger. He combines a single prism of spar of 75° refringent angle, with a fluid prism (sulphide of carbon, oil of cassia, or other liquid) of the same angle. The dispersion is very great. The red image of the protuberances can be obtained with great intensity, there being small loss by absorption and none by reflection.—On the function which expresses the gaseous state, by M. Gouilly.—On cuproso-cupric sulphite, by M. Etard.—On a hydrate of chromic bromide, by M. Varenne.—Action of hydracids on alkaline chromates, by M. Varenne.—Reply to M. Debray on dissociation of sulphydrates of ammonia, by MM. Engel and Moitessier.—On the vapour-tensions of carbamate of ammonia, by M. Isambert.—Modifications of composition of green fodder kept *en silo*, by M. Lechantier. Maize and trefoil lost a little of their azotised matter, but the loss of glucosides was much greater; the chief loss being now in the glucose and sugar group, now in the starch and cellulose. Fatty matter increased.—Artificial peridote produced in presence of steam, at ordinary pressure, by M. Meunier.—Action of hydriodic acid on chloriodide of propylene and on chloride of isopropyl, by M. Silva.—On the contagion of tuberculosis, by M. Toussaint. *Inter alia*, tuberculosis becomes more powerful and rapid in its action the oftener it is inoculated.—On the physiological action of codethyline, by M. Bochefontaine. This action seems to consist in an exaltation of the reflex properties of the grey substance of the bulbo-medullary nerve-centres.—Contribution to a study of Flagellata, by M. Kunstler. He has found an organism very like noctiluca, but living in fresh water.—Observations on rotators of the genus *Melicerta*, by M. Joliet.—On the vitality of germs of *Artemia salina* and *Blepharisma lateritia*, by M. Certes.—On the winter spores of *Peronospora viticola*, by M. Prillieux.—Discovery of gypsum in the strata of the superior Eocene formation of Peru, by M. Caraven-Cachin.—On the characters of speech in deaf-mutes taught to articulate, by M. Hément. He maintains that these persons have the accent of their country, indicating organic conformations similar to those of their parents. M. Blanchard disputed this.—On the spontaneous insensibility of the sensitive plant, by M. Musset. A sudden fall of temperature suspends spontaneous movements of the plant (as chloroform, &c., suspend provoked movements)

CONTENTS

ERRATUM.—Vol. xxiv. p. 509, in the letter of Prof. Alex. Agassiz, for *Polydonia* read *Polyclonia*.