reports of all the professors, lecturers, and heads of departments connected with natural science.

Prof. Thomson (Cavendish Professor of Physics) reports that during the Lent term ninety students attended the demonstrations, and there were ten persons doing original work in the laboratory. Lord Rayleigh states that during the last five years about 2500*l.* has been spent on the Cavendish Laboratory in addition to the University expenditure. This has come partly from fees, partly from the apparatus fund raised by subscription.

The Chemical Laboratory has been much over-crowded and improvements are scarcely possible until the new laboratory has been completed.

The register of the mineralogical collections is completed. The number of students increases; fifteen attended Mr. Solly's demonstrations in the Michaelmas term and nineteen in the Lent term.

The department of mechanism has continued to grow rapidly. During the year two new woorkrooms and a new foundry have been added and have met the most urgent requirements. Upwards of 1000*l.* worth of new machinery has been added at Prof. Stuart's expense during the last two years to meet immediate wants; and during that time the pupils have doubled in number. The lecture-rooms have become over-crowded, and new ones are much wanted. Prof. Stuart urges that the University should now purchase the machinery and apparatus used in teaching, which is his property. The undertaking is now wholly self-supporting, paying interest on the capital involved, and providing an adequate sinking fund.

The classes of practical morphology and elementary biology are now much better accommodated in the new rooms. One hundred Zeiss's microscopes have been purchased. The Balfour library has been enlarged, and proves of great value to students. Seven demonstrators have been fully occupied in the classes, in addition to two ladies who have superintended the women students. In the May Term, 1884, in which two years of students were combined, 206 men and 12 women went through the course of elementary biology. In the Lent term of 1885, 128 men and 7 women attended. In Elementary Morphology there were 68 students in last October term, and 87 in the recent Lent term.

Prof. Macalister has utilised the services of seven assistant Demonstrators, in addition to Mr. Hill, whose labour has been unremitting. Subjects for dissection have been secured from a wide area. Prof. Macalister has presented a series of models of the viscera of the body showing their proper relative positions, casts of frozen sections, 26 crania, and 160 specimens of bones showing peculiarities. No department of University work is so badly housed as the Department of Anatomy; but much good work is done in the limited space.

In the Museum of Comparative Anatomy and Zoology 72 additional species from Dr. Dohrn's collection have been re-mounted and displayed. An extensive collection of marine invertebrata from the New England coast has been forwarded from the National Museum at Washington, through the kind offices of Prof. Baird. The work of the Curator in Invertebrate Zoology has been principally expended upon the MacAndrew collection of shells. Mr. Cooke has published two extensive papers, and progressed with the rectification of the nomenclature and the catalogue.

A fine adult Echidna from New Guinea has been presented by Dr. Guillemard. Both skin and skeleton have been mounted. A complete skeleton of the red deer in a sub-fossil state has been procured from Burwell Fen by Mr. W. Stubbings, Assistant in the Museum; a complete skeleton of an African elephant, shot by Mr. W. Heape near Port Elizabeth, has been presented. Many other interesting acquisitions are named in the report.

Dr. H. Gadow, the Strickland Curator, has been forming a manuscript catalogue of the skins of birds in the Museum. An exhibited series of specimens is being placed systematically, with the important anatomical parts, nests and eggs, in an educational series. Twenty maps have been placed in the cases to illustrate the geographical distribution of birds. The University collection now consists of 9653 specimens of 3290 species. The Strickland collection, in addition, contains 600 specimens of 3125 species; and, with Mr. E. Newton's collection, there are in all 17,000 specimens, representing probably 4500 species.

Prof. Foster reports that the number of students of elementary physiology has risen from 77 in the Easter term, 1884, to 141 in the recent Lent term, exclusive of women students. Twenty-eight have attended advanced lectures also. Several important additions, such as a gas-engine, a centrifugal machine, recording and other apparatus, have been made to the Laboratory, by the aid of a gift of 500*l.* by an anonymous donor. The inadequacy of accommodation, both for practical work and for lecturing, is severely felt.

Prof. Ray has been successful in organising extended practical courses, as well as systematic lectures. The *post-mortem* examinations at Addenbrooke's Hospital have been placed under his superintendence. At present the only laboratory space available is obtained by encroaching on Dr. Foster's already overcrowded rooms.

Prof. Babington reports that the arrangement of the general Herbarium is now complete. The plants have been placed in orders and genera, according to Bentham and Hooker. The arrangement of species has not as yet been attempted. Mr. Potter and Mr. Gardiner have commenced the formation of a small Botanical Museum similar to that of Comparative Anatomy. Mr. Vines finds the new rooms very suitable both for class purposes and for research. Last term there were 29 advanced and 30 elementary students working in the laboratory.

The Geological Museum has acquired a fine collection of fossils from the Oolites of Dorset, chiefly by the liberality of Prof. Henry Sidgwick. Messrs. Roberts and Small brought useful additions from the Jura. Mr. Marr has added largely to the Cambrian and Silurian series. Mr. Keeping has collected and restored many specimens from Pliocene and Pleiostocene deposits. Mr. J. Robarts has worked most energetically as Prof. Hughes' assistant, in the museum, in teaching and collecting. Work is much hindered by the want of a lecture room and class-room.

Mr. Walter Gardiner, whose original work in vegetable histology is so well known, has been elected to a Fellowship at Clare College.

SOCIETIES AND ACADEMIES

London

Royal Society, May 6.—"On charging Secondary Batteries," by William Henry Preece, F.R.S.

Mr. Preece said he had for some months past been experimenting with secondary batteries with a view of getting an efficient, uniform, and constant source of current for electric lighting his house. The cells are of the Planté type, manufactured by the Elwell Parker Company of Wolverhampton. Each cell contains fourteen plates of plain sheet lead 17" × 11", which are suspended in well-insulated wood boxes filled with diluted sulphuric acid in the proportion of about 1 to 19. These plates are grouped in two groups of seven, each group being soldered to a lead strip, forming alternately the positive and negative poles of the cell. The plates of the respective poles are prevented from touching each other by ebonite grids or separators introduced by Mr. Charles Moseley to prevent short-circuiting through the buckling of the plates. Each plate offers a surface of 1·3 square feet, so that the total surface of lead of each group opposed to each other is 9·1 square feet; that is, 9·1 square feet of peroxidised lead is opposed to 9·1 square feet of spongy lead. Mr. Preece employs 24 of such cells. The charging current varies from 3 to 3½ amperes per square foot, while the current of discharge used in lighting his house varies from 1 to 1½ ampere per square foot. The total weight of each cell is 120 lbs. The plates are prepared by the Parker-Planté process before insertion in the cell, those forming the positive pole being well peroxidised, while those forming the negative pole are well coated with spongy lead. This process consists in immersing for a few hours the lead plates in a solution of nitric and sulphuric acids in the proportions—

Nitric acid	1
Sulphuric acid	2
Water	17

before fixing in the cells. This not only chemically cleans the lead surfaces, but it favours the formation of sulphate of lead in such a way as to be readily converted into lead peroxide and spongy lead on the passage of a strong current through the cells. The formation of the cells is thus expedited. They are thus, when put together, prepared at once to be charged. If they are not at once charged, local action sets in, and lead sulphate is injuriously formed.

A hydrometer, having a scale graduated from 1·050 to 1·150, is used to indicate the density of the liquid while the cells are being charged and discharged. Mr. Preece puts into his battery a charge of about 120 ampere-hours twice a week. Hourly measurements of E.M.F. current and density of liquid have enabled him to know the condition of his battery at any period of charge or discharge. These measurements have been plotted out into curves, the ordinates showing volts, amperes, and specific gravity, and the abscissæ hourly observations. When each magnitude reaches its constant, bubbles of gas are freely given forth and energy is being wasted. The variation of the electromotive force and current strength is clearly due to the counter-electromotive force of the cells, which becomes a maximum only when the plates are fully formed. The counter-electromotive force partakes of the character of a higher resistance opposing the charging current, and increasing the proportion of the current through the shunt of the dynamo. Hence the changes of eleetromotive force are more marked than those of the current. Indeed, the changes in the electromotive force, as given by the voltmeter, are sufficient alone to indicate the progress and completion of the charge. They are more reliable than the evolution of gas.

The electrical leakage of Mr. Preece's cells is obviated by standing each cell on three porcelain supports, having cups half filled with resin oil on Messrs. Johnson and Phillip's plan.

Mr. Preece gives the E.M.F. of the battery at its terminals as—

When charging	2·25 per cell
When idle...	2·05 ,,
When discharging	1·90 ,,

and the internal resistance per cell as—

When charging	·0060 ohm
When discharging	·0017 ,,

But the latter is said to vary very markedly within the strength of current of discharge. This is shown by the following experiment, made with 23 cells of a smaller type than those described above, which are used in the Post Office :—

Current of discharge in amperes	Internal resistence in ohms
4·39	0·7608
7·25	0·4607
15·84	0·2816
25·07	0·1969

Thinking that this remarkable diminution of internal resistance might be due to the evolution of heat, Mr. Preece measured the temperature with a delicate thermometer.

Normal temperature of cell 12½° C. current of discharge :—

5 amperes	No alteration of temperature perceived
10 ,, ...	An exceedingly slight change
16 ,, ...	About 12¾°
20 ,, ...	Barely 13°

The current in each case was kept on for twenty minutes, hence the diminution, Mr. Preece says, is not due to heat.

Since the internal resistance varies in this way Mr. Preece now always takes the internal resistance with the same current, viz., 10 amperes.

The author of this paper asserts that the capacity of these batteries certainly improves with age, and up to the present time he has seen no sign of decay or deterioration.

M. Planté informed him that, though in course of time the peroxidised plate becomes very brittle, it is impossible to peroxidise it completely through ; there always remains a metallic core to give it strength. Mr. Preece finds that this is so. Up to the present moment he has made no careful measurements of the efficiency of his battery. He puts in about 240, and takes out about 200 ampere-hours weekly, and does not observe any change or fall in the electromotive force. When the electromotive force of these cells falls, it falls rapidly, indeed almost suddenly. Occasionally one plate of a group becomes inactive from undue local action, or from bad connection (shown by the colour). This plate is removed and put in a "hospital" cell, where it is brought into order either by a greater density of current or by reversal.

Reversing has a great beneficial action on a cell ; it not only improves its capacity, but it removes any cause of irregular working. It is advisable to do this periodically. Mr. Preece has two extra cells, which enables him to have two cells always under reversal by means of the charging current. It takes from 1,000 to 1,200 ampere-hours to reverse a cell, so that at this time of year it takes a month or more to complete the operation, and it will take a year to reverse the whole battery. Sixteen cells have been reversed during the past twelve months.

Chemical Society, May 21.—Dr. Hugo Müller, F.R.S., President, in the chair.—Messrs. E. G. Amphlett and E. G. Hogg were formally admitted fellows of the Society.—The following papers were read :—A colorimetric method for determining small quantities of iron, by Andrew Thomson, M.A. —On some sulphur compounds of calcium, by V. H. Veley. —Spectroscopic observations on dissolved cobaltous chloride, by Dr. W. J. Russell, F.R.S. The characteristic absorption-spectrum given by cobaltous chloride after dissolution in such media as pure and dry potassium chloride, sodium chloride, calcium chloride, alcohol, glacial acetic acid and in chlorhydric acid, is seen also in an aqueous solution. Hydrated cobaltous chloride gives an entirely different spectrum. If a somewhat faint indication of the spectrum of the chloride be taken as a standard, it is found possible to determine with tolerable accuracy when the amount of anhydrous chloride in solutions of varying strength and temperature is identical with that in the standard solution. A solution containing 4·18 grams of cobalt chloride in 10 c.c. of water at 0° C., when observed through a thickness of 7 mm., forms a convenient standard. If to 10 cc. of such a solution 2·9 cc. of water be added, then on raising the temperature to 33° an amount of anhydrous chloride is re-formed identical with that existing in the standard solution at 0° : this rise of temperature exactly counteracts the effect of adding 2·9 cc. of water. A series of determinations were made in this manner, and it was found that the number of c.c. of water added to the 10 cc. of standard being as given in the upper line, the temperature at which the spectrum appeared was as given in the lower line in the table :—

2·1	2·9	4·3	7·4	8·9
26°	33°	43°	55°	63°
10·3	12·1	15·0	16·0	
70°	75°	87°	95°	

Again, taking the most dilute solution, in which 16 cc. of water had been added to 10 c.c. of the standard solution, it was found that the same change was effected—*i.e.* that the chloride spectrum could be developed in it, by the addition to the solution of either 0·864 gram of hydrogen chloride gas, or 5·26 of sulphuric acid, or 2·47 of calcium chloride ; but that the addition of sodium chloride would not develop the bands, although on heating the solution after saturating it with this salt a temperature of 34·5° was sufficient, instead of 95°, to develop the bands. Zinc chloride was found to act in a different manner. Notwithstanding its power of combining with water, on adding it to the cobalt solution no banded spectrum shows itself, and even when added to a solution in which the spectrum is visible it causes its disappearance. The explanation is that it must have combined with cobalt chloride, forming a new and stable compound. On evaporating the solution this was found to be the case, and a new salt, a compound of cobalt and zinc, crystallised out. Cobalt bromide, both as a solid and in solution, gives a spectrum very similar to that given by the chloride, but the corresponding bands are nearer the red end of the spectrum. The salt is far more soluble in water than the chloride, and has a stronger affinity for water, as is shown by the much higher temperature required to neutralise the power with which water combines with it. The following determinations similar to those made with the chloride show the increase of temperature necessary to counteract the combining power of giving quantities of water with cobalt bromide :—

Standard 10 c.c.	+ Water	Temp. 0° C.
10 ,,	+ 3·0	51
10 ,,	+ 4·3	57
10 ,,	+ 7·4	91

—The sulphides of titanium, by Prof. T. E. Thorpe, F.R.S.—Note on the formation of titanous chloride, by Prof. T. E. Thorpe, F.R.S.

Zoological Society, June 2.—Prof. W. H. Flower, V.P.R.S., President in the chair. Mr. Sclater exhibited drawings of and made remarks upon the specimens of various species of Coly living in the Society's Collection. Mr. Beddard, on behalf of himself and Mr. Treves, read a paper on the anatomy of the Sondaic Rhinoceros (*Rhinoceros sondaicus*) which had died in the Society's Gardens in January last. A communica-was read from Dr. Julius von Haast, F.R.S., C.M.Z.S., on *Megalapteryx hectori*, an extinct gigantic representative of the *Apteryx*, of which the remains had recently been discovered in New Zealand. Dr. Guillemard, F.Z.S., read the fourth and fifth parts of his report on the collection of birds formed during the voyage of the yacht *Marchesa*. The present communications treated of the birds collected at Celebes and on the Molucca Islands. Mr. J. Bland Sutton, F.Z.S., read a paper on the development and morphology of the human sphenoid bone, in which he attempted to show that the basi-temporals of the bird are not homologous with the *lingulæ sphenoidales*, but with the so-called pterygoid bones of the crocodile, and that the human *lingulæ* are homologous with the sphenotic of the bird.—Mr. Edgar A. Smith, F.Z.S., read a report on a collection of shells, chiefly land and fresh water, obtained by Mr. H. B. Guppy, R.N., Surgeon H.M.S. *Lark*, during a recent visit to Solomon Islands.

PARIS

Academy of Sciences, June 2.—M. Bouley, President, in the chair.—Human locomotion: stereoscopic images of the trajectories described in space by a point of the body while walking, running, or otherwise moving (two illustrations), by M. Marey.—Remarks on the "Registres d'expérience," a collection of sixty-nine volumes in MSS. by Henry Victor Regnault, dealing with a great variety of questions in chemistry, physics, thermodynamics, hygrometry, &c., presented to the Academy by M. Reiset.—On the treatment of nervo-pulmonary asthma and cardiac asthma by inhaling certain vapours all containing a special substance known as pyridine (C_5H_5N), by M. Germain Sée.—Account of a species of anæsthesia unattended by sleep, and with the perfect preservation of the intellect, the voluntary movements, the senses and sensibility to the touch, by M. Brown-Séquard. From numerous experiments made on the dog, monkey, and man, the author shows that, under the influence of an irritation set up in the laryngeal mucous membrane, sensibility to pain may disappear or be diminished for many hours without the least disturbance of the mental faculties, the senses, or the voluntary movements in man and animals.—Remarks on M. Lucien Biart's work on "The Aztecs, their History, Manners, and Customs," presented to the Academy by M. de Quatrefages. It was stated by the Secretary that this volume forms one of a series entitled "The Ethnological Library," to be edited by MM. de Quatrefages and Hamy, and to comprise, besides a general history of the races of mankind, a number of monographs devoted to the detailed study of the various branches of the human family.—Observations of the solar spots, faculæ, and protuberances made at the Observatory of the Roman College during the first quarter of the year 1885, by M. Tacchini. Compared with the corresponding period of the previous year the spots appear to have been more numerous, but of relatively smaller size, while little difference was observed in the recurrence of the faculæ. The same peculiarity was again noted of a maximum of faculæ coinciding with a minimum of spots.—Remarks on the physical appearances of the planet Uranus in the months of March, April, and May of the present year, by Père Lamey.—On a method of measuring the magnetic rotatory force of solid, fluid, and gaseous bodies in absolute unities, by M. Henri Becquerel. The numbers determined in various ways by other observers correspond very closely with that of the author as shown by the subjoined table:—

Gordon	0′·0433
Lord Rayleigh	0′·0430
L. Arons	0′·0439
Becquerel	0′·04341

—An optical method for the absolute measurement of short distances, by M. Macé de Lépinay.—On the spectrum of bodies in "radiant matter," in which many substances emit a phosphorescent light, by M. W. Crookes.—On the velocity with which prismatic sulphur is transformed to octahedric sulphur, by M. D. Gernez.—On the presence of sulphurous acid in the atmosphere of towns, by M. G. Witz. From the analysis of the ozone made at Montsouris and elsewhere the author finds that sulphurous acid exists in the air of towns where coal is consumed, its presence causing a considerable diminution of atmospheric ozone, accompanied by the formation of sulphuric acid; further, that by the slow but continuous action of sulphurous acid, and under the influence of the frequent changes in the degree of humidity, the peroxide of red lead used in colouring certain placards, is destroyed and sulphated. At the same time the protoxide of lead thus liberated is transformed to an insoluble sulphite. This salt being easily analysed, a new and certain means is thus obtained for determining the condition of the atmosphere in large cities.—The arsenic present in the soil of cemeteries considered from the toxicological standpoint, by MM. Schlagdenhauffen and Garnier.—Classification and anatomy of the Tectibranchea, a family of mollusks abounding in the Bay of Marseilles, by M. A. Vayssière. Of this family twenty-two species are grouped under the sub-order Cephalaspidea, six under Anaspidea, and nine under Notaspidea. All belong to the order of Opistobranchea, the exceptions indicated by Hering being based on erroneous data.—On the spores and reproductive processes in *Sphærocarpus terrestris*, *Targionia hypophylla*, and other plants of the same order, by M. Leclerc du Sablon.—On the problem of repetitions and symmetry in the mineral kingdom (one illustration), by M. P. Curie.—On an apparatus adapted for the comparative study of opaque minerals, which cannot be easily examined under the microscope, by M. A. Inostrauzeff.—On a unique specimen of hydrous silex belonging to the quaternary formation of the Loing Valley, department of Seine-et-Marne, by M. Stan. Meunier.—On the upper Miocene formations of the Cerdagne district, a lacustrine basin on the southern slope of the Eastern Pyrenees, by MM. L. Rérolle and Ch. Depéret.—Description of a self-registering calorimeter adapted for recording the temperature of the human body, three illustrations, by M. A. d'Arsonval.—On electric alcoholic fermentation, by M. Em. Bourquelot. From his experiments the author finds that this fermentation, as originally determined by Dubrunfant, may be modified by the temperature, by dilution, and by the alcohol formed during the fermentation itself.—On the uniformity of the process of spermatogenesis in the order of mammals, by M. Laulanié.—Action of cocaïne on the invertebrate animals, by M. Richard.—A contribution to the study of antiseptics: action of the antiseptics on the higher organisms, iodide and chloride of mercury, by MM. A. Mairet, Pilatte, and Combemal.—Influence of the lunar declinations on the displacement of the atmospheric currents, a reply to M. de Parville, by M. A. Poincaré.

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