THURSDAY, DECEMBER 1, 1881

THE ACCIDENTS IN MINES COMMISSION

THE Preliminary Report of this Commission, recently issued, affords a rather striking illustration of the amount of unpaid work which is occasionally done for the public by our busiest men. The Commission was appointed to inquire whether "the resources of science furnish any practicable expedients not now in use which are calculated to prevent the occurrence of accidents in mines or limit their disastrous effects." In its constitution science was represented by the following Fellows of the Royal Society:—Mr. Warington Smyth, Prof. Abel, Prof. Clifton, and Dr. Tyndall. The employers were represented by Sir George Elliot, M.P., Mr. William Thomas Lewis, and Mr. Lindsay Wood; the employed by the Member for Morpeth, Mr. Burt. Earl Crawford (then Lord Lindsay), who was added by a subsequent Royal Warrant, combined the man of science and the employer. He is a Vice-President of the Royal Society, and is largely interested in mining industry. Mr. Warington Smyth was very properly selected by the Home Secretary to preside over the Commission, for his scientific attainments are supplemented by varied and accurate knowledge of practical mining

The Commissioners set about their work in the most thorough manner. "In order to ascertain in what direction they could most usefully prosecute their inquiry," they "obtained the best possible evidence on the circumstances under which mines are worked, and on the acknowledged or probable causes of accident." They examined all the inspectors of mines, a large number of experienced colliery viewers and mining engineers, and a number of workmen selected by the miners' associations. They visited and inspected collieries in all parts of the kingdom, including most of those in which explosions of serious magnitude have recently occurred. At an early stage of their inquiry they found that they must make a series of extensive experiments, "involving much time and labour." They did not hesitate, they say, to "enter upon these experimental researches," and "there is good reason to hope," they add, "that their prosecution will result in the development, and perhaps in the settlement of, important questions bearing upon the elimination of accidents in mines."

In the meantime, as these experimental inquiries must necessarily take some time, they have thought it best to present at once the evidence which has been taken by them.

This evidence is preceded by a very interesting summary: One of the most important facts to which they draw attention is the great improvement which, so far as safety is concerned, has taken place during the last thirty years. Whilst the total number of deaths remains almost the same, the number of persons employed has nearly doubled, so that the fatalities have been reduced by nearly one-half.

These satisfactory results—as they point out in detail—are due to the scientific treatment of the various problems involved in underground operations, and to the increased care and regularity exercised generally by workmen and officials in the daily routine of their work.

The body of evidence which they have presented is full of interest and importance to all who are concerned in this great branch of our industry, whether as colliery owners, officials, or workmen. It has evidently satisfied the Commissioners as to the direction in which they must prosecute their inquiry, and as to the scientific problems which still remain to be solved. The source of danger which has hitherto defied all the efforts of science is the existence of light carburetted hydrogen gas—popularly known as "fire-damp"—in the coal. Falls of roof and side cause more than half the fatal accidents in mines. But a fall of roof never exacts more than one or two victims, and attracts scarcely any attention. The issue of fire-damp from the coal may—and often does—destroy hundreds of lives at a time, with a sudden, swift, and awful explosion, which strikes a natural terror into the whole mining population.

Wonderful as have been the recent improvements in ventilation, which are described in this Blue Book, the enormous volumes of air obtained by the best constructed furnaces or the most gigantic fans are unable to cope with the "sudden outbursts" of gas, which appear to increase in number as the deeper measures are reached. Recent experiments made by one of the Commissioners—Prof. Abel, at the request of the Home Office, and described in the summary—have revealed another danger, which improved ventilation may, under some circumstances, increase rather than diminish. From these experiments it appears that the presence of coal dust in the air of a mine renders it explosive if the air contains a proportion of fire-damp so small that it cannot be detected by the most experienced observer with the means at present in use. Here it is that the Commissioners appear to consider that patient research and experiment may be of some avail. Fire-damp is harmless unless it be ignited. The only two ways in which it needs be ignited are by the lights used for lighting the mine and by the explosives used for driving headings and bringing down the coal. If a method of lighting could be devised which would not ignite an explosive mixture of fire-damp, all danger in that direction would be removed. If an explosive or other equally efficacious agent were devised which would not ignite such an explosive mixture, all danger in that direction would be removed. The Commissioners have had the electric light introduced experimentally at the Pleasley Colliery, near Mansfield. But though they say that an admirable illumination was obtained with Swan's electric lamps, they add that "further experiments and a full examination into all details connected with its application are needed before it can be decided whether the electrical illumination of workings is practically achievable."

With reference to the existing system of lighting by safety lamps, the Commissioners afford another instance of laborious inquiry. They found a powerful blower of natural gas at Mr. Smethurst's Garswood Hall Colliery, near Wigan. Here they had suitable apparatus put up, and made several hundreds of careful experiments with about fifty varieties of safety lamps, for the purpose of determining the relative safety of each variety. Not satisfied with those, they say it will be desirable "to carry on these experiments in further detail, and to repeat them in other localities with other varieties of fire-damp." We understand that the Commissioners have nearly completed arrangements for continuing these experiments at the Llwynpia Colliery of the Glamorgan Coal Company, where there is a large blower of natural gas.

On the subject of the other source of danger they make the following observations:—"The use of gunpowder and other explosives is at the present day so widely spread, and is held by many to be so indispensable, that all suggestions for checking their application in certain cases on account of risk need to be very carefully weighed." "An overwhelming majority of our witnesses assert that it is practically impossible, as a rule, to work mines without powder." They conclude however a review of the evidence on this subject with the following rather significant statement:—"In the meanwhile it has appeared to us to be desirable to make trials of such methods of 'falling' or bringing down the coal as may do away with the danger caused by sparks and flame; and with this view a series of experiments already commenced will be continued in different localities."

The result of these further inquiries and experiments with reference to lighting and blasting, it is of course impossible to forecast. We fear it would be rash even to hope for an announcement that for the future fiery seams may be worked with a light, and brought down by an explosive, neither of which can ignite an explosive mixture, and both of which can be readily adopted without adding to the cost of getting the coal. But we await with much interest the conclusion of an inquiry which has been conducted in such a thoroughly scientific manner, and upon which so much practical experience, time, and labour have been bestowed.

CELESTIAL OBJECTS FOR COMMON TELESCOPES

Celestial Objects for Common Telescopes. By the Rev. T. W. Webb, M.A., F.R.A.S. Fourth Edition, revised and greatly enlarged. (London: Longmans, Green, and Co., 1881.)

THIS is a new and much extended edition of a work which has attained considerable popularity amongst the many amateurs of astronomy in this country who are limited to the use of instruments of moderate optical capacity, or as the author terms them, "Common Telescopes." By this term are intended achromatics with aperture of from three to five inches, or reflectors of somewhat greater diameter, yet as telescopes of higher pretensions are now in the possession of private observers, the author in the selection of additional objects has aimed at including such as may be considered tests for a superior class of instrument. The increase in telescopic range applying chiefly to the sidereal branch of astronomy, the additions have been taken for the most part from the works of the Struves and Burnham for double stars, and Sir John Herschel's catalogue for nebulæ: the total increase in the number of objects brought together in this new edition over the preceding one, is stated to be about 1500.

The first part of the work relates to the solar system, with a popular account of the actual state of our knowledge of the characteristics of its various members, so far as they fall within reach of moderate telescopes. In treating of the sun, the author collects many cases of the observation of dark spots in motion upon the disk, including that recorded by Mr. Capel Lofft of Ipswich, in January, 1818, to which, if we mistake not, attention was first specially directed by Mr. Webb in an earlier edition of the present work. He reproduces Pastorff's drawings of what he supposed to be the great comet of 1819, in transit across the sun, on June 26, taken from the originals, which are in the possession of the Royal Astronomical Society. The *phosphorescence of the dark side* of Venus, a phenomenon not as yet satisfactorily explained, is dwelt upon, as also the problematical satellite assigned to this planet. The moon is the subject of detailed description, the peculiarities of her surface, and the various craters, walled plains, valleys, clefts or rills, annular mountains, &c., are brought together in an interesting form; a map of the lunar surface forms the frontispiece to the volume, and a full index to the five hundred spots marked upon it, with an "Alphabetical Table of Lunar Nomenclature," is amongst the contents: indeed our satellite forms the subject of special treatment, which is amongst the most notable and useful features of Mr. Webb's work. An outline chart of the surface of Mars follows, with the actual nomenclature, which we hope at no distant time to see placed upon a more satisfactory foundation. The principal points of interest furnished by telescopic observation of the disks of Jupiter and Saturn are referred to, though, from the limited space at disposal, in less detail than the reader might perhaps desire. Cases of visibility of the brighter satellites of Uranus, and the satellite of Neptune, with telescopes of moderate dimensions, are recorded.

After a brief notice of comets, the author passes to the main division of his work—sidereal astronomy, or, as he phrases it, "The Starry Heavens,—Double Stars, Clusters, and Nebulæ." In this division, as it appears to us, Mr. Webb is at a disadvantage in being compelled to employ a system of abbreviation which, in the eyes of some readers, will not be without its disadvantage: but he has been perfectly aware of this, and in his Introduction asks the reader "to excuse a condensed form of expression, the result of necessity rather than of choice"; the amateur who intends to make practical use of the work must therefore accustom himself at the outset to Mr. Webb's abbreviations, and it must be admitted that it would have been difficult, without some such system, to have given the amount of information which is contained in the 300 pages or less, devoted to stellar astronomy. Mr. Webb follows the convenient plan of taking the constellations in alphabetical order, so far as they are visible in these latitudes: telescopic objects in the southern heavens are only noticed in a short appendix. The positions of the various objects are given to the nearest minute of time only in right ascension and the nearest minute in declination, but it may be remarked that the former is not a sufficiently close indication of the places of several interesting objects which fall well within the scope of observation of many amateurs, whom it might be desirable to enlist for their more systematic observation. We allude to cases like that of Tycho Brahe's star of 1572, Kepler's star of 1604, or Anthelm's in 1670. For the former the author gives R.A. 0h. 19m., Decl. 63° 24′ N., and recommends that a minute star near the place should be watched; but any one acquainted with the neighbourhood will know that a closer indication of its place is necessary for the identification of the suspicious object: it is the same with the small stars near the positions of Kepler's and Anthelm's stars. Variability has been remarked in small stars which occupy places very close to the observed positions of Tycho's and Anthelm's stars, and probably also in the case of Kepler's, and it is very desirable that a strict scrutiny of these spots should be maintained. As happens in so many popular treatises, there is a confusion in Mr. Webb's statement with regard to Kirch's variable star χ Cygni (Bayer): the Greek letter is attached at p. 288 to the double star No. 2580 of Struve, and it is added, "About $4^m f$, 50's is 17, or χ Bayer, discovered by Kirch; 1686, to be var., sometimes up to 5m.," &c. It is, however, Flamsteed's 17 Cygni which corresponds to Struve's double-star, while the variable star is χ Cygni of Bayer. Flamsteed, it is true, attached the letter χ to his 17 Cygni, though, as was pointed out by Argelander many years since, through a mistake: he saw no other sufficiently bright star near the place to correspond to Bayer's, but the explanation of this circumstance is found in the fact that at the dates of Flamsteed's observations "the variable star was down," to borrow an expression with which observers of these objects will be familiar, so Flamsteed seized upon the nearest naked-eye star for Bayer's χ. Mr. Webb dwells particularly upon the colours of the double-stars, one of their most interesting characteristics, and has brought together a large number of attractive notes upon the objects which he includes in his survey of the northern heavens. That his volume will maintain its popularity amongst amateur astronomers is not to be doubted, and we must add that it well deserves to do so.

CARNAC

Excavations at Carnac. By James Miln. (Edinburgh: Douglas, 1881.)

MR. MILN, to whom we are already indebted for a work on Roman remains found near Carnac (Britanny), has continued his researches in this interesting locality, and has given us a second work, consisting of a record of archæological researches in the alignments or stone avenues of Kermario.

The alignments of Kermario consist of ten rows of undressed stones, which extend for about two miles in an easterly direction, after which begin the avenues of Kerlescant. The stones, which consist of a close-grained granite, are some of them as much as twenty feet high, though the majority are much smaller. At the base of many of them Mr. Miln found ashes, charcoal, and fragments of pottery of a character which led him to the conclusion that these mysterious and almost unique avenues of stones were erected as sepulchral monuments. Although the whole monument is of such an extensive character, Mr. Miln is of opinion that it had not been completed. He draws this inference from the fact that in the neighbourhood he found several heaps of long stones, which he supposes had been brought there in order to be erected.

Among the stone avenues run certain ancient earthworks, and at the head of them are, as Mr. Miln found, the remains of ancient buildings. It was in these earthworks, at the base of the menhirs (which however he was very careful not to overturn), and among the ruins of these buildings that Mr. Miln's excavations were carried on.

The principal interest of the objects discovered in his researches, is the evidence they afford as to the period at which these menhirs were erected, and Mr. Miln comes to the conclusion from the result of his investigations that between Kermario and Kerloquet we have a long stretch of defensive works erected by the Celts at a period anterior to the Roman invasion; that the Romans on their arrival had occupied some of these, and in the more advantageous positions had constructed other works of greater solidity. On the other hand there seems some evidence that the erection of standing stones or menhirs did not altogether cease at this period, for under some of them, and in positions which would seem to show clearly that they were placed there at the time the menhirs were erected, fragments of Roman tiles and pottery have been discovered. These menhirs, however, formed no part of the "alignments."

It is interesting that, as Dr. Closmadeuc had already pointed out, we have evidence that there has been a change in the level of the land since the erection of these monuments. Mr. Miln considers that nearly the whole, if not the whole, of the bay of Quiberon must then have been dry land. On the Quiberon side of the bay the rows of menhirs extend under water, and on the Carnac side too, Gallo-Roman potters' furnaces have been found below high-water mark.

We much regret to add that the author died the very day after he had finished the proof sheets of this work. The present writer had the pleasure of examining Mr. Miln's excavations with him in the autumn of 1877, and may be permitted to add his personal expression of regret at the loss which archæological science has experienced in his death.

OUR BOOK SHELF

The Mind of Mencius. By the Rev. E. Faber. Translated by the Rev. A. B. Hutchinson. (Trübner's Oriental Series. 1881.)

MR. FABER is already well known in the field of Chinese studies by his digest of the doctrines of Confucius. In the present volume he gives us a systematic digest of those of Mencius, the greatest and most popular of the disciples of Confucius. These two philosophers form the bulwarks of Chinese conservatism, against the doctrines of socialism and communism, which first thrust themselves into notice after the death of Confucius. These men, as the translator remarks, made no appeal to external credentials; they rather based the truth of their mission on the conformity of their doctrines with the essentials of the human mind, as shown by observation. To them the "state" is everything—it is "the sum of all human endeavours, natural and civilised, working together as a united organisation." For about 3000 years the political fabric of China, based on the principles of which Confucius and his disciples were the exponents rather than originators, has held together in spite of shocks before which any other system known in history would have disappeared, and at the present day seems as vital and vigorous as at any portion of its existence. To explain by the light of the best commentators what these principles, as enunciated by Mencius were, is the object of Mr. Faber. This philosopher was a contemporary of Plato and Aristotle, but his doctrines are still living and active principles in Chinese ethics and politics. The value of this work will be perceived when it is remembered that at no time since relations commenced between China and the West has the former been so powerful—we had almost said aggressive—as now. She is drawing closer to us as time goes on, but there is no evidence that the tenacity of her hold on her ancient political doctrines is relaxing. For those who will give it careful study Mr. Faber's work is one of the most valuable of the excellent series to which it belongs.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Primitive Traditions as to the Pleiades

IN Dr. Tylor's recent review in NATURE (vol. xxiv. p. 529) of Mr. Dawson's work on the "Folk-Lore of the Natives of Victoria," he refers to their tradition of "the lost Pleiad," and assumes that it must have been borrowed by them from Europeans. The indefatigable Astronomer Royal for Scotland, conceiving that my researches as to the Pleiades, and especially as to traditions respecting those stars among the Australians, had been improperly ignored, wrote a letter to the Editor of NATURE, which, having been submitted to Dr. Tylor, was sent to my Canadian address, with his reply, by Prof. Piazzi Smyth, and has only reached me within the past week.

Dr. Tylor states that he has frequently heard of my researches respecting the Pleiades, but has never met with any publication of mine on the subject; and that he would be much surprised if I could show that the story of the "Lost Pleiad" is really a primitive and original myth of savages.

Before touching on that point I think it but right to say that, so far from feeling aggrieved by the omission, I am afraid that I rather owe an apology to Dr. Tylor and to anthropologists for not having long ago published the results of my labours.

If a paper on the subject would have been only read and used by Tylors and F.R.S.s., I should long ago have given them the substance of the fruits of my investigations. Unfortunately there are scores of imaginative persons who have a fondness for discussing scientific novelties, without having the caution and training necessary for such work. Hence the unfortunate discoverer or explorer of any new and difficult field of research is apt to find that, long before he feels justified in inviting the attention of the scientific world to his favourite subject, it has been invaded and discredited by hasty theorists; and that his first work is the unpleasant task of clearing the field of the rubbish with which it has been encumbered.

Now there are few subjects as to which greater caution is needed than that of anthropology, and especially that branch which deals with the myths and religious ideas of savages. Dr. Tylor's works are therefore very satisfactory, as they contain a vast mass of facts, and evince an entire absence of fanciful or hasty theories. Had I confined my researches to the study of the folk-lore of savages I should never have supposed that the Pleiades deserve the prominence which my conclusions have assigned to them.

As my researches are unknown to most persons, and only imperfectly known to a few through my privately printed journals of investigations, letters, &c., having been partially published by others, permit me to explain the course of my investigations, and the grounds for my conclusions as to the Pleiades and their influence on the calendars and mythologies of nations.

It is now almost a lifetime, some thirty years ago, since I first noticed the universality of the number *seven* on ancient symbolism. As seven stars frequently met me as an architectural symbol, or a religious emblem in the New World, as well as in the Old, sometimes too in connection with the prehistoric cross, I suspected that these stars must have been the Pleiades, and that they must have in some way consecrated that symbol and the number *seven*, a number, too, which I had noticed as being prominent in the grouping of some prehistoric structures. Why such apparently unimportant stars should have once acquired such world-wide significance I was utterly unable even to offer a conjecture.

After corresponding with Mr. Prescott, Sir Austin Layard, and others on this subject, I made up my mind that I had got hold of the wrong end of a very important inquiry, and that for years to come I must carefully collect facts and religiously avoid hasty generalisation.

On subsequently paying my first visit to England the late Sir Henry Ellis, the editor of "Brand's Popular Antiquities," requested me to prepare a paper on the coincidences of customs among savages and civilised nations, and I accordingly selected those connected with the Feast of Ancestors, as I fouud that my references and notes on it were very numerous.

I had previously noticed that a Spanish Jesuit missionary had expressed surprise that the Peruvians and Christians observed the feast of the dead on the same day—the second of November. I of course looked on the coincidence as purely accidental, but when I had written a paper giving the results of my notes, to my great amazement I found that this coincidence was very widely spread, and that the feast of ancestors was very generally held about the beginning of November. Here then was a truth not hitherto "dreamed of in our philosophy"; and I therefore thought it prudent to defer reading my paper until I could solve the mystery.

How could this singular coincidence have been caused and preserved throughout the world, in the northern as well as in the southern hemisphere? It was plain that this festival must have been regulated by something very simple and plain, such as the rising of some star. If this was the case, then it was equally clear that that star must have been very carefully observed throughout the world, and may therefore have become an object of peculiar reverence. I at once thought of the widespread symbolism of the Seven Stars, which I had long before noticed, and therefore, as I was not an astronomer, I asked Prof. Everett, F.R.S., then a professor in King's College, Windsor, Nova Scotia, whether the Pleiades could ever have risen in November. He of course replied in the negative, for it must have been at least twelve thousand years since those stars rose heliacally at that time of the year. I had, however, my conjecture fully confirmed by finding that in one of the most ancient calendars in the world, that of the Brahmins of Tirvalore, the name of November was *Kartica* ("the month of the Pleiades"). I subsequently found a year, still in use in Polynesia, regulated by the rising of the Pleiades at sunset, or by their being visible all night long, and I also discovered that the three days' feast of the dead was also held in November by the Australian savages as a great annual corroboree in honour of the Pleiades. Since then I have found this primitive calendar, or fossil traces of it, all over the world.

I also found that early astronomers constructed great years or cycles on the basis of this simple calendar, which were also regulated by the Pleiades. With this calendar and its festivals and these cycles I found flood traditions and primitive myths associated, and that the key to some of the most remarkable features in early religions and traditions is to be found in the year of the Pleiades.

In 1863 I printed privately a paper of 103 pages on the Feast of the Dead, and the calendar of which it was a new year's festival, and in 1864 a second paper on the connection of the Pleiades with the cycles of the ancients and with prehistoric chronology.

As Prof. Piazzi Smyth, in 1865, was intending to carefully measure and examine the Great Pyramid, I sent him a copy of my papers, as I believed that my early impressions as to the connection of the Pleiades with primitive architecture would prove to be well founded. In his work on the Pyramid he republished seventy pages of my first paper, my request that it should not be published having fortunately reached him too late.

My excuse for this long delay is the desire, before publishing my conclusions, to work out many interesting problems connected with the Pleiades and early myths and religious beliefs, and the great difficulty of such inquiries; for the era when the Pleiades thus left their impress on the calendars and traditions of nations must be very remote, so much so that such researches are like investigations into the fossils that tell of organisms that lived in a world and breathed an atmosphere different from our own.

I am, however, preparing at last to bring out a work which will deal with the connection of the Pleiades, first, with the calendars, festivals, and cycles of nations; and next, with the myths and traditions associated with the year of the Pleiades. I had recently intended to have published some articles which I had prepared on the connection of the Pleiades with primitive ideas as to Paradise, but it seemed prudent to defer doing so, and to bring out the whole subject in one volume. To show, however, how widely spread these traditions as to the Pleiades are, I may attempt to give the information which Dr. Tylor invites, as to the myth of the lost Pleiad being a heritage among savages. Those stars are only apparently six, yet all the world over, among civilised and savage races, in Europe, in India, China, Japan, America, and Africa, this diminutive star group is not merely regarded as seven stars, but what is still more surprising, as "*The* Seven Stars," though the far brighter seven stars of the Great Bear might seem to deserve the title.

There are various myths to account for the missing Pleiad, but one I think will suffice to show that the Australians did not borrow the idea from Europeans.

I once asked a native of the Gold Coast, a negro Hercules in strength, who had therefore been christened (probably by some pious naval officer) *Fivehorsepower*, whether he knew anything of the stars. "No!" he replied, "I know nuffin about de stars." "But don't you know anything of 'the seven stars'?" "Oh yes, of course," he answered; "every nigger knows de seben stars." "Why do you call them seven?" I asked him; "can you count seven stars?" "No," he replied, "you count one, two, three, four, five, six; then todder one hide herself, no let you count her." There is also a savage tradition, which I can recollect, that the Pleiades are young women, six of whom are very beautiful, but the seventh is so plain that she conceals herself from sight.

Some tribes of the Australians dance in honour of the Pleiades, because "they are very good to the black fellows." Was this borrowed through Europeans from "the sweet influences of the Pleiades" which Job celebrates?

Ask a negro in the Southern States to look through a telescope, and he will invariably turn it towards the Pleiades, "for they are berry good to the darkies." The natives of America, both North and South, regard the Pleiades as beneficent stars, and dance in their honour. "Oh what do we owe to thee!" is the grateful salutation of one tribe. Whence then did this arise? It was not merely because those stars announced spring, and were "stars of rain," or because they were "for signs, and for seasons, and days, and years," but also because they were connected with the idea of Paradise and the abode of the Deity. The problematical theory of Moedler, that Alcyone, the brightest of the Pleiades, is the central sun of the universe, is most interesting on account of the singular fact that such was actually the belief of early ages. I have within the past year found unexpected, and I think conclusive, proofs that the name *Alcyone* (or rather, *Alkyone*), meaning a centre, pivot, or turning-point, was not given without some reason to that star, for the ancients in very remote ages undoubtedly believed that it was the centre of the universe, and that Paradise, the primæval home of our race and the abode of the Deity and of the spirits of the dead, was in the Pleiades, traces of which ideas we even find among savages.

The *Alkyonic* Lake, the waters of which led to the world of spirits, must have meant simply "the waters of death" leading to Alkyone or Paradise, and reminds us of Ulysses' voyage to the abodes of the dead and to the Gardens of Alkynöos.

With the Pleiades, too, sacred birds (birds of paradise) were connected. In my journal of researches (1863) I expressed my conviction that *Manu* (a word meaning, in the Indian Archipelago, a fowl or bird) would be found to have been connected with the Pleiades. I have been recently gratified at finding that in far-distant Samoa there is a sacred bird called, not *Manu-alii*, the royal bird, as some European writers have assumed, but *Manu-lii*, the bird of the Pleiades.

What a singular link we have here between the folk-lore of these savages and that of the Old World, for to this very day, from Britain to Japan, the Pleiades are popularly known as "the hen" or "hen and her chickens."

In Mexico the beautiful kingfisher was a sacred bird. May not the name of the same bird in Greece have been a survival of similar ideas, as it was called the *Halcyon*, *i.e.* belonging to Alcyone, or a bird of paradise?

The bright sunny days, too, at the end of autumn, that shining season of the Pleiades, called in America the Indian summer, were *Halcyon* days among the Greeks, which we should now render heavenly days.

Even if the theory of prehistoric astronomers and of some modern men of science, that the Pleiades are the centre of the universe, should prove to have been unfounded, I am persuaded that the day is coming when the learned will admit that those stars are the "central sun" of the religions, calendars, myths, traditions, and symbolism of early ages—an era, however, so marvellously remote, that investigations respecting it bear the same relation to the study of anthropology and to the science of religion that palæontology does to natural history.

I shall be greatly disappointed if I cannot satisfy even so cautious and careful an observer as Dr. Tylor, that there is a mass of original and primitive traditions as to the Pleiades among isolated savages in various quarters of the globe.

In the meantime, until these conclusions are submitted in a proper and scientific shape to the learned, Dr. Tylor is perfectly justified in adopting the prudent legal maxim, *De non apparentibus et non existentibus eadem est ratio.*

I may however invite his attention to Mr. Ernest de Bunsen's recent work on the Pleiades—"The Pleiades and the Zodiac," published in German (Berlin, 1879), and his recent learned work, the "Angel Messiah." The former he has kindly dedicated to me as the pioneer in this new and difficult field of research.

R. G. HALIBURTON

The Pronunciation of Deaf-mutes who have been Taught to Articulate

IN NATURE (vol. xxv. p. 72) it is reported that at the last meeting of the French Academy M. Hément made some observations to show that deaf-mutes who have been taught to articulate speak with the accent of their native district. This curious circumstance, which was contested by M. Blanchard, has already been recorded. One case is given in an old number of the *Philosophical Transactions*, No. 312. About the age of seventeen a young man, a congenital deaf-mute, was twice attacked by fever. "Some weeks after recovery he perceived a motion of some kind in his brain, which was very uneasy to him, and afterwards he began to hear, and, in process of time, to understand speech. This naturally disposed him to imitate what he heard, and to attempt to speak. The servants were much annoyed to hear him. He was not distinctly understood, however, for some weeks; but is now understood tolerably well. But what is singular is that he retains the Highland accent, just as Highlanders do who are advanced to his age before they begin to learn the English tongue. He cannot speak any Erse or Irish, for it was in the Lowlands he first heard and spoke." The curious circumstance of his possession of the Highland accent is confirmed by the testimony of similar phenomena in the deaf and dumb schools of Spain. "One fact," says Ticknor, "I witnessed, and knew therefore personally, which is extremely curious. Not one of the pupils, of course, can ever have heard a human sound, and all their knowledge and practice in speaking must come from their imitation of the visible mechanical movement of the lips and other organs of enunciation by their teachers, who were all Castilians, yet each speaks clearly and decidedly, and with the accent of the province from which he comes, so that I could instantly distinguish the Catalonians and Biscayans and Castilians, whilst others, more practised in Spanish, felt the Malagan and Andalusian tones" ("Life and Journals of George of Ticknor," vol. i. p. 196, London, 1876). A similar case has been mentioned to me by Mr. J. J. Alley of Manchester. E. R. became deaf and dumb at a very early age, and did not talk until he was about seventeen, when he was taught articulation by Mr. Alley. He speaks with the accent of his native county of Stafford. These facts are cited in my paper on "The Education of the Deaf and Dumb," in the "Companion to the Almanac" for 1880.

WILLIAM E. A. AXON

Tanganyika Shells

IN the *Proc.* Zool. Soc. Lond. for May, 1881, pp. 558–561 Mr. Edgar A. Smith has described two new species of shell from Lake Tanganyika, Africa, for which he has proposed the new generic name of *Paramelania*. These forms are, without doubt, generically identical with the *Pyrgulifera humerosa* of Meek (see U.S. Geol. Sur. 40th Parallel, by Clarence King, vol. iv. p. 176, pl. xvii. Figs. 19 and 19*a*), which antedates Mr. Smith's name by at least five years. Mr. Meek's species has hitherto been the only known member of the genus, either fossil or recent, and was only known to occur in the strata of the

Laramie group, an extensive brackish water formation in Western North America, which holds a transitional position between the Mesozoic and Cenozoic series. Associated with *Pyrgulifera humerosa*, among various other fresh and brackish-water forms, is one that I have described under the name of *Goniobasis cleburni*, which is evidently congeneric with the *Melania* (*Sermyla*) *admirabilis* of Smith, an associate of *Pyrgulifera damoni* and *P. crassigranulata* in Lake Tanganyika. As that lake has evidently once been a brackish water sea, it is not strange that there should be certain similarities between its molluscan fauna and the faunæ of similar bodies of water that existed in Mesozoic and Cenozoic time. It is, however, remarkable that the two generic types here especially referred to should appear in their integrity living in Africa, and not in North America, where the fossil forms occur; and especially so because so many of the fresh-water and land-molluscan types now living on the latter continent are found fossil in its Mesozoic and Cenozoic strata. C. A. WHITE

Washington, D.C., November 4

Velocity of Wind

THE following observations regarding the velocity of the wind in the south-west gale of the 21st and 22nd of November at Edinburgh may be of interest. The observations were made by me about nine o'clock on the morning of the 22nd, when the wind had somewhat moderated:—

	Miles per hour.
Mean velocity	62·3
Velocity during a squall	71·6

These observations are calculated from the velocity of clouds of *smoke* issuing from the chimney of the Caledonian Distillery, and travelling for a distance of 2100 feet, and are thus free from instrumental errors. The chimney is 225 feet high, and its base is about 200 feet above the sea-level.

CHARLES ALEX. STEVENSON

Arctic Research

No one can hold in higher honour and respect than I do the opinions of the greatest of Arctic navigators, Sir Edward Parry, although these opinions were expressed more than half a century ago, since when our knowledge of Arctic shores has very materially increased.

My letter in NATURE vol. xxv. p. 53, where alluding to navigable waters through channels, &c., in the Arctic Sea, specially referred to Arctic America and the lands lying north of it, in which category Greenland can scarcely be included, certainly not that part of its western shores along which a navigable passage is almost invariably to be found.

The following passages from the extract from "Sir Edward Parry's writings" (NATURE, vol. xxv. p. 78) are those which specially bear upon the statements made by me:—

"We experienced a striking example of this kind [ice obstruction] in coasting the eastern shore of Melville Peninsula in 1822 and 1823, the whole of the coast being so loaded with ice as to make the navigation extremely difficult and dangerous."

I do not in the least doubt this, but difficulties of ice-navigation are comparative, and I believe from Eskimo report that the opposite side of Fox's Channel would have been worse. On asking the natives of Repulse Bay why they did not go over to Southampton Island, which forms the eastern shore (having a western aspect) of Sir Thomas Roe's Welcome, the reply was, there were no seals or walruses there, the ice being too much on shore. The same is said of the east side of Fox's Channel.

The sea on the west side of Melville Peninsula is said never to be free from ice [1]; such was its condition during the summer of 1846; and in 1847, when I traced its whole shore, there was a fringe of heavy and rugged hummocks some miles wide all the way.

In the springs of 1847 and 1854 the opposite coast, being the west side of Committee Bay—having an eastern aspect—bore evidence, by the small quantity of rough ice met with, that there had been navigable water at some time during the previous summer.

There can, as a rule, be no better or truer guide to the *side* of a channel, inlet, &c., which is *least* ice-obstructed than the assembling of marine animals, seals, walruses, and whales (provided always that these animals have not been driven away by constant attacks to less favoured resorts) along its shores, on which the Eskimos have their chief camping-grounds, and of which there are many along the east shore of Melville Peninsula and southward on the same coast-line to lat. 64°, near which the Americans have had their chief whaling and sealing stations for many years.[1]

[1] See Rae's "Arctic Expedition," 1846-7, p. 49.

On August 19 and 20, 1859, Sir Leopold McClintock ran 150 miles down Prince Regent's Inlet, along the side, having an eastern aspect, to Bellot Strait, without seeing a bit of ice except one large iceberg, and returned by the same route in 1860 (August 10 to 16), but on this occasion was stopped near Fury Point by ice, forced in by a strong easterly breeze of four days' duration; when the wind changed to west the obstruction was speedily removed, and there was no further difficulty. Dundee whalers have not infrequently visited Cresswell Bay in this locality, and killed whales there. So much for shores having an eastern aspect being navigable, notably that of Smith Sound.

The second passage from "Parry's Writings" I wish to comment upon is—

"These facts, when taken together, have long impressed me with the idea that there must exist in the Polar regions *some general motion of the sea towards the west*, causing the ice to set in that direction, when not impelled by contrary winds or local or occasional currents."

When it can be proved that permanent currents exist in the sea, irrespective of wind influence, we must naturally assume that the motion of the sea and of the ice floating on it is in the same direction.

The *Resolute*, one of Sir Edward Belcher's ships, abandoned near the south entrance of Wellington Channel in 1854, must have driven eastward for 300 miles through Barrow Strait and Lancaster Sound, into Baffin's Bay, and was picked up far to the south by the Americans some years afterwards.

Sir Leopold McClintock in 1859 and 1860 found Bellot Strait free from ice, and quite navigable, entering from the east, but impenetrably blocked with thick old ice-floes at its western extremity. In his chart is a note: "Bellot Strait, flood and *permanent* current to eastward."

Sir Edward Parry experienced a somewhat similar permanent easterly current in the Strait of the Fury and Hecla, as the following extract from Capt. Lyon's (who commanded one of Parry's ships) journal (p. 275) will show: "That there was a prevailing set from the westward we had long known, even before entering the strait, and we saw by the driving of the loose ice against an easterly wind that it ran with great force. As an extraordinary instance in point, the *Hecla* broke adrift on the 13th in consequence of a piece of ice parting, and was carried (eastward) against a fresh easterly breeze, about a mile from the fast floe. All sail being set before the wind, we were nearly two hours in recovering this one mile, though to all appearance and by the log going between three and four knots through the water."

Here are examples of two permanent currents running to the east, through straits narrow, it is true, but the only passages known to exist in two lands extending about six degrees, or 360 miles north and south.

The conclusion to be arrived at seems to be, that the sea to the west of these lands is at a higher level than it is to the east of them, and consequently if the general motion of the "sea is towards the west," according to Sir Edward Parry's idea, it must, in the localities named, be moving in opposition to its own currents, or up hill. J. RAE

4, Addison Gardens, November 26

ARE not the facts of ice-accumulations at "the western sides of seas or inlets," mentioned in your last number (p. 78), to be explained by reference to Baer's law for the flow of rivers? This law, corroborated by many observers in all parts of the world (see for instance NATURE, vol. xv. p. 207), states, as a simple consequence of the earth's rotation, the deviation to the right bank of all rivers of the northern hemisphere running north and south, *i.e.* to the west, if the flow is from the north, and to the east if from the south. Considered from this point of view, it may suffice that the masses of ice are borne by currents from the north, to account for the accumulations on the western borders of these currents, *i.e.* on "the eastern coast of any portion of land." I am well aware that the principle in question was applied to the theory of ocean-currents, long ere C. E.

[1] Along this shore, seal, walrus, and the right whale abounded in 1846, 1847, and 1853, when I was there. In 1854 constant easterly winds kept the ice close to the land for ten days, so that few marine animals were seen during that time.

von Baer extended it to the phenomena of rivers; the above case may be considered as connecting together both classes of phenomena.

D. WETTERHAN

Freiburg-im-Breisgau, November 26

Spectrum of the Electric Light

WILL you, or one of your spectroscopical contributors, kindly inform me in what respects (if at all) the spectrum of the electric light differs from that of the sun? At a time apparently not far distant from the almost universal application of the electric light, the question I ask is not unimportant, as it, I believe, affects the tolerance of the human eye for other than solar light. It is already well known that much work done by gas-light is by many found prejudicial to their vision, and this may, I presume, be caused by the inherent qualities of the light. It will be interesting to me therefore to learn in what respects electric light and gas-light differ from solar, as shown by spectrum analysis.

J. HOPKINS WALTERS

Reading, November 28

A GLIMPSE THROUGH THE CORRIDORS OF TIME[1]

II.

AT the remote epoch of which we are speaking the solar tides were very small, as they are at present. Yet, small as they are, there was a particular circumstance which may have enormously increased their importance. The point to which I refer can be illustrated very simply. We have here a weight of 14 lbs. freely suspended, and here I have a small wooden mallet which barely weighs half an ounce, yet small as this mallet is, I can make the heavy weight swing by merely giving it blows with the mallet. Let me try. I give the weight blow after blow. I hit it as hard as I can, yet the weight hardly swings. I have not yet been successful. The art of succeeding is merely to time the blows properly; this I am now doing, and you see the weight swings in an arc which is steadily augmenting.

We therefore see that a succession of impulses, in themselves small, can yet produce a great effect when they are properly timed. In the present case the impulses should succeed each other at the same interval as this pendulum requires for one to and fro oscillation. The time therefore depends on the body struck, and not at all on the body which gives the impulses.

Just as this pendulum swings with a definite period so the vibrations of the primæval earth had a certain period appropriate to them. Suppose that the liquid primæval globe were pressed in on two quadrants and drawn out on the two others, and that the pressures were then released. The globe would attempt to regain its original form, but this it could not do at once, any more than the pendulum can at once regain its vertical position; the protruded portions would go in, but they would overshoot the mark, and the globe would thus oscillate to and fro. Now it has been shown that the period of such oscillations in our primitive globe is about an hour and a half, or very close to half the supposed length of the day at that time. The solar tides, however, also have a period half the length of the day. Here then we have a case precisely analogous to the 14 lb. weight I have just experimented on. We have a succession of small impulses given which are timed to harmonise with the natural vibrations. Just as the small-timed impulses raised a large vibration in the weight, so the small solar tides on the earth threw the earth into a large vibration. At first these vibrations were small, but at each succeeding impulse the amplitude was augmented until at length the cohesion of the molten matter could no longer resist: a separation took place: one portion consolidated to form our present earth; the other portion consolidated to form the moon.

There is no doubt whatever that the moon was once quite close to the earth; but we have to speculate as to what brought the moon into that position. I have given you what I believe to be the most reasonable explanation, and I commend it to your attention. There are difficulties about it, no doubt: let me glance at one of them.

I can easily imagine an objector to say, "If the moon were merely a fragment torn off, how can we conceive that it should have that beautiful globular form which we now see? Ought not the moon to have rugged corners and an irregular shape? and ought not the earth to show a frightful scar at the spot where so large a portion of its mass was rent off."

You must remember that in those early times the earth was not the rigid solid mass on which we now stand. The earth was then so hot as to be partially soft, if not actually molten. If then a fragment were detached from the earth, that fragment would be a soft yielding mass. Not for long would that fragment retain an irregular form; the mutual attraction of the particles would draw the mass together. By the same gentle ministrations the wound on the earth would soon be healed. In the lapse of time the earth would become as whole as ever, and at last it would not retain even a scar to testify to the mighty catastrophe.

I am quite sure that in so large and so cultivated an audience as that which I am now addressing, there are many persons who take a deep interest in the great science of geology. I believe however that the geologist who had studied all the text-books in existence might still be unacquainted with the very modern researches which I am attempting to set forth. Yet it seems to me that the geologists must quickly take heed of these researches. They have the most startling and important bearing on the prevailing creeds in geology. One of the principal creeds they absolutely demolish.

I suppose the most-read book that has ever been written on geology is Sir Charles Lyell's "Principles." The feature which characterises Lyell's work is expressed in the title of the book, "Modern Changes of the Earth and its Inhabitants considered as Illustrative of Geology." Lyell shows how the changes now going on in the earth have in course of time produced great effects. He points out triumphantly that there is no need of supposing mighty deluges and frightful earthquakes to account for the main facts of geology.

Lyell attempts to show that the present action of winds and storms, of rains and rivers, of ice and snow, of waves and tides, will account for the formation of strata, and that the gentle oscillations of the earth's crust will explain the varying distribution of land and water. In this we can to a great extent follow him. I am quite satisfied with the oscillations in the land. If the land rises an inch or two every century in one place and falls to the same extent elsewhere, all that is required has been explained. Nor do I feel at present disposed to question his views as to rivers or to glaciers, to rains or to winds. There is however one great natural agent of which Lyell does not take adequate account. He does not attach enough importance to the tides. No doubt he admits that the tides do some geological work. He even thinks they can do a great deal of work. The sea batters the cliffs on the coasts, and wears them into sand and pebbles. The glaciers grind down the mountains, the rains and frosts wear the land into mud, and rivers carry that mud into the sea. In the calm depths of ocean this mud subsides to the bottom; it becomes consolidated into rocks; in the course of time these rocks again become raised, to form the dry land with which we are acquainted.

The tides, says Lyell, help in this work. Tidal currents aid in carrying the mud out to sea; they aid to a considerable extent in the actual work of degradation, and

[1] Lecture delivered at the Midland Institute, Birmingham, on October 24, 1881, by Prof. Robert S. Ball, LL.D., F.R.S., Andrews Professor of Astronomy in the University of Dublin, and Royal Astronomer of Ireland. Contributed by the Author. Continued from p. 82.

thus contribute their quota to the manufacture of stratified rocks. Such is the modest *rôle* which Lyell has assigned to the tides, and no doubt the majority of geologists have acquiesced in this doctrine. Nor can there be any doubt that this is a just view of tidal action at present. That it is a just view of tidal action in past times is what I now deny. Lyell did not know—Lyell could not have known—that our tides are but the feeble surviving ripples of mighty tides with which our oceans once pulsated. Introduce these mighty tides among our geological agents, and see how waves and storms, rivers and glaciers, will hide their diminished heads.

I must attempt to illustrate this view of tidal importance in ancient geological times. Let me try by the aid of the tides to explain the great difficulty which every one must have felt in regard to Lyell's theory. I allude to the stupendous thickness of the Palæozoic rocks.

Look back through the Corridors of Time in the manner in which they are presented to us in the successive epochs of geology. We pass rapidly over the brief career of prehistoric man; then through the long ages of Tertiary rocks, when the great mammals were developed; back again to the much earlier period when colossal reptiles and birds were the chief inhabitants of the earth; back again to those still earlier ages when the luxuriant forests flourished that have given birth to the coal-fields; back once more to the age of fishes; back finally to those earliest periods when the lowest forms of life began to dawn in the Palæozoic era.

As we date remote ages astronomically by the distance of the moon, so we date remote ages geologically by the prevailing organic life. It is a great desideratum to harmonise these two chronological systems, and to find out, if possible, what lunar distance corresponds to each geological epoch. In the whole field of natural science there is no more noble problem. Take, for example, that earliest and most interesting epoch when life perhaps commenced on the earth, and when stratified rocks were deposited five or ten miles thick, which seem to have contained no living forms higher than the humble Eozoon, if even that were an organised being. Let us ask what the distance of the moon was at the time when those stupendous beds of sediment were deposited in the primæval ocean. We have in this comparison every element of uncertainty except one. The exception is, however, all important. We know that the moon must have been nearer to the earth than it is at present. There are many very weighty reasons for supposing that the moon must have been very much nearer than it is now. It is not at all unlikely that the moon may then have been situated at only a small fraction of its present distance. My argument is only modified, but not destroyed, whatever fraction we may take. We must take some estimate for the purpose of illustration. I have had considerable doubts what estimate to adopt. I am desirous of making my argument strong enough, but I do not want to make it seem exaggerated. At present the moon is 240,000 miles away; but there was a time when the moon was only one-sixth part of this, or say 40,000 miles away. That time must have corresponded to some geological epoch. It may have been earlier than the time when the Eozoon lived. It is more likely to have been later. I want to point out that when the moon was only 40,000 miles away, we had in it a geological engine of transcendent power.

On the primitive oceans the moon raised tides as it does at present; but the 40,000-mile moon was a far more efficient tide-producer than our 240,000-mile moon. The nearer the moon the greater the tide. To express the relation accurately we say that the efficiency of the moon in producing tides varies inversely as the cube of its distance. Here then we have the means of calculating the tidal efficiency for any moon distance. The 40,000-mile moon being at a distance of only one-sixth of our present moon's distance, its tidal efficiency would be increased $6 \times 6 \times 6$ fold. In other words, when our moon was only 40,000 miles away it was 216 times as good a tide-producer as it is at present.

The heights to which the tides rise and fall is so profoundly modified by the coasts and by the depth of the sea, that at present we find at different localities tides of only a few inches and tides of 60 or 70 feet. In ancient times there were no doubt also great varieties in the tidal heights, owing to local circumstances. To continue our calculation we must take some present tide. Let us discard the extremes just indicated and take a moderate tide of 3-feet rise and 3-feet fall as a type of our present tides. On this supposition what is to be a typical example of a tide raised by the 40,000 mile moon? If the present tides be 3 feet, and if the early tides be 216 times their present amount, then it is plain that the ancient tides must have been 648 feet.

There can be no doubt that in ancient times tides of this amount and even tides very much larger must have occurred. I ask the geologists to take account of these facts, and to consider the effect—a tidal rise and fall of 648 feet twice every day. Dwell for one moment on the sublime spectacle of a tide of 648 feet high, and see what an agent it would be for the performance of geological work! We are now standing, I suppose, some 500 feet above the level of the sea. The sea is a good many miles from Birmingham, yet if the rise and fall at the coasts were 648 feet, Birmingham might be as great a seaport as Liverpool. Three-quarters tide would bring the sea into the streets of Birmingham. At high tide there would be about 150 feet of blue water over our heads. Every house would be covered, and the tops of a few chimneys would alone indicate the site of the town.

In a few hours more the whole of this vast flood would have retreated. Not only would it leave England high and dry, but probably the Straits of Dover would be drained, and perhaps even Ireland would in a literal sense become a member of the United Kingdom. A few hours pass, and the whole of England is again inundated, but only again to be abandoned.

These mighty tides are the gift which astronomers have now made to the working machinery of the geologist. They constitute an engine of terrific power to aid in the great work of geology. What would the puny efforts of water in other ways accomplish when compared with these majestic tides and the great currents they produce?

In the great primæval tides will probably be found the explanation of what has long been a reproach to geology. The early palæozoic rocks form a stupendous mass of ocean-made beds which, according to Prof. Williamson, are twenty miles thick up to the top of the silurian beds. It has long been a difficulty to conceive how such a gigantic quantity of material could have been ground up and deposited at the bottom of the sea. The geologists said, "The rivers and other agents of the present day will do it if you give them time enough." But unfortunately the mathematicians and the natural philosophers would not give them time enough, and they ordered the geologists to "hurry up their phenomena." The mathematicians had other reasons for believing that the earth could not have been so old as the geologists demanded. Now, however, the mathematicians have discovered the new and stupendous tidal grinding-engine. With this powerful aid the geologists can get through their work in a reasonable period of time, and the geologists and the mathematicians may be reconciled.

I have here a large globe to represent the earth, and a small globe suspended by a string to represent the moon. At the commencement of the history the two globes were quite close; they were revolving rapidly, and the moon was constantly over the same locality on the primæval earth. I do not know where that locality was; it was probably the part of the earth from which the moon had been detached. No doubt it was somewhere near the equator, but the distinction of land and water had not then arisen. Around the primæval earth the moon revolved in three hours; the earth also revolved in three hours, so that the moon constantly remained over the red region. This I can illustrate by holding the small globe which represents the moon in one hand, and making the large globe which represents the earth revolve by the other.

This state of things formed what is known as unstable dynamical equilibrium. It could not last. Either the moon must fall back again on the earth, and be reabsorbed into its mass, or the moon must commence to move away from the earth. Which of these two courses was the moon to take? The case is analogous to that of a needle balanced on its point. The needle must fall some way, but what is to decide whether it shall fall to the right or to the left? I do not know what decided the moon, but what the decision was is perfectly plain. The fact that the moon exists shows that it did not return to the earth, but that the moon adopted the other course, and commenced its outward journey.

As the moon recedes, the period which it requires for a journey round the earth increases also. Initially that period was but three hours, and it has increased up until our present month of 656 hours.

The rotation of the earth has been modified by the retreat of the moon. Directly the moon began to retreat the earth was no longer under an obligation to keep the same face thereto. When the moon was at a certain distance the earth made two rotations for every revolution that the moon made. Thus as I carry the small globe round the large globe the latter makes two revolutions for one revolution of the small globe. Still the moon gets further and further away, until the earth performs three, four, or more rotations for each of the moon's revolutions. Do not infer that the rate of the earth's rotation is increasing; the contrary is the fact. The earth's rotation is getting slower, and so is that of the moon; but the retardation of the moon is much greater than that of the earth. Even though the rotation of the earth is much more than the primitive three hours, yet that of the moon has increased to several times the rotation of the earth.

The moon recedes still further and further, and at length a noticeable epoch is reached, to which I must call attention. At that epoch the moon is so far out that its revolution takes twenty-nine times as long as the rotation of the earth. The month was then twenty-nine times the day. The duration of the day was less than the present twenty-four hours, but I do not believe it was very much less. The time we are speaking of is not very remote, perhaps only a very few million years ago. The month was then in the zenith of its glory. The month was never twenty-nine times as long as the day before. It has never been twenty-nine times as long as the day since. It will never be twenty-nine times as long as the day again.

Resuming our history, we find the moon still continuing to revolve in an ever-widening circle the length of the month and of the day both increasing. The ratio of the day to the month was still undergoing a change. When the moon was a little further off the earth only revolved twenty-eight times instead of twenty-nine times in one revolution of the moon. Still the velocity of the earth abates until it only makes twenty-seven revolutions in one revolution of the moon. This is an epoch of especial interest, for it is the present time. In the present order of things the moon revolves round the earth once while the earth rotates twenty-seven times. This has remained sensibly true for thousands of years, and no doubt will remain sensibly true for thousands of years to come, but it will not remain true indefinitely. Wondrous as are the changes which have occurred in times past, not less wondrous are the changes which are to occur in time to come. The tides have guided our gropings into the past; they will continue to guide our researches to make a forecast of the future.

Further and further will the moon retreat, and more and more slowly will the earth revolve. But we shall not pause at intervening stages; we shall try to sketch the ultimate type to which our system tends. In the dim future, many millions of years distant, the final stage will be approached. As this stage draws nigh, the rotation of the earth will again approach to equality with the revolution of the moon. From the present month of twenty-seven days we shall pass to a month of twenty-six days, of twenty-five days, and so on, until eventually we shall reach a month of two days, and lastly a month of one day. When this state has been attained the earth will constantly turn the same region towards the moon. I do not know what is the locality on the earth which is destined for this distinction.

Here you see that the first state and the last state of the earth-moon history are in one sense identical. In each case the same face of the earth is constantly directed towards the moon. In another way, how different are the first stage and the last. At the beginning the day and the month were both equal, and they were each three hours. At the end the day and the month will be again equal, but they will each be 1400 hours. The moon will then go round the earth in 1400 hours, while the earth will rotate on its axis in the same time. In other words, the day is destined in the very remote future to become as long as fifty-seven of our days. This epoch will assuredly come if the universe lasts long enough. When it has come it will endure for countless ages. It would endure for ever if the earth and the moon could be isolated from all external interference.

We heard a great deal a few years ago about the necessity of shortening the hours of labour. I wish to point out that the social reformers who are striving to shorten the hours of labour are pulling one way, while the moon is pulling the other. The moon is increasing the length of the day. The change will be very gradual, but none the less is it inevitable. Where will the nine-hours' movement be when the day has increased to 1400 hours? This will be a very serious matter, and there is only one way by which it can be avoided. The question is one rather for engineers than for astronomers; but I cannot help throwing out a suggestion. My advice is: Anchor the moon, and keep it from going out. If you can do this, and if you can also provide a brake by which the speed of the moon can be controlled, then you will be able for ever to revel in the enjoyment of a twenty-four-hour day.

Should this engineering feat never be accomplished, then we have only the 1400-hour day to look forward to. Nor is there anything untoward in the prospect, when we take natural selection as our comforter. By natural selection man has become exactly harmonised with his present environment. No doubt natural selection moves at a dignified pace, but so in all truth does tidal evolution. Natural selection and tidal evolution have advanced *pari passu* through all the past millions of geological time. They will advance *pari passu* through all the ages yet to come. As the day lengthens, so will man's nature gradually change too, without any hardship or inconvenience. All that is necessary is plenty of time. Should we think it a hardship that our children should have a day of twenty-four hours and one second instead of twenty-four hours? That the day enjoyed by our grandchildren should be a second longer than the day of our children? That the day of our great-grandchildren should be a second longer still, and so on continually? This would be no inconvenience whatever. No one except the astronomers would be able to detect the change, and daily life would be unaltered. Yet, carry on this process for only 150 million years, and we shall find that the whole change of the day f twenty-four hours to 1400 hours has been accomplished. The actual rate of change is indeed much less than this, and is at present so small that astronomers can hardly even detect it.

Our remote posterity will have a night 700 hours long, and when the sun rises in the morning 700 hours more will elapse before he can set. This they will find a most suitable and agreeable arrangement. They will look back on our short periods of rest and short periods of work with mingled curiosity and pity. Perhaps they will even have exhibitions of eccentric individuals able to sleep for eight hours, work for eight hours, and play for eight hours. They will look on such curiosities in the same way as we look on the man who undertakes to walk a thousand miles in a thousand hours.

I am beyond all things anxious to give you the impression that I am not indulging in any mere romance. No doubt the various figures I have mentioned are but estimates. They may be found to require correction—perhaps large correction; but the general outline of the theory must be true. Should any traces of doubt still linger in the mind of some prejudiced person, let me finally dissipate them. Perhaps some caviller may say, Where are the proofs of all this action of the tides? How do you know that the tides are sufficiently powerful to produce such changes? I believe I have shown this abundantly, but some people require a great deal of conviction. I have therefore kept my best argument for the end.

For an overwhelming proof of tidal efficiency I shall summon the heavens themselves to witness, and I shall point to the stupendous task which tides have already accomplished. As the moon has made and is making tides on the earth, so the earth once raised tides on the moon. These tides have ceased for ages; their work is done; but they have raised a monument in the moon to testify to the tidal sufferings which the moon has undergone. To that monument I now confidently appeal. The moon being much smaller than the earth, the tides on the moon produced by the earth must have been many times as great as the tides on our earth produced by the moon. It matters not that the moon now contains no liquid ocean. Nor does it matter whether the moon ever had a liquid ocean. In very ancient days the moon was not the hard, rigid mass which it now appears. Time was when the volcanoes raged on the moon with a fury which nothing on our earth at present can parallel. The moon was then in a soft or a more or less fluid condition, and in this viscous mass the earth produced great tides.

Great tides in truth they were, for the earth is eighty times as heavy as the moon. On the other hand, the moon is only one-fourth the diameter of the earth; so that the actual height of the tides on the moon would be still many times as great as the tides on the earth. When the moon was nearer to us, as it was in early ages, those tides were still greater. Think for one moment of what a lunar tidal wave of such magnitude would be capable. This wave is perhaps of molten lava; it would tear over the surface with terrific power, and anything that friction could accomplish that great current would do. That tidal current has done its work; even if the moon were fluid at the present day it could no longer be distracted by tides. Remember, it is not the mere presence of the tide which produces friction. It is the action of the tide in rising and in falling which accomplishes the work. If, therefore, the moon moved so that it was always high tide at the same place, the tides could produce no further effect. The spot where the tide is high on the moon is the spot which is towards the earth. It hence follows that the action of the tides will cease when the moon constantly directs the same face to the earth. The moon has thus at length gained a haven of rest from a tidal point of view. No doubt the moon has a high tide and it has a low tide, but those tides no longer ebb and flow: the moon has succumbed to the incessant action of friction, and has assumed the only attitude which can relieve it from incessant disturbance.

For many centuries it had been an enigma to astronomers why the moon should always turn the same face to the earth. It could be shown that there were many million chances to one in favour of this being due to some physical cause. The ordinary theory of gravitation failed to explain the cause. Every one had noticed this phenomenon. Yet the explanation was never given till lately. It was Helmholtz who showed that this was a consequence of ancient tides, and this simple and most satisfactory explanation has been universally accepted. The constant face of the moon is a living testimony to the power of the tides. What tides have accomplished on the moon is an earnest of what tides will accomplish on the earth.

In the great conflict of the tides the earth has already conquered the moon, and forced the moon to render perpetual homage as a token of submission. Remember, however, that the earth is large, and the moon is small. Yet small though the moon is, it gallantly struggles on. "You have forced me," cries the moon to the earth, "to abandon the rotation with which I was originally endowed; you have compelled me to rotate in the manner you have dictated. I will have my revenge. It is true I am weak, but I am unrelenting; day by day I am exhausting you by the tides with which I make you throb. The time will assuredly come, though it may not be for millions of years, when you shall be forced to make a compromise. When that compromise is made the turmoils of the tides will cease; our mutual movements will be adjusted. With equal dignity we shall each rotate around the other; with equal dignity we shall each constantly bend the same face to the other."

There is another point to be considered. We must not forget that there is a sun in the heavens as well as a moon. The sun also produces tides in the earth. Those tides were much smaller than the lunar tides, so that we could afford to neglect them. But we have seen that the lunar tides will gradually decrease to nothing. It behoves us then to consider what the solar tides can effect which shall be worthy of our attention. In a lecture which I gave here some years ago, I made allusion to the discovery of the satellites of Mars. I mentioned that one of the satellites of Mars presented a phenomenon unparalleled in the solar system. The satellite revolved around Mars in a period of seven hours, while Mars himself rotated on his axis in a period of twenty-four hours. We here actually find the moon of Mars rotating around Mars in much less than one of Mars' own days. This was a most curious and unexpected circumstance, but the observations of the discoverer, Asaph Hall, placed the great fact beyond any doubt. The mystery has now been explained. It is due to the action of the solar tides on Mars. Nay more, we can actually foresee that at some incredibly remote future time our earth and moon are destined to present the same movements which have seemed so anomalous in Mars.

Left to themselves, the earth and the moon would have remained for ever in the condition of compromise. The moon would have revolved round the earth in 1400 hours. The earth would have rotated on its axis in 1400 hours also. But now the solar tides intervene. They have little effect upon the moon; it revolves as before, but the solar tides begin to retard the earth still further. Instead of a period of 1400 hours, the earth will have a still longer day, so that finally the moon revolves more rapidly around the earth than the earth rotates on its axis.

It seems to me that the episode I have mentioned is one of the most interesting in the whole of modern astronomy. We have first a most delicate telescopic discovery of the tiny satellite of Mars and of its anomalous movements. We then have a beautiful explanation of how this anomalous motion has arisen from the action of solar tides. Finally we have in this miniature system of Mars a foreshadowing of the ultimate destiny of our earth and our moon.

Do I say the ultimate destiny? Nothing is ultimate in nature. The moon and the earth would have come to an amicable and a final agreement had they been let alone. But now the sun has intervened and disturbed the earth's rotation. The truce once broken, the moon again produces tides on the earth, the earth reacts on the moon, and a whole chain of complicated movements are the consequence. I shall not now attempt to trace the further progress of events.

I have dealt with very large figures in this lecture, and perhaps I have taxed your imagination by my demands that you should conceive of periods of tens of millions of years. Yet after all let us look at the results in their true proportion, compared with the universe in which our lot has been cast.

Truly we have been engaged with a very trifling matter. Is not our earth one of the most insignificant bodies in the universe? And our moon is much smaller still. Nor is it even the life-history of our earth that we have been considering, it is merely a brief episode in that history. What are the periods of time we have been discussing when compared with those infinitely longer periods during which the solar system has been evolved? Even the solar system is but one out of one hundred million such systems, each of which has its own life-history. Viewed in their true proportions, the phenomena I have described are but of infinitesimal importance, and the time they have occupied is merely ephemeral.

No doubt we have only dwelt upon the tides on the earth and the tides in the moon, which have been of such infinite importance. But do not suppose that tides are confined to the earth and to the moon. So far as we know, every body in the universe is capable of producing, and actually does produce, tides in every other body. Every planet throbs in response to the tides produced in it by every other planet. Every star has a distinct tidal wave produced in it by every other star. You may say that such tides are infinitesimal, but you must remember that infinitesimal causes, sufficiently often repeated, can achieve the mightiest effects.

We know that tides have wrought our solar system into its present form; and are we to say that the wondrous powers of the tide have no grander scope for their exercise? I prefer to believe that tides operate far and wide through the universe, and that in the recognition of the supreme importance of tidal evolution we mark a great epoch in the history of physical astronomy.

POPULAR NATURAL HISTORY[1]

THE present volume of this finely illustrated work finishes the account of the Vertebrates with the history of the Fishes, and gets over as well an immense mass of the Invertebrates. The story of the Fishes is contributed by Prof. H. G. Seeley, who, in the limited compass of 150 pages, of which about one-sixth is occupied with figures, has given a very fair and comprehensive notice of this class. The Fishes are the only primary division of the Vertebrata which live in water, and have no representatives passing their lives upon land or in the air. This condition of existence is probably the cause of the close correspondence in bodily form in the majority of fishes, which progress through the water chiefly by movements of the tail, and use the fins as organs with which to steer a path. "Clear as is the idea which rises in the mind at the mention of a fish, the multitude of forms which fishes exhibit are greater, perhaps, than those to be found in any of the other great groups of Vertebrate animals described in the previous four volumes of this series. The slender form of the lamprey or eel contrasts with the expanded body of the turbot or the plaice; the short deep form of the sun-fish is unlike the broad, flattened, and long-tailed skate; the sea-horses, when attached to sea-weeds by their prehensile tails, at first sight present none of the familiar characteristics of fishes. The flying-fish, which have the fins so expanded as to serve some of the purposes of wings, present a remarkable contrast to the spheroidal spiny body of the globe-fish, while the hammer-headed shark exhibits a form of body in some respects more singular still. When we turn to details of proportion and structure, and contrast the shapes of the head or of the tail, the variety among fishes is altogether exuberant."

As an illustration of the woodcuts to be found plentifully in this volume, we select a sea-horse some time since described by Dr. Günther, the strange *bizarre* form of which will at once attract attention. The illustration is a very fair copy of the beautifully-drawn figure of Mr. Ford in the *Proceedings* of the Zoological Society of London for 1865, and represents, of the natural size, a specimen of *Phyllopteryx eques* from South Australia. "There is no doubt," writes Dr. Günther, "that these fish attach themselves with the prehensile end of their tails to stems of sea-weed and other objects; and when they are in the vicinity of sea-weed of a similar colour to themselves, their resemblance to it must be so great that they would easily escape being observed by their enemies." We fancy that Prof. Seeley is wrong in stating that, "as the name implies, this fish has very much the aspect of a moving plant." The idea in Swainson's mind was doubtless nearer to the actual meaning of the words he formed the generic title from—that of leaf-winged—and we may venture to call Dr. Günther's species the Leaf-finned Sea-horse.

The section on Fossil Fishes is very short, but a great deal of information is contained therein. "A large proportion of fossil fishes belong to the division Palæichthyes. This group comprises most of the fishes which have been met with in the primary rocks and many of those found in the Secondary strata; but in Tertiary deposits the Teleostean division is quite as well represented in the geological formations as in existing seas. There is no evidence of any gradual succession of fishes in the order of increased complicity of structure, as the deposits in which they occur approach nearer to the present day, and there is no reason to suppose that the oldest fishes known were the first that appeared upon the earth. The earliest fishes discovered were met with in the Lower Ludlow rocks, which form the upper part of the Silurian strata. The most ancient genus is Scaphaspis, a small buckler-headed fish, which had the body covered with scales. Many allied genera are found in the overlying Old Red Sandstone, in which fishes appear in extraordinary variety. Among the allies of Scaphaspis are Pteraspis, Cephalaspis, &c., some of which range down to the Silurian rocks. Near to these fishes must be placed Coccosteus, Pterichthys, and the immense American fossil of Devonian age named Dinichthys. These fishes are thought to be related to Ganoids and Sharks, but in external form they more closely approximate to Loricaria, though the tail is heterocercal. They form a distinct group named Placodermi."

While four volumes and a goodly portion of a fifth are devoted to the Vertebrata, there are not wanting signs that the immense divisions of the animal kingdom here grouped as Invertebrata are to be treated of after the usual stereotyped fashion, and that at most one further volume will bring this series to a close. The Invertebrata, we are told, are divided into great types, or groups, which are (1) the Mollusca; (2) the Arthropoda; (3) the Vermes; (4) the Echinodermata; (5) the Zoophyta; and (6) Protozoa. "These great divisions are not exactly

[1] "Cassell's Natural History." Edited by P. Martin Duncan, M.B., F.R.S. Vol. v., illustrated. (London: Cassell, Petter, Galpin, and Co., 1881.

defined in nature, and they are subdivided into secondary groups, and are also united in some instances by forms of life which cannot well be placed in any particular one." We presume these "latter forms of life" are those called "intermediate groups," which are "(1) the Tunicata, which have a more or less leathery or cartilaginous covering sac." "They may be placed in the neighbourhood of the Vermes and Mollusca in their classification." "(2) The Molluscoida, which have the body with shells placed differently to those of the Mollusca, or have a tubular or shell-like covering." "The Bryozoa and Brachiopoda are included in this group, and in their structures, embryonic and adult, they show resemblances to those of Vermes, Mollusca, and Tunicata."

The chapters on Mollusca and Tunicata are by Dr. Henry Woodward; the Bryozoa and Brachiopoda by Agnes Crane; the introduction to Insecta and the account of the order of the Hymenoptera is from the pen of Mr. Dallas, and the chapter on the order of Coleoptera is by Mr. Bates. In passing we may note that the reader will find no hint that the Arthropods are jointed-limbed animals containing the Crustacea and Arachnids, unless incidentally when Mr. Dallas is describing the true Insect type.

It is scarcely necessary to state that within the limits at his disposal Dr. H. Woodward has given a very interesting account of the Molluscan forms. We are glad to note too that he has devoted a good portion of his space to an account of the Cuttle-fishes, which is more exciting and interesting reading than the necessarily brief accounts of such families as those of Cancellariadæ and Pyramidellidæ. The chapter on that "intermediate type," the Tunicata, is poor indeed, and not what we should have expected from its author. Surely we have

The Leaf-finned Sea-horse.

learned something more of this group since the writings of Forbes and Savigny.

The chapters on the Brachiopoda and Bryozoa by Agnes Crane appear to be extremely carefully written. The illustrations—many of them—are refreshingly new, and taken from the best of sources. We altogether disagree with the authoress as to adopting the name of Bryozoa for the group she calls Sea-mosses, but she states the case for and against the use of the term Polyzoa most fairly; and nowhere have we met a more neatly compiled account, brought down, too, to the very latest date of this group—even the facts brought to light by the expedition of the *Challenger* are alluded to therein.

The introduction to the group of Insects is remarkably well done. The classification is primarily based on the presence or absence of a perfect metamorphosis, and the secondary divisions are based on the structure of the mouth. As for certain small groups of insects which undergo no metamorphosis at all, "They may be residues of groups formerly more numerous and abundant, in which case they ought probably to be kept distinct from the other existing orders of Insects," or as we prefer to think, "they may be degraded representatives of the orders to which they appear to be most nearly related." The account of the first order on the list, that of the Beetles, is written by H. W. Bates, and few possess more knowledge of the many forms that compose this group. It need not be said that he does not attempt to treat of the 80,000 and upwards of known forms in the fifty pages at his service, but from what he tells us of the habits of those he does describe, we feel our interest in the subject increasing, until, when we come to the account of the Ladybirds, "upwards of 1500 species of which are known," we feel sorry that we have come to the very last line long ere the author had evidently come to the last of his subject.

We give, through the courtesy of the publishers, another illustration taken from the chapter on Weevils. It is of a weevil known as *Rhyncophorus palmarum*. Its fat grubs live on the stems of palm-trees, and are often very destructive. Several of the species are very injurious to the sugar-cane. One found in sugar-plantations in Guiana contain in their intestines lumps of a sweet waxy substance—the altered saccharine food on which they

The Palm Weevil.

live—and for this they are boiled and eaten by the natives. The fine fat larva and the pupal condition, as well as the full-grown weevil, are to be seen in the engraving.

The account of the immense and important order of the Hymenoptera is written by Mr. Dallas; but only the history of the Aculeata is here given, and the other sections are reserved until the succeeding volume

AMI BOUÉ

THE decade which closes this year will remain a memorable one in the annals of geology for the great names which appear in its obituary. Not a few of the early leaders, to whom it was possible to master fully every department of the infant science and to strike out into new untrodden paths in almost any direction, have lived on to witness the vast development of the studies which they did so much to foster. In this country we have lost only lately Murchison, Sedgwick, Lyell, Phillips, Scrope, whom we early learnt to reverence as demi-gods of the heroic age. And now to these names another falls to be added which, though not that of a Briton, has long been a household word among the geologists of this country. The veteran Ami Boué has just passed away. Ripe in years and universally honoured, he has remained perched on his beloved mountain slopes like a boulder stranded above the reach of the all-devouring sea. But the tide of mortality has at last swept him away, and has thus broken one of the most interesting ties that bound us to the early days of geology. Having for many years enjoyed the privilege of his friendship and having heard from his own lips many of the incidents of his life, I am able to give here a few personal reminiscences which may be of general interest at the present time, without at present attempting to offer any summary or review of the scientific work of his life. It is much to be desired that his own notices of his life should be published. His early wandering years were especially eventful, and their history is intimately bound up with that of the science which he cultivated with so much ardour.

Ami Boué was born, so far as I can make out, on March 16, 1794, so that he had reached the eighty-eighth year of his age. He was descended of an old French family, and could trace his pedigree back for some four centuries. In the time of Louis XIV., when so large a part of the Protestant population fled on the Revocation of the Edict of Nantes, his ancestor escaped from Bordeaux in a barrel. The family went first to Amsterdam, and finally settled at Hamburg. His mother's family belonged to an Alsatian stock, by name Roth-Hut, which, when they came to Geneva, was changed into Chapeaurouge. She was the daughter of a rich merchant who had established himself at Hamburg, but she was sent at an early age to her relatives in Geneva. Hence French became her early, and to the end of life her natural, language, for though she returned to Hamburg and married there, she never acquired fluency in German, and French was the language in which she always talked to her children. Thus, though born in Hamburgh, Boué spoke and wrote French, and not German, as the language of his boyhood. Both his father and mother appear to have died when he was still very young. He was accordingly sent to the care of his uncles in Geneva to be educated. It was intended that he should enter the mercantile life, in which most of his relatives were engaged. But at that time the French were menacing Hamburg, and the state of Europe was so unquiet that his guardians, deeming him safer in Geneva, kept him there studying jurisprudence. His tastes were already, however, strongly turned towards natural science, and he threw himself heartily into the pursuit of mineralogy and botany. He was accordingly allowed to prosecute these studies, in which he made considerable progress. The political horizon continuing still ominously dark, Boué's future was somewhat uncertain. There was family property enough in Hamburg to secure a small competence for himself and his brothers; but it consisted of property and stock which might be destroyed by the French, as had happened already to one of his uncles. So his guardians determined that he ought to have some profession to fall back upon in case of the destruction of the Hamburg property. He chose medicine as the career that promised most facilities for prosecuting natural history studies. Britain offering at that time the only safe retreat for him, he was sent to the medical school of Edinburgh University. As he used to say himself, "I really went to Scotland to escape from Napoleon." Coming with good introductions from Prevost of Geneva and others to Dugald Stewart and other eminent men, he found a welcome in the most cultivated society of Edinburgh. For three months he employed himself principally in acquiring English, which he eventually mastered sufficiently to be able to read it fluently, and with less success to speak and write it. To the end of his long life he was glad of every opportunity of using his knowledge of English. His letters to me were always in English, closely written, without spectacles, in an almost microscopic handwriting, and not seldom sealed with a thistle and "Dinna forget," which he cherished as one of the souvenirs of his student days in Scotland. He studied chemistry under Hope, and took voluminous notes in French, which he had carefully preserved. He knew more botany, he used to say, than his professor, and profited nothing by that class. But the natural history class under Jameson greatly stimulated his mineralogical and geological zeal. In the fortnight between the winter and summer sessions he would always rush off for an excursion into some part of the country with hammer, bag, or vasculum. The long autumn vacation, too, was put to a similar use. In this way he made himself personally familiar with much of the Scottish Highlands, including Mull and Arran. He extended his rambles into the basaltic tracts of the north of Ireland, and visited also the Lake District and part of Derbyshire. Besides receiving the friendly assistance of his teacher, Jameson, he was intimate with Playfair, and accompanied MacCulloch in his yacht round Arran.

Meanwhile events of worldwide importance and of the utmost interest to Boué had been rapidly passing on the Continent. The final disaster at Waterloo, by shattering Napoleon's power, had freed Boué's Hamburg property from all risk of attack, and left him at liberty regarding his future career. He resolved to complete his medical education, and accordingly took his degree at Edinburgh in 1816. During the course of his medical work he had made many researches and experiments with the view of offering as his graduation thesis a treatise, *De Urina*. But finding he could not afford to publish so voluminous a mass of materials as he had collected, he chose another subject to which he had likewise given much attention—the causes of the present geographical distribution of plants. He was at that time much impressed by the writings of Humboldt on kindred topics, and in the course of his rambles over Scotland he had been in the habit of noting carefully the relations between the flora of each district and its geological structure. Accordingly he duly presented to the Senatus a Latin thesis, "De Methodo Floram regionis cujusdam conducendi, exemplis e florâ Scoticâ &c., ductis, illustrata." It was characteristically and gratefully dedicated to his maternal uncles and guardians.

Having graduated as a doctor of medicine at Edinburgh, he left Scotland immediately thereafter, and went to Paris to prosecute his studies in physics and chemistry. While thus engaged he brought together the large collection of notes he had made in Scottish geology, and elaborated them into his well-known "Essai Géologique sur l'Écosse" a work which will always rank as one of the early classics of the science. Unfortunately for the book he left Paris on his travels before it had passed through the press. He placed the revision of the proofs in the hands of a friend, and hence many errors crept both into the text and the plates.

Being now free to move about as he chose, he devoted himself with all the ardour of his enthusiastic nature to the prosecution of geology. He personally visited most of the more interesting tracts of France and Central Europe, but finally devoted himself to the eastern regions, as being those about which least was known. At the age of thirty-two he married a lady six years younger than himself, who accompanied him in many of his journeys, and who now survives him. The best evidence of his constant industry is furnished by the list of papers and memoirs, some 200 in number, which during his long life he published in the scientific journals of Europe. Some of his best work was done in Turkey, of which country indeed he was the first great geological explorer. The volumes in which he embodied the results of his researches there show at once his skill as an observer and the quiet indomitable courage with which he must have faced every kind of privation and even danger. On one occasion, as he told me, he was poisoned by his servant—a nobleman, who leaving him for dead, made off with the carriage and everything belonging to the poor traveller except his watch, which, being only of silver, was not considered worth stealing.

After some years spent in field-work he published at Paris (1835) his excellent "Guide du Géologue-Voyageur," in which he gives the sum of his own practical experience, with a digest of what had been done by others. Though much of these two little pocket volumes has been superseded by the progress of science, they remain as an admirable summary of the geology of their time, while many of their sound practical directions may be usefully read and remembered in all time coming. The closing sentences of the preface may be quoted here for their personal reference. "Thrown from my earliest days on the highways of the world, as most of my kin have been, having spent my life among seven capitals of Europe, and having near relatives in a dozen cities of the north-west and centre of this continent, my travelling disposition may be easily understood, and my irresistible tendency to a vagabond life. I was left an orphan at eleven years, and became entirely master of my own movements at twenty. This want of a fixed residence, this facility of moving about and making myself at home everywhere, adopting the customs and language of each country, must naturally have taught me to travel, and may to some extent excuse my pretension to say more on these matters than others. I have traversed a good part of Europe, and have been able to examine in detail all the formations of this continent. In spite of trying adventures, it is no mere invalid who now speaks and bids adieu to an active life, but one who, having seen much during a period of twenty years, believes that he may usefully recapitulate his observations for the benefit of his fellows, before again starting on the wandering life to which fate seems to have condemned him. The West flees from me, the East summons me; my grave shall be where heaven may please." During one of his sojourns in Paris he and a few others founded the present distinguished Geological Society of France. In a letter which I had from him at the time of the jubilee of the Society last year, he writes: "The Geological Society of France was created in my library room, April 1, 1830; present were Brongniart (Alex.), Cordier, Férussac, Blainville, Constant Prevost, Jobert—all dead. [This is not quite correctly remembered; for the meeting took place on March 17, 1830, in the rooms of the Philomathic Society of Paris, Boué himself in the chair.] They wish I should preside at this solemn meeting, but at eighty-six years of age, with my infirmities, it was impossible." He was one of the early presidents of the Society, and through life continued to take a paternal interest in its welfare.

Some forty years ago or more, after many wanderings in Austria and the adjacent countries, Boué obtained a piece of land at Vöslau, on the last spurs of the Eastern Alps, looking over the great plain which stretches eastwards to the Carpathian mountains. There were at the time few or no houses about the place, and the three or four acres acquired by Boué were a free gift from the proprietor to encourage building there. Now it is a fashionable watering-place for the Viennese, with numerous villas and hotels gathered round a copious hot spring, the water from which is caught in a swimming basin. I visited the veteran there in 1869, and found him established for the summer among his vineyards and his orchard well stocked with quinces, almonds, peaches, and apples. He had no children, but had adopted as a daughter a relative of his wife. It was charming to see the enthusiasm with which he threw himself into everything that he did. In spite of severe suffering and numerous operations of lithotomy he still retained, for an old man of seventy-five, an extraordinary vigour and vivacity. He made wine enough not only to supply his own needs, but to sell to the dealers, and looked after every detail of the process as if wine-making had all along been the only occupation of his life. He took me with him on some interesting excursions in the neighbourhood, and warm though the weather was, he walked at a pace to which even young geologists are not accustomed in this country. It was delightful, too, to listen to his reminiscences of old times. He had known most of the geologists of note of the century, and had corresponded with all of them. He had amusing little personal recollections to give, mostly in English, which he would now and then, when the words failed him, exchange for German. He remembered down to the minutest details his life at Edinburgh and his rambles in Scotland. Now and then in a pause of our talk, as his memory drifted back again into the old student days, his face would lighten up with a sudden gleam of satisfaction as he would question me as to some quarry or brook-section he had visited more than half a century before, and which stood out as distinctly as if it were again in front of him. At his town house in Vienna, whither he used to return for the winter, he showed me his tabulated geological indices, in which he said that every geological work or memoir published in his time in every language was catalogued. It is much to be desired that these indices, which were carefully written out by himself, should be promptly published. They are particularly full, I believe, in the department of physical geology. Up to the last he retained his interest in the progress of the science, and communicated thoughtful papers on the work of others when no longer able to make original researches himself. The many long letters he wrote to me were always full of gossip as to the doings of his friends in Vienna, and shrewd remarks on passing events, scientific or otherwise. They were always in English, as I have said, but often with such strange idioms and spelling as occasionally made their meaning not very clear. I am tempted to give a quotation from one which I received from him in November, 1870, during the time of the Franco-German war:—"I was retain to late in the country this year by bad weather. My vintage did protract itself so late in October that we are hardly established comfortably now in town. Besides, the dreadful war preoccupations did take me all time from thinking at scientific matter, and now perhaps that distress will approach till nearer our abode. When you will know that I have very good and near parents in both armies and you perceive the possibility of parents killing themselves without recognising themselves, nor having the opportunity to do so, you will understand that I have often headach when I ride the newspapers or hear from the quite useless slaughters which have been prevented only by those men at the head of the human Society. I have parents in Paris, other exiled in Spain in England in Switzerland. The country houses of some by Paris are German hospitals or barracks. . . . As descending from Frenchmen I fill myself quite happy to be a German and to have remain such my whole life on."

With the regret that accompanies the severance of a tie that links us with so many interesting associations of the past there mingles in no common measure the feeling of personal bereavement. Retired for so many years in his Austrian retreat, Boué kept up the freshness of his youthful sympathy with progress and the kindliness of his hearty exuberant nature. May the dust lie light on his honoured head! To have even seen his round, good-natured face and sparkling eye was something to remember with satisfaction; but to have been privileged with his friendship was an honour the recollection of which will be more than ever precious to those from whom it has now been for ever withdrawn.

ARCH. GEIKIE

NOTES

THE International Exhibition of Smoke-abating Appliances at South Kensington was opened yesterday with great *éclat*. The opening meeting was held in the Albert Hall, the Lord Mayor in the chair, supported by the Marquess and Marchioness of Lorne, Doctors Siemens and Frankland, Captain Galton, Sir H. Thompson, Lord Aberdare, and many men of science and others interested in the movement. The following awards will be made :—A prize of 100 guineas, given by Dr. Siemens; two prizes, together of about 100 guineas, given by ladies interested in the National Health and Kyrle Societies, for the best domestic fire-grate; the Society of Arts medals; a prize of 50*l.*, given by the Manchester Association for the Prevention of Noxious Vapours, and certificates to be awarded by the Council.

THE Annual Meeting of the Royal Society was held yesterday. The usual business was transacted. Part of the President's interesting address will be found in another column.

MR. H. N. MOSELEY, F.R.S., has been elected to the Linacre Chair of Physiology in the University of Oxford, vacant by the death of Prof. Rolleston. We heartily congratulate Prof. Moseley and the University of Oxford, whose appointment must be regarded with genuine satisfaction.

BARON NORDENSKJÖLD was in town for a few days last week, leaving again on Sunday, much to the disappointment of many who wished to make up for the poor reception he met with when he called here on his way home round Europe and Asia. It will be remembered that he reached London on a Good Friday, when no one expected him, and when we were in the throes of an exciting parliamentary election. His present visit was therefore looked forward to as affording an opportunity of showing worthily England's appreciation of his great work. Unfortunately, however, he was compelled to leave before anything could be done. Baron Nordenskjöld's narrative of his great voyage will be published in a very few days, and will, we believe, besides describing the incidents and discoveries of his own voyage, contain a narrative of research on the northern shores of Europe and Asia from the earliest times down to the present day. Its scientific value is likely to be very great.

IN consequence of an appeal from Mr. Leigh Smith's relations and friends, the Council of the Geographical Society on Monday last resolved to ask the First Lord of the Admiralty to receive a deputation from their body, accompanied by experienced Arctic navigators, who will urge upon him the necessity for taking immediate steps for the relief of the *Eira*. It is considered by Mr. Smith's friends that a well-equipped and commanded steamer alone can meet the requirements of the case, as it is not impossible that the *Eira* may have met with some serious disaster, and that it would certainly be necessary to visit without delay Eira Harbour and other points on the south coast of Franz-Josef Land. Perhaps a more modest request that two or three gunboats should at once be ordered to cruise up and down the ice-limit during the winter, and keep a bright look in all directions, might receive more attention, and would in the end probably prove as effective, and certainly less dangerous than the other plan. The *Eira* left Peterhead in the middle of June, and appears to have been only once spoken, viz. by the Norwegian vessel *Proven*. She first met the *Eira* on June 30, steering for the Matyushin Shar, and eight days later met her again steering a northerly course. It may fairly be assumed, therefore, that in the mean time Mr. Leigh Smith had made an ineffectual attempt to pass through the strait.

IN his report for the present year General W. B. Hazen, Chief Signal Officer of the United States, makes some useful remarks on International Polar research. From the progress made by the Signal Corps in the study of meteorology in late years, it has become clear that, owing to the very mobile nature of the atmosphere, the changes taking place in one portion of the globe—especially the Arctic zone—quickly affect very distant regions. The study of the weather cannot be properly carried on without a daily map of the whole of the northern hemisphere, and the great blank space of the Arctic region has long been a source of regret. General Hazen was, therefore, glad to cooperate in the work of the International Committee on Polar Research in their project for forming Arctic and Antarctic Stations. Their general object will be to accomplish by observations made in concert at numerous points such additions to our knowledge as cannot be acquired by isolated or desultory travelling parties. No special attempt will, he says, be made at geographical exploration, nor will there be any endeavour to reach the North Pole. The U.S. Signal Service undertook to organise two of these expeditions this year, one of which, as we know, was safely established under Lieut. Greely, in August last, at Discovery Harbour, Lady Franklin Bay, and we are glad to be able to announce that the other, under Lieut. Ray, was left in safety at Point Barrow on September 17 by the *Golden Fleece*, in which vessel it had been conveyed from San Francisco. The position of the former station, we may add, is in N. lat. 81° 40′, W. long. 64° 30′.

ON Monday last an unusually interesting paper was read before the Geographical Society by Mr. E. C. Hore of Ujiji, on his experiences in East Central Africa, and more particularly on Lake Tanganyika. His knowledge of Lake Tanganyika is unrivalled, as he has examined it carefully along its whole coast-line of some 900 miles, and he has crossed it in various parts. His description of the River Lofu, at the southern end, was very effective, and the same remark applies to the scenery of various parts of the lake-shore. Mr. Hore says that there are ten tribes living along its coast region, and he referred to their industries, including peculiar modes of fishing, and the species of co-operation among them which raised them far above the level of the natives on the sea-coast. He mentioned a number of the products of the country, among which are various kinds of timber used for making canoes, spear-heads, &c. Two species of crocodile are found in the lake, and Mr. Hore created some amusement by saying that Stanley's water-hyænas, on investigation, turned out to be otters. Owing to the singular formation of the lake, its depth is a matter of some interest; but all Mr. Hore can say is that he could obtain no bottom with about 170 fathoms of line. Among the other matters dealt with were visits to the Lukuga outlet of the lake, the current of which has lately got much slacker, and the Malagarasi, one of the largest rivers emptying into the lake. At Mr. Hore's first visit the latter was 500 feet broad, with a swift current and rapids five and a half miles from its mouth. On subsequent visits the channel was found comparatively empty, a result largely brought about by the lowering of the lake level.

MR. E. C. HORE has presented to the Geographical Society the map of Lake Tanganyika which he constructed from careful surveys and observations made during his various explorations, the results of which he described in his paper above referred to.

M. PLATEAU describes as "*un petit amusement*" the following experiment :—A flower like a lily, with six petals each about an inch long, was constructed in outline in thin iron wire; the wire being first slightly peroxidised by dipping for an instant into nitric acid. This wire frame was then dipped into a glyceric-soap-solution, which, when it was withdrawn, left soap-films over the petals. The stalk was then set upright in a support, and it was covered by a bell-glass to protect it from air-currents. In a few moments the most beautiful colours made their appearance. If the solution is in good condition the films will last for hours, giving a perpetual play of colour over the flower.

THE stories which we have from time to time heard respecting an alleged discovery of relics and journals of the long-lost explorer, Dr. Ludwig Leichhardt, and upon which discredit has lately been thrown, would appear to have some foundation after all, for by the last Australian mail news has been received that the New South Wales Government have agreed to the somewhat exorbitant demands of the bushman, Mr. J. R. Skuthorpe, and will give him 6000*l.* for the relics, &c., provided their genuineness be established by certain tests. Mr. Skuthorpe has now no excuse for keeping his alleged "find" buried in the far interior, and it cannot be long before the matter will be settled one way or the other. Mr. Skuthorpe is stated to have given an outline of the contents of the journals, among which are accounts by Classen of Dr. Leichhardt's death and his own life among the natives.

PROF. HAECKEL is at present in Ceylon, where he is to stay for three months for a scientific exploration of the island.

THE German Government is considering the participation of German men of science in the plan of International Polar Research. The Reichstag has been asked to grant the necessary funds, which are fixed at 300,000 marks (15,000*l.*). Besides this sum 180,000 marks (9000*l.*) are asked for the Transit of Venus Expedition in 1882, and 75,000 marks (3750*l.*) for expeditions to Central Africa.

THE forthcoming lecture arrangements at the Royal Institution will include the usual Christmas course of six lectures, to be given this year by Prof. R. S. Ball, the Astronomer-Royal of Ireland, on the Sun, Moon, and Planets (with illustrations by the electric light, &c.). Eleven lectures by the new Fullerian Professor of Physiology; four lectures by Prof. H. N. Moseley on Corals; four lectures by Dr. P. L. Sclater on the Geographical Distribution of Animals; three lectures by Prof. Tyndall; four lectures by Prof. Pauer on Louis van Beethoven (with illustrations on the pianoforte); four lectures by Mr. W. Watkin Lloyd on the Iliad and Odyssey. The Friday evening meetings will begin on January 20 at 8 p.m. Dr. W. Huggins will give a discourse on Comets. Succeeding discourses will probably be given by Mr. R. S. Poole, Professors Odling, Frankland, J. G. M'Kendrick, and W. E. Ayrton, Capt. Abney, Mr. A. Tylor, Mr. J. W. Swan, Mr. W. Spottiswoode, and other gentlemen. Mr. H. H. Statham's four lectures on Ornament, delivered at the Royal Institution, are to appear in the Portfolio for January and following months.

PREPARATIONS are being made in Edinburgh for the celebration of the centenary of Sir David Brewster's birth next month.

MR. EDISON has entered the field of competitors in the construction of storage batteries for electric currents. His particular method of storing currents has however not yet been made public.

THE *Daily News* Naples correspondent writes that a small party of travellers is proceeding to India, one of whom is Paolo Mantegazza, the organiser of the expedition, the object of which is, on his part, to make anthropological studies of the Indian races, and to collect skulls and bones for the Museum at Florence. One of his companions, Signor Fabricotti, a naturalist, will collect animals and plants, and the other, Signor Michela, an artist, will reproduce or copy the antique Indian ornamentation of the monuments, china and bronzes, that adorn Indian temples and houses. Signor Mantegazza is particularly interested in the races of the Himalaya, and, after a general survey of India, it is to this region that the attention of himself and of his companions will be especially devoted.

HERR J. N. AROSENIUS gives in the last number of the *Zeitschrift für die wissenschaftliche Geographie* (vol. ii. fascicule 5), an account of the ethnographical frontier between Finns and Swedes in Northern Sweden. This frontier does not coincide either with the old one, which ran along the range of hills between the Torneo and Kemi rivers, or with the present one which runs along the Torneo. It begins on the shore of the Gulf of Bothnia, between the post stations Sangits and Säivits, and runs straight north to the Kengis iron-works. But some three or four hundred miles south-west of this frontier there are in Sweden numerous small patches inhabited by Finns, which patches make a broken chain going from the Wermland to the Medelpad province. The flat land and the valleys altogether are inhabited by Swedes, but nearly everywhere in the most remote parts of the forest are to be found one or several Finnish houses, built in the old Finnish fashion. Isolated in the wilds, Finnish people in Sweden gradually forget their former language, and mostly speak Swedish, especially after having reached a certain age. In the province of Dalarne the Finnish language is quite forgotten by the Finns, and their origin can be discovered only by their customs, dwellings, and by very few remains of their former language; thus M. Arosenius has seen a woman who knew only a single Finnish sentence, one of the most frequently used, however, "Light me the pipe." As to the remains of Finnish population in the province of Smaland, the question still remains open; but it is proved that there are remains of two different peoples, one of which must have been of Lapp origin, whilst the other, which knew the use of bronze implements and agriculture, must have been, M. Arosenius thinks, Finnish.

DON JUSTO ZARAGOZA contributes to the *Boletin* of the Geographical Society of Madrid a series of interesting papers on ancient canal schemes between the Atlantic and the Pacific in Central America. There were three places which the Spanish of the sixteenth century thought of for these schemes: the isthmus of Tehuantepec in New Spain, now Mexico; the river of San Juan, of the Lake of Nicaragua, in the republic of the same name; and the Chagre River, and other parts of the Isthmus of Panama. The investigation of Tehuantepec was abandoned at that time, to be renewed in our century; those of Nicaragua were actively pursued in the seventeenth century, and were nearly being executed about the middle of the eighteenth century, during the reign of Charles III., and the scheme of a canal through the Isthmus of Panama, also abandoned, has now been renewed by M. Lesseps. In the paper published in the October number of the *Boletin* D. Zaragoza gives interesting information on the little-known scheme of a canal *vià* the Lake of Nicaragua, which scheme appeared in the year 1548, with a map of the land prepared by Arias Gonzalo. In 1606 Captain Ochoa de Leguizamo explored, on the same account, the Puertos de Caballos and Fonseca Bay; and during the years 1780 to 1783 a map of the projected canal, still existing, was prepared, and a survey was made between the Pacific and the Lake of Nicaragua, which last proved to be 133 Castilian feet above the sea-level, the height of the water-shed being 604 feet. This scheme met with great opposition, the chief reason for which was found in the statement of Juan Bautista Antonelli, an engineer sent by Philip II., who declared the scheme quite impracticable; and D. Zaragoza publishes an interesting memoir, by J. Antonio de Escartin, to prove the possibility of the canal. The paper will be continued.

PROF. A. H. CHURCH gives a course of lectures on Chemistry at the Royal Academy of Arts on December 2, 7, 9, 12, 14, and 16; of course the lectures will have special reference to the bearing of Chemistry on Art.

ADMIRAL MOUCHEZ is continuing with vigour the completion of his astronomical museum. Eight oil paintings have been placed in the foreign astronomers' room, representing respectively Copernicus, Tycho Brahé, Galileo, Kepler, Huyghens, Newton, Bradley, and J. Herschel. A large number of engravings and photographs, representing either celebrated astronomers, large instruments, or foreign observatories, have been collected in the same room.

A VERY hopeful Report has been published by the Winchester College Natural History Society. This is its Fifth Report, though the Society has been in existence ten years. It has not been thought necessary to publish any account of the doings of the Society for five years, though we are assured that it has been none the less doing good work. This is what is wanted, and the present report bears evidence that the Winchester Society is in a healthy and fairly vigorous condition. The sectional reports are good, and the Society has formed some very fair collections.

THE Berlin Philosophical Society, founded in 1843 by the disciples of Hegel, but now numbering amongst its members men of the most various philosophical creeds, has applied the surplus of funds recently collected for a monument in memory of Hegel to the foundation of a Hegel Institution, the object of which is the furtherance of philosophical research. The Society has just issued the following prize theme: "A critical and historical account of the dialectical method of Hegel." The treatises may be written either in German, French or English, and must be sent in before December 31, 1883. The prize is 450 marks (22*l.*).

A NEW natural history serial will soon be published by Enke of Stuttgart. Its editor is Dr. Georg Krebs of Frankfort on the Maine, and its title, *Humboldt, Monatsschrift für die gesammten Naturwissenschaften.*

THE "Encyklopædie der Naturwissenschaften," published by Trewendt of Breslau, is now well advanced. Part 25 contains the seventh instalment of the Dictionary of Zoology, Anthropology, and Ethnology, and only brings it down to *Distoma.* Parts 26 and 27 contain the eleventh and twelfth (the concluding) instalment of the Handbook of Mathematics.

DR. NAGORSKY, having measured the capacities of lungs of 630 boys and 314 girls in the schools of the district of St. Petersburg, now publishes the results of his investigation in a Russian medical paper, the *Surgeon.* He has found that the capacity of lungs, in relation to the weight of the body, is 65 cubic centimetres for each kilogramme of weight in boys, and 57 cubic centimetres for girls. The law of Quetelet being that with children below fifteen years of age, the weight of the body is proportionate to the square of the height, Dr. Nagorsky has found that it is proportional to 2·15 of the same; whilst the capacity of lungs is proportional to 2·4th of the height for boys, and to the square of the height for girls. Dr. Nagorsky's researches will soon be published as a separate work. As to the relation between the weight of man and the capacity of lungs, it is tolerably permanent, and its variations are mostly due to differences in the amount of fat in the bodies of different men.

IN our article o the Geological Congress (NATURE, November 10) in the table of terms, in the first column of p. 35, the word *Cycle* should be *Ère* (*era*).

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. R. M. Edger; a Blackbird (*Turdus merula*), two Song Thrushes (*Turdus musicus*), a Starling (*Sturnus vulgaris*), two Skylarks (*Alauda arvensis*), a Greenfinch (*Ligurnis chloris*), two Chaffinches (*Fringilla cœlebs*), two Common Quails (*Coturnix communis*), British, presented by Mr. Edward Lawrence; a Black-winged Peafowl (*Pavo nigripennis*) from Cochin China, presented by Mr. J. Marshall; a Common Kestrel (*Tinnunculus alaudarius*), British, presented by Mr. A. Lidbury; a Grecian Ibex (*Capra ægagrus*) from South-East Europe, four Orange-cheeked Waxbills (*Estrelda melpoda*), two Common Waxbills (*Estrelda cinerea*) from West Africa, two Maja Finches (*Munia maja*) from Malacca, a Black-headed Finch (*Munia malacca*), an Indian Silver-bill (*Munia malabarica*) from India, a Song Thrush (*Turdus musicus*), British), a Blue-crowned Parrakeet (*Tanygnathus luzonensis*) from the Philippines, a White-eared Conure (*Conurus leucotis*) from Brazil, deposited; a Bar-tailed Godwit (*Limosa lapponica*), two Razorbills (*Alca torda*), two Common Lapwings (*Vanellus cristatus*), two Golden Plovers (*Charadrius pluvialis*), two Knots (*Tringa canutus*), a Red-throated Diver (*Colymbus septentrionalis*), British, purchased; a Spotted Ichneumon (*Herpestes auropunctatus*) from Nepal, a Geoffroy's Dove (*Peristera geoffroii*), two Brazilian Teal (*Querquedula brasiliensis*) from South America, two Mandarin Ducks (*Aix galericulata*) from China, received in exchange.

OUR ASTRONOMICAL COLUMN

THE SATURNIAN SYSTEM.—In a memoir published in t. xxvii. 2me partie, of *Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*, entitled "Recherches sur Saturne, ses Anneaux et ses Satellites," M. Wilhelm Meyer, assistant-astronomer at the Observatory of Geneva, presents results of his observations made with the 10-inch refractor, the gift of Prof. Plantamour to the establishment, during the opposition of 1880. They consist of measures of the rings and equatorial and polar diameters and observations of the satellites Enceladus, Tethys, Dione, Rhea, and Titan, with elements deduced from them. M. Meyer was not certain that he had observed Mimas in 1880, but in a note he mentions that on the night of September 4, 1881, which was "une des plus belles, quant à la diaphanité de l'atmosphère," he obtained an undoubted observation of it; at 13h. 13m. 27s. Greenwich mean time it was distant 31"·1 from the centre of Saturn, exactly in the plane of the ring on the preceding side, or, as he expresses it, $x = -31''\cdot1$, $y = 0$.

For the outer diameter of ring A he finds 40"·47 for the mean distance of Saturn, which, like other measures with the filar-micrometer (employed for all the measures at Geneva) is in excess of the results given by the double-image micrometer; Kaiser found the outer diameter with the latter 39"·47. Considering the difficulties attending measures of this class with the filar-micrometer, preference, no doubt, is to be given to the double-image principle, though without much practice there may be a tendency to *clip* the measures made with the instrument. If it were preferred to take something like a general mean of the reliable measures to this time, the outer diameter of the ring would be found to differ little from 39"·75.

M. Meyer has referred all his times to the meridian of Greenwich, because, as he says, it is that adopted by Mr. Marth in the calculation of his elaborate ephemerides of the satellites, to which he acknowledges his obligations.

We subjoin the elements of the four satellites interior to Titan which were measured at Geneva:—

	ENCELADUS	TETHYS	DIONE	RHEA
Epoch	Oct. 8·0	Oct. 27·0	Oct. 27·0	Oct. 27·0
	° ′	° ′	° ′	° ′
Mean long.	5 18·3	300 2·2	155 5·2	309 42·9
Peri-Saturnium	181 45·3	204 6·8	180 16·8	239 26·0
Node	127 5·9	113 57·6	124 17·0	127 4·5
Inclination	4 38·0	7 0·7	6 41·5	6 36·2
Eccentricity	0·066235	0·006847	0·016888	0·014657
Semi-axis major	34"·29	42"·48	54"·58	75"·97
	d. h. m. s.	d. h. m. s.	d. h. m. s.	d. h. m. s.
Tropical revolution	1 8 52 40·5	1 21 18 8·4	2 17 40 54·1	4 12 25 25·4

The node and inclination are referred to the plane of the terrestrial equator.

The separate values of the mass of Saturn which M. Meyer deduces from his observations are discordant.

THE LUNAR ECLIPSE ON DECEMBER 5.—The eclipse of the moon next Monday evening, though very nearly total, will not be actually so, the magnitude being 0·973. The first contact with the shadow occurs at 3h. 28m., but the moon does not rise at Greenwich till 3h. 50m. The middle of the eclipse occurs at 5h. 8m., and the last contact with shadow at 6h. 49m. The shadow enters upon the moon's surface at about 60° from the N. point of the limb towards the east. The fifth magnitude star ι Tauri is occulted at Greenwich at 6h. 23m., before the shadow is off the disk.

On October 13, 1856, there was a lunar eclipse of similar character, magnitude 0·994.

VARIABLE STARS.—R Leporis. According to Dr. Julius Schmidt's observations during the interval 1865–1875, the mean period of this variable appears to be about 436½ days, and a maximum may be expected about January 19, 1882; its magnitude at maximum has been estimated 6·5 by Schmidt and 6 by Gould; at minimum it is about 8·5. Observations of the degree of intensity of colour in this "crimson star" are desirable, as there are indications that it has varied with variation in brightness. At times it has been recorded that the red colour was not particularly striking, whereas at the first observation of this star in October 1845 it arrested attention whilst comet-sweeping. (2) R. Draconis. Dr. Schmidt noted a maximum on April 22 in the present year, or 251 days after the preceding one, so that another maximum may be looked for about December 29. The star is Lalande 30387, and its variability was detected at Christiania; the position for 1882·0 is in R.A. 16h. 32m. 20s. Decl. + 67° 0'·1; it is followed by a star 8·9m. (L 30413) by 53s., 1'·5 to the south of it. Prof. Pickering's suspected variable of 1881, September 13, is about 5½° to the north; R.A. 16h. 31m. 32s., Decl. + 72° 32'; it is "red, spectrum-banded."

(3) μ Cephei (Bayer) is probably now on the increase, but we do not find very recent observations; the position of this "garnet-sidus" for 1882·0 is in R.A. 21h. 39m. 53·7s., Decl. + 58° 14' 21"; Argelander's mean period is 432 days, Prof. Schönfeld calls it "irregular."

THE ROYAL SOCIETY—ADDRESS OF THE PRESIDENT [1]

ON the occasions of our anniversary our first glance is usually retrospective, in memory of those once among our numbers, but now surviving only in their works. On our home list we have this year lost more than a score of Fellows. On the foreign list we have lost but one; that loss will however be severely, if not so widely, felt.

In Michael Chasles mathematicians recognise a geometer of unusual powers, who, having devoted a long life to his favourite study, has left an extensive and characteristic train of researches behind him. But a larger circle of friends recognised in him a great and good man, beloved by all who knew him, and respected beyond the range of his personal acquaintance. As a pure geometer he belonged to a class of mathematicians for which the Academy of Sciences of Paris has long been justly celebrated; but whose numbers appear liable to a perceptible fluctuation, perhaps partly owing to the brilliant opportunities and the varied fascinations which modern algebra offers to the student. Eminent in a nation which has always been intolerant of obscurity in science, he showed in a remarkable degree how much might be elicited through precision of thought and by clearness of exposition from a few well-selected and fertile ideas. Such, for instance, proved to be the consideration of Anharmonic Ratios, the principle of Correspondence, and the method of Characteristics. Whether in the latter he had struck a vein so completely out of the range of the analyst, as he himself supposed, may perhaps be still claimed as an open question; but certain it is that he showed the fertility of the method by continuing to deduce from it an apparently inexhaustible flow of theorems, even after the more serious part of his mathematical work had been done. And there is little doubt that long after the time when many subsequent works have fulfilled their purpose, and have fallen into a natural oblivion, his "Aperçu Historique," his "Géometrie Supérieure," and the fragment of his "Traité des Sections Coniques," will be regarded as classics in the library of the mathematician.

Turning to the home list, the remark made in my last address, viz. that our losses had been mainly among our older Fellows, might be repeated with even more emphasis on the present occasion. Of the twenty-two who have died during the intervening period nine had reached the age of three score and ten, eight that of four score, and one, Dr. Billing, had attained his ninety-first year.

In Lord Beaconsfield and Sir James Colvile we have lost two distinguished members, elected under the statute which gave a new definition of the privileged class a few years ago. Lord Hatherley will be recollected as having served on our Council within recent years, and as having often given us very useful advice on subjects requiring the sound judgment of an experienced mind. Although Lord Hatherley would doubtless have been elected, as a member of the Privy Council, under the statute above mentioned, it is perhaps worth remark that he was elected under statute previously existing, and that his fellowship dated from the year 1833.

The late Dean of Westminster furnishes another instance of the wise exercise of a power which the Royal Society has always reserved to itself, notwithstanding the changes made in 1847, of electing from time to time men of eminent distinction in other avocations of life than those of strict science. Of Dr. Stanley's attainments and merits in those other directions it is not my province to speak; and, indeed, it is the less necessary that I should do so, for they were so many and so varied that in one way or other they were known to all. But he was conspicuous, both among the members of his own profession and among many others who have neither predilection nor training for actual science, for his genuine and honest sympathy with its principles and its objects, and with the labours of those who cultivate it.

In Dr. Lloyd, whose age was coeval with the century, and who was a fellow-worker with Herschel, Whewell, Peacock, and Sir W. R. Hamilton, we seem to have lost one of the links which connected us with a past generation. While himself no mean mathematician, he was distinguished especially in the sciences of optics and of magnetism. In the subject of optics he had the rare opportunity of supplying the experimental verification of Sir W. R. Hamilton's brilliant geometrical conclusions on the configuration of the wave-surface; and it was largely due to his patience, his delicacy of touch, and his almost instinctive sagacity, that the phenomena of conical refraction were first made visible to the human eye. In magnetism he assisted in the formation of the great survey of the globe, initiated by Sir E. Sabine, and as director of a magnetic observatory in Dublin he made valuable contributions to the subject. His scientific remains, brought together in one volume, have been a welcome addition to the library both of the mathematician and of the experimentalist. His interest in science and in its promoters was active throughout his long life; and those on whom the honorary degree of LL.D. was conferred at the late meeting of the British Association in Dublin, will always cherish as a pleasant reminiscence the fact of having received it at his hands.

Dr. Bigsby was one of the earlier cultivators of Geology. Some of his first studies were made at a time when the subject was hardly a science; but in attaining the advanced age of eighty-nine he lived to see it what it has since become. He founded a medal at the Geological Society, of which he was for many years a member.

We are again reminded of the progress which has been made in science, and in the cultivation of it during the present generation, by the fact that until the last day of last year we could reckon among our Fellows Dr. John Stenhouse, one of the surviving founders of the Chemical Society.

On the subject of our property there is little change to report. Further investments have been made in due course on account of the Fees Reduction Fund. The sale of the Acton estate has not yet been completed, but a deposit is in hand, and a half year's interest on the balance has been received.

The Charitable Trusts Bill, which was introduced into Parliament last session, and which would have affected our interests had it not been for a clause introduced by our Fellow the Marquis of Salisbury, specially exempting the Royal Society from its operation, was withdrawn.

The collection of portraits in the possession of the Society has been enriched by the addition of a portrait of Sir Joseph Dalton Hooker, painted by John Collier, Esq., at the expense of a considerable number of our Fellows, who were desirous of expressing their sense of the important services rendered by Sir Joseph to the Society, and at the same time of securing a permanent memorial of their late president. It is to be hoped that advantage may be taken of any suitable occasions that may arise from time to time of adding to our gallery of historical records of the great men whom we have reckoned among our Fellows.

The Fellows will learn with satisfaction that the first part of the new edition of our library catalogue is published. This part, consisting of 232 pages, contains the *Transactions, Proceedings*, and *Journals* published by societies and institutions in nearly all parts of the world; and also the observations, reports, and accounts of surveys which are to be found in our library. As our Library Committee has always devoted great attention to securing by exchange or by purchase publications of this class, and as the main strength of our library consequently lies in our collection of them, the part in question will form the most important section of the entire catalogue.

[1] Address of William Spottiswoode, D.C.L., LL.D., the president, delivered at the anniversary meeting of the Royal Society on Wednesday, November 30, 1881.

Progress has also been made in the more voluminous portion of the catalogue, viz. that of the general collection of scientific books, of which thirteen sheets, extending to the end of the letter C, are printed off, or are in type; and subsequent titles are in type. It may fairly be hoped that before our next anniversary the whole will be published.

The last part of the *Philosophical Transactions* for 1880 was published in March of the present year, completing a volume of nearly 1100 pages, with upwards of fifty plates. Of the *Transactions* for 1881, Parts I. and II. have already appeared; from which an early publication of Part III. may be anticipated.

Of the *Proceedings*, vol. 31 was published in June, and vol. 32 at the end of October.

Although, as I remarked last year, we are more concerned with the quality than with the quantity of the communications made to the Society, it may still be interesting to carry on the table of the number of papers presented per annum to a tenth year. It stands as follows:—

1872	... ...	99 papers received.
1873	... ...	92 " "
1874	... ...	98 " "
1875	... ...	88 " "
1876	... ...	113 " "
1877	... ...	97 " "
1878	... ...	110 " "
1879	... ...	118 " "
1880	... ...	123 " "
1881	... ...	127 " "

These 127 papers include one from Mr. Brooks of Baltimore, two from Prof. Helmholtz, and one from Capt. Mannheim, of the École Polytechnique, Paris. On reference to the papers themselves it will be noticed that several prominent men are carrying on with vigour the series of researches on which they have been, in some cases for years, engaged. Among them there may be mentioned, in physics, those of Professors Liveing and Dewar, and of Mr. Lockyer, on the Spectra of Terrestrial Substances and of the Sun; those of Prof. Hughes on Minute Interactions of Electric Currents and Magnetism; those of Mr. Crookes on High Vacua; and those of Mr. H. Tomlinson on the effect of Stress and Strain on the action of Physical Forces. Mr. G. H. Darwin continues his already classical memoirs on the mechanical history of the solar system; and Capt. Abney has opened out to view, by photographic means of his own invention, a part of the spectrum of the sun and of other bodies, beyond the red, hitherto invisible; and last, but not least, Prof. Tyndall in his Bakerian Lecture has given an account of his researches on the action of Free Molecules on Radiant Heat, and its Conversion thereby into Sound. In Biology I may mention the investigations of Mr. Romanes on nerve systems; those of Prof. Ferrier on the connection between special portions of the brain and special motor organs of the animal system; those of Mr. Parker on the Skull of the Batrachia, and of Prof. W. C. Williamson on the fossil plants of the Coal-measures. Among the newer subjects, the experiments of Dr. Young and Prof. George Forbes on the velocity of light of different colours have naturally arrested considerable attention for several reasons, and especially because the conclusions thence deduced, if ultimately established, would fundamentally modify our views of the constitution of the luminiferous ether.

For several years past I have been able with much satisfaction to report that there had been no change in the staff of officers of the Society. I much wish that I could have done so again. But the longer a capable man lives and is available, the more will work accumulate on his hands; and the time at last comes when something must be given up, lest, in the multiplication of avocations, powers which might otherwise have been devoted to some great and good purpose, and on operations not within the grasp of every one, should become dissipated among a variety of objects. A feeling that life must not be spent merely in running hither and thither, and a desire that it should be something better than a mere feat of mental agility exhibited in passing rapidly from one occupation to another, doubtless operated in leading Sir Joseph Hooker to resign the presidentship; and a similar feeling has recently led to the resignation of the secretaryship by Prof. Huxley. That this loss is great will be felt by every Fellow of the Society; it will be more keenly felt by his brother secretaries and the treasurer, but most of all by your president. Connected as I have been with him through a series of years by ties of office in the Society, by bonds of friendship and trust as thorough as can exist between man and man, I cannot but miss for a long time to come his ever willing support, his sound counsel and advice, and the cheery manfulness with which he would always address himself to any business, however difficult, uninviting, or heavy.

The post is one which it is not easy to fill. Many qualifications go to make up a good secretary; and although none of us so "despaired of the republic" as to doubt that a good successor would be found, we still felt some anxiety until we were in a position confidently to recommend a name for your consideration. Prof. Michael Foster's great scientific attainments, his administrative powers as shown in founding the great School of Biology at Cambridge, the confidence with which he inspires all around him, alike point him out as a man eminently fitted for the post. It would indeed have been agreeable to your president to have had one of the principal secretaries resident in London; but the means of communication are now so different from what they formerly were that questions of distance almost disappear; and it is certainly not without its advantages that the two principal secretaries, if not resident in London, should reside in the same city.

In the course of the spring of the present year Sir Joseph Copley, the present representative of the Founder of the Copley Memorial, explained in a visit to the president his wish to "provide in perpetuity an annual bonus of 50*l.* a year, to be given to the recipient of the Copley Medal." As the donor's views on the terms of the gift were completely made up, and were not offered for discussion by the Society, or otherwise open to modification, the Council decided to accept the offer in the spirit in which it was made, and on the terms prescribed. In accordance with this, Sir Joseph transferred a sum in Consols sufficient to provide for the bonus proposed. This acceptance will not in any way affect the adjudication of the Medal, nor, it is to be hoped, the high estimation in which that award has always been held.

The period of five years during which the experiment of the Government Fund of 4000*l.* per annum was to be tried has now expired. In a former address I have expressed opinions gathered from many of the Fellows of the Society, and have indicated my own. The President and Council have now, at the request of the Department of Science and Art, through which the vote is made, drawn up a report on the question, based upon the experience gained up to the present time, and have made suggestions with a view to a modified arrangement for the future. The Society will be duly informed of the result of those communications. In the mean time it may not be out of place to remind the Fellows that a statement of all grants made within the year is published in the report of our anniversary proceedings.

The report of the *Challenger* Expedition, of which mention was made last year, is in the course of publication; and three volumes have now appeared. Copies of these have been presented by the Treasury to our library. Vols. ii. and iii. refer to the curious forms of life found in what Sir Wyville Thomson has called the "Abysmal Region," and are copiously illustrated with lithographs. The interest which attaches to this publication is evinced by the fact that the first edition of the second volume is already exhausted. A second edition of it is in the course of printing. The Fellows will doubtless have observed that the printing of the text and the execution of the plates are maintained at the same high standard as that exhibited at the outset.

Among other scientific publications of the year, I may mention the third volume of Roscoe and Schorlemmer's work on Chemistry; Mr. Balfour's on Embryology; and Mr. Darwin's on Vegetable Mould.

In December last the Council authorised the loan of the *Philosophical Transactions* from one of our complete sets, five volumes at a time, to the Delegates of the Oxford University Press, for the preparation of a Philological English Dictionary, under the editorship of Dr. Murray. It is hoped that this loan will contribute to the completeness of the work in respect of scientific terms. Forty-one volumes have been already utilised in this way.

Towards the close of last session a communication was received from the India Office inclosing a copy of a report and memorandum, on Pendulum Observations, by Major Herschel, and asking the advice of the President and Council thereon. Subsequently there followed another communication from the same office, inclosing a copy of a letter from the same officer, with an extract from a letter to him from Mr. Peirce of the United States Coast Survey. These documents were referred to a Committee consisting of Sir George Airy, Prof. J. C. Adams, and Prof. Stokes.

The Report of that Committee was forwarded to the India Office; the following extracts from it contain those parts which refer to the main scientific questions raised:—

"The object in referring these documents to the Royal Society was to assist the India Department in coming to a conclusion as to what, if anything, might yet be required in order to render the pendulum operations which have been carried out in connection with the great trigonometrical survey of India reasonably complete as an important contribution towards the determination of gravity all over the earth.

"At present the stations which have been directly connected with the Indian stations are confined to Aden, Ismaïlia in Egypt, and Kew; and no one of these has been differentially connected with any of the chains of stations that have hitherto been used in the determination in this way of the figure of the earth, though Kew is now a station at which an absolute determination has been made. We think it would be a reasonable expectation on the part of the scientific public that the Indian group of stations, which have already been connected with Kew, should be differentially connected with at least one chain of stations which are so connected with one another, and which have been employed in the determination of the figure of the earth.

"We approve accordingly of the suggestion that gravity at Kew should be compared, by means of invariable pendulums, with gravity at another station belonging to another group. Greenwich has been named as such a station.

"In connection with this subject, we would refer to the suggestion, which has been brought before us, made by Mr. Peirce, of the United States Coast Survey, that Major Herschel should swing the same two pendulums that were used in India, first at Kew and then at Washington.

"As Washington is, or shortly will be, connected differentially with a large chain of stations widely distributed in America and elsewhere, we think that the value of the Indian series would be decidedly increased by being connected with one of the American stations, such as Washington. We think, however, that its connection through Kew with one of the older series should not on that account be omitted.

"The observations required for the purpose of these connections are such as certainly can be made, and have been made, by existing methods; and the labour of making them, which will be approximately in proportion to the number of stations at which the pendulums will have to be swung, is only a fraction of that already incurred on the Indian stations, and the three which have been included in the same group with them."

In October last a letter was received from the Treasury asking the opinion of the President and Council respecting arrangements for observing the transit of Venus in 1882. Under the advice of a Committee appointed for the purpose, it was recommended that a special Committee of the Royal Society should be appointed to decide upon the observations considered essential, and to advise Her Majesty's Government as to the best method of carrying them out. In conformity with this advice, and at the request of the Treasury, a Committee was appointed to draw out a scheme of stations, and of the constitution, strength, and equipment of the observing parties, and to frame an estimate of the total cost. The Committee reported recommending the adoption of certain stations in South Africa, the West Indies, Australia, and New Zealand, and the Falkland Islands; and they at the same time added other particulars, and furnished an estimate of the whole, adopting in the main the recommendations of that Committee; the Treasury then requested the President and Council to nominate an Executive Committee, by which (accounting to the Treasury) any vote of Parliament for the purpose of these observations might be administered; and under whose advice the observers and assistants might be selected and appointed. In compliance with this request the following Fellows were nominated as an Executive Committee, viz. the President, Prof. J. C. Adams, Sir G. Airy, Mr. Hind, Sir G. Richards, Prof. H. J. Smith, and Mr. Stone. That Committee is now continuing its labours, and has appointed its member, Mr. Stone, of the Radcliffe Observatory, Oxford, directing astronomer of the expeditions; and under him the selection of instruments, as well as the training of the observers, will be made.

With a view of making the observations ultimately as comparable as possible, the Committee, at an early stage, put itself, through the Foreign Office, into communication with the corresponding Commissions in foreign countries, on the subjects of the instructions to be given to the various observers; and a draft set of instructions, drawn up for this purpose, was circulated for comment and suggestion.

Moved perhaps in some degree by this action, the Governme n of France took advantage of the assemblage of scientific men collected in Paris for the Electrical Congress and Exhibition, to summon a Congress of Astronomers, having especially in view a consensus of arrangements for the observation of the Transit. This Congress met in Paris on October 5, under the auspices of the Minister of Public Instruction. M. Dumas was appointed President; MM. Foerster and Weisse, Vice-Presidents; MM. Tisserand and Hirsch, Secretaries. The various countries of Europe were represented; but it was a matter of much regret that no representative from the United States of America was present. Mr. Stone attended on behalf of the British Committee. I must here express my regret at having been unable to attend in person to support our directing astronomer, who made the journey at much inconvenience to himself; but I should at the same time add that my absence in no way diminished the effectiveness of Mr. Stone's counsels, which proved of great service in promoting a unanimity in the views finally adopted by the Congress.

Two Committees were appointed: (1) for the selection of stations; (2) for a discussion of methods of observation.

As the British stations had been already chosen, and did not admit of material alteration, the first of these Committees did not directly concern us. But, judging from the number of observations contemplated to be made in South America by foreign expeditions, it seems not impossible that the party which we had proposed for the Falkland Islands might be advantageously transferred to some other locality, so as to strengthen the parties requiring support, for example, in Australia.

As regards the discussion of methods, the draft instructions drawn up by the British Committee, and especially the definition of contact to be observed, strongly insisted upon by Mr. Stone, were in the main adopted. The following are the principal points agreed upon:—

With a view to uniformity of method of observation it is necessary that instruments of nearly the same aperture (six inches) should be used, also that the observations of contact should be made in a field of just sufficient brightness to allow of the clear separation of two threads at one second of arc apart when seen projected on the sun with a power of 150. The times corresponding to the internal contacts should be defined as follows:—

At Ingress.—"The time of the last appearance of any well-marked and persistent discontinuity in the illumination of the apparent limb of the sun near the point of contact."

At Egress.—"The time corresponding to the first appearance of any well-marked and persistent discontinuity in the illumination of the apparent limb of the sun near the point of contact."

It is a point of primary importance that all the observers shall, as far as possible, observe the same kind of contact; and it is therefore desirable that the times recorded for contacts should refer to some marked *discontinuity* in the illumination of the sun's limb about which there cannot be a doubt, and which may be supposed to be recognisable by all the observers. If a pure geometrical contact is alone seen, there can be no doubt about the time which should be given; but, if haze is noted, it should be haze nearly as dark as the outer edge of the planet; and if a ligament is seen, it should be nearly as dark as the outer edge of the planet.

A further proposal was made to establish a Central Bureau in Paris to receive and discuss the observations, and to enter upon other work more or less directly connected with the determination of solar parallax. But, as this question was not contemplated in the instructions given to our representative, and indeed exceeded the powers of the British Committee, no definitive resolution was passed on the subject.

On the subject of the longitude of a point in Australia, to which I made allusion in my address last year, as important for the observations of the transit of Venus, I have lately received a letter from Mr. Todd, of the Observatory, Adelaide, from which the following is an extract: "With regard to the determination of Australian longitudes: as it is understood that Lieut.-Commander Green, U.S.N., will call at Port Darwin to determine its longitude by signals from Singapore on the one side, and with the Adelaide Observatory on the other, I have taken no further steps for going to Port Darwin, as previously arranged. I shall take all the necessary observations here, and exchange signals with Lieut.-Commander Green over my overland telegraph; and, in conjunction with Messrs. Ellery and Russell, make fresh determinations of the difference of longitude between Adelaide, Melbourne, and Sydney."

Since our last anniversary, Sir George Airy, the late Astronomer Royal, having completed his eightieth year, and nearly half a century of office, has retired. Of his services to science, and to this Society as President, and in other ways, the time to speak has happily not yet arrived. His great intellectual powers are in fact in no way impaired, and so far from having brought his period of activity to a close, he hopes to employ his well-earned leisure in completing a favourite work, the Numerical Lunar Theory.

His successor, Mr. Christie, from his long experience in the Royal Observatory, will combine a thorough training in the remarkable organisation and methodical administration for which his predecessor was so conspicuous, with the full vigour of life, and an active interest in the more modern developments of astronomy, in which he is already distinguished.

The future of the Royal Observatory is a subject on which the mind of Sir George Airy often exercised itself, and to which he alluded more than once in his Reports to the Board of Visitors. With his fundamental proposition that observational astronomy, in its bearing on the improvement of navigation, must always be its main line of work, every one must agree. Over and above this, the expressed wish of the Board of Visitors, and the practice of the last few years, have already sanctioned the addition to the ancient duties of the Observatory of some of those long and systematic series of observations, such as that of the solar protuberances, and the motion of the fixed stars in the line of sight as shown by the spectroscope, which are beyond the scope of an amateur, and above the power of any individual astronomer, however devoted to his work, to permanently maintain. How far it may be desirable to continue magnetic and meteorological observations beyond the necessities of an astronomical observatory, are questions which will doubtless engage the attention of the present director. The main question must be, What distribution of these branches of study among Greenwich, Kew, and other establishments, will in the end best conduce to the progress of science? And with a view of giving full scope to the judgment and skill of the present and future holders of the office the Board of Admiralty have, as I understand, decided to consider a revision of the terms of the Royal Warrant under which the appointment is made.

This year has been signalised by the meeting of a most important scientific congress—the International Congress of Electricians, held at Paris. The recent developments of the practical applications of electricity rendered the occasion favourable both for organising a special exhibition devoted solely to this branch of science, and also for assembling the electricians of all countries.

The general purpose of this Congress was to discuss, and if possible to settle, some of the numerous difficulties which perplex both the physicist in his studies and the constructor in his work.

But chief among the subjects proposed to, and undertaken by, the Congress was that of fixing a system of electrical measures for international adoption.

Perhaps in no subject is the necessity of uniform system of standards so striking as in electricity. This science, both in its practical applications, such as telegraphy, and in the great natural problems of terrestrial magnetism and atmospheric electricity, refuses to recognise any artificial divisions of the surface of the globe, whether ethnological or political. It rarely happens, in operations undertaken on so large a scale as the study of electricity and its industrial applications, that an opportunity presents itself of arranging for concerted and harmonious action through a period extending to a distant future. Before a branch of industry has attained sufficient importance to claim international recognition, it has usually gone through the process of considerable development in different countries; and in each of these developments it has often received a stamp of local character which makes it difficult to reduce the whole to one uniform system. But in the case of electricity there were fortunately present special circumstances which facilitated the adoption of uniform standards. Foremost among these was the fact that the development of its practical applications, in other departments than telegraphy, were so recent that it was not too late to legislate for it as though it were but just about to begin. Secondly, the international character of telegraphy, and the fact that the manufacture of its apparatus had always been confined to the great centres of civilisation, had both tended to limit the number of existing systems of measurement, and prevented that multiplicity of standards which would certainly have arisen had such manufacture been carried on in numerous and in isolated localities. But by far the most important influencing circumstance was the happy idea due to the British Association of adopting standards based on absolute measures. The Association did not allow the idea to remain barren; but, through the instrumentality of its Committee on Electrical Standards, it gave to the world the admirable units of the Ohm, the Volt, and the now re-christened Weber; and the eminent men who formed that Committee may now point with honourable satisfaction to the fact that the Electrical Congress decided unanimously to recommend for universal acceptance those units which that Committee so early adopted.

With the single exception of the unit of current which, in order to avoid an ambiguity in the signification of Weber, receives the title of Ampère, the names are left substantially without change.

The adoption of these units for international use is to be preceded by a new and more careful redetermination of the ohm at the hands of the great physicists of all nations. And it is intended that this redetermination shall result in a standard for general adoption. Thus electricity will be the first of the practical sciences to be freed from all difficulties due to local standards; and it is to be hoped that this example may be followed in other sciences concerned with practical life.

The following are the actual resolutions adopted by the International Congress of Electricians at the sitting of September 22, 1881:—

1. For electrical measurements, the fundamental units, the centimetre (for length), the gramme (for mass), and the second (for time), are adopted.

2. The ohm and the volt (for practical measures of resistance and of electromotive force or potential) are to keep their existing definitions, 10^9 for the ohm, and 10^8 for the volt.

3. The ohm is to be represented by a column of mercury of a square millimetre section at the temperature of zero Centigrade.

4. An international commission is to be appointed to determine, for practical purposes, by fresh experiments, the length of a column of mercury of a square millimetre section which is to represent the ohm.

5. The current produced by a Volt through an Ohm is to be called an Ampère.

6. The quantity of electricity given by an Ampère in a second is to be called a Coulomb.

7. The capacity defined by the condition that a Coulomb charges it to the potential of a Volt is to be called a Farad.

The remainder of the work of the Congress consisted mainly of the discussion of various interesting questions bearing upon electricity; and although these did not in many cases issue in precise recommendations, yet they were not altogether devoid of practical results. The questions which chiefly attracted its attention were those of terrestrial magnetism and earth-currents, atmospheric electricity, and the more practical but perplexing question of lightning conductors. In all these matters the need of close and continuous intercourse between the observers of different nations was strongly felt; and the Congress passed resolutions recommending combined action both in the way of observations carried on simultaneously and with like apparatus, and also of frequent if not continuous telegraphic communication of the results of these observations. The organisation of so extensive and perhaps so costly a system of combined observations must depend to a great extent on the various Governments, and also on the goodwill and generosity of the great telegraphic companies; but it is much to be wished, for the sake of science, that some progress in that direction may soon be effected. The present state and prospects of electro-physiology also received careful discussion, but the difficulties of the subject precluded any definite conclusions. The same was the case with the question of photometry as applied to the intense light with which electricity furnishes us. Resolutions recommending the adoption of certain provisional photometric standards were passed; but these only evidenced the strong feeling that prevailed in the Congress, that some new departure must be made, and that a new standard of illumination (such as perhaps the glow of platinum on the point of fusion) must eventually be adopted for electric lights.

I have described the more important of the results of the deliberations of the Congress. Perhaps, however, the most important of all (with the exception of the choice of electrical units) will prove to have been the impetus given to electrical science by the interchange of ideas that took place among the leading physicists of all nations, and the light that was thrown on the various problems which came under discussion in the meetings of the Congress.

I cannot conclude this imperfect sketch of this important Congress better than by quoting the eloquent words of M. Dumas at the conclusion of its sittings: "Greek mythology, in its happy personification of the forces of nature, placed the winds and the waves under the direction of divinities of the second rank; it made the celestial representative of light its god of poetry and of the arts; and by an admirable forethought, it reserved lightning for Jupiter. Science and industry have long since laid their hands on the forces which air and water have placed at the disposition of man. Steam, animated by fire, has enabled him to overcome many obstacles and to rule the waves. Light has no longer any secrets from science, and the arts are daily multiplying its marvellous applications. But there remained one labour to accomplish: namely, to wrest lightning itself from the hands of the ruler of the gods, and to bend it to the needs of humanity. This is the feat which the nineteenth century has now accomplished, and of which this Congress is the evidence and the witness. This feat will mark an epoch ever memorable in history; and, amid the turmoil of politics and of questions which agitate the human mind, it will be recognised as the characteristic feature of our era. The nineteenth century will be the century of electricity."

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The following is the speech delivered in the Senate House on November 24 by the Public Orator (Mr. J. E. Sandys, Fellow and Tutor of St. John's) in presenting Dr. Thomas Sterry Hunt for the Honorary Degree of LL.D.:—

"Dignissime domine, domine Procancellarie, et tota Academia:

"Scientiam illam Geologicam, quae, in orbis terrarum origine et natura investiganda, neque temporis finibus terminatur neque saeculorum spatio coercetur, nos certe pro rei magnitudine, temporis praesertim angustiis impediti, orationis brevissimae intra spatium laudare non possumus. Iuvat potius hodie scientiae tam magnae professorem insignem vestro omnium nomine salutare, qui in republica illa maxima trans Atlanticum natus, nostrae tamen, provinciae Canadensis rupibus explorandis quinque et viginti annos dedicavit; qui de omnium animantium (ut nonnullis videtur) antiquissimo, quod Eozoon Canadense nuncupatur, doctissime disputavit; qui (ne plura commemorem) non modo vetustissimorum illorum saxorum, quae Laurentia nominantur, sed aliorum quoque complurium originem primam vicesque varias sagacissime investigavit. Quid autem si, in tot tantisque argumentis totiens retractandis, non semper sibi constare, non semper eadem sentire, visus est? Vos certe ex Academicae philosophiae disciplina didicistis, virum vere sapientem (ut Ciceronis nostri verbis utar) 'quod dixerit, interdum, si ita rectius sit, mutare; de sententia discedere aliquando.' Ceterum idem necessitudinis vinculo in perpetuum duraturo nobiscum idcirco conjunctus est, quod professoris illius nostri, qui has inter umbras plusquam quinquaginta annos studiis Geologicis lumen praetulit, et interpres et defensor egregius exstitit. O utinam hospiti nostro, nuper ex Italia ad nos advecto, mox autem, favente (uti par est) Neptuno suo, in patriam transituro, inter tot aedificia variis doctrinae studiis consecrata, novum illud Museum quod Nestoris illius nostri sempiternum fore monumentum iamdudum exspectamus, si non ad ipsum finem adductum, at inchoatum certe ostendere potuissemus. Ipsi meministis veteris poetae monitum illud:

"'Gratia ab officio quod mora tardat abest';

vestrum igitur officium est, viri Academici, qui beneficiorum tantorum non immemores estis, monumentum illud magnum ad exitum felicem quam maturissime perducere; nos interim nostro qualicunque laudis officio perfuncti, plausus illos vestros, qui hospiti nostro iam diu debentur, non iam amplius morabimur.

"Ergo vobis praesento Regiae Societatis Londinensis Socium, virum de studiis Geologicis optime meritum, Thomam Sterry Hunt."

OXFORD.—The Brackenbury Natural Science Scholarship at Balliol College has been awarded to Mr. T. F. McArthur, of Manchester Grammar School. *Proxime accessit*, Mr. J. J. Hart, Exhibitioner of the College. The following gentlemen distinguished themselves in the examination:—Mr. A. Ford Smith, Bedford Modern School; Mr. A. Wentworth Jones, Clifton College; and Mr. P. Hawkridge, Derby School. Mr. Ford Smith was elected to a Natural Science Exhibition.

The Statute respecting the inspection and licensing of lodging-houses was finally passed by Congregation on November 23. The following clauses were inserted concerning the duties of the Controller of Lodging-Houses and the Sanitary Inspector:—

"The Controller shall inspect every house proposed to be licensed for the residence of Undergraduates; he shall also visit, with or without notice, every licensed house once at least in each year, and report thereon to the Delegates.

"There shall be a Sanitary Officer appointed by the Delegates, for such period and under such conditions as they may determine. He shall inspect every house proposed to be licensed for the residence of Undergraduates, and shall make a Report to the Delegates on the sanitary condition of each house thus inspected. He shall also visit each licensed lodging-house once at least in every year, and any licensed lodging-house at any time by the order of the Delegates. The stipend of the Sanitary officer shall be determined by the Delegates in conjunction with the Curators of the University Chest.

"The Delegates may obtain, when occasion shall arise, additional advice, whether medical or of any other professsional kind. Any person whom they may thus employ shall receive such fee as shall be agreed on by the Delegates in conjunction with the Curators of the University Chest."

SOCIETIES AND ACADEMIES

LONDON

Meteorological Society, November 16.—Mr. G. J. Symons, F.R.S., president, in the chair.—Twenty-seven gentlemen were elected Fellows of the Society.—The evening was devoted to an account of the gale which passed across the British Isles, October 13–14, 1881, which had been prepared by Mr. G. J. Symons, F.R.S., with the assistance and co-operation of Mr. C. Harding and other gentlemen. There is evidence of the storm being formed in the Atlantic, about 150 miles south of Nova Scotia on October 10, and that at noon on the 13th there was a considerable disturbance about 600 miles west of Galway. At that time there were scarcely any instrumental indications in the British Isles of the coming storm; the barometer was falling at Valentia, but not rapidly, and at some of the western English stations it was rising. The curves of barometric fluctuation show very plainly the advance of the depression from west to east, for while at Valentia the minimum occurred at 2 a.m. on the 14th, on the east coast of Norfolk it is recorded that it did not occur till 4 p.m. This fact, coupled with others, seems to indicate an easterly progression of the barometric minimum at nearly forty miles per hour. As far as the sea is concerned, the chief force of the gale was felt on the afternoon of the 14th in the German Ocean, and there the great loss of life and destruction to shipping seems mainly due to the exceptionally violent squalls which were peculiar to this gale, as well as to the extremely sudden manner in which the wind increased to hurricane force. The afternoon became quite darkened by the salt water blown into the air, so that it was impossible to see a ship's length ahead. The barometric chart for 9 a.m. on the 14th showed that the pressure in the north of England was an inch lower than in the south, and nearly two inches lower than in the South of France. The area over which injury was produced was very large, and although not without precedent, it was happily rare. The record of 56 lbs. per square foot at the Royal Observatory, Greenwich, was the highest ever registered in that locality, and close by thirty-five trees were blown down in the park, and fifteen feet blown off the top of a spire which had been erected about forty years, the stone of which shows no sign of decay, and which had retained its position almost, if not wholly, by the gravitation of its mass. The general opinion seems to be that the structural damage over the greater part of the country was by no means unprecedented, and in the greater part of Ireland and the south-west of England was not even of an unusual character; but along the east coast and in the East Midlands the damage was excessive, and on the north-east coast unprecedented. In Scotland the destruction of trees was enormous.—Mr. J. Wallace Peggs, F.M.S., also read a paper on the structural damage caused by the gale as indicative of wind force, and remarked that since the

Tay Bridge disaster attention had once more been directed to the subject of wind pressure. He suggested that a conference of delegates from societies specially interested in the subject should be held, who should make experiments and carefully consider the whole question.

Entomological Society, November 2.—H. T. Stainton, F.R.S., president, in the chair.—Exhibitions: An aberration of *Urapteryx sambucaria*, L., Mr. C. O. Waterhouse.—A new species of *Antheræa* from the Gold Coast; and some microscopic preparations of the saws, &c., of various *Hymenoptera*, prepared by Mr. P. Cameron of Glasgow, Mr. W. F. Kirby.—Pieces of honeycomb constructed on a bare wall, without any protection; and specimens and figures of new varieties of *Armadillium vulgare*, L., and *Porcellio icaber*, Latr., Rev. A. E. Eaton.—A specimen of *Lycæna icarus*, Rott., var *Icarinus*, Scriba, Dr. H. G. Lang.—An undescribed species of *Cicadidæ* from Borneo, with unusually developed opercula, Mr. W. L. Distant.—A female specimen of *Dufourea minuta*, Lep., Mr. T. R. Billups. —A specimen of *Scleroderma domestica*, Westw.; the larva was found parasitic on that of a Longicorn beetle in a pine-tree at Lyons; and some *Diptera* which attack figs in Turkey and Egypt, Sir S. S. Saunders (this led to an interesting discussion on fig-parasites and caprification).—Some remarkable tubes formed by Lepidopterous larvæ at Aden; and a specimen of *Cerura vinula*, L., which it was thought at first might belong to *C. erminea*, Esp., the President.—Papers read: Descriptions of new genera and species of Heterocerous *Lepidoptera* from Japan (concluded), by Mr. A. G. Butler; and a memoir on the various Dipterous insects (*Muscidæ* and *Tipulidæ*) destructive to cereals in Britain, by Prof. Westwood.

Geological Society, November 2.—R. Etheridge, F.R.S., president, in the chair.—Richard Paley Gardner, Henry Neville Hutchinson, Henry Johnson, William Regester, and George Tate, Ph.D., were elected Fellows of the Society.—The following communications were read: On the genus *Stoliczkaria*, Dunc., and its distinctness from *Parkeria*, Carp. and Brady, by Prof. P. Martin Duncan, M.B. Lond., F.R.S., F.G.S., Pres.R.M.S. —On the elasticity- and strength-constants of Japanese rocks, by Thomas Gray, B.Sc., F.R.S.E., and John Milne, F.G.S.— The glacial deposits of West Cumberland, by J. D. Kendall, C.E., F.G.S.

EDINBURGH

Royal Society, November 28.—The following were elected office-bearers, viz.:—President, the Right Hon. Lord Moncreiff; Vice-presidents: David Milne Home, LL.D., Sir C. Wyville Thomson, LL.D., Prof. Douglas Maclagan, M.D., Prof. H. C. Fleeming Jenkin, F.R.S., Rev. W. Lindsay Alexander, D.D., J. H. Balfour, M.D., F.R.S.; General Secretary, Prof. Tait; Secretaries to ordinary meetings: Prof. Turner, Prof. Crum Brown; Treasurer, Adam Gillies Smith, C.A.; Curator of Library and Museum, Alexander Buchan, M.A.; Members of Council: Prof. Campbell Fraser, Prof. Geikie, Rev. Dr. Cazenove, David Stevenson, Prof. Chrystal, Sheriff Forbes Irvine, Prof. A. Dickson, the Right Rev. Bishop Cotterill, Rev. Prof. Duns, Dr. Ramsay Traquair, John Murray, William Ferguson.

PARIS

Academy of Sciences, November 21.—M. Wurtz in the chair.—The following papers were read:—On the condition of achromatism in phenomena of interference, by M. Cornu. In a system of fringes of interferences produced with heterogenous light having a continuous spectrum there is always an achromatic fringe which plays the *rôle* of central fringe, and is found at that point of the field where the most intense radiations present a maximum or minimum difference of phase. M. Cornu indicates the properties of the achromatic line, and shows the inaccuracy of the accepted theory for determination of the central fringe. —Reactions of salts of gallium, by M. Lecoq de Boisbaudran. —On a bed of reindeer remains near Paris, by M. Gaudry. This bed was found by M. Vasseur at Montreuil, and the remains have been sent to the Museum. They comprise, with numerous bones of reindeer, remains of elephant, rhinoceros, horse, bison, freshwater shells, &c. The deposit (which is surmounted by beds of grey sand and mud) is supposed to belong to the great glacial epoch of boulder-clay. M. Gaudry is enabled to sketch the history of quaternary times in the Parisian basin.—Observations on the *rôle* of faults in the geological structure of the Western Alps, by M. Lory. Some large fractures can be traced continuously right through Dauphiné, Savoy, and Valais, producing longitudinal zones with different orographic characters and strata.—On the crystallisation of sulphides of cadmium and zinc, by M. Hautefeuille.—On the agreement of the curve of solar spots with the actions resulting from the eccentric motion of large planets, by M. Duponchel. Reviewing the observations collected by Wolf from 1608 to our time, he finds the mean period of the oscillations not 11·2 years, but 11·86, the time of a revolution of Jupiter, with which it seems really connected. The perturbations of the curve are distinctly *en rapport* with the times of revolution of the three large superior planets.—On the winter egg of phylloxera, by M. de Lafitte.—Elements of the orbit and ephemerides of the planet (217) Endore, by M. Callandreau. On some series for the development of functions with a single variable, by M. Halphen.—On a particular curve of the third order and on certain uniform functions of two independent variables, by M. Picard.—New method of dividing the circle into equal parts, by M. Pellet.—Integration of differential equations of the vibratory motion of a spherical bell, by M. Mathieu.—Numerical application of the theory of maximum yield of two dynamo-electric machines employed for transport of force, by M. Lévy. Referring to a case discussed by M. Deprez, he shows that, by adopting different resistances, he would obtain 10 horse-power at 50 km., with a maximum electromotive force of 5356 volts, instead of about 7000.—On M. Lippmann's method for determination of the ohm, by M. Brillouin.—Remarks on the electrolysis of water, by M. Tommasi. In decomposing water with a single element, copper wire being used as positive electrode, and platinum wire as negative, the quantity of copper dissolved is greater than the quantity deposited on the negative electrode; and this is explained by the thermal theory.—On the diformine of glycerine, by M. Van Romburgh.—On some spectral reactions of alkaloids and glucosides, by M. Hock. —Electric current produced by light, by M. Laur. Light affects the American process of amalgamation in Mexico. The author elucidated the action by experiments which reproduce, in complex form, effects that have been indicated by M. Edm. Becquerel (as that physicist pointed out).—On some new cases of phosphorescence in plants, by M. Crié. He lately observed *Auricularia phosphorea* and *Polyporus citrinus* to emit luminous radiations; also *Rhizomorpha* or the vegetative apparatus of many champignons; also *Xylaria polymorpha*. This is the first time emission of light has been observed in Ascomycetes.—Influence of the nature of food on sexuality, by M. Yung. He fed separate sets of tadpoles with fish, meat, coagulated albumen of hens' eggs, yellow of eggs, and with a mixed diet. These aliments do not appear to have a very distinct influence on the sex; but along with M. Born's experiments, those of M. Yung support the idea that a special diet afforded to young tadpoles from the time of leaving the egg, favours the development of a female genital gland.—Development of the egg of Melicerta, by M. Joliet.—On spermatogenesis in Selachians, by M. Hermann.— M. Hément communicated some further observations on the articulation of deaf mutes.—M. Daubrée presented an Italian work by Prof. Cossa, "Chemical and Mineralogical Researches on the Rocks and Minerals of Italy."

CONTENTS