THE new number of the *Deutsche Geographische Blätter* continues the interesting account by Dr. Arthur Krause of the researches of himself and his brother in the Chukchi peninsula and Alaska; there is, besides, a separate catalogue of the ethnological collections, and a short paper by Dr. Kuntz of the plants collected. The number contains a useful paper on South New Guinea from the observations of D'Albertis, Moresby, Macfarlane, and others. In the *Zeitschrift* of the Berlin Geographical Society are several papers of interest. Major Lovemann gives the leading results of the new survey of Russia, which is being carried out; Dr. Hann examines the data of Dr. Rholl's for the altitudes in the oasis of Kufra; Herr G. A. Krause gives some account of the Saharan town of Chat, which is followed by an abstract of the census of Bulgaria; and a preliminary account of Prof. Haussnecht's Oriental travels. Dr. W. Götz contributes a valuable paper on a subject which is taking great prominence in Germany—commercial Geography, while Dr. Reiss contributes an analysis of recent researches in some tributaries of the Amazon. In the December number of the *Deutsche Rundschau* for geography and statistics (Vienna, Hartleben), we have the conclusion of Baron von Lehnest's paper on his Land Formations in the Lunda region, the first of a series of pictures from East Africa, by Karl Berghoff; a short paper on the distribution of islands, and a biography of Mr. A. R. Wallace, with a good portrait. The number contains many other short papers and notes.

THE new quarterly number of the *Bulletin* of the Paris Geographical Society reports at length several important papers: Commander Gallieni gives an account of his mission to the Upper Niger and Segou, with a map and several interesting illustrations, some of which show curious formations, suggesting the buttes of some of the North American rivers. M. A. d'Abbadie has a useful paper on the spelling of foreign words; M. Jules Garnier an account of his excursion to the country of the Don Cossacks; M. M. Biollay, a paper on Finland; M. Dutreuil de Rhins, on Père Creuse's journeys to Southern China; M. Romanet du Caillaud, notes on the Ting-King; and M. Theodore Ber the first part of an elaborate paper on the Titicacon valley of Tiahuanaco.

THE December number of *Petermann's Mittheilungen* contains some supplementary information by Dr. Junker on his Welle explorations, in addition to the letters already referred to. Herr R. A. Hehl contributes a geographico-geological sketch of the Brazilian coast-lands between 20° and 23° S. lat. Along with the chief results of the Hungarian Census is an excellent series of statistical maps showing the various aspects of the figures. Signor P. Gialussi contributes an interesting paper on the changes which have resulted from recent geological action in an Istrian valley, while Herr Hehl gives a detailed account of the German colonies in South Brazil.

THE Carpathian Club, which was formed at Hermannstadt (Transylvania) after the pattern of the Alpine Club in 1880, having for its object the study and minute investigation of the mountains of the country, as well as the endeavour to direct the attention of tourists to that region, already numbers no less than 1200 members. It is divided into nine sections. Quite recently the second year-book of the Club appeared, which contains a number of valuable scientific papers, as well as descriptions of tours in the Carpathian Mountains.

SCHWEIGER-LERCHENFELD'S interesting work "Die Adria," has just been completed in twenty-five parts, and published by Hertleben of Vienna. The fact that the eastern coasts of the Adriatic are so little known by the general traveller, renders the book valuable. In an appendix the commerce of the Adriatic, as well as the fisheries, are spoken of, and an excellent map is added to the work.

THE ROYAL SOCIETY[1]

II.

THE subject of the Circumpolar Observations mentioned in my address last year, was since that time brought more formally before our Government by that of Russia. At the request of the Treasury, the President and Council, after consultation with the Meteorological Office, advised as follows:—

"The object of the undertaking is to throw light on the influence of the great inaccessible region surrounding the pole on the meteorology and magnetism of the earth. With this view it is proposed to take simultaneous observations at a chain of circumpolar stations for a full year at least.

"A chain of not less than eight stations will be occupied independently of any co-operation by this country. This chain, however, leaves a gap of 90° in longitude in the northern part of America, the centre of which would be advantageously occupied by a station in the Dominion of Canada. The value of the results will be greatly enhanced by the addition of this link to the chain. Independently of this, such a station would be of great value as being of a continental character, in contrast with the other stations, which are in close proximity to the coast. By choosing for the station one of the forts of the Hudson's Bay Company, no great outlay need be involved in its occupation."

The point first proposed was Fort Good Hope, near the mouth of the Mackenzie River; but it was found too late to erect the necessary huts and to transport the party and its provisions there during the present season. Fort Simpson, on the same river, was next suggested. Guided by considerations of facilities of access and sustentation, the Committee came to the conclusion that either Fort Rae or Fort Providence, on Great Slave Lake, is to be preferred to Fort Simpson, with which the former forts nearly agree in latitude; and accordingly the President and Council recommended one of these.

"In framing an estimate, it was thought well to assume that the expedition might last a year and eight months, so as to allow a sufficient margin for travelling to and from the station, and for possible detention in waiting for the Hudson's Bay Company's brigade. It is calculated that the cost might be safely estimated at 3,000*l.*, which would include salaries of one officer and three men; journey of the party from England and back, including reasonable baggage; rations, allowances, and all other expenses."

To this communication the following reply was received:—

"My Lords have to thank you, and the Committee whom the Council appointed to advise them in the matter, for the valuable information contained in Dr. Michael Foster's letter of the 16th ultimo. Acting upon that information and upon the advice of the Royal Society, Her Majesty's Government have decided that this is an object on which public money may properly be employed and they are prepared to ask Parliament to provide a total sum not exceeding 2,500*l.* for the purpose. My Lords understand that there is good reason to hope that the balance required to make up the total estimated cost of 3,000*l.* will be forthcoming from other sources.

"I am to ask whether the Royal Society would be so good as to take charge of the Expedition under similar conditions to those under which the Transit of Venus Expedition is being conducted; accounts of the expenditure chargeable to the Parliamentary grant being rendered to this Department. The choice of stations, the appointment of observers, and the methods of procedure would be left entirely to the Society, subject to the condition that the total amount chargeable on public funds does not exceed 2,500*l.* My Lords understand that it is expected that not more than 1,500*l.* of this amount would come in course of payment during the present year, and they will present estimates to Parliament for 1,500*l.* and 1,000*l.* at the proper times."

The Canadian Government has since promised a contribution of 4,000 dollars towards the expenses of the expedition.

A committee, consisting of the President, Dr. Rae, Sir George Richards, Mr. R. H. Scott, and Prof. Stokes, was accordingly appointed to superintend the expedition, which, comprising Captain H. P. Dawson, R.A., in command, Sergeants J. English and F. Cookesley as observers, and W. Wedenby, as artificer, left England on May 11, for Quebec, was heard of at Fort Carlton on 27th June, and was about to proceed the next day for Green Lake, on the way to Portage Loche. It was still not quite certain whether it might not be necessary to push on to Fort Simpson, on account of insufficient accommodation, as well as lack of time and materials for building at Fort Rae.

Two parts of *Mittheilungen der Internationalen Polar Commission* have been published, containing full particulars and instructions relating to the whole circumpolar scheme.

The geological, mineralogical, and botanical collections, formerly in the Museum in Bloomsbury, have been properly arranged in the new building in Cromwell Road, and are on exhibition in their respective galleries. A commencement has

[1] Address of the President, William Spottiswoode, D.C.L., LL.D., delivered at the Anniversary Meeting, November 30, 1882. Continued from p. 137.

been made in the transfer of the zoological collections. The osteological specimens, hitherto packed out of sight in an obscure vault in the basement of the old Museum, have been safely removed to the new building, and are now exhibited in a large and well lighted gallery. The collection of shells, which occupied the floor space of the long eastern gallery in Bloomsbury, is now suitably exhibited at South Kensington. Some of the corals have been removed, in order to clear the way for the removal of other specimens; and many of the stuffed quadrupeds and mammalian skins which had been stowed away in the old Museum basement are now in the new repository.

The removal of the general collection of mammalia, of the birds, of the entomological specimens, and those of British zoology, will not be undertaken until after the coming winter. The fittings for the galleries prepared for them are not fully completed. The detached building designed for the specimens preserved in spirit cannot be made ready for their reception before the opening of next spring. It is, however, expected that the whole of the zoological collections will have been transferred to the new Museum by the end of June, 1883.

The subject of Technical Education has continued to be prominently under the notice of the country during the past year. The appointment of a Royal Commission on Technical Instruction, to which I have previously referred, has done much towards awakening the interest of manufacturers, and exciting curiosity in regard to the efforts that are being made abroad to improve the education of artizans. The Commissioners issued in March last their first Report, which dealt exclusively with primary education and apprenticeship schools. The Commissioners expressed an opinion adverse to the establishment of apprenticeship schools in this country; and in this view they are supported by nearly all our large manufacturers, and by the action of the City and Guilds of London Institute for the Advancement of Technical Education. At the request of the Executive Committee, I myself gave evidence before the Commission, explaining generally the objects of the City Guilds and Institute, and describing the progress already made towards their attainment. As a member of the Executive Committee of this Institute, I have watched its progress with interest, and have observed with satisfaction that its scheme of Technical Instruction is being gradually matured. The general Examinations in Technology undertaken by this Institute, were held in May last at 147 centres in 37 subjects. Of the 1,972 candidates who presented themselves for examination, 235 passed in Honours, and 987 in the Ordinary Grade. In 1881, 895 candidates passed, showing an increase of 307. The Examinations were held this year for the first time under the revised Regulations, which appear to have worked very satisfactorily. Two points deserve notice with respect to these Examinations. In the first place, the Institute experiences very great difficulty in obtaining properly qualified teachers. The applicants are either practical men working in the factory, or at their trade with no scientific knowledge whatever, or men possessing a very elementary science knowledge, and little or no practical acquaintance with the details of the industry, the technology of which they profess to understand. In order to indicate the kind of qualifications required in an ordinary technical teacher, the Institute has inserted in its programme a paragraph to the effect that persons who are engaged in teaching science under the Science and Art Department, and who at the same time have acquired a practical knowledge of their subject in the factory or workshop, may be registered as teachers of the Institute. The second point calling for consideration is the fact referred to in the Report of the Directors,—that of the 1,220 candidates who, this year, passed the examinations, most of whom are workmen or foremen in various branches of industry, not more than 450 are qualified to receive the full Technological Certificate, by having previously passed the examinations of the Science and Art Department in certain science subjects. This fact clearly indicates that widely beneficial as has been the action of this Department of State, there is still a large field for its influence among the population who are engaged in manufacturing processes, and desire to receive Technical Instruction.

One of the most satisfactory results of the Examinations of the City and Guilds of London Institute is the impulse they have given to the establishment, in different parts of the country, of properly equipped technical schools. At Manchester, Preston, Dewsbury, Hawick, Sheffield, Leicester, and other places, efforts have been made during this year towards organising schools for the technical instruction of artizans and others in the application of science and art to specific industries. At Nottingham, a grant of 500*l.* has been made by the Institute, to be followed by an annual contribution for a limited period of 300*l.*, towards the establishment of technical classes in connection with the University College; and at Manchester a subscription of 200*l.* a year has been promised to assist the funds now being raised for the conversion of the Mechanics' Institution into a Technical School. The attention of the Council has been greatly occupied of late with arrangements for the opening of the Finsbury College. Classes in Electrical Engineering and in Technical Chemistry, have been carried on for nearly three years in temporary rooms belonging to the Cowper Street Schools. The attendance at these classes has been eminently satisfactory, much more so than could have been anticipated. During the past session 960 class tickets were sold at fees varying from 5*s.* to 12*s.* The staff of the College has recently been doubled by the appointment of a Professor of Mechanical Engineering, and a Head Master to the new Department of Applied Art, the establishment of which, as I stated last year, was then under the consideration of the Committee. In January next, it is anticipated that the new building in Tabernacle Row, which is already nearly completed, will be opened for the reception of students. The programme of instruction, prepared by the Director and the Professors of the College, has been for some time under the consideration of the Committee, and it is hoped that in the instruction given in this College will be found the realization of a very important part of the Institute's Scheme of Technical Education.

Grants to the Technical Science Classes at University College and King's College, London, to the Horological Institute, to the School of Art Wood Carving, and other institutions, have been continued during the past year.

The Technical Art School in Kennington Park Road, established and maintained by the Institute, has been satisfactorily attended; and a proposition is to be brought before the Committee for supplementing the teaching of this school by technical science classes, with a view of establishing in the south of London a Technical College for Artizans, similar to the one about to be opened in Finsbury.

The building of the Central Institution or Technical High School in Exhibition Road, the foundation stone of which was laid by H.R.H. the Prince of Wales, President of the Institnte, in July, 1882, is rapidly advancing and promises to be completed within a year. It is not expected, however, that this school will be ready for the reception of the students before the commencement of the session 1884-5. Meanwhile, the Council and Committee are fully occupied with the development of other parts of their scheme.

In forwarding the Report of the Meteorological Council to the Treasury in December last, the President and Council took occasion to remind their Lordships that the arrangement for the organisation of the Meteorological Office generally, in May, 1877, would terminate with the then financial year. The Treasury, in reply, asked the advice of the Royal Society. After consultation with the Meteorological Council on various points connected with the subject, the President and Council reported fully to the Treasury, and concluded with the following general recommendation: "The President and Council beg leave to express a hope that the constitution of the Meteorological Council may remain unchanged, and that the same gentlemen who have hitherto performed its duties and administered its funds with such intelligence and judgment may be disposed to continue their labours." To this recommendation the Treasury cordially assented; deciding at the same time that no period should be fixed to the Meteorological Council for their tenure of office, but that it might be terminated by either party at any time on twelve months' notice.

The Meteorological Office has completed during the past year a series of charts of sea-surface temperature, for the three great oceans of the globe, and for the representative months of February, May, August and November. The work, which is now in the course of publication, will consist of twelve large charts, for the Indian, Atlantic, and Pacific Oceans respectively; and of four on a reduced scale, showing, for the four months, the isothermal lines of sea-surface temperature over the entire globe. In the preparation of these charts, all the observations existing in the Log Books of the Meteorological Office, and in the Remark Books of the ships of Her Majesty's Navy, have been employed, as well as the information which has been already rendered accessible in scientific memoirs, and in the narratives of the great scientific voyages. The isotherms agree

substantially with those which have been already given for the months of February and August, in the wind and current charts published by the Hydrographic Department of the Admiralty; but as the present series is founded on a much larger number of observations than have ever before been available for a similar purpose, it may fairly be regarded as a valuable contribution to a not unimportant part of terrestrial physics. Between the limits of 50° north and 50° south latitude, the mean annual surface temperature, so far as it can be deduced from the data now available, appears to be 74°·9 F. for the Indian, 69°·5 F. for the Atlantic, and 68°·6 F. for the Pacific Ocean. The North Atlantic is 4°·6 F. warmer than the South Atlantic Ocean; the corresponding difference in the case of the Pacific Ocean is only 1°·8 F.

Among other contributions to Ocean Meteorology, which the past year has produced, I may mention (1) the Physical Charts of the Atlantic Ocean, published by the Deutsche Seewarte, at Hamburg; (2) the second volume of the narrative of the voyage of H.M.S. *Challenger*, containing the magnetical and meteorological observations; and (3) a report by Captain Toynbee, F.R.A.S., on the Gales of the Ocean District adjacent to the Cape of Good Hope, which completes the discussion by the Meteorological Council of the meteorology of that tempestuous part of the sea.

The meteorology of our own country has been actively studied during the year. The Scottish Meteorological Society have given in their Journal a series of monthly pressure charts for the British Isles, together with a revised edition of the temperature charts already published by them in 1871. The charts now embody the results of observations extending over a period of twenty-four years; the revised edition, as well as the original publication, are due to the indefatigable activity of Mr. Alexander Buchan, F.R.S.E., the Secretary of the Scottish Meteorological Society. An atlas of convenient size, intended for the use of observers in the United Kingdom, and conveying similar information derived from data partly different, and quite independently discussed, has been already prepared by the Meteorological Office, and will immediately appear.

It is a fact now universally recognised that the greater part of the changes of weather which are experienced in the British Isles are occasioned by travelling areas of excessive or defective atmospherie pressure, which arrive at our shores from the Atlantic Ocean. The importance of a systematic study of the weather of the North Atlantic being thus indicated, the Meteorological Council have resolved to undertake the preparation of synoptic weather charts for the thirteen months beginning 1st August, 1882, and ending 31st August, 1883, and have issued a special appeal to the British shipping interest for active co-operation during that period. It is satisfactory to know that this appeal has not been fruitless, and that there is every prospect that the number of observations available for the discussion will exceed 200 per day.

This is, perhaps, the proper place to make mention of some results having an important bearing on meteorology, obtained by Prof. Tyndall in the course of a larger research on the action of radiant heat on gases.

By methods which he has applied to gases and vapours generally, Tyndall has established anew the action of aqueous vapour upon radiant heat, and the sensibly perfect diathermancy of dry atmospheric air. The phenomena of solar and terrestrial radiation are profoundly modified by the presence of aqueous vapour in the earth's atmosphere, the temperature of our planet being thereby rendered very different from what it would otherwise be.

The celebrated experiments of Patrick Wilson, wherein were observed a rapidity of radiation and a refrigeration of the earth's surface previously unknown, are explained by the fact that when they were made, the amount of aqueous vapour in the air was infinitesimal, the unhindered outflow of heat towards space beng correspondingly great. The sagacious observation of Six and Wells, that the difference between the surface temperature and that of the air a few feet above the surface, on equally serene nights, is greatest in cold weather, is explained by the fact that, when the temperature is low, the agent which arrests the surface radiation is diminished in quantity. Wells, moreover, found that the heaviest dews were deposited on nights when the difference between air temperature and surface temperature was small; while the greatest difference between the two temperatures was observed on nights when the deposition of dew was scanty. The explanation offered by Tyndall is this:—copious dew indicates abundant vapour; and abundant vapour, by arresting the terrestrial rays, prevents the refrigeration observed in drier air. Strachey's able discussion of observations made at Madras, point distinctly to the action of aqueous vapour on the radiation both of the sun and of the earth; while the experiments of Leslie, Hennessey, Hill, and other distinguished men, which were long considered enigmatical, are readily explained by a reference to the varying quantities of vapour with which the atmosphere is charged, on days of equal optical transparency. The interesting observations of Desains and Branley, made simultaneously on the Rigi and at Lucerne, are well worthy of mention here. The difference of level between the two stations is 4,756 feet, and within this stratum 17·1 per cent. of solar heat was proved to be absorbed. This absorption being due to aqueous vapour, is tantamount to the transmission of the sun's rays through a layer of water of a definite thickness. A sifting of the rays would be the consequence, and on *a priori* grounds we should infer that the percentage transmission through water at Lucerne must be greater than on the summit of the Rigi. This was the exact result established experimentally by Desains and Branley. H. Wild, the distinguished Imperial Astronomer of St. Petersburg, basing his statement on experiments made by himself according to Tyndall's method, has expressed the opinion "that meteorologists may, without hesitation, accept this new fact in their endeavours to explain phenomena which hitherto have remained more or less enigmatical." The correctness of this statement is illustrated by the foregoing examples, to which, if necessary, many more might be added.

At the recommendation of the Committee on Solar Physics of the Science and Art Department, a grant of 350*l.* was made from the Society's Donation Fund to Captain Abney and Mr. Lockyer in aid of their proposed observations of the total eclipse of the sun at Thebes in May last. Unfortunately the state of Captain Abney's health precluded his taking part in the expedition; but Dr. Schuster generously undertook the conduct of his observations, and, notwithstanding the short time remaining for preparation, he carried them out in the most satisfactory manner.

Three photographs of the corona itself were obtained during the eclipse. They show that the corona had the characteristic features observed during the time of the maxima of sun-spots. The long streamers in the plane of the ecliptic seen during sun-spot minima were absent, and the corona showed much disturbance. A bright comet appeared in all the photographs at a distance slightly less than a solar diameter.

A complete photograph of the spectrum of the prominences and the corona was for the first time obtained. The prominences give a spectrum in which the lines of calcium bear a conspicuous part by their intensity. The ultra-violet hydrogen lines, photographed in star spectra by Dr. Huggins, were seen, as well as a number of unknown lines.

The corona gives a very complicated spectrum. Close to the limb of the sun the spectrum was so nearly continuous and so strong as to hide any lines which might have been present. Further away the continuous spectrum fades off, the solar group G appears as an absorption line, and a large number of coronal lines hitherto unobserved appear in the ultra-violet.

In addition to these photographs one was obtained in a camera, in front of whose lens a prism was placed without a collimator. This photograph allows us to study the spectra of different prominences. As the picture was produced on one of Captain Abney's infra-red plates, all the tints of the prominences ranging from the ultra-red to the ultra-violet made their impressions, and some interesting differences in the spectra of different prominences can be noticed.

But, beside taking part in this expedition, Mr. Lockyer has continued with unwearied perseverance his observations on the spectra of solar prominences and spots, and has recently combined with these the results obtained by him during the late eclipse. During this eclipse he made naked eye observations, which he considers to be of a crucial character between the two rival hypotheses regarding the nature of the sun's atmosphere. The results of this investigation have in his opinion considerably strengthened the views which he first put forward in 1873 on the constitution of the solar atmosphere. A statement of these views will be found in a paper by him recently read before the Society.

In the present state of the questions there raised, it must I think be admitted that, after giving all due weight to the facts and reasonings adduced by Mr. Lockyer, additional and varied observations are greatly to be desired; and that no opportunity

reasonably available, for adding to our knowledge of the subject, should be neglected. And, therefore, without committing myself or the Society to the support of any particular proposal or expedition, I think it may be fairly claimed as a *primâ facie* duty on the part of the present generation to obtain as many faithful records of the various phenomena occurring during solar eclipses as possible.

From a discussion of the meridian observations of Mars made during the favourable opposition of 1877, at Washington, Leiden, Melbourne, Sydney, and the Cape, Prof. Eastman has deduced the value 8″·953 for the solar parallax—a value which, though considerably larger than any of those found by other methods, agrees closely with that obtained by Mr. Downing, in 1879, from the meridian observations of Mars at Leiden and Melbourne, as well as with the values found from similar observations in 1862. In this investigation, Prof. Eastman rejects the observations at Cambridge, United States, as they were made in a slightly different manner, and gives (in combination with Melbourne) a very large value for the solar parallax, viz., 9″·138.

The detailed account of the British Observations of the Transit of Venus, 1874, was published at the beginning of the year, and the observations of the transit made at colonial observatories have been recently printed in the Memoirs of the Royal Astronomical Society.

The Transit of Mercury last November was well observed in Australia and other places, and the results are of special interest in connection with the late Transit of Venus. The discordances in the times of internal contact recorded by different observers seem to show that such observations are subject to much uncertainty.

An important memoir on astronomical refraction has been lately published by M. Radau, who, after a discussion and comparison of previous theories, gives formulæ and tables for refraction, in which allowance may be made for difference in the rate of decrease of temperature with the height above the earth's surface at different seasons of the year. M. Radau also discusses the case in which the surfaces of equal temperature in the atmosphere are inclined to the earth's surface.

A new map of the solar spectrum, containing a much larger number of lines than are shown in Angström's classical normal spectrum, has been published by Prof. Vogel in the publications of the new Astrophysical Observatory at Potsdam. In this work Prof. Vogel has bestowed great care on estimates of the breadth and intensity of each line. In the same volumes are given the results of Prof. Spörer's sun-spot observations at Auclam from 1871 to 1879, in continuation of those for the years 1861 to 1870, previously published. From a comparison of the rotation-angles for 78 spots with the formula, Prof. Spörer finds that the larger deviations are always towards the west, indicating that a descending current has brought down with it the larger velocity of the higher regions of the sun's atmosphere. The law previously deduced by Prof. Spörer, that, about the time of minimum, spots commence to break out in high latitudes, and that the zone of disturbance gradually approaches the equator till at the minimum it coincides with it and dies away, to be replaced by a new zone in high latitudes, is confirmed by the recently published Auclam results, comprising (with Carrington's series) two complete spot-cycles.

In astronomical photography an important advance has been made by the successful application of the new processes to the nebulæ as well as to the comets. Prof. Henry Draper and Mr. Common have obtained photographs of the great nebula in Orion, showing considerable detail, and Mr. Huggins and Prof. Henry Draper have succeeded in photographing its spectrum. Mr. Huggins finds in his photograph a very strong bright line in the ultra-violet at wave-length 3730, in addition to the four nebular lines previously discovered by him in the visible portion. Prof. H. Draper's photographs do not show this bright line, though they have faint traces of other lines in the violet, and he thinks that this may be due either to the circumstance that he had placed himself on a different part of the nebula or to his use of a refractor with glass prism, while Mr. Huggins used a reflector and Iceland spar prism. The most striking feature of Prof. Draper's photographs is perhaps the discovery of two condensed portions of the nebula (just preceding the Trapezium) which give a continuous spectrum.

Prof. Schiaparelli has recently called attention to a peculiar feature on the planet Mars. In 1877 he remarked a number of narrow dark lines, which he called "canals," connecting the dark spots or so-called "seas" of the southern and northern hemispheres. He now finds that these lines are each doubled, so that according to his view the equatorial regions of Mars are covered by a network of pairs of parallel straight lines. It is to be remarked that though the appearance of Mars as depicted by Prof. Schiaparelli differs greatly from previous representations, indications of these double "canals" are to be found in the sketches of other observers.

The two bright comets of this year possess more than usual interest. The bright comet discovered at Boston by Wells, on March 18th, was the first comet since the spectroscope was applied to these objects, which presented a spectrum unlike the hydrocarbon type common to all other comets which appeared since 1864. The eye observations, as well as its photographic spectrum (taken by Mr. Huggins), showed an absence of the hydrocarbon spectrum, which was replaced by a brilliant continuous spectrum and bright lines, including those of sodium.

In September, a very brilliant comet appeared near the sun. It seems to have been discovered independently by Ellery, at Melbourne, Finlay at the Cape. Mr. Common in this country, and also by Thollon and Cruls. This great comet has been a brilliant object in the early mornings during the past two months. On September 17th, an observation, apparently unique in the history of astronomy, was made by Mr. Gill at the Cape, who watched the comet right up to the sun's limb. It could not, however, be detected in the sun, and this circumstance of appearing neither bright nor dark when in front of the sun, appears to suggest a very small substantiality, or great separation of the cometary matter. After perihelion it presented a magnificent appearance, having a tail 30° long, and even on October 30th the tail covered a space greater than the mean distance of the earth from the sun.

On October 9th, Prof. Schmidt discovered a nebulous object not far from the great comet, the orbit of which strongly suggests a connection in the past with the great comet. This fact is of more interest when the orbits of the great comet of this year, of Comet I, 1880, and of the well-known comet of 1843 are compared. The very near approach of the great comet to the sun will lead astronomers to watch with great interest for its return to our system, whatever may be its destiny, to fall ultimately into the sun, or to disappear through a process of gradual disintegration. In the *Astronomische Nachrichten*, just published, Prof. Pickering, who has computed the elements of the orbit of this comet, states, "I believe the deviation from a parabola to be real, although the corresponding period may be very long. These differences seem to indicate that the disturbance suffered by the comet in passing through the coronal region could not have been great."

This comet presented a spectrum similar to that of Comet Wells, but while receding from the sun, the bright lines of its spectrum became fainter, and then the usual hydrocarbon spectrum made its appearance. This observation, taken in connection with those of the previous comet, suggests a modified condition of an essentially similar chemical constitution. The phenomena would admit more easily of explanation if the cometary light is supposed to be due to electric discharge as it is well known how preferential is the electric discharge when several substances are present together in the gaseous form.

Before leaving this subject, I venture to quote the following passage from the *Observatory*, which puts in a very clear form the speculations now current, on the relation of the present great comet to that of 1880, 1843, and possibly 1668.

"The physical appearance of the comet, which like that of 1843, and unlike that of 1880, showed at first a decided nucleus, together with the intimation of a period very considerably greater than that of the interval from 1880, January 27, the date of perihelion of the 1880 comet, suggest that perhaps the 1843 comet suffered disintegration when at its nearest approach, and that the 1880 comet was a portion of its less condensed material, whilst the body of the comet with the principal nucleus, suffering less retardation than the separated part, has taken two and a-half years longer to perform a revolution. The remarkable discovery made by Prof. Schmidt, of Athens, on October 8, of a second comet only 4° S. W. of the great comet, and having the same motion, would seem to confirm this view."

The scientific year now concluded has not been so fertile as its predecessor in the initiation of great national and international undertakings, neither have any of those larger enterprises which I took occasion to mention last year, such as the circumpolar observations, or the Transit of Venus Expeditions, as yet been brought to their final issue. Nevertheless, in some of them we

have evidence that good work is already being done, and in the others, of which we have as yet no information, there is no reason to doubt that the same is the case. Nor again, in the border-land betweeen science proper and its applications, have I to record anything so important as the Paris Electrical Exhibition. That Exhibition, however, bore legitimate fruit in the Electric Lighting Exhibition at the Crystal Palace, and in the technical experiments lately carried out on a large scale at Munich. Perhaps the most prominent feature of the Crystal Palace Show was the incandescent light. At Paris that mode of illumination appeared to be little more than a possibility, in London it had become an accomplished fact. The importance attaching to this advance in electric lighting may be measured both by the rapid extension of its use, and also by the fact that not a few of our leading minds consider that the incandescent lamp is the lamp of the future, not merely for domestic, but even for many other public purposes.

But in another way the present year has witnessed the most important step which could have been taken for the promotion of electric lighting in this country. The Legislature has passed the Electric Lighting Bill, and, so far as legislation can effect the object, it has brought electricity to our doors. Up to this time installations of greater or less magnitude had sprung up sporadically in many parts of country, in railway stations, manufacturing works, and occasionally in private houses. But, compared with the lighting of a whole town, or even of separate districts of a large city, even the most important of these must be confessed still to partake of the nature of experiments; experiments, it is true, on a large scale, and, as I believe, conclusive as to the ultimate issue. Indeed, by multiplication of machines it is certainly, even now, possible to increase the lighting power to any required extent; but this can hardly be regarded as the final form of solution of the problem, inasmuch as such a method would be as uneconomical as it would be to use a number of small steam-engines instead of a large one. And when we consider that at the time of the passing of the Act in question, there was but one machine actually constructed which was capable of illuminating even one thousand incandescent lamps (I mean that of Edison), we cannot but feel that much remained to be done before the requirements of the public could be fully met. I do not mean thereby to imply that the Act was passed at all too soon; on the contrary, it has already given just that impetus which was necessary for producing installations on a larger scale. In illustration of this, I cannot help mentioning, as the first fruit of the impetus, a remarkable machine, by our countryman Mr. J. E. H. Gordon, which appears capable of feeding from five to six thousand lamps.

But beside the impulse above described, the Bill will have a scientific influence perhaps not contemplated by its original promoters. Under this Act, for the first time in the history of the world, energy will come under the grasp of the law, will become the subject of commercial contracts, and be bought and sold as a commodity of everyday use. It is, in fact, far from improbable that the public supply of electricity will be reckoned and charged for in terms of energy itself. But whether this be literally the case or not, a measurement of energy must lie at the root of every scale of charge.

And, further, since the Act allows no restriction to be placed upon the use of the electricity so supplied, it follows that it may be used, and undoubtedly will be used, at the pleasure and convenience of the customer, either for lighting, or for heating, or for mechanical, or for chemical purposes. This being so, it is clear that the public must by this process become, practically at least, familiar with the various modes of the transformation of force; and the Act in question might, from this point of view, have been entitled An Act for the better Appreciation of the Transformation of Force.

While offering to the public this new commodity, electricians may, in one respect, especially congratulate themselves, namely, that their article is incapable of adulteration. An electric current of a given strength and given electro-motive force is perfectly defined, and is identically the same whether it comes from a Siemens or a Gramme, from a magneto- or from a dynamo-machine, or as suggested by an eminent counsel before the Select Committee of the House of Commons, from one machine painted red or from another painted blue.

It has been said, and perhaps with truth, that the electric light will be the light of the rich rather than that of the poor. But in more ways than one electricity may now become the poor man's friend. The advantages in avoidance of heat and of vitiated atmosphere in workshops and factories have often been pointed out, and may ultimately become an important factor in the physical growth and prosperity of our population. But besides this, when electricity is literally brought to our doors, it will become possible, by converting it into motive power of limited extent, to revive some of the small industries which during the last half century have been crushed by the great manufacturing establishments of the country. There are operations which are capable of being carried out by the wives and families of workmen; there are works of small extent which can be performed more advantageously in a small establishment than in a large one, and it can hardly fail to be a gain to the community if this new departure should give fresh opportunities for the development of our industry in these directions.

The Copley Medal has been awarded to Prof. Arthur Cayley, F.R.S., for his numerous profound and comprehensive researches in Pure Mathematics.

One Royal Medal has been awarded to Prof. William Henry Flower, F.R.S. During the last thirty years Prof. Flower has been actively engaged in extending our knowledge of Comparative Anatomy and Zoology in general and of the Mammalia in particular.

His Memoirs on the Brain and Dentition of the Marsupialia published in the *Phil. Trans.* for 1865 and 1867, established several very important points in morphology, and finally disposed of sundry long-accepted errors.

His paper "On the Value of the Characters of the Base of the Cranium in the Carnivora" (1869), and numerous memoirs on the Cetacea, are hardly less valuable additions to zoological literature.

Prof. Flower has been for more than twenty years Curator of the Museum of the Royal College of Surgeons, and it is very largely due to his incessant and well-directed labours that the museum at present contains the most complete, the best ordered, and the most accessible collection of materials for the study of vertebrate structure extant.

The publication of the first volume of the new Osteological Catalogue in 1879, affords an opportunity for the recognition of Prof. Flower's services in this direction. It contains carefully verified measurements of between 1300 and 1400 human skulls, and renders accessible to every anthropologist a rich mine of craniological data.

The other Royal Medal has been awarded to Lord Rayleigh, M.A., F.R.S.

The researches of Lord Rayleigh have been numerous, and extend over many different subjects; and they are all characterised by a rare combination of experimental skill with mathematical attainments of the highest order.

One class of investigations to which Lord Rayleigh has paid much attention is that of vibrations, both of gases and of elastic solids. The results of most of these researches are now embodied in Lord Rayleigh's important work on the "Theory of Sound," a work which not only presents the labours of others up to the time of writing in a digested and accessible form, but is full of original matter.

The subject of vibration naturally leads on to a mention of other hydro-dynamical researches. Lord Rayleigh has investigated the motion of waves of finite height, and in particular has shown that the "great solitary wave" of our late Fellow, Mr. Scott Russell, has a determinate character; and he has investigated the circumstances of its motion to an order of approximation sufficient to apply to waves of considerable height.

Lord Rayleigh has examined more fully than had previously been done the theory of diffraction gratings, and the effects of irregularities; and also investigated the defining power of optical combinations, and its limitation by diffraction and spherical aberration.

He has lately been engaged in the elaborate re-determination of the B.A. unit of electrical resistance.

The Rumford Medal has been awarded to Capt. W. de W. Abney, R.E., F.R.S. Capt. Abney has contributed largely to the advancement of the theory and practice of photography by numerous investigations. In the Bakerian Lecture for 1880 he has given an account of a method by which photography can be extended to the invisible region below A, which had been hitherto but very imperfectly examined by means of the thermopile.

Making use of plates prepared with silver bromide in a particular molecular condition, Capt. Abney, by means of a diffraction grating containing 17,600 lines to the inch, constructed a detailed map of the infra-red region of the solar spectrum extending from A down to λ 10,650 (Plate XXXI. *Phil. Trans.*,

1880). The lowest limit of this map was fixed by conditions of the diffraction-apparatus, and not by a falling-off of the sensitiveness of the plates at this low point; for, when a prismatic apparatus was used, photographs were obtained which show a continuous spectrum down as far as λ 12,000.

In a subsequent paper (*Phil. Trans.*, 1881, p. 887), Capt. Abney, working with Lieut.-Col. Festing, R.E., applied this new extension of photography to a research on the influence of the atomic grouping in the molecules of the organic bodies on their absorption in the infra-red region of the spectrum. The authors believe that their results indicate, without much doubt, that the complex substances they examined can be grouped according to their absorption spectra, and that such grouping, as far as their experiments go, agrees on the whole with that adopted by chemists. They have more confidence in their results, as they were careful to select such bodies as might be regarded as typical; but, of course, much patient labour of many, for a long period, will be necessary before this new branch of physico-chemical research can be regarded as fully established in any complete form.

Capt. Abney has since carried on his work in this new region of the spectrum at different elevations during a recent visit to Switzerland.

The Davy Medal has been awarded to D. Mendeleeff and Lothar Meyer.

The attention of chemists had for many years past been directed to the relations between the atomic weights of the elements and their respective physical and chemical properties; and a considerable number of remarkable facts had been established by previous workers in this field of inquiry.

The labours of Mendeleeff and Lothar Meyer have generalised and extended our knowledge of those relations, and have laid the foundation of a general system of classification of the elements. They arrange the elements in the empirical order of their atomic weights, beginning with the lightest and proceeding step by step to the heaviest known elementary atom. After hydrogen the first fifteen terms of the series are the following, viz. :—

Lithium	7	Sodium	23
Berylium	9·4	Magnesium	24
Boron	11	Aluminium	27·4
Carbon	12	Silicon	28
Nitrogen	14	Phosphorus	31
Oxygen	16	Sulphur	32
Fluorine	19	Chlorine	35
		Potassium	32

No one who is acquainted with the most fundamental properties of these elements can fail to recognise the marvellous regularity with which the differences of property, distinguishing each of the first seven terms of this series from the next term, are reproduced in the next seven terms.

Such periodic reappearance of analogous properties in the series of elements has been graphically illustrated in a very striking manner with respect to their physical properties, such as melting-points and atomic volumes. In the curve which represents the relations of atomic volumes and atomic weights analogous elements occupy very similar positions, and the same thing holds good in a striking manner with respect to the curve representing the relations of melting-points and atomic weights.

Like every great step in our knowledge of the order of nature, this periodic series not only enables us to see clearly much that we could not see before, it also raises new difficulties, and points to many problems which need investigation. It is certainly a most important extension of the science of chemistry.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The examiners for the Natural Science Tripos in 1883 are Lord Rayleigh, Mr. Vernon Harcourt (Oxford), Dr. A. M. Marshall (Owens College), Dr. R. D. Roberts, Mr. J. N. Langley, Mr. L. Fletcher (Oxford) of the British Museum, Mr. A. Hill, and Dr. Vines.

The time for the presentation of the report of the Syndicate appointed to frame regulations for the Doctorates of Science and of Letters is extended to the end of next term.

The increased work of the museums and the larger number of departments has caused an excess of expenditure over the ordinary income 3000*l.* allowed by the University, during the past year. The expenditure has included a provision of microscopes for the morphological and physiological laboratories at a cost of nearly 150*l.*, and a Bianchi air-pump for the chemical laboratory, costing 83*l.* The balance which has accrued is 804*l.* which is asked for as a special grant from the chest.

Mr. A. S. Shipley, of Christ's College, has been nominated to study at the Zoological Station at Naples for the first six months of 1883.

A Clothworkers' Exhibition of 52*l.* 10s., tenable for three years, will be awarded by means of the examination of the Oxford and Cambridge Schools Examination Board in July next. The successful candidate must be or become a non-collegiate student at Oxford or Cambridge.

There will be an examination at Gonville and Caius College, beginning on March 9, 1883, for one Shuttleworth Scholarship, value 60*l.* per annum, tenable for three years, open to medical students of the University, who are of at least eight terms' standing. The subjects are Botany and Comparative Anatomy; practical work will be given as part of the examination. The scholarship may be held with any other scholarship at the College, and a candidate may be recommended at the same time for a foundation scholarship. Particulars may be obtained from the Rev. A. W. W. Steel, Tutor of the College.

The following nominations have been made to the Electoral Board of the under-mentioned professorships, with varying tenure of office to secure due rotation :—Plumian of Astronomy: Prof. Stephen Smith (Oxford), the Astronomer Royal, Prof. Adams, Mr. Spottiswoode, P.R.S., Prof. Stokes, the Master of Caius (Dr. Ferrers), Prof. Cayley, and Mr. Todhunter. Mechanism and Applied Mechanics: Sir John Hawkshaw, Lord Rayleigh, Messrs. R. F. Martin, W. Airy, and Coutts Trotter (Trinity), the Master of Emmanuel (Dr. Phear). Mr. W. H. Besant, and Prof. Cayley. Physiology: Prof. Humphry, Prof. Huxley, Mr. J. N. Langley, Prof. Burdon-Sanderson, Dr. Vines, Dr. Pye-Smith, Prof. Paget, Prof. Stokes. Knightbridge of Moral Philosophy, Prof. Caird (Glasgow), Mr. Leslie Stephen, Mr. J. Venn, Prof. Fowler (Oxford), Prof. Hort, Prof. Seeley, Mr. Todhunter, and Dr. Campion. The Boards of Physics and Chemistry and of Biology and Geology hape concurred in recommending that students who have passed in the Mathematical Tripos may be permitted to enter the second part of the Natural Science Tripos without passing in the first part. It is thought desirable to encourage mathematical students thus to take up the practical and experimental work in physics required of the Natural Science students; at present they have not time for studying the elementary parts subjects required of the latter.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, December 7.—Sir J. Lubbock, Bart., president, in the chair.—The following gentlemen were elected Fellows of the Society:—The Rev. R. Baron, F. O. Bower, T. H. Corry, O. L. Fraser, D. Houston, A. W. Howitt, H. McCallum, E. A. Petherick, S. Rous, and H. C. Stone.—The Rev. R. T. Murray showed specimens of *Althæa hirsuta*, *Vicia Orobus*, and *Phlomis fruticosa*, obtained by him last summer in Somerset.—Mr. W. T. Thiselton Dyer exhibited and explained maps illustrative of the rapid spread of Phylloxera in Spain and Portugal, observing that within the last year quite a wide area of the wine-growing districts therein were affected. He also exhibited photographs and made remarks on the Cinchona cultivation in Ceylon.—Mr. W. B. Espeut drew attention to some Kola nuts, and mentioned their remarkable sobering effects after intoxication by spirituous liquors.—Mr. G. Brook read notes on some little known Collembola and the British species of the genus Tomocerus. Tullberg refers to their occurrence in Sweden, but the four species in question have not hitherto been accorded a British habitat.—A paper by J. G. Otto Tepper was read on the discovery of above ninety species of Tasmanian plants near Adelaide, South Australia.—A contribution by Dr. W. Nylander and the Rev. J. M. Crombie was read, viz. on a collection of exotic lichens made in Eastern Asia by the late Dr. A. C. Maingay. Those enumerated were from British Burmah, China, and Japan; some are interesting as illustrative of lichen distribution, and others as new species and varieties.—Remarks on the genera of sub-family Chalcidinæ with synonymic notes and descriptions of new species of Leucospidinæ and Chalcidinæ was a paper by Mr. F. Kirby.—The Rev. R. P. Murray afterwards