THURSDAY, AUGUST 7, 1884

ELECTRIC LIGHTING

A Practical Treatise on Electric Lighting. By J. E. H. Gordon. (London: Sampson Low and Co., 1884.)

PRACTICAL treatises on this subject are very numerous, but they do not emanate from the right men. We want a book from a perfectly independent authority, unflavoured with the taint of invention, the result of practical experience. Mr. Gordon is in many respects well qualified for the task, but he is an inventor, and his book is strongly impregnated with prejudice and a green-spectacle view of the subject. He is, however, a staunch believer in the immediate future of successful electric lighting, and is very hopeful that the dark clouds that now envelop it will be dispelled by the enlightenment of steady progress.

After an introductory chapter on the general principles of artificial lighting, he deals with the conversion of electric currents into heat, and shows how carbon, when raised to incandescence, fulfils all the conditions required to give the maximum light with the minimum expenditure of heat. The problem is to concentrate the heat in a solid of the smallest possible size or with the smallest possible cooling surface. Electrical units—amperes, volts, ohms, coulombs—and their relation to each other and to the ordinary heat and work units are explained, though, curiously enough, that most useful and much employed unit the *watt* is not even mentioned. The rules that regulate derived currents lead to an investigation of the method of calculating the power wasted in a network of conductors—a matter of very serious consequence in the commercial aspect of electric lighting, though Mr. Gordon does not touch on any of the recent methods devised to reduce the excessive cost of mains. We then have a disquisition on the experimental measurements of currents, electromotive forces, resistances, and power developed, with a description of various indicators and measurers employed. No reliable instrument has yet been introduced for ordinary practical use, and there are many instruments now undergoing trial which Mr. Gordon has not touched upon—particularly those of Marcel Deprez in use on the Continent, and which were exhibited at Munich and Vienna.

A capital chapter is devoted to glow lamps. "The first public exhibition of incandescent lamps that was made in this country was made by Mr. Swan before the Society of Telegraph Engineers on November 24, 1880. The first exhibition in America was made by Mr. Edison" (p. 62). Mr. Gordon does not give the date! Arc lamps follow, Mr. Crompton's admirable lamp being that selected for description.

Perhaps the most valuable and certainly the most novel chapter in the book is that written by Mr. Crompton on carbons used in arc lamps. The following information is useful (p. 105):—

"The diameters most commonly used have been as follows:

For currents from	7–12 amperes	9 mm. to 11 mm. diameter.
,,	12–18 ,,	11 mm. to 13 mm. ,,
,,	18–25 ,,	13 mm. to 15 mm. ,,
,,	25–40 ,,	15 mm. to 18 mm. ,,
,,	40 upwards	18 mm. to 20 mm. ,, "

And the following is startling:—

Illuminating Power per Electrical H.P. of 13 mm. Carbons of different Makers. Currents from 15 to 20 amperes

Name of Maker	Candle Power per H.P.
Siemens (cored), pos. / Carré (cored), neg.	4270
Siemens (cored)	3514
Barnsley Co.	3500
Johnson and Phillips	2986
Sautter and Lemonnier	2920
Carré (not cored)	2773
Silvertown (Gray's)	2580
Carré (cored)	1972

We then have a chapter on magnets and electro-magnetic induction, which leads to the general principles and theory of electric generators, including a very admirable account of that important subject, self-induction.

"*It is found experimentally, and can be proved mathematically, that if a coil of wire forms part of a circuit, and an alternating E.M.F. sends a current through it, that the current will be much less than it would have been had the same resistance been interposed in the form of a straight wire.*

"*Further, the proportional diminution becomes greater as the current is increased by the reduction of the resistance; and finally, for a given E.M.F., a given rate of alternation, and a coil of given shape, a limit is reached beyond which even reducing the resistance to zero does not increase the current*" (p. 123).

"*This diminution, however, does not, to the best of my belief, waste energy or diminish the efficiency of the machine; it only diminishes its output. Thus self-induction increases the size of a machine required to feed a certain number of lamps, but it does not perceptibly increase the H.P. required to drive the machine with that number of lamps on it.*

"The effect of self-induction increases as the current increases, and therefore *short-circuiting a coil of an alternating machine does not indefinitely increase the current in that coil, and seldom increases it enough to injure the insulation*" (p. 137).[1]

Of course we have a good description of alternate-current machines, and after some adverse criticism of the Ferranti type (which is imperfectly described), and not justified by the performance of the latter, Mr. Gordon describes his own form, which is chiefly distinguished by its size and weight. A few direct-current machines are described—not the best—and their regulation briefly referred to, with the curious conclusion (p. 183):—

"CONCLUSION.

"*The true secret of successful regulation is to have very large dynamos, because then, as we have said before, the maximum number of lamps that can be turned out at one time is a very small percentage of the whole*, and when there are a great number of lamps on one machine, the cost per lamp of regulating, either by hand or by an elaborate mechanical contrivance, is very trifling."

Goulard and Gibbs' secondary generators and the various secondary batteries are briefly despatched. *Apropos* of the latter he says (p. 191):—

"*There is no doubt that the interest and depreciation on a set of secondary batteries large enough to enable an electric light plant to work day and night, and so give*

[1] The italics are not ours.

out to the lamps no electricity in the day but a double quantity in the night, is vastly greater than the interest and depreciation on a complete duplicate set of engines, boilers, and dynamos."

Photometry has only one page devoted to it, and Chapter XIX. is so unique that we reproduce it in full (p. 201):—

"CHAPTER XIX

"CENTRAL STATION LIGHTING

"I had intended to write a long chapter with the above heading, but, for various reasons, I am not yet prepared to do so. I have, however, left in the heading, for the convenience of inserting such a chapter in a future edition of this book, should one ever be required."

This reminds one of the celebrated chapter about Snakes in Ireland: "There are no snakes in Ireland."

The book ends with the excellent rules and regulations for the prevention of fire risks prepared by the Society of Telegraph Engineers. Several useful tables are given in the appendix.

The book is disappointing not for what it contains but for what it does not contain. There is in it a strange mixture of the elementary and the advanced. After an algebraical description of the relations that exist between current work and power, we are told by a footnote (p. 19), "The symbol $\sqrt{\ }$ means 'square root of' the quantity under it." There is much hasty editing. At p. 30 we are promised in a footnote a mathematical proof in the appendix which does not appear there. At p. 25 the symbol for a battery is wrong—the poles are reversed. The present value of H at Greenwich is given at p. 40 as ·1794, and at p. 48 as ·181. The illustrations, it may be remarked, are excellent.

It is to be hoped that a second edition will soon be required, so that Mr. Gordon may be able to remedy the defects of the present one. A good practical treatise is very much needed.

W. H. P.

OUR BOOK SHELF

A Text-Book on the Method of Least Squares. By Mansfield Merriman. (New York: John Wiley and Sons, 1884.)

THIS may almost be looked upon as a second edition of the "Elements" by the same author, which we favourably noticed in NATURE (vol. xviii. p. 299) soon after its appearance. The sale of the entire edition of the smaller book may be taken as evidence of its having met a want. The present work, though larger in appearance, covers about the same extent of ground, but, as is pointed out by the author, "the alterations and additions have been so numerous and radical as to render this a new and distinct book rather than a second edition."

In Chapters I. to IV., which present the mathematical developments of the principles, methods, and formulas, Dr. Merriman gives an introduction, and discusses the law of probability of error, the adjustment of observations, and the precision of observations at some length, and illustrates with numerous (for this subject) examples. In Chapters V. to IX. the application of the above to different classes of observations is made. These chapters are respectively headed: Direct Observations on a Single Quantity, Functions of Observed Quantities, Independent Observations on Several Quantities, Conditioned Observations, and the Discussion of Observations. These discussions are likely to be of use to engineers and others specially interested in this branch of mathematics. In an appendix, *inter alia*, there is a short statistical statement on the history and literature of the subject, but the fuller list of literature of the earlier book is not reproduced: there are also given here eight handy tables and some other useful material. It is the only work of the kind with which we are acquainted, and is even better adapted, in our opinion, for the end Dr. Merriman has in view than his earlier book was.

Some Propositions in Geometry. In Five Parts. By John Harris. (London: Wertheimer, Lea, and Co., 1884.)

WHEN we received the parcel containing this work with some others for review, we speculated upon what the Editor could have sent us, and hope rose within our breast that some *magnum opus* awaited our perusal. But as we had heard no whisper of such work being on its way, our expectation cooled, and again casting our eyes on the unopened packet, and remembering former works of similar dimensions, a chill seized us, and we thought to ourselves, "Aut H. aut..." Shade of De Morgan! what are we to do with a work occupying 144 + 8 quarto pages treating of a subject so thoroughly threshed out, we had hoped, in your immortal "Budget"?

The title is an attractive one, and much of the work appears to be sound, but when we come across such problems as the trisection of any angle, the inscription of heptagons and nonagons in circles, *et id genus omne*, one draws in one's breath, and one's hair stands on end! The tentative methods given we dare say would enable one to perform these several operations to a very close degree of approximation, but this is not what ordinary mathematicians want. But we must be careful here, for Mr. Harris puts the question, "What is a *mathematician?*" and in his answer splits the creature up into "sorts." There is, for instance, the very positive and readily incensed mathematician, the highly exalted mathematician, the profound mathematician, and the exclusive orthodox mathematician.

It is under this last "sort" that we fear we must be classed. With him "'Mathematics' is a sort of privileged religion, having its special *articles* and technical dogmas. None but the initiated must enter its temple, and woe be to him who dares to do so without a formal certificate from its priests. One of his most valued dogmas is that $\pi = 3\cdot14159\ldots$ This is called an approximation; and which if a man do not faithfully believe he will inevitably go—— Ah, well, never mind where he will go to; but, at all events, no mathematician must hold converse or communication with such a profane person."

It will be seen from this extract that Mr. Harris is a man of some humour, but even such oases do not render the vast Sahara of much of his book pleasanter reading. Indeed we have found it very hard work, and so we contented ourselves (for review purposes) with the careful reading of one of the "trisection" proofs; but we gave up in despair, as this proof involved the mastery of a previous proof, and we feared it would be a case of little fleas and lesser fleas, "and so *ad infinitum*." What did we do next? Why we applied a trigonometrical test, and found that the method in the text would not give the result at all, except in a special case. Life is really too short for such verification, and we must leave the task to others. The figures, as usual with Mr. Harris, are carefully drawn and very elaborate diagrams.

We regret more and more that so much labour should be bestowed upon such studies, which, we fear, an unbelieving world will never take up. What, then, is the value of π? It is here said to be (Mr. Harris would say, proved to be) equal to $\sqrt{8} \times \frac{10}{9} = 3\cdot142696\ldots$

We lay down the book more in sorrow and pity than in anger and scorn.

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 insure the appearance even of communications containing interesting and novel facts.*]

"Gas-Burners, Old and New"

PERMIT me to point out a very obvious clerical error in the notice, in last week's NATURE (p. 270) of my little work having the above title, and to make a few remarks concerning your criticisms on the book. In the sentence, "'Owen Merriman' has taken pains to insist on the two great *desiderata* of gas-burners—high temperature and low temperature," the latter word is doubtless intended for *pressure;* and the sentence should read "high temperature and low pressure." It would have been scarcely necessary to make this correction, but that the notice may perhaps be read by many who are incapable of suggesting the correct reading, and to whom therefore the sentence as it stands will be absolutely meaningless.

While fully appreciating the kindly nature and intent of your criticisms, I cannot pass by, without a word of defence, your statement that you think I have "gone too far in attempting to give a popular theory of luminous combustion." I hope to be able to show that the particular extracts from that portion of the book to which exception is taken are practically correct, and, so far as could be looked for in a work addressed to miscellaneous readers, sufficiently precise. To this end I will deal with the various extracts *seriatim.* That "the various gases which constitute ordinary coal-gas do not all burn together in the flame" is a matter I had thought to be established beyond reach of dispute. But if evidence is required of the truth of the assertion, I need only point to a table prepared by Prof. Landolt, showing the composition of gases in the different parts of a gas flame, which is given by Prof. T. E. Thorpe, F.R.S., in a lecture on "Flame," forming one of the Manchester series of Science Lectures (Manchester: John Heywood). By this table it is clearly shown that in a gas flame, 3½ inches high, the olefines, or heavy hydrocarbons, do not diminish in amount until a height of 1·58 inches is reached; while the proportion of hydrogen is considerably diminished at a height only of 0·39 inch. Although it may not be mathematically correct to say that "the amount of light developed by any coal-gas flame is *directly proportional* to the degree of intensity to which the temperature of the carbon particles is raised," seeing that the light emitted is not in *exact* proportion to the temperature of heat, the statement is sufficiently correct for a popular treatise. What was chiefly intended to be enforced was that the amount of light evolved from a gas flame increases with its temperature, and in such a work a mathematical degree of exactitude is hardly looked for. Now, with regard to the other matters which are raised. To account for the destruction of luminosity which occurs when air is introduced into a gas flame, two theories have been put forward. According to the first, the heavy hydrocarbons at once meet with sufficient oxygen and are immediately consumed, without their carbon being first raised to a white-hot state; but this theory alone will scarcely explain the phenomenon, seeing that the effect of pure oxygen is to increase the luminosity of a flame. The other and more rational theory—and the one which is more generally accepted—supposes that the inert nitrogen which is thereby introduced reduces the heat-intensity of the flame "below the temperature required to decompose the hydrocarbons." It may be that to some extent both causes are at work. Lastly, as to the relative temperatures of a luminous and a non-luminous flame. Although the *average* temperature of the latter is higher than the former—as indeed it must be, seeing that the same *quantity* of heat is contained in a less space, the non-luminous flame nowhere develops so high a temperature as is found at certain of the hottest portions of the luminous flame. Mr. R. H. Patterson, in an article on the action of the blowpipe considered with reference to the principles of gas illumination (*Journal of Gas Lighting,* &c., vol. xxxv. p. 831), states that in the luminous region of an ordinary gas flame he has succeeded in melting a platinum wire: a result which he could never attain with a non-luminous flame."

July 21 "OWEN MERRIMAN"

[We thank our correspondent for pointing out the clerical error "low temperature" for "low pressure" in our article. We consider that the sentence, "The various simple gases which constitute ordinary coal do not all burn together in the flame; the temperature required to effect their ignition being lower for some of them than for others," is misleading. The ordinary reader would understand this to mean that the constituent having the lowest ignition point catches fire and burns away first, and then the constituent of next lowest ignition point catches fire and burns away, and so on; whereas Blochmann's researches show that the combustions are not distinct, but that the *rate* of combustion of the hydrogen is greater than the rate of combustion of the other inflammable gases.

We do not think it "sufficiently correct" to say that the intensity of light is *directly proportional* to the temperature of the coal-gas flame: perhaps it would be nearer the mark to say that the intensity of the light varies as the fifth power of the temperature within certain limits. The admission of air into the Bunsen flame destroys the luminosity more by *dilution* and *oxidation* than by *refrigeration.*—ED.]

The "Cotton-Spinner"

IN a note on this rare British Holothurian (published in NATURE on June 12, p. 146), I drew a distinction between the kind of observations that were possible to a student in a museum and to one who was working at a laboratory specially adapted for biological investigation and situated on the sea-shore.

The experiences of the last few days have shown me only too well that this distinction was not overdrawn or too refined. By the kindness of Mr. John Snell of Truro, I have been favoured with two consignments of the "Cotton-Spinner;" three specimens which reached me on Monday by parcels post gave very sufficient evidence of having died some hours before. This mishap induced me to propose to Mr. Snell that he should send me specimens by express, and entrust them to the charge of the guard of the train; for this suggestion I am indebted to Dr. Günther. Mr. Snell not only did this to-day, but he was good enough also to warn me by telegram that the specimens would reach Paddington at 8 p.m. this evening. I was at the station to meet them, and I have no doubt that the comparatively fresh condition of the sea water was due to the attention of the guard of the train. Notwithstanding all this care and trouble, the three "Cotton-Spinners" were dead.

I have given this detailed, and, I fear, tedious exposition of the whole case, because it seems to me to clench the argument that the problems of the physiology of marine forms, and especially of those less-known creatures which live at a depth of—like the "Cotton-Spinner"—ten to twenty fathoms, are not soluble at some distance from the coast, however great be the trouble or the care that is taken in forwarding them. We must have a laboratory on the sea-shore.

The only fact that I have been able to observe is that the threads of the "Cotton-Spinner" do undoubtedly attach themselves to objects in their vicinity: one of the specimens obtained this evening was attached to sea-weed; from the cloacal orifice a connected strand of threads, about one-fifth of an inch in width and an inch in length, spread out at its free end into a number of more free threads which had attached themselves to the sea-weed which had been placed in the water; they extended over about two inches in breadth. From what I have learnt of the extensile and swelling power of these threads, I should take it that about as much had been expelled as would occupy the greater part of the cloacal cavity. A woodcut illustrating the cloacal cavity so filled by tubes, and drawn from a spirit specimen preserved in the British Museum, will be given in my paper on this animal, which will be published in the next (October) part of the *Proceedings* of the Zoological Society.

August 1 F. JEFFERY BELL

Krakatoa

I MOST respectfully beg to point out to you a few errors made in the English version of my "Short Report on the Krakatoa Eruption," published in NATURE, May 1.

It says on p. 15:—"In this eruption very curious objects were ejected, *i.e.* very smooth, round balls, resembling marbles, to the size of 1½ to 6 centimetres in diameter. *They are full of acids;* they contain 55 per cent. carbonate of lime," &c.

The words italicised are wrong. The original says: *Zÿ Cruisen sterk met Zuren,* which means "*hey strongly effervesce when*

moistened by powerful acids. P. 11, column 1, line 34, "1860" should be "1680"; p. 12, column 2, line 28, and also p. 13, column 1, line 5, *steatite* should be *pitchstone* (a vitreous variation of pyroxene andesite). R. D. M. VERBECK,
Director of Java Geological Survey
Buitenzorg, Java, June 19

THE METEOROLOGY OF BEN NEVIS

AS regards changes of weather and many other problems of meteorology, a knowledge of the vertical variations which take place in the atmospherical conditions is of first importance; and the only way we can hope to arrive at this knowledge is by regular observations made at stations as near each other as possible in horizontal direction, but differing as much as possible in height. This point was very clearly seen many years ago by the late Mr. Allan Broun, and the idea was practically worked out by him in the elaborate series of meteorological and magnetical observations simultaneously made on the peaks and ridges and in the adjoining valleys of the Western Ghats. These observations are the best anywhere yet made to supply the observational data for the discussion of some of the more important problems of meteorology; and the science sustained no ordinary loss in the death of Mr. Broun before he had discussed the observations which had been collected by his genius, energy, and self-denial.

Next in scientific value to Mr. Broun's observations are those made on Ben Nevis since June 1881. The special advantages of Ben Nevis as a meteorological observatory are that it rises to a height of 4406 feet, and is little more than four miles distant from the sea at Fort William, and that it is situated in the track of the great storms which sweep over North-Western Europe from the Atlantic. Hence observations made on the top and at the base of Ben Nevis possess a value altogether unique in meteorology; particularly in discussing the atmospheric movements which accompany cyclones and anticyclones, and in investigating tornadoes and other destructive winds which originate when the air is abnormally warm and moist near the surface, while aloft the temperature and humidity diminish with abnormal rapidity.

For the preliminary inquiry which is necessary in order to determine the chief points in the meteorology of Ben Nevis, there are now available for a comparison of the climate of the top of the mountain with that of the sea-level at Fort William, simultaneous observations for twenty-two months, viz.: from June to October of the years 1881 and 1882, and from June 1883 to June 1884. As regards the temperature, the monthly means for Fort William were compared with the normal monthly temperatures of that place as given in the paper on the "Climate of the British Islands" (*Journ. Scott. Met. Soc.*, vol. vi. p. 33). From the differences thus obtained, the approximate normal temperatures at Ben Nevis Observatory were determined. The coldest month is February, the mean being 22°·0, and the warmest, July, 41°·3, August being nearly as warm, the mean being 41°·1; and the annual mean temperature 30°·9. Comparing the normals with those of Fort William, the greatest difference is 18°·0 in May, from which it steadily diminishes to 14°·9 in December, and then rises more rapidly to the maximum in May; the annual difference is 16°·3. The greatest difference, or the most rapid fall of temperature with height, is in the spring and early summer, when the climate of the west is driest, the temperature of the Atlantic lowest relatively to that of the air, and the top of the mountain still covered with snow. The least difference is in late autumn and early winter, when the climate of the west is wettest, Ben Nevis most frequently and densely clouded, and the temperature of the Atlantic highest relatively to that of the air. The observations of temperature at the high- and low-level stations show a variation with the hour of the day even more decidedly marked than that with season. Thus, in January the decrease of temperature, deduced from the mean maxima and minima respectively were 16°·2 and 15°·2, but in April these were 23°·1 and 12°·9, being thus in January nearly equal, whereas in April the difference of the maxima was nearly double that of the minima.

The annual means give, therefore, a decrease of temperature with height at the rate of 1° for every 270 feet of ascent—the most rapid decrease being 1° for every 245 feet in April, and the least rapid 296 feet in December.

But the individual observations show wide divergences from these rates of decrease. As disturbing conditions, the more important of these are the instances of abnormally large decrease, seeing that these imply a temperature near the surface much above the normal with respect to the higher strata, by which the equilibrium of the atmosphere is destroyed, and rapidly ascending and descending currents are generated, thus giving rise to some of the most destructive storms of wind. Of the illustrations the observations give of a rapid decrease, reference may be made to those of October 13, the day preceding the great storm which proved so destructive to the fishermen on the Berwickshire coast.

Even more striking, and, as regards their bearing on the theory of storms and weather changes, perhaps even more important, are those instances of abnormally small differences between the temperature at the top and base of the mountain, of which a good example which occurred on September 21, 1882, was given in NATURE, vol. xxvii. p. 176. All such cases have been accompanied with a high temperature and an excessive dryness of the air. It is these qualities of air which immediately connect the phenomena with the great cyclonic and anticyclonic systems in which or near to which Ben Nevis is for the time situated. The most striking case of all occurred on December 31, 1883, on which day the maximum temperature at Fort William was 30°·6, and minimum 27°·2, these being at Ben Nevis Observatory 32°·0 and 22°·8. At 11 a.m. the temperature at Fort William was 27°·5, but on Ben Nevis it was 32°·0, with a wet bulb as low as 24°·4. Hence at this hour the temperature of the air was 4°·5 higher at the Ben Nevis Observatory than at Fort William, 4406 feet lower down, and this relatively high temperature was accompanied with excessive dryness represented by the humidity of 33. From 6 a.m. to noon temperature was continuously higher on Ben Nevis than at Fort William. At 11 a.m. the abnormality in the vertical distribution of the temperature amounted to 20°·5. It is of importance to note that at this time of relatively high temperature and great drought, atmospheric pressure was very high at the Observatory, the reading of the barometer at 32° being 25·915 inches, being absolutely the highest that has occurred from November 28, 1883, to June 30, 1884. At Fort William the sea-level pressure was 30·608 inches.

Another peculiarity of the temperature is the small diurnal variation caused by the sun at all seasons, but particularly in winter; and the large variation due to the temperature changes which accompany the passage of cyclones and anticyclones over the Observatory. The means of the hourly observations show that even in May the difference between the mean warmest and mean coldest hour was only 3°·3. In January the difference was only 0°·8, and in this month the highest hourly mean occurred during the night, and the lowest during the day. On the other hand, the difference of the mean daily maxima and minima for January was 6°·7. In truth, the influence of the sun on the temperature of the air is all but eliminated during the winter months owing to the thick covering of mist, fog, and cloud, in which the mountain is almost constantly wrapped.

Since June 1881 the highest temperature on Ben Nevis was 59°·3 on August 8, 1882, and the lowest 9°·9, on February 2, 1884. During these months the extremes at Fort William were 73°·8 and 27°·0.

The barometric observations at Fort William and Ben Nevis were dealt with in a similar manner, and a table of corrections of the Ben Nevis observations to sea-level was constructed directly from the observations of the two stations, the table giving the approximate corrections for each tenth of an inch of the sea-level pressure, and for each degree of mean temperature of the stratum of air from the Observatory to sea-level, which was assumed to be the arithmetic mean of the temperatures at the two stations. The normals of atmospheric pressure for Ben Nevis were then calculated. The lowest normal monthly pressure is 25·141 inches for January, and the highest 25·410 inches for June, and for the year 25·281 inches. Comparing the normal pressures at the high- and low-level stations, pressure on Ben Nevis is on the mean of the year 4·557 inches lower than at the sea-level at Fort William, the least monthly difference being 4·484 inches in July, and the greatest 4·620 inches in February.

The morning maximum of pressure was at 10 a.m. in January, at noon in February and March, 1.30 p.m. in April and May, while in June it was delayed to 3 p.m. From Mr. Wragge's observations in 1882, the same diurnal phase of the pressure occurred about 9 a.m. in the summer months at Fort William, being thus six hours earlier than on the top of Ben Nevis. From February to June the morning minimum of pressure was very large. On the other hand, the afternoon minimum was comparatively small; and as the season advanced it became less and less pronounced, till in June the diurnal oscillation approached closely to one single minimum and maximum. Owing to the low readings of the morning minimum and the high readings of the afternoon maximum, which have their explanation in the diurnal change of the temperature of the aërial stratum below the level of the Observatory, the diurnal range of pressure on Ben Nevis exceeds that of any other meteorological station in Scotland.

The rainfall on the top of Ben Nevis is very large. At Fort William the mean annual amount is about 83 inches. During the three years beginning 1881, while the rainfall at Fort William was 24·59 inches from June to October, it was 47·10 inches on Ben Nevis. During the two years 1882 and 1883, for the same months, the rainfall at Fort William was 21·96 inches; at the lake (1840 feet high), 28·42 inches; but on Ben Nevis, 44·35 inches: hence during the summer months the rainfall on Ben Nevis is nearly double that of Fort William, and the greater part of the increase in the rainfall from Fort William to the top of Ben Nevis takes place above the level of the lake. No inconsiderable proportion of the large rainfall collected on the top is due to driving mists and drifting wet fogs, during which, though often no raindrops are visible, or only a few small drops at wide intervals apart, yet everything is dripping wet, and the funnel of the rain-gauge is crowded with numerous runnels of clear water, steadily trickling down into the receiver of the gauge.

On plains and extensive plateaux the wind attains a diurnal maximum velocity shortly after noon which is generally nearly double the minimum velocity, which occurs shortly before sunrise. But on Ben Nevis, in common with other observatories which are situated on peaks rising to a considerable height above the whole of the surrounding region, the reverse of this takes place, the maximum velocity occurring during the night, and the minimum during the day. The difference between the mean minimum and maximum hourly velocities on Ben Nevis in each of the seven months ending June last was about five miles. A tendency to a secondary maximum was shown in May, but in March, April, and June no such tendency was apparent. A full gale from south-east blew almost continuously at the Observatory from February 15 to 21, and during these seven days there was a mean maximum of 58 miles from 5 to 6 a.m. and a mean minimum of 42 miles from 4 to 5 p.m. With an hourly difference of 16 miles, the daily variation in the velocity of the wind was maintained during the continuance of this great storm.

Another main object in constructing the table of corrections to sea-level for Ben Nevis Observatory was to afford a ready comparison between the atmospheric pressure at sea-level and that on Ben Nevis from the important bearings of the observed differences on the changes of weather which precede, accompany, and follow storms, and on such inquiries as the singular and opposite relations which obtain during storms of wind and during the remarkable weather which often occurs within, or on the confines of, anticyclones.

ALEXANDER BUCHAN

THE FORESTRY EXHIBITION

SINCE our last notice of the International Forestry Exhibition great progress has been made in the concentration and arrangement of the various products which testify to the importance of the subject. We believe that the juries have now met, and such names as Sir Joseph Hooker, Colonel Moncreiff, R.A., Profs. T. R. Fraser of Edinburgh, Bayley Balfour of Oxford, Dr. Lyons, M.P., with several Indian and Scotch Forest Officials, and others will inspire confidence in their work. We to-day give a description of one of the most interesting sections, which well repays a visit.

The Japanese Court occupies the eastern transept, and forms one of the largest and most important sections. The whole arrangements have been carried out in the most thorough and business-like manner. Immediately on the arrival of their goods, knowing beforehand the amount of space required, and working with a rapidity and skill which might put to shame some more civilised nations, the Japanese Commissioners have shown that they are far in advance of many countries in business capacity as well as in the science of forestry. In Great Britain the importance of forestry to the welfare of the country and its colonies has but lately been recognised. In Japan, on the contrary, it has long formed an important feature in national education. This is evident from the ingenious devices represented on the walls of the department, and which can only have been the outcome of long experience.

With excellent taste the Japanese have placed the timber in the most prominent position, and the products in the background, giving at once the impression that it is purely a forestry exhibit. The central tables are occupied with longitudinal sections of trees, with the surface planed so as to render the grain visible. Above these are similar sections, but showing the bark, and above these are coloured drawings of the trees yielding them. At the foot of these sections a paper explains in English the Japanese name, the botanical name and habitat, and the relative rarity or abundance of the tree, its girth and height at fifty years old and at maturity, the best mode of propagation, the quality and uses of its wood and of other parts. Each section, drawing, and description is marked with a corresponding number. On the wall of the Southern Court are some artistic drawings in monochrome of the various devices for felling and floating the trees along mountain streams, for slipping them over precipitous cliffs, and for stopping and collecting the timber at certain localities in its course for storage. The expedients adopted for floating the timber down narrow gullies, and the sledges used for sliding it down over the snow in winter, and other details of forest work and a forester's life, are depicted in a manner that is easy to remember from the quaint dress, the life-like attitude, and excessive energy thrown into the actions represented. These drawings are mounted in wooden frames, and the background tastefully decorated in a simple manner with fragments of veneer of different colours. They are accompanied by models which still better illustrate the means adopted in mountainous countries, and must prove exceedingly instructive to students of forestry.

Next in order come the tools used in the various operations of cutting, transporting, and working the timber and peeling the bark. Some of the axes and saws are of extremely peculiar shape, but admirably fitted for the purposes for which they are intended.

According to a printed table hung on the end wall, the area of the Japanese Empire is 38,563,718 chos (a cho = 2·450 acres), the area of forest (excluding the islands of Okinawa and Hokkaido) being 11,866,626 chos, or rather less than one-third of the country. Of this area 5,259,182 chos are worked by the Government, and 6,607,443 chos by private individuals. About a quarter of the Empire has, however, not yet been surveyed; the above figures, therefore, only refer to the surveyed portion. Accompanying this table is a map giving the distribution of trees in Japan, and marking out certain zones, each indicated by some particular tree forming a prominent feature in the landscape. Of these zones *Ficus Wightiana* characterises the lowest, *Pinus Thunbergii* the second; then follow in order *Fagus sylvatica*, *Abies Veitchii*, and *Pinus Cembra*. The extent of these zones is marked in colours on the map, and on excellent coloured drawings representing the habit of the five trees, and their foliage, flowers, and fruit in life-size are presented at one glance. The less important productions of the forests are appropriately illustrated by smaller collections, a simple expedient by which an idea of their relative consequence is easily conveyed. Fungi, dried and preserved in pickle, and a dried lichen (a species of *Gyrophora*), and a collection of seeds of forest-trees, well preserved, and carefully named, are placed near. Several fungi are cultivated on special trees. According to notes affixed to the tree-sections, among the trees thus employed are *Celtis sinensis*, *Carpinus laxiflora*, *Quercus crispula*, *cuspidata*, and *glandulifera*.

Roots, barks, and seeds used in medicine are not so well represented as usual. Even menthol, now tolerably well known in this country as a remedy for neuralgia, is not exhibited. A beautiful specimen of insect wax resembling spermaceti in appearance, but much harder, and identical with that used in China to coat candles to prevent their guttering, is exhibited. The insect producing it is cultivated on *Ligustrum Ibotu* and *Fraxinus pubinervis*.

An exceedingly ingenious double chop-stick is here shown, consisting of a piece of white wood, slit two-thirds of its length; on pulling the pieces apart, a wooden toothpick is seen inclosed in the centre. As the wood has never been entirely split, it is puzzling to know how the toothpick was inserted. This is done by cutting it with a special instrument when the wood is wet and can be extended. The leaves of two other plants besides those of tobacco are shown, the one made into cigarettes, and the other simply dried for smoking (*Sterculia platanifolia*).

The cooperage work seems to be carefully done, the barrels having polished surfaces, and in some instances the bands are made of plaited bamboo. The polishing of rough surfaces appears to be effected by the rough leaves of *Aphananthe aspera* and the stems of a species of *Equisetum*. Japanese tooth-brushes are exhibited, made of the frayed-out ends of a piece of white wood; and combs, and even tooth-combs, are made of similar material of a harder character, such as the wood of *Olea Aquifolium* and *Hovenia dulcis*. Dyeing and tanning barks are comparatively few in number, and walking sticks do not present any great variety, only a few being engraved or ornamented. A simple flower-pot for the wall of drawing-rooms consists of two joints of a large bamboo, with a piece cut out at the side of each joint so as to permit of a fern or bouquet depending over it.

In the left-hand court may be seen some bent wood furniture that might fairly compete with that of Austrian manufacture. In one corner may be seen a series of young trees four or five years old, imported from France, Germany, the United States, and other countries; indicating that acclimatisation of the useful trees of other countries has already been commenced in Japan. Wood-engraving and printing in one or more colours is illustrated by the engravings placed side by side with the blocks. The celebrated Japanese lacquer is exhibited in the crude state, and also applied to knick-knacks and other articles, some specimens of lacquered slabs having so high a polish as to appear like glazed ornamental tiles. These are accompanied by a coloured drawing of the foliage and flowers of the lacquer-tree painted on the wood of the same tree and framed, with other portions having the bark attached. Several other useful timber-trees are illustrated in the same ingenious manner. The almost transparent yet strong and tough paper made from the fibre of the paper mulberry-tree (*Broussonettia papyrifera*) is shown, but its manufacture is not illustrated by drawings, the exhibits being limited to products. This paper rolled into the form of a spill is strong enough to be used like string. Exceedingly thin planed shavings of wood, scarcely thicker than the paper above alluded to, occupy a conspicuous position. These are used for packing butter or other goods of similar description. A cursory glance at the notes appended to the sections of wood reveals many interesting facts regarding some Japanese trees and shrubs commonly cultivated in this country. Thus an oil is obtained from the seeds of the common Camellia (*C. japonica*), and rope is made from the stems of *Wistaria sinensis*. Charcoal, for the manufacture of gunpowder, is prepared from the wood of *Paulownia imperialis*, and the wood of the deliciously-scented *Olea fragrans* is used for wood-engraving and combs. A shrub, also indigenous in this country, *Viburnum opulus*, furnishes tooth-picks. A very ingenious use of the trunks of trees is the hollowing them out into drain-pipes, each about 6 or 8 feet long, and fitting into each other at the end. On the walls of this court illustrations are given of the mode of preventing the slipping away of soil on mountain-sides, and of the trees and shrubs and herbs useful for binding sandy soil or embankments, &c. Altogether the Japanese section is an exceedingly interesting one, and offers many useful suggestions to the foresters of Western countries.

PRACTICAL TAXIDERMY

AMIDST the many criticisms which are passed by visitors upon the collections in the new Natural History Museum of South Kensington, there is always to be found a word of praise for the improved appearance of the mounted animals in that Museum, and it may fairly be said that the encomiums which are heard on all sides have been justly earned by Dr. Günther and the staff of the Zoological Department; that is to say, if an honest endeavour to present to the public something better than can be seen in other museums counts for anything. The officers of the British Museum, in transferring the zoological collections from Bloomsbury to South Kensington, were heavily handicapped, for it was impossible to commence the mounting of the collections *de novo*, and they therefore had upon their hands a vast number of interesting specimens unfit to exhibit to the public, but valuable to the naturalist, and worthy of preservation as forming a historical part of that great zoological collection which is admitted by naturalists to be intrinsically the finest in the world. For some time before the removal a careful selection of duplicate specimens had been made, and these had been distributed to various provincial museums, but all those which possessed any scientific value, such as types, &c., have been carefully unmounted and added to the collection of skins, and it was curious to note the progress of the art of taxidermy which these specimens exhibited. It is notorious that for many years the authorities of the Zoological Department have been troubled with the preservation of antique specimens of natural history which seemed to be falling into a state of natural decay, although no actual reason could be assigned for their dissolution, and moths and beetles have never been known to do any harm to the collections, thanks to the constant care which is exercised in that department. But on dismounting some of the ancient specimens, such as those presented by Colonel Montagu, it was discovered that they had never been properly skinned, and with the exception of the extraction of the entrails, the bones and flesh of the birds had been left entire, and apparently without an attempt to further preserve the specimens. The result may be imagined, and the difficulty of preserving these interesting relics will be fully appreciated by the naturalist of to-day. It has often been a source of wonder to zoologists as to what has become of many of the types of species recorded by Latham and the older writers on ornithology as existing in the British Museum, which certainly are no longer in the national collection. The records of the Museum show that they never descended to modern times, and there can be little doubt that the defective preparation of a hundred years ago was inadequate for their preservation, and that they were allowed to fall into decay by the earlier custodians of the national Museum, in whom the sacred value of a type was not so inherent as it is in the age in which we live.

We may hope that the improved preparation of the specimens in the Natural History Museum marks the commencement of a new era in the art of taxidermy, for the skilful mounting of animals is a real art, and ought to be recognised as such. An artist who portrays animal life successfully reaps the full appreciation of his countrymen, and is well paid for his work, but hitherto the taxidermist has never been properly appreciated, and until adequate remuneration is provided for the artists who reproduce natural specimens, we can never hope for the success of taxidermy as an art which ought to rank as high as that of the animal painter. The undoubted success which has attended the production of the groups of British birds which now adorn the corridors in the Natural History Museum is a great encouragement to those who have at heart the welfare of the art of taxidermy, and it cannot be denied that the mounting of these groups does credit to all concerned. We are aware that Prof. Flower (himself no mean taxidermist) takes a great interest in the improvement in the mounting of animals in the Museum of which he is so able a Director, and the exertions of Dr. Günther in this direction have been manifest since his appointment as Keeper of the Zoological Department in the British Museum, while the frequent occurrence of Lord Walsingham's name as a donor of many of these beautiful groups of "British birds in their haunts," shows the practical utility of having as a trustee a naturalist who labours to supply the wants of the institution of which he is one of the guardians. In the Bird Gallery itself, as well as in that of Mammalia and Osteology, the same wish to improve the natural appearance of the specimens exhibited is seen at every turn, and it is to be hoped that the lesson thus taught by the British Museum will be imprinted on the mind of every provincial curator, who will feel henceforth that the value of the collection under his charge will consist not so much in the array of mounted specimens which he can muster on his shelves, as in the excellent preparation of the few leading types which are really all that are necessary for the instruction of the public.

The above thoughts have been inspired by a perusal of a little work which has fallen into our hands, viz. the second edition of Mr. Montagu Brown's Essay on Taxidermy. Mr. Brown is the Curator of the Leicester Museum, and he is a man of whom any provincial museum may well be proud. In a lecture delivered many years ago at Leicester Mr. Bowdler Sharpe gave some hints on what he conceived it to be the object of a County museum. It seemed to him that in the first place it was expected of every County museum to make as perfect a collection as possible of the natural productions of that County—that this should be the aim and object of every curator, and that all these exhibits should be arranged in the most popular and attractive form. It was impossible, he pointed out, for a local museum to attempt to show a perfect collection of all the classes of animals. This ought to be left to the British Museum; but he insisted that it was within the province of every such museum to exhibit a typical series of animals which would be useful for comparison with local species, and would educate the minds of an intelligent public towards an appreciation of the varied forms of animal life upon the globe, as compared with the zoology and botany of the county in which they lived. Shortly after the Committee of the Leicester Museum carried out this idea to a limited extent under the curatorship of Mr. Harrison, a most intelligent custodian, who is, we believe, now located at Birmingham; but the plan was fully developed by his successor, Mr. Brown, who has employed his talents as a taxidermist in a popular direction, and the result is that the collection of birds at Leicester is mounted in cases with the natural surroundings explaining their habits at a glance, and in a manner with which no guide-book attempting to illustrate a collection on a conventional plan can hope to vie. It may be a question for naturalists whether this will not be the museum of the future, but as evidence of the value of practical taxidermy this may be considered already *un fait accompli;* and in making these remarks it would be unfair not to mention the names of some of those who in England have contributed to the improvement of this art. Of these the honoured name of John Hancock stands first, for the influence of Waterton, who strove to import into this country an improved system of mounting animals, seems to have been but small among the generation which followed him. Mr. Hancock's groups in the Great Exhibition of 1851 left an indelible impress upon British taxidermy, and his rendering of a bird of prey is only equalled for life-like delineation by one of Wolf's pictures. Mr. A. D. Bartlett, the well-known Superintendent of the Zoological Gardens, is certainly one of the best taxidermists which this country has produced, while the art of mounting Mammalia has been studied with success by Mr. Rowland Ward and Mr. Edward Gerrard—most of the best examples of the latter class in the British Museum having been mounted by the last-named artist. Many provincial men, such as Mr. Swaysland of Brighton, Mr. Shaw of Shrewsbury, and Mr. Quartermain of Stratford-on-Avon, have proved their ability as taxidermists, and London itself possesses adepts in the art who are equal to the great taxidermist Termayer of Holland, whose masterpieces may be seen in the Museums of Amsterdam and Leyden; but we doubt whether anybody has exercised more influence on the improvement in the mounting of animals than Mr. E. T. Booth of Brighton, whose collection of British birds exhibited in the Dyke Road Museum is one of the sights of England. To him belongs the credit of being the first to attempt a collection of British birds with their natural surroundings, and it is upon the lines introduced by Mr. Booth that the beautiful groups of our native species in their natural habitats has been attempted at the British Museum; and if the genius of Mr. Pickhardt who has mounted the birds, and of Mr. Mintorn, to whose skill the beautiful modelling of the flowers and trees is due, does not satisfy the aspirations of British naturalists, we shall feel that the improvements in the taxidermy of recent years have no real existence.

NOTES ON THE CANADIAN NORTH WEST

THE excursion to the Rocky Mountains, along the Canadian Pacific Railroad, will probably prove a most attractive feature in connection with the British Association meeting this season. Living on the cars for several successive days and nights is a novel experience for most people, and one, it might be supposed, that would prove monotonous; but the alternation of forest, lake, prairie, and mountain scenery, each with its associated peculiarities, will probably prevent the trip becoming at all tedious. Some members of the Association may prefer taking the route through the United States to Winnipeg, but from thence all will proceed through the rich wheat lands of Manitoba, then over the rolling prairies west of Brandon, with their numerous alkali lakes and relatively unproductive soil beyond Moosejaw; through the cattle-ranching district at the eastern base of the Rocky Mountains, and up the winding Bow Valley to the summit-level in the Kicking Horse Pass. Here at Stephen, on the confines of British Columbia, the railway terminates for the present.

On crossing the prairies for the first time, many interesting peculiarities will arrest the attention; perhaps none so strongly as the general flatness and absence of timber, which as a rule only occurs skirting the rivers, or as a low scrub in certain wet or marshy lands, or in scattered individuals along the dry sand and gravel ridges. These are probably the patches of country that escape the prairie fires, owing to the vegetation being either too damp or too scanty to support a conflagration. Vegetation as a rule is luxuriant, especially on the rich lands, where the grasses grow to a great height. The soil is mostly a rich black loam of variable thickness, accumulating by the annual decay of the grasses or by the ash from the fires. The loam is thickest on those flat lands with clay subsoil that lie south of the Manitoba lakes: in the arid districts of the western sections it becomes very light.

The subsoil is for the most part stratified sand and subangular gravel, which often contain large boulders of gneiss and quartz; it appears to be in a great measure of glacial origin; but in many places, as in the vicinity of Winnipeg, the subsoil is a stiff brown clay which is probably the filling of an ancient lake: it is seen in the banks of the Red River and Assiniboine. In the high banks of the Saskatchewan at Medicine Hat the clay has more the appearance of a stiff boulder-clay.

A few miles up the River Saskatchewan from Medicine Hat there is an important outcropping of coal; another seam is exposed on the Bow River near Crowfoot Creek; but the most important is that on the Belly River, where there are active collieries, the fuel being conveyed down the river to Medicine Hat, whence it is distributed along the line of railway. These fuels are lignitic in character, and are considered to be either of later Cretaceous or early Tertiary age. They come to the surface in many localities, and evidently underlie a large portion of the western plains. Adjacent to the eastern face of the Rocky Mountains the strata in which the coals reappear are more indurated and highly inclined, and some of the beds contain silicified wood.

In the section of country between Moosejaw and Medicine Hat alkali lakes are numerous; the smaller ones evaporate during the dry season, leaving a flat surface covered by a thick, white, glistening deposit: from this district fine specimens of selenite are obtainable. Probably some of the largest of these bitter lakes are those called the Old Wives Lakes, which lie in a large, sterile depression, on Le Grand Coteau du Missouri, evidently representing the site of a former large inland sea. The fresh-water lakes and marshes, locally numerous along the track, generally teem with wild fowl. In many of them also the tall elevation of reeds, formed by the musk-rat, may be seen.

Of other animal life on the plains there is a great absence. However, the so-called "blackbird" or purple crakle (*Quiscalus*) is locally very abundant; during the early season they keep in pairs, but, on the ripening of the corn, immense flocks of them congregate about it; prairie chicken are also numerous, but of other birds there are very few. Snakes abound in some places; they are constantly to be seen basking in the sun along the railway track. Of mammals the most frequent is the little Gopher or "prairie dog." Almost the only other visible quadrupeds are foxes and a few antelope.

Of the former great numbers of the now practically exterminated buffalo there is abundance of evidence. Their wallowing holes and runs are seen in all directions; the latter, narrow furrow-like tracks, stretch in straight lines across the plains, being most numerous in the vicinity of water. Bleached bones and skeletons, which lie scattered about in great profusion, testify to the wholesale destruction effected, chiefly by the Indians and half-breeds. On the introduction of modern repeating rifles whole bands of buffaloes were ruthlessly slaughtered, solely for their tongues and skins, and often nothing save the tongues were taken from the carcasses.

This indiscriminate destruction has reduced the Indian of the plains to a state of the most abject poverty and destitution, for formerly most of his wants were supplied by the buffalo; now he is wholly dependent on the Canadian Government, which allows a grant to each individual for his support, amounting in all to about 200,000*l*. per annum. Alcohol is not permitted amongst them, and there is a very heavy penalty for bringing intoxicating liquors into the North-West Territories. Of the various tribes, Sioux, Crees, and Assiniboines are met on the eastern portions of the plains; the Blackfoot reserve is situated near the Blackfoot crossing on the Bow River, where an Indian supply farm has been established. The Sarsee reserve is near Calgary; and at Morley the Stonys have their reserve; the latter, however, migrate into the mountains early in the season, and spend the summer in hunting; and although game is now very scarce, they are better off in this respect than their brethren of the plains. From these they differ greatly in physique, being shorter and more thick-set. They are more tractable than many of the other tribes, and a mission has been for some time established among them at Morley.

The country of the plains does not appear to be wholly adapted for agricultural purposes; Manitoba and a great part of Assiniboia are very rich, producing magnificent crops of corn; but the most fertile belt appears to stretch away from Brandon towards Edmonton, the line of the railway traversing a less fertile district to the south. West of Moosejaw the agricultural prospects are indifferent, and in many cases very poor. About Calgary the season is short, but a good deal of cattle-ranching has been done, and the district is considered well suited for it, although two years ago about 75 per cent. of the imported cattle died; this mortality seems to have been the effect of bringing cattle from lower latitudes late in the season, as, on arriving, they were in such a poor condition that they were unable to bear the winter, which that year set in unusually early, and was particularly severe.

Further north, towards Edmonton, the climate is not considered to be so harsh as about Calgary: this is probably owing to the lower altitude of the mountains permitting the warm Pacific winds to be more beneficial.

Beyond Calgary the railway follows the valley of the Bow River through the district of the Foot Hills for a distance of about fifty miles, when it enters the Rocky Mountain by the Bow Pass at Padmore, or the Gap. Between Calgary and the mountains the character of the country is very different from the prairie districts: the surface is hilly, with patches of pine forest. The strata are more indurated and folded, being often highly inclined. Several well-marked river-terraces can be traced along this valley, the uppermost extending far up the Bow Pass. In many districts on the plains the flies are so abundant as to interfere with surveying operations, alighting on the object-glasses in such numbers as to obscure the view. In all the houses the black flies literally cover everything. Earthworms do not occur in the north-west. To the botanist the plains are most attractive, there being an almost endless variety of grasses and pretty little flowers; many of our ordinary garden annuals growing wild over the plains.

To one who crosses the plains by the usual railroad route, the Rocky Mountains are first seen from near Crowfoot Creek, at the distance of about 150 miles. They appear as a serrated ridge on the south-western horizon, and numerous patches of snow can very soon be distinguished on them. The entrance to the Bow Pass, by which the mountains are entered, cannot be detected till one is close to the range. It is a comparatively broad winding valley, the direction of the bends being either south-west, across the strike of the strata, or north-west along that strike. The mountains rise precipitously on each side, but the valley itself presents a flat bottom, through which the river winds. This wide level plain, as a rule, is well timbered, the woods extending to a considerable altitude on the mountain sides; but forest fires have reduced the amount of available timber considerably. The trees are mostly either spruce or red fir, and, over the burnt areas, cotton-wood. Along the valley frequent large open untimbered spaces, locally called "parks," bear good pasturage. The removal of the timber from their surface was evidently effected by recurrent fires.

The strata which compose the mountains are regularly disposed, striking north-west and south-east, and having a regular dip to the south-west, which at the outskirts of the range is moderate, but gradually increases till the beds are almost vertical about Castle Mountain. Westwards, in the main divide, they lie more flat. The chief rocks are crystalline magnesian limestones, with calcareous slate, and locally, peculiar siliceous rocks containing opal; amongst the upper beds of the series there are quartzites, grits, and conglomerates.

Near Cascade Mountain an outlier of coal of the same age as the beds on the plains, but much more indurated, rests unconformably on the older rocks, showing that in all probability these Secondary or Tertiary rocks formerly covered most of this Palæozoic area. The older rocks which compose this part of the range are probably of Devonian or Carboniferous age; along the edge of the plains they are cut off by a large fault having a downthrow to the east, which brings the Cretaceous or Tertiary rocks into juxtaposition with them, while to the west they pass under newer strata. River terraces occur along the valley, and near Cascade Park there is a large accumulation of drift, apparently of glacial origin.

Many geologists will probably be disappointed in the Rocky Mountains of the Bow Pass section, for they hardly equal the familiar descriptions of the ranges further south. To the mineralogist, too, they promise but a poor field; the small amount of plication in the strata, and the absence of crystalline rocks, being unfavourable for the development of good mineral specimens. As to the industrial minerals, the resources of the valley have not yet been determined, but it appears that at least one metalliferous belt passes through the highly inclined rocks in the vicinity of Silver City: it bears copper pyrites and glance in veins running transversely to the general direction of the belt. Whether these veins are sufficiently rich, or whether there are large bunches of ore in the belt, has not yet been proved. Argentiferous galena is also known to occur in the grits and quartzites.

The climate of these mountains is very enjoyable in summer-time. During the day it is sometimes rather hot in the valleys, and the flies prove very troublesome, while at night there are often severe frosts. On the hills the temperature is much more equable, there being usually a cool breeze during the day, and at night the air feels warm and balmy. The timber line here is about 6000 feet above sea-level, and although it is only the highest peaks that rise above the line of perpetual snow, yet there are large accumulations of snow on the northern slopes and in many of the valleys, extending some distance below the timber line. On warm days snow-slides may be constantly heard descending with a loud roar. Glacial lakes occur in several of the valleys and cooms.

Fish abound, but they are difficult to catch except in the small rivers and lakes, where, however, they are small.

To the botanist the mountains would probably prove even more attractive than the plains, as there is such variety in the flora according to the altitude. Above the present timber limit vegetation rapidly diminishes, only scattered individuals occurring at a distance above it, one of the most remarkable of these being the forget-me-not, bright blue patches of it not uncommonly occur right up alongside the snow banks.

GERRARD A. KINAHAN

NATIVE AMERICAN LITERATURE AND ETHNOLOGY[1]

OUR apology for grouping together so many valuable works on native American literature must be the extraordinary rapidity with which such productions are accumulating. Unless dealt with in this somewhat summary way, they run the risk of not being noticed at all. The great activity recently displayed in this department is largely due to the personal efforts of Dr. Brinton, whose spirited attempt to form a "Library of Aboriginal-American Literature" has already made some progress towards realisation. The first book on our list is practically a reply to those who may be sceptical as to the existence of sufficient materials to warrant such an enterprise. Based on a paper laid before the Congress of Americanists at Copenhagen last year, it takes a summary but comprehensive survey of all the still extant monuments of native literature in the various branches of history, legend, ritual, oratory, poetry, and the drama. In some of these branches the quantity of available matter is considerable. Hundreds of native tales and legends have been committed to writing by the Christian Eskimo of Greenland, and Dr. Heinrich Rink's manuscript collection of their historical traditions fills over two thousand pages. But the quantity of folk-lore and tribal myths floating about in the oral state amongst the Dakotahs, Athabascans, Algonquins, and other North American nations is alone sufficient to supply abundant materials for Dr. Brinton's undertaking. These, however, cannot be properly utilised until the natives have been educated and taught to write their own language, as, for instance, some of the Eskimo, Cherokees, and Iroquois have already learnt to do.

A brilliant result of such education is the "Iroquois Book of Rites," second on our list, which is now printed for the first time from native manuscripts recently brought to light by the editor, Mr. Horatio Hale. In the introduction a curious account is given of these manuscripts, of which there are three extant, two in the Canienga dialect procured at the Iroquois Reserve near Brantford, and one in the Onondaga dialect found at the Reservation near Syracuse, New York. The former are duplicate copies of the "Book of Rites" proper, and one of them appears to be traceable to an original, composed during the latter part of the last century, probably by the

[1] "Aboriginal American Authors." By Daniel G. Brinton, M.D. (Philadelphia, 1883.)
"The Iroquois Book of Rites." Edited by Horatio Hale, M.A. (Philadelphia, 1883.)
"The Güegüence: A Comedy Ballet in the Nahuatl-Spanish Dialect of Nicaragua." Edited by D. G. Brinton. (Philadelphia, 1883.)
"Sixteenth and Seventeenth Annual Reports of the Peabody Museum of American Archæology and Ethnology." (Cambridge, 1884.)

Canienga Chief, David of Schoharie. The other, written by one "John Green," of the Mohawk Institute at Brantford, and dated November 1874, is based on an unknown text differing in some respects from that attributed to Chief David. The Onondaga is not a copy of the Canienga work, but its complement, comprising the speeches addressed by the younger to the elder nations when a chief of the latter is mourned, and hence named the "Book of the Younger Nations." All the original texts may possibly have been composed about the middle of the eighteenth century, by which time several of the natives had been sufficiently instructed by the English missionaries to read and write their mother tongue fluently.

Such is briefly the history of the "Book of Rites" in its written form, which consists mainly of the speeches, songs, formulas, and ceremonies performed at the meetings of the Great Council, or "Council of Condolence," of the Iroquois Confederacy, when it met for the combined purpose of mourning the death of a chief and celebrating the induction of his successor. The proceedings to be observed on this important occasion had evidently been handed down orally from the time of the formation of the famous League, or "Great Peace," an event usually referred to the middle of the fifteenth century. Much of the contents of the "Book of Rites" may therefore fairly claim to date from that period. But although the strictly ceremonial portions may have been written down in the very words in which they had been orally preserved for some three hundred years, the text as it now stands has obviously been coloured by the spirit of the eighteenth century, and is, so far, not a faithful reflection of the social ideas and inner life of the Iroquois nation in pre-European and pagan times." Such passages as "The Great League which you established has grown old"; "Hail, my grandsires! You have said that sad will be the fate of those who come in the latter times"; "ye are in your graves who established it [the League]. Ye have taken it with you and have placed it under you, and there is nothing left but a desert," were written by men who felt that the Confederacy was already a thing of the past. The whole tone of the work is in fact pervaded by a spirit of sadness and despondency, and its very scope seems to have been the preservation of the empty forms and ceremonials of an institution whose days were already numbered. This point should be borne in mind in reading the comments of the editor on the present text, and especially the arguments drawn from it in favour of the superiority of the Iroquois race over "the Aryans of Europe" in humanity, public spirit, and political sagacity. The curious theory is even advanced that the fine qualities of the European Aryan, as compared with his barbarous Asiatic kindred, "may have been derived from admixture with an earlier population of Europe, identical in race and character with the aborigines of America" (Introduction, p. 98). And in an unfortunate appendix, where this idea is worked out at some length, it is suggested that the time is approaching when the "servile Aryans will cease to attract the undue admiration which they have received for qualities not their own; and we shall look with a new interest on the remnant of the Indian race, as possibly representing this noble type of man, whose inextinguishable love of freedom has evoked the idea of political rights and has created those institutions of regulated self-government by which genuine civilisation and progress are assured to the world" (p. 190).

Mr. Hale is more instructive in the section of his erudite introduction devoted to the genius and inner structure of the Iroquois language. Here he shows, against the general conclusions of philologists, that Iroquois really abounds in true abstract terms. Such are *otaritènsera* = heat, *atariatitsera* = courage, *kanaièsera* = pride, *kanakwensèra* = anger, regularly derived by the affix *sera* from verbal forms. He also makes it clear that true grammatical gender exists, forming, as in the Semitic system and in some neo-Sanskritic idioms, a distinctive feature of verbal conjugation. But its use is entirely restricted to the third person singular, dual and plural, as in *watkahtos* = she sees, *kiatkahtos* = they two see (fem.), *kontkahtos* = they see (fem.). This point is of great importance as affecting the various psychological systems of linguistic classification that have been proposed by certain German theorists. It may be incidentally remarked that in Africa also the distinction between gender (Hamitic) and non-gender (Negro) languages no longer holds good; for it now appears that gender is also characteristic of the Masai, and of many Nilotic negro tongues.

Dealing with the tendency of Iroquois and so many other American languages to fuse the terms of the sentence into a single compound word, Mr. Hale observes: "The notion that the existence of these comprehensive words in an Indian language is an evidence of deficiency in analytic power, is a fallacy long ago exposed by . . . Duponceau. As he has well explained, analysis must precede synthesis. In fact, the power of what may be termed analytic synthesis—the mental power which first resolves words or things into their elements and then puts them together in new forms—is a creative or co-ordinative force indicative of a higher natural capacity than the act of mere analysis. The genius which framed the word 'teskenonhweronne,' ['I come hither again to greet and thank'] is the same that, working with other elements, produced the steam-engine and the telephone" (p. 150). Here again it is to be feared that bias has got the better of reason. Certainly the world would have had to wait very long indeed for the steam-engine and the telephone had their invention depended on the natural evolution of the people who "framed the word" in question. Prof. Sayce ("Science of Language") has also made it tolerably evident that analysis does not precede synthesis, and that the unit or starting-point of speech is rather the sentence than the word. Hence the American polysynthetic is an infantile compared with the English analytical process in the example appealed to. But, apart from these eccentric views, it is a great pleasure to be able to say that Mr. Hale has given us an admirable edition of the "Book of Rites"—a priceless treasure opportunely rescued by him from the imminent danger of destruction.

An equal share of praise is due to Dr. Brinton as editor of the "Güegüence," which forms the third volume of his Library Series. This curious document presents considerable interest, both from the ethnological, philological, and literary points of view. An original native drama in the strict sense it can hardly be called. But although dating no further back than the last century, and composed in a strange medley of bad Spanish and Nahuatl (Aztec), it may be regarded as almost the last surviving specimen of the aboriginal semi-dramatic compositions which appear to have been in common use amongst the Central American peoples long before and after the Conquest. Such compositions, prepared for oral recitation at the public feasts and ceremonies, were so far dramatical that they took the form of dialogue, and turned on some simple incident with a happy *dénouement*. In the present instance the Güegüence, that is, the elder or village headman (from the Aztec "*huehuentzé*" = "dear old man"), is brought with his two sons before the provincial governor, charged with entering the province without a permit. This leads to a good deal of repartee, some broad jokes, and intentional misunderstandings on the part of the hero, who in the end comes off best and manages to bring about a marriage between one of his sons and the governor's daughter. The language of the piece is very peculiar, and will doubtless be appealed to by the advocates of mixed forms of speech in favour of their views. Yet a careful study of the text shows that here the Spanish and Aztec elements are not harmoniously fused, as are, for instance, the Saxon and Latin elements in

English. Thus we have sometimes two or three tolerably correct consecutive Spanish sentences with due observance of its grammatical forms, as, for instance, Pues, tome! Uno, dos, tres, quatro. Ha! mi plata, muchachos! Cuatro cientos y tantos pesos le he dado á mi amigo Cap[n] Alguacil. But beyond abrupt exclamations such as "*Mascamayagna, Güegüence*" = "at your service, Güegüence," complete grammatical Aztec sentences never occur, and the composition may on the whole be regarded as essentially Spanish copiously interlarded with native words and phrases. Hence it is rather a medley than a true *lingua franca*, or a jargon, such as "Pigeon-English," and the Chinook of the Columbia river, which involve a total destruction of the relational forms of all the constituent elements, thus preparing the way for a fresh grammatical departure. Thus only is it conceivable that true mixed languages can be developed, and the conditions favourable for such combinations are necessarily so exceptional that they must in any case always remain the rarest of linguistic phenomena.

Little space is left to speak of the last "Reports of the Peabody Museum," which are more than usually rich in original ethnological materials. Conspicuous amongst these are the graphic descriptions at first hand of the "White Buffalo Festival of the Unepapas," the "Elk Mystery or Festival of the Ogallala Sioux," the "Religious Ceremony of the Four Winds as observed by the Santee Sioux," the "Shadow or Ghost Lodge: a Ceremony of the Ogallala Sioux," and the "Wa-Wan or Pipe Dance of the Omahas," all by Miss Alice C. Fletcher, who has recently been spending some profitable time in the midst of these North American tribes. By taking up her residence amongst them, sharing in their domestic joys and sorrows, making herself one of them, this enterprising and benevolent lady has enjoyed rare opportunities of penetrating into the inner life of the aborigines. Hence the great value of her remarks, especially on their religious views, a correct appreciation of which can only be had in this way. On the vexed subject of nature-worship and animism some current misconceptions are combated and fresh light thrown on the attitude of the native mind towards the outward and invisible world. "Careful inquiry and observation," she writes, "fail to show that the Indian actually worships the objects which are set up or mentioned by him in his ceremonies. The earth, the four winds, the sun, moon, and stars, the stones, the water, the various animals, are all exponents of a mysterious life and power encompassing the Indian, and filling him with vague apprehension and desire to propitiate and induce to friendly relations. This is attempted not so much through the ideas of sacrifice as through more or less ceremonial appeals. More faith is put in ritual and a careful observance of forms than in any act of self-denial in its moral sense as we understand it. . . . To the Indian mind the life of the universe has not been analysed, classified, and a great synthesis formed of the parts. To him the varied forms are all equally important and noble. A devout old Indian said: "The tree is like a human being, for it has life and grows; so we pray to it and put our offerings on it that the god may help us." Here we have placed in a vivid light the very essence of Anthropomorphism—ultimate base and starting-point of all primitive religions.

In the Curator's Report reference is made to the imprints of human feet discovered by Dr. Flint on December 24, 1883, in the volcanic rock some fourteen feet below the surface soil in Nicaragua. The tracks are in several series running nearly parallel with the banks of Lake Managua, within 300 feet of the present margin. Above the prints is a bed of clay and volcanic material containing fossil leaves, and over this four distinct beds of more recent volcanic matter. Blocks of rock containing the prints have been cut away and forwarded to the Museum. "That they were made by the feet of men while the material of which the rock is formed was in a plastic condition there is not the least doubt. The imprints are from nine to ten inches long and about four wide across the ball of the foot . . . with heel-ball and toes perfectly distinct. Dr. Flint states that the stride was only from eleven to eighteen inches, which indicates slow walking over the plastic substance." It is hoped that a clue to the geological age of the deposit may be obtained from the fossil leaves, a report on which is expected from Prof. Lesquereux. A. H. KEANE

NOTES

THE International Conference on Education was opened at the Health Exhibition on Monday by the address of Lord Carlingford, and has been continued during the week. There is a very large attendance both of English and foreign educationists, while the papers and discussions have been of much interest and importance. We hope to speak in detail of the Conference in our next number.

THE summer meeting of the Institution of Mechanical Engineers began at Cardiff on Tuesday with the address of the president, I. Lowthian Bell, F.R.S. The papers to be read are all of a technical nature. The meeting will be continued during the week, and many excursions have been organised, and visits to engineering and other works.

THE French Association for the Advancement of Science will hold its next meeting at Blois from September 4 to 11 next. The lecturers and subjects of lectures have not yet been decided upon.

DR. SCHWEINFURTH will return to Africa in a few weeks, on a commission from the Berlin Academy of Sciences; but the field of his exploratory labours has not yet been finally selected.

THE Government having decided to appoint a Royal Commission for the Exhibition of India and the Colonies, which is to be held in London in 1886, the Prince of Wales has issued a certain number of invitations to those persons whom it is desired should serve on this Commission.

THE death is announced of Mr. Charles Manby, F.R.S., M.Inst.C.E., for forty-five years identified with the Institution of Civil Engineers, for seventeen as the paid secretary, and for twenty-eight years as the honorary secretary. He was born on February 4, 1804, and was the eldest son of Aaron Manby, the founder of the Horseley Iron Works in Staffordshire, and later of the Paris Gas Works, and of ironworks at Charenton, near Paris, and who re-organised the now famous ironworks at Creuzot. For his father he was also engaged on the design and construction of the first pair of marine engines with oscillating cylinders, upon the building of the *Aaron Manby*, the first iron steamship that ever made a sea voyage, and upon the several works in France before enumerated. In 1839 he was appointed secretary of the Institution of Civil Engineers, and soon afterwards threw himself, heart and soul, into a movement which revolutionised the Society. As evidence of the appreciation in which he was held it may be mentioned that when, in 1856, he relinquished the position—which has since been filled by his pupil, James Forrest—he was presented with a service of plate and a sum of two thousand guineas, "as a token of personal esteem, and in recognition of the valuable services he had rendered to the members individually and collectively." Again, in 1876, Charles Manby received from the members of the Institute of Civil Engineers a silver salver and a purse of upwards of 4000*l*. "in friendly remembrance of many years valuable services."

ON Monday, August 4, taking advantage of Bank Holiday, the Essex Field Club held a meeting at Colchester. The party, about fifty or sixty in number, were met at the station by Mr. J. Horace Round, who conducted them through the older parts of the town to the Castle, the history of which was lucidly sketched and the main points of interest shown by Mr. Round. A hurried visit to the Castle Museum, with its splendid collection of local antiquities and natural history objects, was next made under the guidance of the Rev. C. L. Acland and Mr. Round. The party then proceeding to lunch at the Cups Hotel. After lunch, a drive of about eight miles along the Mersea Road, passing through the villages of Abberton and Peldon, the scenes of the earthquake of April 22, brought the party to West Mersea, where Mr. H. Lauer addressed them upon the history of this and the surrounding districts during Roman times, suggesting that the Roman town of Othona may have been situated on the opposite shore of the River Blackwater in the neighbourhood of Bradwell. Mr. Lauer next called attention to the interesting and mysterious "salting-mounds" or "red hills," which occur also on the Norfolk coast and along the rivers in Suffolk and Kent, and of which eighteen still exist between Strood and Virley in Essex. These, according to Mr. H. Stopes, F.G.S., often cover as much as 10 to 30 acres, and are from 2 to 4½ feet deep, being composed of red burnt clay mixed with rude broken pottery, charcoal, ashes, and often bones. A ramble eastward along the coast of Mersea Island brought the party to the "decoy" for the capture of wild-fowl, the working of which in former times was explained by Mr. Lauer. Here Mr. J. C. Shenstone gave a short demonstration of the interesting coast flora. Driving homewards the party stopped at the ruins of Langenhoe Church, wrecked by the earthquake, where Mr. R. Meldola gave a short statement on this subject in anticipation of the detailed report which he proposes to present to the Club. He stated that the area of structural damage covered about fifty square miles. After tea an ordinary meeting was held, Mr. R. Meldola in the chair, and the evening concluded with a *conversazione* at the Hotel, collections of insects, dried plants, and living insectivorous plants being exhibited by Mr. W. H. Harwood, Mr. Shenstone, and Dr. Alexander Wallace. The Mayor and many of the townspeople were present during the evening to listen to the short addresses on natural history subjects given in explanation of the various exhibits.

THE repeated failures of steamers to reach Siberia from Europe do not seem to have deterred M. Sibiriakoff, the well-known Russian merchant, from again despatching two steamers this year. Early last month the steamers *Nordenskjöld* and *Obi* left Tromsö (Norway) to attempt, it is stated, for the last time to reach Siberia. When in lat. 70° 55′ N. and long. 52° 15′ E. the engines of the *Nordenskjöld* broke down, and she was with great difficulty towed back to Vardö.

A SUBSCRIPTION has been opened at St. Petersburg, in order to raise the money for instituting at the University five bursaries in the name of Charles Darwin, to be employed for the maintenance of five students in the five chief branches of natural science.

THE Russian review, *Russkaya Starina*, and the *Journal* of the Russian Chemical and Physical Society have lately devoted some attention to the first steam-engine that was made in the Russian Empire, in 1763, at the ironworks of Barnaoul, in Western Siberia, by a mining engineer, Polzunoff. It appears from M. Woyeikoff's description of this steam-engine, the model of which exists still at Barnaoul (both reviews have figured it on plates), that Polzunoff's engine was a reproduction of the "fire-engine" of Newcomen, with some original improvements. Thus it has two cylinders, instead of one, and, instead of the beam, Polzunoff made use of a wheel which received the chains of the pistons, and transmitted the circular movement, transformed again into a rectilinear one, to a pair of bellows, used for blowing air into a high furnace. The distribution of vapour was automatic, as in Newcomen's engine, but with several improvements. The engine, which had cylinders 9 feet long and 9 inches in diameter, worked during two months from May 20, 1766, and 3100 cwts. of silver ore, yielding 5 cwts. of silver, were melted with its help. But Polzunoff did not see his engine at work, as he died from consumption four days before. He obviously was a remarkable man for his time, several of the physical remarks he made in the description of his engine showing not only a wide knowledge, but also a serious spirit of true physical reasoning, together with a notable skill for determining the limits of knowledge of that time. In his theoretical remarks about "Air, Water, and Vapour," he notices also that physicists are not yet agreed as to the origin of heat, some of them seeing in it a much-divided, fine moving matter, while others "see the origin of heat in friction and in the vibratory motion of the particles inaccessible to our senses, of which the bodies are constituted." He obviously quotes here the words of Lomonosoff, who stated in these very words the mechanical origin of heat in his most remarkable but unhappily little-known memoir, written as an instruction to Tchitchagoff's Polar Expedition.

SEVERAL severe shocks of earthquake were felt on Sunday afternoon at Foca, in Bosnia. The duration of each shock was over two seconds.

A BROCHURE just issued by M. Ch. Montigny at Brussels contains in convenient form the result of his studies on the state of the atmosphere as affecting stellar scintillation, with a view to forecasting the state of the weather. From the fact determined by W. Spring, that the colour of pure water in great bulk is blue, he explains the predominance of this colour in the scintillation of the stars just before and during wet weather. The luminous rays, he argues, traversing the air charged with large quantities of pure water are necessarily tinged with the blue colour of this medium. The excess of blue thus becomes an almost certain means of predicting rain. This theoretic conclusion corresponds with the results of his observations continued for several years past on the appearance of the stellar rays in connection with the state of the weather. During the few months of fine weather in the present year blue has been much less conspicuous than in the corresponding months of previous years since 1876, when wet weather prevailed. It also appears that green, which had always coincided with clear skies during the fine years before 1876, has recently again become predominant. Hence he thinks it probable that we have got over the cycle of bad seasons, and that dry weather and more normal summers may be anticipated at least for some time to come.

PROF. F. NEESEN publishes a reprint of his paper in the *Archiv für Artillerie- und Ingenieur-Offiziere* for 1884 on a generalisation of Sebert's method of registering the velocity of shot within the tube of a gun. Sebert's apparatus necessarily registers for a space somewhat shorter than the diameter of the ball. This defect is remedied and the registration extended to the whole length of the tube by means of a revolving appliance to which the registering tuning-fork is attached, and disposed parallel with the periphery of the cross-section of the shot. Pencils fastened to the prongs of the tuning-fork and vibrating with it are thus made to describe curves indicating the velocity of the ball in its course through the tube. The only objection to the process, which is made perfectly clear by several accompanying illustrations, is that by the concussion the registering apparatus may get deranged or jammed with the shot. This danger it is proposed to obviate by making the apparatus of the best steel, and diminishing the effect of the concussion by filling the shot with some fluid when fired for experimental purposes.

IN the last number of the *Bollettino* of the Italian Geographical Society, Dr. G. A. Colini continues his valuable paper, already noticed in NATURE, on the Indians of the Upper Amazon regions. Much original and curious information is supplied regarding the Caribos, Shipivos, Amahuacs, Campas, Shetevos, and many other Christian and Pagan tribes, especially of the Ucayali and Huallaga basins. Thus we are told that most of the Christian women in the Ucayali villages don a European smock to attend mass, but after the service lay it aside for the native *pampanilla*, a scanty garment, white at first, but afterwards dyed blue or red with geometrical designs to save the trouble of washing it. Here also the men carefully pluck out the beard with pincers made of two shells, because the women consider this appendage as a sign of old age. Hence bearded youths are regarded as superannuated, while clean-faced old men are still eligible in the matrimonial market. The South American Indians are usually described as altogether beardless, an inference due probably to this custom, which appears to be very general.

THE principal articles in the current number of *Petermann's Mittheilungen* are on Arctic subjects. Prof. Mohn of the Norwegian Meteorological Institute writes on the hydrography of the Siberian Arctic from the observations of the *Vega*, while Lieut. Hovgaard, a member of the expedition, contributes a paper on the ice in the Kara Sea, and M. Lauriasen of Copenhagen on the point reached by Behring in his first expedition. In addition to these we have papers on the names of places in the Niger region, on the new map of Germany prepared by the general staff, and the usual notes.

THE plague of rabbits in our Australasian colonies is one of which much has been heard, and it appears that another European animal, the dog, is about to follow the example of the rabbit, and make himself a pest in place of a pet. It appears that the number of wild or semi-wild dogs has recently increased largely in Victoria and New South Wales, and the consequence is a great slaughter of sheep by these nomads. The Government has already offered rewards for their destruction. In New Zealand some enterprising people have hit on the idea of importing weasels and stoats from England to keep down the rabbits; but if the former increase in their new habitat as rapidly as the latter have done, the last state of New Zealand will be worse than the first, for a plague of rabbits must be as nothing compared to a plague of weasels, and a great increase of the latter, from their predatory and destructive habits, must be followed by a considerable alteration in the distribution of the fauna of New Zealand. In Jamaica, according to the last report of the Director of Public Gardens in that colony, the planters suffered greatly from the depredations of rats among the sugar-canes. The rat-eaten canes were good for nothing except rum, and accordingly large sums were spent in poison and dogs to keep down the rats, but apparently without much success. At last an enterprising planter determined to import the mongoose from India to destroy the rats on his sugar estate. The sugar-planters, Mr. Morris says, have unquestionably benefited greatly by its introduction, and rat-eaten canes are now hardly known where formerly they were found in large quantities. But the new importation continues to multiply and spread, not only on sugar estates, but on the highest mountains, as well as along shore, even amidst swamps and lagoons; and when the sugar-cane rat is wholly exterminated, the mongoose will still go on increasing, and what then? Must the colonists find something else to exterminate the mongoose, and save their poultry, and so on *ad infinitum?* As it is, negro settlers and persons not connected with sugar estates complain of its ravages amongst their poultry and even accuse it of destroying fruit and vegetables; and, although Mr. Morris doubts whether these complaints are all well founded, he acknowledges that the mongoose is the cause of great disturbance in the animal life of Jamaica. Harmless yellow and other snakes, lizards, ground-hatching birds, rabbits, and many members of the indigenous fauna of the island are likely to become extinct at no distant date. It will be interesting to watch the effect of the introduction of the mongoose, and we hope Mr. Morris will enlighten us from year to year on the subject.

AT the last meeting of the Asiatic Society of Japan (as reported in the *Japan Weekly Mail*) a paper was read by Dr. Whitney on "Medical Progress in Japan." The first era in Japanese medicine was the mythological age, when the treatment of disease appears to have consisted in the use of charms and the employment of the simplest remedies originated by the "Great-name-possessing Deity"; the next period covers nearly 900 years from the middle of the second century B.C., during which Corean and Chinese medicine was introduced, as well as Buddhism and the useful arts. At the close of the eighth century the University and a medical school were established, and here commences the third period in the history of Japanese medical progress, which lasts down to the middle of the sixteenth century. In the medical college of those days the students pursued a seven years' course, and appear to have received a thorough and systematic training in Chinese medicine, which, as then taught, was embodied in works consisting chiefly in numerous dissertations and philosophical deductions based upon incorrect notions as to the anatomy of the human frame and the relation of its various viscera with one another and with the different phenomena of nature. In the fourth period, from the middle of the sixteenth century, when the Portuguese first appeared in Japan, down to the restoration of 1867, occurred the revival of both the Japanese and Chinese schools, and the introduction of Western medicine, which appears to have played no unimportant part in the temporary success of the missionaries. They received at one time a grant of 7500 acres of public lands for the purpose of cultivating medicinal plants. In 1775 was published the translation into Japanese of a Dutch work on anatomy, which was the first of its kind published in Japanese. Vaccination was introduced in 1824 from Russia by some Japanese fishermen, and in 1858 a medical school was founded in Nayaski, in which Western medicine only was taught. With the effects of the revolution of 1868 on medicine, as on most other things in Japan, most people are familiar. The physicians and surgeons of new Japan are required to go through a three years' course of study, and to pass examinations in the manner familiar in Europe. Apothecaries, dentists, and midwives must similarly be provided with diplomas, which can only be obtained after satisfactory examination. Contagious diseases acts, the examination of drugs, a strict control of the sale of opium for medicinal purposes, and the numerous other measures by which governments seek to protect the public health, are now found in full working order in Japan.

DR. R. LENZ describes, in the last *Bulletin* of the St. Petersburg Academy of Sciences, a new application of the telephone to the measurement of temperatures at a distance. Let us imagine two stations, A and B, connected together by an iron and an argentan wire, which are looped together at both stations. If the looping at A has a different temperature to that of B, a thermal current will circulate through the wires; and if a silent interrupter and a telephone be introduced into the system, the telephone will emit a sound, which will cease immediately the observer at B has raised or lowered the temperature of his looping place, so as to render it equal to that of A, and to destroy thus the thermal current. The exactness of this method depends on the exactness of determination of the moment when the lull ceases in the telephone, which moment is influenced by a remnant of lull in the instrument after the equalisation of temperature at both ends of the apparatus. In a series of experiments where the points A and B were one metre distant, Dr. Lenz determined temperatures by this method with great accuracy, the errors being only from 0°·01 to 0°·17; and he concludes that, by using iron-argentan wires two millimetres thick, the measurements could be made at a distance of five kilometres, which distance could be still increased, say to twenty-five kilometres, if antimony and bismuth wires were used.

THE last number (12) of the *Journal* of the Straits Branch of the Royal Asiatic Society has the continuation of a paper on Malayan Ornithology, by Capt. Kelham, and an official report by Mr. L. Wray, of Perak, on gutta-producing trees. Mr. Maxwell writes on "Shamanism in Perak," the term in this instance being applied to the incantations and ceremonies employed by the Malays to cure the sick. But surely Shamanism in its home in Thibet is something more than this. Mr. Ferguson contributes some notes on the curious changes which consonants undergo in passing from one Malay dialect to another. The papers, properly so called, conclude with a report on the Meteorology of the Straits. In the Annual Report of the Council of the Society we notice that it is intended to republish in a collected form valuable papers published in the Eastern Archipelago at one time or another, but now either out of print or difficult of access; also a text-book of the geography of the region, under the editorship of members of the Society, and a skeleton map of the Malay Peninsula, on a scale of a quarter of an inch to a mile, upon which all new information will be entered from time to time as exploration advances.

SEVERAL honorary promotions have been recently made by the French Government for scientific services. Dr. Cornelius Herz, director of *La Lumière Electrique*, has been nominated Commander in the Legion d'Honneur at the request of M. Cochery, Minister of Postal Telegraphy, for his works on Electricity. The Minister of Public Instruction has appointed Madame Camille Flammarion an officer of the Academy for having acted as a secretary to her husband in all his work in connection with astronomy. The Municipal Council of Paris has decided that one of the new streets of the Thirteenth Arrondissement shall be named Giffard, in commemoration of the inventor of the injector.

AN experiment has been made in Vienna which proves that even with incandescent lights special precautions must be taken to avoid any risk of fire. A lamp having been enveloped with paper and lighted by a current, the heat generated was sufficient to set fire to the paper, which burnt out and caused the lamp to explode.

ON July 27 there was celebrated at the Trocadéro Palace the centenary of the death of Diderot, the celebrated French philosopher, who was also a man of science in his time and editor of the famous *Encyclopædia*.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus* ♀) from India, presented by Miss A. E. Sturge; a Bonnet Monkey (*Macacus sinicus* ♂) from India, presented by the Rev. T. Rickards; a Common Fox (*Canis vulpes*), British, presented by Mr. Thomas Legg; a King Vulture (*Gypagus papa*) from South America, presented by Mr. August Strunz; two Red-tailed Buzzards (*Buteo borealis*) from Jamaica, presented by Mr. D. Morris; a Martinique Waterhen (*Jonornis martinicus*), captured at sea, presented by Mr. A. Jones; two Jackdaws (*Corvus monedula*), British, presented by Mrs. Frank; a Kestrel (*Tinnunculus alaudarius*), British, presented by Mr. G. Westrup; a Crested Curassow (*Crax alector*), an Anaconda (*Eunectes murinus*) from British Guiana, presented by Mr. G. H. Hawtayne, C.M.Z.S.; a Grey Amphisbæna (*Blanus cinereus*) from Portugal, presented by Mr. W. C. Tait, C.M.Z.S.; a Golden-crowned Conure (*Conurus aureus*) from South-East Brazil, deposited; a Black Hornbill (*Sphagolobus atratus*) from West Africa, purchased; a three-quarter bred Mesopotamian Deer (between *Dama mesopotamica* ♂ and hybrid *Dama vulgaris*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE NEW COMET.—A circular issued from Dun Echt on July 31, contains the following approximate elements of the comet discovered by Mr. Barnard on July 16, calculated by Mr. S. C. Chandler of Harvard College Observatory:—

Perihelion passage, 1884, August 17·63 G.M.T.

	° ′
Longitude of perihelion	302 4
,, ascending node	357 52
Inclination	7 2
Logarithm of perihelion distance	0·14780

Motion—direct.

The comet will probably be observable in this country after perihelion passage, as will appear from the subjoined positions resulting from Mr. Chandler's orbit:—

12h. G.M.T.	R.A. h. m.	N.P.D. ° ′	Distance from Earth	Intensity of Light
September 3	18 27·2	123 8	0·682	1·06
,, 7	18 44·2	122 6	0·701	0·98
,, 11	19 0·2	120 58	0·722	0·91
,, 15	19 15·9	119 46	0·747	0·83

At discovery on July 16 its distance from the earth was 0·627, and that from the sun 1·480, consequently the intensity of light was 1·16.

The supposition that this comet had been observed at Melbourne, Madras, and the Cape, arose from a mistake in telegraphing. M. Trepied (Algiers) calls it "nébulosité sans queue; condensation centrale."

PERIODICAL COMETS IN 1885.—During next year three comets of short period will return to perihelion. Encke's comet is due in March, probably in the first or second week, according to the elements of 1881. The next is Tempel's comet, 1867 II., in the case of which it is not possible to assign the time of perihelion passage without the calculation of the perturbations due to the attraction of Jupiter, near which planet the comet was situated during the last half of the year 1881; the least distance of the two bodies having been about 0·57 in October. The third comet referred to is Tuttle's, last observed in 1871, the perihelion passage probably in September or October.

A VARIABLE-STAR IN AQUARIUS.—Attention has been already directed in this column to a star, the position of which for 1884·0 is in R.A. 22h. 29m. 48s., N.P.D. 98° 12′·4, on the score of variability from the ninth magnitude to invisibility, or at least to below the twelfth magnitude. Mr. Knott has just made an observation which confirms the variation of the star, as notified by Mr. Hind some thirty years since. On August 1, by the method of gauging, Mr. Knott found its magnitude 11·7. It was 9m. according to the Markree Zones on October 27, 1848, and on four occasions was estimated 9·5 at Bonn. It was considered a ninth magnitude, probably in August 1855, at the late Mr. Bishop's observatory. Generally it seems to have been about 11·5m. There is some reason for supposing that it does not continue very long at maximum. Argelander was inclined to think that there was a mistake as to the variability of this star, but the evidence in favour of it appears now to be too strong to be thus set aside. It has not been included in Schönfeld's catalogues of known or suspected variables.

PTOLEMY'S 30TH OF CENTAURUS.—In Sûfi's "Description of the Stars," according to Schjellerup, we read: "Ptolemy has reported that there are in this constellation (Centaurus) thirty-seven stars, but in reality there are only thirty-six, the thirtieth is wanting." The star is No. 964 of Baily's edition of Ptolemy's Catalogue, and is rated γ, the twenty-ninth star immediately preceding (ϵ Centauri) being called β. From Ptolemy's longitudes and latitudes we find that the thirtieth star followed the twenty-ninth 0° 34′ in R.A. and 1° 10′ to the south of it. Q Centauri follows ϵ 26″·5, and is south 1° 5′·7; it is estimated 5·7 m. in Gould's *Uranometria*, but is a double-star, the components 6¼ and 7½. Notwithstanding the difference in brightness, the approximate agreement of positions seems to point to Q Centauri as Ptolemy's thirtieth star.

OBSERVATIONS ON A GREEN SUN, AND ASSOCIATED PHENOMENA[1]

THE rarity of the phenomenon of a green or blue sun makes it desirable to record with the greatest accuracy and detail the observations made during its appearance in India during several days of September 1883.

The notes taken at Madras at the time of the appearance will best illustrate the general features of the phenomena:—

On September 9, the sun, before setting, assumed a peculiar silvery appearance, and its brightness was so much decreased that for about half an hour before sunset it could be observed with the naked eye. This was observed, I believe, though to a less extent, on the two days preceding, but I did not myself see it on these days. On September 10, from 5 to 5.30 p.m., the sun could easily be looked at with the naked eye, yet the limbs were sharply defined. At 5.30 the sun entered a low bank of clouds, and did not fully appear again; but a narrow strip seen through a rift in the cloud at 5.43 was coloured a bright pea-green. Round Madras this colour had been seen in the morning, but in Madras itself clouds concealed the sun till it had risen to a considerable altitude. Of the morning of the 11th I have no record, but in the evening the green colour was brilliant, and was visible for more than half an hour, being preceded, as on the former night, by the silvery white appearance of the sun's disk. On this evening a large sunspot about 1′ long was so conspicuous an object that it attracted the attention of even the most casual observers.

September 12.—At 12.35 a.m. the moon, which was near the horizon, appeared a pale green. Bright stars near the horizon showed the same tint. From 5.15 to 5.30 the clouds to the east were coloured reddish brown. At 5.55 the sun rose with a yellowish green colour, but was almost instantly lost in clouds. It reappeared at 6·4, and was then of a bright green colour: this colour rapidly got fainter, but was quite perceptible till 7 o'clock. In the afternoon the phenomena of the previous nights were repeated, and, the horizon being free from clouds, the actual sunset was observed. The entry in my notes is: "6.3.—The sun set as a greenish yellow ball; cumulus, stratus, and nimbus clouds near the horizon, but moon fairly clear; some blue sky, but hazy." The change from green to greenish yellow was evidently due to the great increase in the strength of the low-sun-band close to the horizon, which left the strip of yellow between that band and the rain-band by far the most prominent feature in the spectrum.

September 13.—In the early morning there was a good deal of distant lightning. The sun rose of a bright, golden yellow colour; no green was seen. In the afternoon there were slight showers.

A most remarkable observation made this morning by Mr. Pogson seems very difficult to explain, except by some form of auroral display. I give his notes in full:—

"1883, September 12, 17h. 0m. Madras mean time.—The sky a most remarkably intense reddish yellow, unusually bright. A dark cloud-bank from about east to south, and the vivid light above uncommonly auroral in appearance, more so than anything I have seen here before.

"At 17h. 10m. the red hue considerably diminished, and bright orange yellow the prevailing tint. The light quite bright enough to make notes by.

"At 17h. 20m. the dark blue-black stratum, now from about north to east, and very near the horizon. Sky tolerably clear to about 20° altitude, but of a rich red tint, with bright yellow clouds above, beginning at about 30°, and covering the rest of the sky.

"At 17h. 30m. all changed within the last four or five minutes, and writing now difficult without a lamp; a thick dark red stratum over the sunrise point, and everywhere else a very greenish yellow.

"At 17h. 40m. the low cloud stratum now sea-green. Light only enough to write by with difficulty.

"At 17h. 50m., sun rising a bright yellowish white, and otherwise nothing extraordinary, all unusual tints having disappeared with the sunrise."

September 14.—Before sunrise the clouds were blue and gray, with patches of red clouds of all sorts—cirrus, nimbus, stratus, cumulus, and mares' tails. Two bright flashes of lightning about 5.30 a.m. In the evening there was a slight green tinge, and after sunset the sky was golden red till 6.50, while Mercury, seen through the red haze, was twinkling strongly.

September 15.—The sun rose golden. In the evening the sunset was very fine: in the west the colour was golden to orange-yellow, in the east it was greenish; red clouds remained till 7.5. There were very brilliant red "rayons de crépuscule."

From September 15 to September 20 the sunrises and sunsets were very fine, with red and gold, for more than half an hour before sunrise and after sunset.

September 21.—Sunset normal.

September 22.—The sun rose as a yellow ball, and showed distinct greenish yellow afterwards. From ten minutes before till sunset the sun was greenish yellow, but the sun was much brighter than on the 10th and 11th.

September 23.—The sun rose very green. At 5.37 p.m. the sun appeared from under clouds, very green; strong absorption in the red end of the spectrum to C; low-sun-bands weak. 5.45.—Clouds grayish purple. There was only one bank of clouds which was near the horizon; above this was a peculiar grayish haze. At 6 the clouds were of a marked purple colour; breaks near the horizon were reddish brown. During the night there was a great deal of sheet-lightning in the south.

September 24.—The sun rose bright yellow. The spectrum showed complete absorption up to B; the rain-band α and β were very thick, and the low-sun-bands less marked than usual. There was lightning all night, beginning in the south, and working round to the south-east. It consisted chiefly of sheet-lightning, with occasional zig-zag flashes, but no thunder; the stars were fairly clear except near the horizon. Saturn and the moon, when near the horizon, were both very dim.

September 25.—Sunrise golden green. In the afternoon the shadows cast on white paper were still quite pink, but the sunset was bright yellow.

September 26.—Much the same as yesterday.

September 27.—Before sunrise C, β, α, the rain-band and the dry-air-band were very strong, but the dry-air-band was less than half as dark as the rain-band. The sun rose golden red. The spectrum showed signs of clearing up; glimpses of A could be obtained. After dark there was very bright lightning in the west.

September 28.—Spectrum still showed great absorption. Lightning at night.

September 29.—Spectrum absorption still very strong. After dark there was a display of luminous clouds specially towards the east. After 11 p.m. there was very heavy rain with much lightning and some thunder.

September 30.—Sunrise golden. The spectrum *on* the sun showed A clearly, a was very thick.

October 2.—In the morning from about 7 to 9 there was a thunderstorm, in which the thunder was almost continuous for about an hour and a half, but although the storm was almost vertically overhead, hardly any lightning was visible. . . . The total rainfall for the day was 4·88 inches.

Accounts were collected from trustworthy observers in various parts of India. All describe the brilliant sunsets of the first week of September, and record the appearance of a green sun on several days. It was seen at Muttum in the south of Madras on the 9th, and continued for several days both in the morning and the evening. The green colour was then lost, but reappeared from the 22nd to the 28th inclusive.

At Bellary the sun was seen "emerald-green" at rising and setting from the 10th to the 14th inclusive. The observations were not carried on longer.

At Coonoor on the Nilgiris the abundance of green tints in the sunsets was noted, but the sun itself was merely described as of a "shimmery" appearance.

The observations at Ongole have been already noticed in NATURE.

The Spectrum.—The spectrum of the sun when green was repeatedly observed and photographed with the large zodiacal-light spectroscope, which is furnished with one large prism of dense glass and a very long collimator permitting the use of a wide slit. The main features of the spectrum taken *on* the sun when green were—

1. A very strong general absorption in the red end.
2. A great development of the rain-band and of all other lines that are ascribed to the presence of water-vapour in the atmosphere, more especially of the group C_1 of α and of the band at W.L. 504.

The absorption in the red end was of very varying intensity,

[1] Abstract of a paper read before the Royal Society of Edinburgh, July 7, by Prof. C. Michie Smith.

but when the phenomenon was at its maximum phase it gradually crept up from about B till past C, as the sun sank towards the horizon. On the 12th, when the sun was within a few degrees of the horizon, the absorption was well marked up to W.L. 621, *i.e.* to beyond *a*, while at the violet end the visible spectrum ended at W.L. 428, or just beyond G.

The lines A and *a* were never visible even *on* the sun, when it was green, and even B could be made out with difficulty from half an hour before sunset onwards, and before it vanished it grew intensely prominent with enormously thick bands on the less refrangible side. The band C_1 on the more refrangible side of C became very broad and black, while the fine line between this and C remained thin and sharp, and C itself thickened out on the less refrangible side. The rain-band was stronger than I have ever before observed it on the plains, and even with the dispersion produced by a single prism at least eight lines could be measured in it, while many more were visible. The low-sun-band was not very conspicuous, but this was partly due to contrast with the very strong rain-band. The line W.L. 568 at the more refrangible side of the low-sun-band was very well marked, and the band itself seemed to consist of a series of equidistant lines.

The apparently much stronger absorption in the red than in the blue end was a very marked feature, which became still more conspicuous when a photograph of the blue end was examined.

Since the passing away of the abnormal conditions I have made careful observations of the sunset spectrum with the same apparatus, and I find that ordinarily A and *a* are clearly visible as well as B, though at times they are strongly marked, and a good deal of shading is observable between them; C_1 is much thinner, and the rain-band is less prominent than the low-sun-band, which however does not now have the appearance of a number of fine lines. The nearest approach to the green-sun spectrum was observed recently during a severe thunderstorm, which was accompanied by a fall of about 1½ inches of rain. A very similar though less intense spectrum can be observed almost any evening by taking advantage of the passage of a small thin cloud over the sun's disk. If a lens is used in front of the slit of the spectroscope, the absorption due to the cloud will be seen as a band in the middle of the bright spectrum from the unclouded part of the sun, and owing to the strong contrast, the details of the absorption will be well seen, just as in the case of the spectrum of a sunspot.

Meteorological Phenomena.—The electrification of the air was carefully studied during the green sun period, and the results are rather curious. From September 3 to 6 the potential of the air was positive in the early morning, diminished to zero between 9 and 10 a.m., then became negative, and remained so until the sea-breeze came on in the afternoon, when the charge was positive again, and continued so all night. The amount of electrification varied greatly and rapidly. On the 7th and 9th the potential was positive all day, on the 8th it was negative for a short time. From the 10th to the 12th it varied in the same way as from the 3rd to the 6th, and this state of matters was repeated from the 20th to the 27th; the electrometer readings from the 13th to the 19th having been normal. All the negative readings were got during a hot land wind from the west. Between the 6th and 9th of September a storm of unusual violence swept over the Madras Presidency from the south-west to the north-east, making itself felt in different ways at different places. The rainfall for September was unusually small all over Madras. The average for fifteen stations was 3·24 inches, not quite half the average for this month during previous years.

The barometric curves for Colombo, Madras, Belgaum, Allahabad, and Calcutta (Alipore) have been drawn and found to resemble each other closely. All over India there was a minimum between the 6th and the 7th, a maximum about the 18th, another minimum on the 21st, then a rise, and a third minimum on the 27th.

The first essential in any attempt to arrive at an explanation of the cause of the green sun is to ascertain the precise dates at which the phenomenon was first observed in various parts of the world. It is difficult to do this, for people are apt to make more precise statements than their observations warrant. For instance, the sun certainly set with a peculiar silvery gleam, but no greenness, at Madras on September 9, and yet many persons have assured me that they saw it set green there on that evening. The reason evidently was that after their attention had been arrested by the green sunsets of the 10th and 11th they remembered having noticed something peculiar about the sunset on the 9th, and immediately concluded that the sun had been green on that occasion also. In consequence of this tendency of the mind, the evidence for all the dates given has been carefully tested, and has been found in all cases sufficient to justify the opinion that these dates are correct.

It appears that in Ceylon, in the south part of the Madras Presidency, and at Ongole in the north, the sun was first observed to be green on the evening of the 9th, and that over the east of the Presidency, when seen at all, it was first seen green on the morning of the 10th. The green sun was reported at Belgaum on the 8th, but although the observer was trustworthy, he did not make a note of the fact until afterwards, and it is just possible that it may be a mistake.

The captain of the *Cleomene* reports a green sun and moon on the 9th, 10th, and 11th, when his position was from lat. 8° N. to lat. 16° N., and from long. 83° 30′ E. to long. 88° 40′ E. The chief officer of the s.s. *Pelican* saw the moon greenish on the night of the 9th, and the sun green on the morning of the 10th. The steamer was more than 1000 miles away from Madras, in lat. 10° 4′ N. and long. 64° 12′ E., wind south-west.

The green sun was not seen further north than Ongole, except at Vizagapatam, Rajamundry, and Simla, and the dates of observation at these stations are not preserved. It was seen at Bombay, but was so inconspicuous that it escaped notice at the Observatory.

In Honolulu the sun's disk was seen to be green before it set on September 4 and 5 (NATURE, vol. xxix. p. 549). On September 4 the master of the *Jennie Walker* "noticed the strange appearance of the sun, which was greenish," in lat. 8° 20′ N. and long. 155° 28′ W. A passenger three days out from Honolulu for Sydney saw it blue on the 5th and 6th (*Ibid.*, p. 181). On September 2 it was observed bluish green in Venezuela and in Trinidad (*Ibid.*, vol. xxviii. p. 577, vol. xxix. p. 77). It was seen at Panama on the 2nd and 3rd, and at Cape Coast Castle apparently on the 1st of September. So much for the first appearance.

The sun was again seen green on September 20, in lat. 12° 50′ N. and long. 48° 26′ E. At almost all stations in Southern India the greenness reappeared on the 22nd, and Hicks Pasha noticed the sun green in the Soudan on the 24th.

The phenomena of the green sun must be distinguished from those of the remarkable sunsets that occurred all over the world some time later, and the reasons for considering them essentially different are:—

1. The general appearances of the sunsets were quite different. The sunsets accompanying the green sun were lurid, and the horizon so misty that stars were lost in it; the subsequent sunsets were remarkable for the play of delicate tints, the rose-coloured after-glow, and the unusual clearness of the horizon.

2. The spectra were totally different. In the latter case the red end was unusually free from absorption; A, a, and B stood out clearly, the rain-band was slight, and the low-sun-bands strong. This contrasts in every way with the description of the spectrum of the green sun already given.

Three hypotheses have been put forward to account for the phenomena of the green sun:—

1. That it was due to vapours or dust from the volcanic eruption at Krakatao. This was at first proposed by Mr. Pogson.

2. That the cause was the presence of an abnormal amount of aqueous vapour—an explanation which I offered at the time of the occurrence.

3. That it was caused by a cloud of meteoric dust.

The supporters of the Krakatao theory view the phenomena of the green sun and the remarkable sunsets as due to the same cause. The two great difficulties with regard to that hypothesis are (1) that there is no proof of the existence of an air current travelling at the enormous velocity required by the dates of the appearances of the green sun at various places, and (2) granting that there was such a current, how it was that the dust was such a long time in reaching India. Mr. Lockyer gets over these difficulties by assuming the existence of an upper current from east to west along the equator, and an under current from south to north. If, however, Mr. Manley's observations are accurate, as there seems every reason to believe they are, the green sun appeared at Ongole as soon as in Colombo, and at least twelve hours sooner than in Madras; and, if the Belgaum observations are correct, it appeared there a day before it was noticed at Colombo. Taking, however, only those observations about which there can be no doubt, we get the following velocities, taking the shortest lines between Krakatao and the various stations:—

To Colombo	2000 miles,	6·7 miles per hour
,, Madras	2240 ,,	7·3 ,, ,,
,, Bellary	2450 ,,	7·9 ,, ,,
Lat. 10° 4′ N., long. 64° 12′ E.	3100 ,,	9·8 ,, ,,

These required velocities increase with the distance, and, taking along with them the rate of forty miles an hour demanded by the Japan observations, it is difficult to believe that dust could have travelled in these various directions with such different velocities.

There is also the negative evidence that rain-water collected in Madras during the period of the green sun contained no volcanic dust, as far as a careful microscopic examination of the residue could determine it. On the dust hypothesis, too, it is difficult to understand the cessation and reappearance of the phenomenon.

There is some definite evidence on which to base the argument for the water-vapour theory. The observations detailed at the beginning of this paper show that the spectrum of the green sun had the absorption-lines of water-vapour very well marked, and that there was also a general absorption in the red. This absorption might indeed be accounted for by supposing a number of dust particles of a certain size to be suspended in the air; but a precisely similar absorption has been observed when the sunlight traversed the very thick clouds of a violent thunderstorm. The fact that water-vapour may make the sun appear green is proved by the numerous observations of a green sun through the escaping vapour from the funnel of a steamer, and through mist. The abundance of water-vapour in suspension was proved by the very heavy monsoonal rains which followed the appearance of the green sun. In Madras the rainfall was 19·17 inches above the average.

The green sun, although uncommon, is by no means so rare a phenomenon as is generally supposed. Since my attention has been directed to it, I have observed it several times, very conspicuously on May 13 and 14. But there is a reason why it should not appear much more frequently, and that is that, supposing the absorption producing it to be brought about by an abnormal amount of water-vapour, that vapour must be in suspension, while in fact it generally partly precipitates, forming clouds that conceal the sun as its hour of setting approaches. An interesting question arises as to whether the clearness of the atmosphere, when a large amount of aqueous vapour was in suspension during the appearance of the green sun, might not be due to an abnormal electrical state. The numerous and intense thunderstorms that occurred during the period showed that all the clouds were highly electrified, and the electrometer observations already referred to also indicated an unusually electrified atmosphere; but I am not prepared to lay much stress on the electrometer readings until I have made a more extended series of observations in ordinary weather.

The presence of abundance of aqueous vapour at the time of the appearance of the green sun may be explained naturally enough by the setting in of the moist monsoon currents in the upper parts of the atmosphere, or at least by the conflict between the north-east and south-west monsoons, which had commenced by that time.

It is not at all improbable that the Krakatao eruption had some influence on the direction of these currents. The ejection of a large volume of heated vapour would produce a centre of low pressure and set up a cyclonic influx of air from other places. It is possible that the peculiarities observed in the Indian barometric curves for some time after the eruptions were due to this cause. The eruption, too, might have something to do with the electrical conditions; for it is known from Prof. Palmieri's observations that electricity is generated by the eruptions of Vesuvius.

I was once inclined to view with favour the theory of the appearances being produced by cosmic dust, supposing the dust to act either by its mere presence or by forming nuclei for absorption; but considerations of the amount of solar radiation during the greenness have shaken my faith in this explanation.

We must, therefore, I think, give up any theory involving the presence of sufficient dust to render the sun green. Whether or not the following sunset glows were due to dust I cannot discuss here; but I would point out that an amount of dust sufficient to produce these effects would probably not materially affect the transparency of the atmosphere.

EDUCATION, SCIENCE, AND ART

THE Select Committee of the House of Commons appointed to consider how the Ministerial responsibility under which the votes for Education, Science, and Art are administered may be best secured, have agreed to the following report:—

Your Committee have examined the present and several former Presidents and Vice-Presidents of the Council, Secretaries to the Lord Lieutenant of Ireland, permanent heads of the Education Department in London, the present Resident Commissioner of National Education in Ireland, and also other gentlemen conversant with the matters referred to your Committee. They have also considered the evidence taken before the Select Committee appointed in 1865 and 1866 to inquire into the constitution of the Committee of Council on Education.

The first question considered by your Committee was whether primary education in Great Britain and in Ireland should be placed under one supervising Minister. Your Committee are satisfied that under present circumstances it would be undesirable to disturb the existing arrangements as to the Ministerial responsibility for primary education in Ireland.

They are also of opinion that primary education in England and Scotland should be under the control of the same Minister.

The Lord President of the Council, almost always a peer, is nominally the head of the Education Department for Great Britain.

The Vice-President represents the department in the House of Commons, and really transacts almost all the business requiring authority above that of the permanent officials.

Your Committee are of opinion that this arrangement is neither logical nor convenient. They see no sufficient reason why there should be any more real connection between the Education Department and the Privy Council than between the Board of Trade and the Privy Council; but as it may be convenient that the Minister for Education should have occasionally the assistance, whether as to English or Scotch Education, of other Privy Councillors specially summoned for consultation with him, they recommend that a Board of (or Committee of Council for) Education should be constituted under a President, who should be the real as well as nominal Minister, in this respect holding a position like that of the President of the Board of Trade. Hitherto there has been a separate Scotch Department of the Privy Council, and your Committee consider that it would be well to have a distinct permanent secretary appointed for Scotland, responsible to the Minister of Education.

Whether the Minister of Education should always be a member of the Cabinet or of the House of Commons, and what should be his salary, are questions upon which it is hardly within the province of your Committee to make absolute recommendations. They think, however, that the duties of this Minister should be recognised as not less important than those of some of the Secretaries of State.

The Minister of Education should have the assistance of a Parliamentary Secretary, able to sit in either House of Parliament.

While on the whole preferring the plan they have suggested, your Committee do not deny that there are objections to the constitution of an administrative department in the form of a board which has no real existence. The permanent secretary and his assistants bind by their signature, nominally the board, really, the political chief.

This system, it must be admitted, tends to lessen the direct control and responsibility to Parliament and the public which is apparent in the office of a Secretary of State.

The second question discussed by your Committee was whether, and if so what, authority should be exercised by the Minister of Education over endowed schools. Your Committee recommend that when schemes for endowed schools, whether in England or in Scotland, have come into operation, the Minister of Education should have full authority to call on the governing bodies to furnish him with such reports and information as he may require, and to direct any inquiries or inspection to be made which he may deem necessary.

As to public schools, your Committee recommend that the Minister of Education should be authorised to call for such reports and information as he may require from the governing bodies, but they are not of opinion that his powers should extend to directing inspection.

With respect to the Universities in Great Britain receiving grants charged on the votes of Parliament or on the Consolidated

Fund, the Minister should be authorised to require from them an annual report in such form as he may order.

Your Committee have not taken any evidence as to reformatory and industrial schools, considering that these have so recently formed the subject of an inquiry by a Royal Commission, the report and recommendations of which are before Parliament. They see no reason for altering the present responsibility for workhouse schools or for the primary schools connected with the Army, the Navy, or the Marines. The responsibility for the administration of the votes for military and naval colleges do not appear to come within the reference to your Committee.

Your Committee see no reason to disturb the existing arrangements as to the supervision of the Science and Art Department.

There are various miscellaneous votes for science and art, such as those for scientific research, distributed through the Royal Society, votes for meteorology, and votes in aid of the Royal Society of Edinburgh and the Royal Irish Academy. These votes, your Committee think, should be moved by the Minister of Education, and reports, when necessary, should be made to him.

Your Committee do not propose to bring the British Museum and the National Gallery into closer relations with Her Majesty's Government than those now existing, with this exception, that, in their opinion, the Minister of Education and the Parliamentary Secretary should be *ex officio* trustees of each of those institutions. The President of the Council, your Committee notice, is now an *ex officio* trustee of the British Museum. The House of Commons would then look to the Education Department for explanations when the votes for the British Museum and the National Gallery are discussed in Committee of Supply.

The Committee, of which the Chancellor of the Exchequer was chairman, included, among other members, Sir J. Lubbock, Mr. Salt, Mr. Raikes, Sir L. Playfair, Mr. S. Morley, Mr. Pell, Mr. Sclater-Booth, and Mr. J. Collings.

THE MARINE BIOLOGICAL ASSOCIATION

THE Council of the Marine Biological Association adopted the following statements at its meeting held on July 25 last :—

MEMORANDUM NO. I.

The Marine Biological Association was founded in March, 1884, at a meeting held in the apartments of the Royal Society of London, Prof. Huxley, P.R.S., in the chair. Its officers and council include the leading naturalists of the country, as well as noblemen and others who took an active part in the late Fisheries Exhibition. H.R.H. the Prince of Wales has consented to be Patron of the Association, and has given evidence of the importance which he attaches to the success of its objects by contributing a handsome donation to its funds. The following is a list of the Executive of the Association :—

President : Prof. Huxley (President of the Royal Society).

Vice-Presidents : The Duke of Argyll, K.G. ; the Duke of Sutherland, K.G. ; the Marquis of Hamilton ; the Earl of Dalhousie, K.T. ; Lord Walsingham (Trustee of the British Museum of Natural History) ; Prof. Allmann, F.R.S. ; Sir John St. Aubyn, Bart., M.P. ; Edward Birkbeck, M.P. (Chairman of the Executive Committee of the International Fisheries Exhibition) ; George Busk, F.R.S. ; W. B. Carpenter, C.B., M.D., F.R.S. ; W. H. Flower (Director of the British Museum of Natural History) ; J. Gwyn Jeffreys, F.R.S. ; Sir John Lubbock, Bart., M.P. (President of the Linnean Society).

Council : Prof. Moseley, F.R.S. (Oxford), Chairman ; C. Spence Bate, F.R.S. (Plymouth) ; Prof. Jeffrey Bell, F.Z.S. (British Museum) ; W. S. Caine, M.P. ; W. T. Thiselton Dyer, C.M.G., F.R.S. (Royal Gardens, Kew) ; John Evans, D.C.L. (Treasurer, R.S.) ; A. C. L. G. Günther, F.R.S. (British Museum) ; Prof. Herdman (Liverpool) ; E. W. H. Holdsworth ; Prof. McIntosh (St. Andrew's) ; Prof. Milnes Marshall (Manchester) ; Sir Philip Cunliffe Owen, K.C.M.G., C.B. ; G. J. Romanes, F.R.S. (Secretary of the Linnean Society) ; P. L. Sclater, F.R.S. (Secretary of the Zoological Society) ; Adam Sedgwick (Cambridge).

Hon. Treasurer : Frank Crisp (Vice-President and Treasurer of the Linnean Society), 6, Old Jewry, E.C.

Hon. Secretary : Prof. E. Ray Lankester, F.R.S., 11, Wellington Mansions, North Bank, N.W.

The object of the Association is to erect one or more laboraories on the coast of the United Kingdom, where studies may be carried on by naturalists, leading to an improvement in zoological and botanical science, and especially to an adequate acquaintance with the food, habits, spawning, and propagation of our marine food-fishes and shell-fish.

Great scientific and practical results have been obtained in other countries, notably in the United States of America, in Germany, France, and Italy, by studies carried on through such laboratories as the Marine Biological Association proposes to erect in this country. The knowledge which can be thus and thus only gained is precisely that knowledge which is at present *urgently* needed in order to regulate and improve British Sea Fisheries, and it therefore seems to be not inappropriate that public bodies as well as individuals interested in the progress of natural history science should take in hand the promotion of the first attempt to institute an efficient sea-coast laboratory in these islands.

It is estimated by the Council that a sum of 10,000*l.* will be required to build and equip an efficient laboratory, and to insure a successful start for the Association. This sum does not include any payment to the naturalists who may conduct the operations of the laboratory, since in the first instance, at any rate, such services will be rendered gratuitously. The money which is now asked for will be expended entirely upon the laboratory, its equipment, and necessary service.

As the result of an appeal to scientific men and their immediate friends the Association has raised a sum of about 2000*l.* In order to obtain the rest of the money which is required it is necessary to appeal to a wider circle.

The Council of the Association feel that they have undertaken a work of national importance, and therefore confidently appeal to those who have pecuniary resources at their disposal to give them substantial aid in its realisation.

According to the bye-laws of the Association adopted at a meeting of members on June 17, 1884, donors of 500*l.* to the Association become governors and permanent members of the Council of the Association. The Council hope that they may receive some contributions of this amount or of larger sums, and would suggest that it might be found convenient by those who may intend to assign sums of large amount to the Association to do so in the form of a payment of so much a year spread over a term of years.

The donor of 100*l.* to the Association becomes a "Founder" and life-member. An annual subscription of 1*l.* 1*s.*, or a composition fee of 15*l.* 15*s.*, is required of ordinary members. Members of the Association have the right to take part in the government of the Association by electing the Officers and Council at their annual meeting : they will receive the printed reports of the Association, and enjoy special privileges in the use of the laboratory and its resources.

It is intended to require an entrance fee of 5*l.* 5*s.* from members who join the Association later than June, 1885.

Signed (on behalf of the Council of the Marine Biological Association),
H. N. MOSELEY, M.A., F.R.S.,
Chairman of the Council,
Linacre Professor of Anatomy in the University of Oxford
July 25, 1884

MEMORANDUM NO. II.—*Nature of the Building, Management, and Work of the Proposed Marine Laboratory and Experimental Aquarium.*—The Council of the Marine Biological Association cannot as yet definitely pledge itself as to details, but the following is a sketch of the nature of the building which it proposes to erect, of the probable management of the Laboratory, and of the kind of work which may be expected to be accomplished by its aid.

The most complete institution of the kind is that at Naples, which is supported by contributions from various European States, and is especially subsidised by the German Imperial Government. The buildings, fittings, and boats belonging to this institution have cost 20,000*l.* It is proposed to *start* such an institution in this country with half this sum.

1. *Building.*—The first laboratory of the Marine Biological Association will probably be erected on the shore of Plymouth Sound. Plymouth is not only by its natural features one of the best possible localities for the purpose, but a Committee of the Town Council has offered to the Association a suitable site free of cost and a contribution of 1000*l.*

With regard to the building, the Council of the Marine Biological Association contemplate erecting a solid brick structure of about 100 × 40 feet ground area, and of two stories. The exterior will be simple and unpretentious. The building will be placed close to the sea-shore, so that sea water can be readily pumped into the laboratory tank, and in order that there may be easy communication with fishing-boats. It will also be desirable to have a floating barge anchored near the laboratory for special experiments on the breeding of fish, &c., and, in close proximity, it will be necessary to erect tanks on the foreshore, open to the tidal water, but arranged so as to prevent the escape of the animals confined in them for study.

The basement of the building will contain a reservoir tank holding several thousand gallons of sea water; on the ground floor there will be two large rooms paved with stone; one fitted with large tanks and a service of sea water, the other used for the reception and examination of a day's trawling or dredging, and also used for keeping stores and for carrying out the pickling and proper preservation of specimens to be sent, as required, to naturalists at a distance. The upper floor will be divided into a series of larger and smaller working rooms fitted with suitable tables, with reagents and apparatus required in microscopy, and with a constant supply of sea water pumped from the reservoir tank. Accommodation for ten workers will be thus provided. One of the rooms on this floor must be set apart as a library and writing-room, and must contain as complete a series of works on marine zoology and botany, pisciculture, and such matters as can be brought together. The provision of such a library is one of the special conveniences which would be offered to naturalists working in the laboratory.

The building must also necessarily contain bed-room and sitting-room for a resident superintendent, and accommodation for one servant or caretaker.

2. *Apparatus and Boats.*—These need not at first be very extensive. Glass tanks, pumping engine and supply tubes are essential. There will be necessarily one small steam-launch for dredging in quiet weather at no great distance from shore, and a row-boat. For special expeditions larger boats or steamers could be either hired or borrowed from time to time. The local fishermen would also greatly aid the laboratory if regularly paid, and thus supplement the special boats of the Association.

3. *Salaried Staff.*—The Council would propose to begin work with the smallest possible number of permanent *employés.* These would be—(*a*) a resident superintendent, who should be a man of fair education and some knowledge of natural history, at a salary of 150*l.* a year, supplemented by free quarters; (*b*) a servant of the fisherman class, who would look after the tanks and workrooms, go out in search of specimens, and manage a boat and dredging apparatus when required. Other fishermen and boys might be hired from time to time. A sum of 100*l.* a year would be required for such service at the least.

4. *Conditions of Admission to Use of Laboratory: Work to be done there.*—The Council would propose to admit to the use of a table and other resources of the laboratory, so far as the space shall permit, any British or foreign naturalist who might make application and furnish evidence of his capability to make good use of the opportunities of the place. A preference would be given to a member of the Association, A fee might in some cases be charged for the use of a table, and other tables might be let out at an annual rental to such bodies as the Universities, this being the system adopted at Naples by Dr. Dohrn.

The Council will endeavour, when the laboratory is erected and in operation, to obtain grants of money from scientific societies, and from the Government, for the purpose of carrying out *special* investigations on a given subject, *e.g.*, the conditions affecting the fall of oyster-spat, the reproduction and general economy of the common sole, the complete determination and enumeration of the fauna and flora of the marine area adjacent to the site of the laboratory, its distribution within that area, and its relation to physical conditions. Naturalists will be nominated by the Council of the Association or by the authorities who find the money by which such naturalists are paid, to make such researches at the laboratory of the Association. When some special investigation is thus started at the laboratory, the other naturalists, who from time to time come there, will be sure to take part in the inquiry, and so help to carry it on to completion. It would be the business of the resident superintendent to facilitate this continuity of work, whilst the Council of the Association will make it a special object to bring together the results attained in the laboratory each year, in the form of a report, so as to gradually organise and direct towards definite ends the work done through its agency.

In the course of time, and with increased provision of funds for the special purpose, the Association might expect to be the means of producing—

1. A thorough knowledge of the life and conditions of the marine area adjacent to the laboratory.

2. A complete and detailed account of the natural history of certain fishes, molluscs, and crustaceans of economic importance with special reference to their increased supply.

3. Contributions to the knowledge of the growth from the egg, adult structure and physiology of such rare or otherwise scientificially interesting animals and plants as occur near the laboratory.

It is not supposed that this can be immediately accomplished by the 10,000*l.* which the Association now seeks to raise. That sum will be expended in erecting the laboratory and in starting it on its career of activity. The laboratory will necessarily attract support and increased means of usefulness as, year by year, its work becomes known, and the facilities which its offers to working naturalists appreciated.

Signed (by order of the Council of the
Marine Biological Association),
E. Ray Lankester, M.A., F.R.S.,
July 25 Hon. Secretary

THE METEOROLOGICAL CONFERENCE

A METEOROLOGICAL conference was held at the Health Exhibition on July 17 and 18; the following is an abstract of the leading papers read at the conference.

Dr. J. W. Tripe read a paper of much interest on some relations of meteorological phenomena to health.

In ages long past these relations excited much attention, but the knowledge concerning them was of the vaguest kind; and indeed, even now, no very great advance has been made, because it is only quite recently that we have been able to compare a fairly accurate record of deaths with observations taken at a number of reliable meteorological stations. The more useful and searching comparison between cases of sickness, instead of deaths, and meteorological phenomena has yet to be accomplished on a large scale in this country, and especially as regards zymotic diseases. In Belgium there is a Society of Medical Practitioners, embracing nearly the whole country, that publishes a monthly record of cases of sickness, of deaths, and of meteorological observations; but the only attempt on a large, scale in this country, which was started by the Society of Medical Officers of Health for the whole of London, failed partly from want of funds, and partly from irregularity in the returns. My remarks, which must necessarily be very brief, will refer to the relations between (1) meteorological phenomena and the bodily functions of man, and (2) between varying meteorological conditions and death-rates from certain diseases.

As regards the first, I will commence with a few brief remarks on the effects of varying barometric pressures. A great deal too much attention is paid to the barometer if we regard it as indicating only, as it really does, variations in the weight of the column of air pressing upon our bodies, because, except at considerable elevations, where the barometer is always much lower than at sea-level, these variations produce but little effect on health. At considerable elevations the diminished pressure frequently causes a great feeling of malaise, giddiness, loss of strength, palpitation, and even nausea; and at greater heights, as was noticed by Mr. Glaisher in a very lofty balloon ascent, loss of sight, feeling, and consciousness. These were caused by want of a sufficient supply of oxygen to remove effete matters from the system, and to carry on the organic functions necessary for the maintenance of life. On elevated mountain plateaus, or even in high residences amongst the Alps, an increased rapidity in the number of respirations and of the pulse, as well as increased evaporation from the lungs and skin, occur.

For some years past, many persons suffering from consumption, gout, rheumatism, and anæmic affections have gone to mountain stations, chiefly in Switzerland, for relief, and many have derived much benefit from the change. It must not however, be supposed that diminished atmospheric pressure was the chief cause of the improvement in health, as its concomitants, viz., a diminution in the quantity of oxygen and moisture contained in each cubic foot of air, probably the low temperature, with a total change in the daily habits of life, have assisted in the beneficial results. The diminution in the quantity of air, and consequently of oxygen, taken in at each breath is to a certain extent counterbalanced by an increased frequency and depth of the respirations, and a greater capacity of the chest. In this country, alterations in the barometric pressure are chiefly valuable as indicating an approaching change in the wind, and as well as of the amount of moisture in the air; hence the instrument is often called "the weather glass." A sudden diminution in the atmospheric pressure is likely to be attended with an escape of ground air from the soil, and therefore to cause injury to health, especially amongst the occupants of basement rooms, unless the whole interior of the building be covered with concrete.

Temperature.—Experience has shown that man can bear greater variations of temperature than any other animal, as in the Arctic regions a temperature of 70 degrees Fahrenheit, or more than 100 degrees below freezing-point, can be safely borne; that he can not only live but work, and remain in good health in these regions, provided that he be supplied with suitable clothing and plenty of proper food. On the other hand, man has existed and taken exercise in the interior of Australia, when the thermometer showed a temperature of 120 degrees Fahrenheit, or nearly 90 degrees above freezing-point, so that he can live and be in fairly good health within a range of nearly 200 degrees Fahrenheit.

The effects of a high temperature vary very much according to the amount of moisture in the air, as when the air is nearly saturated in hot climates, or even in summer in our own, more or less languor and malaise are felt, with great indisposition to bodily labour. With a dry air these are not so noticeable. The cause is evident; in the former case but little evaporation occurs from the skin, and the normal amount of moisture is not given off from the lungs, so that the body is not cooled down to such an extent as by dry air. Sunstroke is probably the result, not only of the direct action of the sun's rays, but partly from diminished cooling of the blood by want of evaporation from the lungs and skin.

The effects of temperature on man does not depend so much on the mean for the day, month, or year, as on the extremes, as when the days are hot and the nights comparatively cool, the energy of the system becomes partially restored, so that a residence near the sea, or in the vicinity of high mountains, in hot climates is, other things being equal, less enervating than in the plains, as the night air is generally cooler. It is commonly believed that hot climates are *necessarily* injurious to Europeans, by causing frequent liver derangements and diseases, dysentery, cholera, and fevers. This, however, is, to a certain extent, a mistake, as the recent medical statistical returns of our army in India show that in the new barracks, with more careful supervision as regards diet and clothing, the sickness and death-rates are much reduced. Planters and others, who ride about a good deal, as a rule keep in fairly good health; but the children of Europeans certainly degenerate, and after two or three generations die out, unless they intermarry with natives, and make frequent visits to colder climates. This fact shows that hot climates, probably by interfering with the due performance of the various processes concerned in the formation and destruction of the bodily tissues, eventually sap the foundations of life amongst Europeans; but how far this result has been caused by bad habits as regards food, exercise, and self-indulgence, I cannot say. Rapid changes of temperature in this country are often very injurious to the young and old, causing diarrhœa and derangements of the liver when great heat occurs, and inflammatory diseases of the lungs, colds, &c., when the air becomes suddenly colder, even in summer.

The *Direct* influence of rain on man is not very marked in this country, except by giving moisture to the air by evaporation from the ground and from vegetable life, and by altering the level of ground water. This is a subject almost overlooked by the public, and it is therefore as well that it should be known that when ground water has a level, persistently less than five feet from the surface of the soil, the locality is usually unhealthy, and should not, if possible, be selected for a residence. Fluctuations in the level of ground water, especially if great and sudden, generally cause ill-health amongst the residents. Thus, Dr. Buchanan in his Reports to the Privy Council in 1866-67, showed that consumption (using the word in its most extended sense) is more prevalent in damp than on dry soils, and numerous reports of medical officers of health, and others, which have been published since then, show that an effective drainage of the land, and consequent carrying away of the ground water, has been followed by a diminution of these diseases.

Varying amounts of moisture in the air materially affect the health and comfort of man. In this country, however, it is not only the absolute but the relative proportions of aërial moisture which materially influence mankind. The quantity of aqueous vapour that a cubic foot of air can hold in suspension, when it is saturated, varies very much with the temperature. Thus at 40 degrees Fahr. it will hold 2·86 grains of water; at 50 degrees, 4·10 grains; at 60 degrees, 5·77 grains; at 70 degrees, 8·01 grains; and at 90 degrees as much as 14·85 grains. If saturation be represented by 100, more rapid evaporation from the skin will take place at 70 degrees, and 75 per cent. of saturation, than at 60 degrees when saturated, although the absolute quantity of moisture in the air is greater at the first-named temperature than at the latter. As regards the lungs, however, the case is different, as the air breathed out is, if the respirations be regular and fairly deep, completely saturated with moisture at the temperature of the body. In cold climates the amount of moisture and of the effete matters given off from the lungs in the expired air, is much greater than in hot climates, and the body is also cooled by the evaporation of water in the form of aqueous vapour. Moist air is a better conductor of heat than dry air, which accounts for much of the discomfort felt in winter when a thaw takes place as compared with the feeling of elasticity when the air is dry. In cold weather, therefore, moist air cools down the skin and lungs more rapidly than dry air, and colds consequently result. London fogs are injurious, not only on account of the various vapours given off by the combustion of coal, but in consequence of the air being in winter generally saturated with moisture at a low temperature. The injuriousness of fogs and low temperatures will be presently dwelt upon at greater length.

Variations in the pressure and temperature of the atmosphere exert a considerable influence on the circulation of air contained in the soil, which is called ground air. As all the interstices of the ground are filled with air or water, the more porous the soil, the greater is the bulk of air. The quantity of air contained in soil varies very much according to the material of which the soil is composed, as it is evident that in a gravelly or sandy soil it must be greater than when the ground consists of loam or clay. The estimates vary from 3 to 30 per cent., but the latter is probably too high. If, therefore, a cesspool leak into the ground, the offensive effluvia, if in large quantities, will escape into the soil, and are given off at the surface of the ground, or are drawn into a house by the fire; but, if small, they are rendered inocuous by oxidation. The distance to which injurious gases and suspended or dissolved organic matters may travel through a porous soil is sometimes considerable, as I have known it pass for 130 feet along a disused drain, and above 30 feet through loose soil.

Winds exercise a great effect on health both directly and indirectly. Directly, by promoting evaporation from the skin, and abstracting heat from the body in proportion to their dryness and rapidity of motion. Their indirect action is more important as the temperature and and pressure of the air depend to a great extent in their direction. Thus winds from the north in this country are usually concomitant with a high barometer and dry weather; in summer with a pleasant feeling, but in winter with much cold. South-west winds are the most frequent here of any, as about 24 per cent. of the winds come from this quarter against 16½ from the west, 11½ from the east, and the same from the north-east; 10½ from the south, 8 from the north, and a smaller number from the other quarters. South-west winds are also those which are most frequently accompanied by rain, as about 30 per cent. of the rainy days are coincident with south-west winds. Another set of observations give precisely the same order, but a considerable difference in their prevalence, viz. south-west 31 per cent., west 14½, and north-east 11½ per cent. Easterly winds are the most unpleasant, as well as the most injurious to man of all that occur in this country.

I now propose discussing very briefly the known relations between meteorological phenomena and disease. I say the known relations, because it is evident that there are many unknown relations of which at present we have had the merest glimpse. For instance, small-pox, while of an ordinary type, and producing only a comparatively small proportion of deaths to those attacked, will sometimes suddenly assume an epidemic form, and spread with great rapidity at a time of year and under the meteorological conditions when it usually declines in frequency. There are, however, in this country known relations between the temperature and, I may say, almost all diseases. As far back as 1847 I began a series of elaborate investigations on the mortality from scarlet fever at different periods of the year, and the relations between this disease and the heat, moisture, and electricity of the air. I then showed that a mean monthly temperature below 44°·6 F. was adverse to the spread of this disease, that the greatest relative decrease took place when the mean temperature was below 40°, and that the greatest number of deaths occurred in the months having a mean temperature of between 45° and 57° F. Diseases of the lungs, excluding consumption, are fatal in proportion to the lowness of the temperature and the presence of excess of moisture and fog. Thus, in January 1882 the mean weekly temperature fell from 43°·9 F. in the second week to 36°·2 in the third, with fog and mist. The number of deaths registered in London during the third week, which may be taken as corresponding with the meteorological conditions of the second week, was 1700, and in the next week 1971. Unusual cold, with frequent fogs and little sunshine, continued for four weeks, the weekly number of deaths rising from 1700 to 1971, 2023, 2632, and 2188. The deaths from acute diseases of the lungs in these weeks were respectively 279, 481, 566, 881, and 689, showing that a large proportion of the excessive mortality was caused by these diseases. At the end of November and in December of the same year there was a rapid fall of temperature, when the number of deaths from acute diseases of the lungs rose from 297 to 358, 350, 387, 541, 553, and 389 in the respective weeks. From November 29 to December 9 the sun was seen only on two days for 4½ hours, and from December 9 to the 18th also on two other days for less than 4 hours, making the total amount of sunshine 8·1 hours only in 20 days. In January and February the excess of weekly mortality from all diseases reached the large number of 504 deaths; in December it was less, the fogs not having been so dense, but the excess equalled 246 deaths per week.

The relations between a high summer temperature and excessive mortality from diarrhœa have long been well known, but the immediate cause of the disease as an epidemic is not known. Summer diarrhœa prevails to a greater extent in certain localities, notably in Leicester (and has done so for years); and the cause has been carefully sought for, but has not been found out. Recent researches, however, point to a kind of bacillus as the immediate cause, as it has been found in the air of water-closets, in the traps under the pans, and in the discharges from infants and young children. In order to indicate more readily how intimately the mortality from diarrhœa depends on temperature, I now lay before you a table showing the mean temperature for ten weeks in summer, of seven cold and hot summers, the temperature of Thames water, and the death-rates of infants under one year per million population of London:—

London. Deaths under 1 Year, in July, August, and part of September, from Diarrhœa per 1,000,000 Population Living at all Ages, arranged in the Order of Mortality

Years	Mean temperature, 10 weeks	Temperature of Thames water	Age 0-1 year. Deaths from diarrhœa per 1,000,000 population living at all ages
	°		
1860	58·1	60·6	151
1862	59·0	62·0	189
1879	58·7	60·7	228
1877	61·2	63·3	347
1874	61·7	63·8	447
1878	63·7	64·1	576
1876	64·4	64·9	642

As may be seen, the deaths of infants under 1 year of age from diarrhœa per 1,000,000 population was only 151; whilst the mean summer temperature was only 58°·1 F. against 189 in 1862, when the mean temperature was 59°·0. In 1879, when the mean temperature was 58°·7, the deaths from diarrhœa rose to 228 per million, but a few days were unusually hot. In 1877 the mean temperature of the air was 61°·2, of the Thames water 63°·3, and the mortality of infants from diarrhœa 347 per million population. In 1874, when the mean temperature of the air was 61°·7, the mortality rose to 447 per million; and in the hot summers of 1878 and 1876, when the mean air temperatures were 64°·1 and 64°·9 respectively, the death-rates of infants were 576 and 642 per million population. The relations, therefore, between a high summer temperature and the mortality from diarrhœa in infants are very intimate. I have selected the mortality amongst infants in preference to that at all ages, as the deaths occur more quickly, and because young children suffer in greater proportion than other persons.

The proportionate number of deaths at *all ages* from diarrhœa corresponds pretty closely with those of infants. To prove this, I made calculations for three years, and ascertained that only 3·9 per cent. of all the deaths from this disease were registered in the weeks having a temperature of less than 50°; 11·9 per cent. in the weeks having a temperature between 50° and 60°, whilst in the comparatively few weeks in which the temperature exceeded 60° F., as many as 84·2 per cent. of the total number of deaths was registered. In the sixteen years, 1840-56, for which many years ago I made a special inquiry, only 18·9 per cent. of all the deaths from diarrhœa occurred in winter and spring, against 81·1 per cent. in summer and autumn. In the twenty years, 1860-79, there were seven years in which the summer temperature was in defect when the mortality per 100,000 inhabitants of London was 200; whilst in ten summers, during which the temperature was in excess by 2° or less, the mortality was 317 per 100,000. The mean temperature was largely in excess, that is to say, more than 2° plus in three of these summers, when the mortality reached 339 per 100,000 inhabitants. These figures show that great care should be taken in hot weather to prevent diarrhœa, especially amongst young children; by frequent washing with soap and water to ensure cleanliness, and proper action of the skin; by great attention to the food, especially of infants fed from the bottle; free ventilation of living rooms, and especially of bedrooms; and by protection, as far as possible, being afforded from a hot sun, as well as by avoiding excessive exercise. All animal and vegetable matter should be removed from the vicinity of dwelling-houses as quickly as possible (indeed these should be burnt instead of being put in the dust-bin), the drains should be frequently disinfected and well flushed out, especially when the mean daily temperature of the air is above 60° F.

Time will not admit of more than a mere mention of the relations between meteorological phenomena and the mortality from many other diseases and affections, such as apoplexy from heat, sunstroke, liver diseases, yellow fever, cholera, whooping-cough, measles, &c., especially as the state of our knowledge on the subject is so very limited. A comparison between the mortality from several diseases in this and other countries shows that certain of these do not prevail under closely corresponding conditions. Thus the curves of mortality from whooping-cough, typhoid fever, and scarlet fever, do not correspond with the curves of temperature in both London and New York, and the same may be said of diarrhœa in India. It is therefore evident that some other cause or causes than a varying temperature must be concerned in the production of an increased death-rate from these diseases. The subject is of great importance, and I do not despair of our obtaining some day a knowledge of the agents through which meteorological phenomena act in the production of increased and decreased death-rates from certain diseases, and the means by which, to a certain extent, these injurious effects on man be prevented.

Mr. R. H. Scott, F.R.S., read a paper on "The Equinoctial Gales—do they occur in the British Isles?" Most scientific meteorologists, Mr. Scott stated, are disposed to give up, almost in despair, the idea of eradicating from the popular mind the belief in the influence of the moon on the weather. There is, however, another belief, not quite so widely spread, but still very generally accepted, which attributes to the equinoxes a peculiarly stormy character. Over and over again have I heard the remark that it would be well for those proposing to take a voyage to wait until the equinoctial gales were over. It has struck me, therefore, that as we have had for several years past a regular system of storm warnings, it might be of interest to ascertain if the record of these warnings, and of the storms with which they were connected, exhibited any maximum of storm frequency about the equinoxes.

The period I have taken has been that of the fourteen years beginning with the spring of 1870, and I have commenced with the spring in order to include the past winter, that of 1883-4. With the year 1870, the systematic checking of storm warnings was commenced on the demand of the late Colonel Sykes. The results were published as "Parliamentary Papers" for the first seven years, and subsequently the returns have been regularly prepared in the Meteorological Office, though only the summary of results has appeared in the Annual Reports. As these returns give not only the storms for which warnings were issued but also those for which none were sent out, they afford a ready index to the storms which have been felt on the coasts.

Only such storms have been selected as have been really severe, such as have attained force 9 of the Beaufort scale at more than two stations, with a velocity exceeding 50 miles an hour recorded by an anemograph for more than a single hour. I have also not discriminated between the directions from which the strongest winds were felt.

The results of these records show that gales are of no greater frequency at the equinoxes than at any other time.

The diagrams show that the storms are all but exclusively confined to the winter half-year, if we take that to include part of the autumn and spring.

The diagrams show that there is no strongly-marked maximum at either equinox, but they do exhibit indications of periodicity which are very interesting.

Leaving the summer alone, as not worth notice, the frequency rises from nine and eight in the periods preceding the autumn equinox to ten at that epoch. The curve then rises rapidly, the value doubling itself and trebling itself in the two succeeding intervals. We then find a falling off at the time of the Martinmas summer in the first half of November, and a second maximum in the end of that month—the period indicated by Sir John Herschel long ago, in an article in *Good Words* for January 1864, as that succeeding what he called "The Great November Wave," a phenomenon which does not receive as much attention now as formerly. The first part of December is comparatively quiet, but after that the frequency rises to its absolute maximum at the latter half of January, from which period the curve descends gradually, with one decided check in February, to the same value which it had in August, and which it attains at the end of April. The check in February reminds us of the well-known tradition of the "halcyon" days at the end of winter. The frequency at the spring equinoctial period is nearly double what it is at the corresponding interval at the autumn equinox, being 19 as compared with 10. In one particular, however, the phenomena agree—the equinoxes are periods of sudden change in storm frequency. In the autumn this rises from 10 to 20 as soon as the equinox is passed; in the spring it falls from 27 to 19 as the equinox arrives. Accordingly, persons who wait till the equinox is passed in autumn improve their chances of falling in with a storm, for the diagram shows no signs of a lull once a heavy storm has occurred. In the spring it would apparently be wise to wait till April was well advanced, if you wished to get calm weather in the Bay of Biscay.

If we now look to see what evidence of recurrence of storms for particular short periods is discoverable in our data, we find that the day most frequently so distinguished is January 1, on which a storm was recorded six times in the fourteen years. This is very remarkable, as December 31 only shows one, and January 2 only two storms. Five days—November 10 and 20, January 18 and 19, and February 26—show five each, and no less than sixteen days show four. The stormiest two-day interval is that of January 18 and 19, which, as just explained, exhibits five storms each. The most disturbed three-day period is that of January 24 to 26, where we find four storms on each day. The date of the Battle of Trafalgar, October 21, is marked by two fours, on the 21st and 22nd, but the end of October is not so disturbed as the end of January.

The diagram also shows that almost every month in the year is occasionally nearly free from storms. October, November, December, and January have only one apiece, but in different years. March is the only month which has at least two storms, thus justifying its epithet, "March many-weathers."

Mr. Scott also read a paper on Cumulative Temperature, of which the following are the leading points:—

On the walls of the Meteorological Annexe will be found a series of diagrams, exhibiting from various districts in the United Kingdom, in a graphical form, the March of Temperature, Rainfall, and Bright Sunshine, from the beginning of the present year, and also for the entire year 1881, which is reproduced for purposes of comparison.

The object of these curves is to show clearly some of the most important factors in the growth of crops.

It is proved, almost beyond a doubt, that each plant, say each individual cereal, requires a definite amount of heat to bring it to maturity. Thus, maize requires more than wheat, and wheat again more than barley or oats.

Now various investigators, and notably Boussingault and Prof. Alphonse de Candolle, of Geneva, have devoted much attention to this subject, and the latter writer, in his "Géographie Botanique," has come to the conclusion that a certain total amount of temperature above a definite base line is necessary for plant growth, and that this amount, or, as he calls it, this "sum of temperature," varies for each crop.

He found that plants, as a rule, did not begin to give indications of active vegetation until the temperature rose above 6° C. This temperature, 6° C., or, in round numbers, 42° F., that is ten degrees above the freezing point, is taken as the base for all the diagrams. Although Prof. de Candolle propounded his views some years ago, as recently as the year 1874, at the Agricultural Conference at Vienna, meteorologists were quite at sea as to how these sums of temperature were to be calculated.

The credit of solving this problem belongs to Lieut.-General Richard Strachey, the Chairman of the Meteorological Council. In the first place he proposes to adopt a certain unit of temperature to supply a standard for calculation, the unit being one degree continued for the unit of time, either one hour or one day, as the case may be. Such a unit may be conveniently called an hour degree, or day degree. The unit of time adopted for the calculations to which I am about to refer is a day, and the unit of what may be termed the effective temperature is therefore *a day degree*. A day degree therefore signifies 1° F. of excess or defect of temperature above or below 42° F. continued for twenty-four hours, or any other number of degrees for an inversely proportional number of hours.

Now the first idea I want you to take in about these day degrees is that when we speak generally of the mean or average temperature for a day, or month, or year, we imply that the resulting temperature is the same as would be observed if the thermometer indicated this mean temperature throughout the entire period for which the mean is taken. Thus, if we were dealing with daily means, an average daily temperature of 62° F., which is an ordinary temperature for a warm summer's day, would mean twenty day degrees of temperature for that day, starting from the assumed base line of 42° F., which has already been mentioned.

The first step therefore towards determining this effective temperature in day degrees resolves itself into determining as speedily and simply as possible the average temperature for the period under consideration.

We have, fortunately, to our hands, a very simple mode of arriving at the mean temperature with accuracy sufficient for our purposes. Almost all observers record the maximum and mininum temperatures once in the twenty-four hours. It is found that the half sum of these readings, the mean between them, is nearly but not exactly the average for the day. It must, of course, be understood that the instruments must be read regularly and at the same hour every day.

The next points which require attention are: whether the maximum and minimum are both above 42°, which occurs in summer, or both below that point, which occurs in winter; or, finally, whether one is above, and the other below. In the first case all the accumulated temperature is to the good; it is all on the positive side. In the second case it is all on the negative side. The third case is the only one which presents difficulty, for when the extreme temperatures are on either side of the line of 42°, one portion of the effective temperature for the day is positive, and the other negative.

Now, General Strachey carried out a long series of calculations, based on the observed hourly temperatures at Kew Observatory, and at other stations in the United Kingdom, in order to ascertain the magnitude of the co-efficient by which the difference between either of these extreme temperatures and the base temperature (42° F.) should be multiplied in order to obtain the values of the temperatures in excess or defect of 42° F. expressed in day-degrees, and he found that this, *for a weekly period*, was 0·4.

Accordingly we get the following rules:—

If the mean of the day is above 42° F., we multiply the difference between the minimum and 42° F. by 0·4 (four-tenths), and call this *the negative effective temperature.*

To find the positive effective temperature we subtract from the difference between the mean for the day and 42°, the negative effective temperature just determined.

If the mean of the day is below 42° F. the proceeding is similar; but we first ascertain the positive effective temperature, and subtract that from the difference between 42° F. and the mean, thus obtaining the negative effective temperature.

The method of determining the effective temperature, which may briefly be called the accumulated temperature, is fully explained in a paper by General Strachey, which will appear in the forthcoming volume of the "Quarterly Weather Report," that for 1878. Meanwhile it is extremely interesting to examine the diagrams in the Annexe somewhat minutely, and to observe how the total accumulated temperature, say, up to July 1, is made up in very different ways in the two years, 1881 and 1884, there exhibited.

The year 1881 was very cold in the winter, and its accumulated temperature was made up in the spring and early summer. In the present year we had practically no frost, but then we had unusually cold weather at Easter and at the end of May.

The practical application of the data thus obtained as standards of comparison for the growth and ripening of various agricultural products must of course be left to the agriculturists, and it will be interesting to learn how far a correspondence between the character of the several crops and the accumulated temperature of the year can be established.

The measure of temperature afforded by this system of computation appears to be as well suited to supply a standard of comparison of climates for hygienic purposes as for agriculture, and the diagrams indicate in a forcible manner the characteristic differences of climate, in respect of temperature, of the portions our islands to which they refer.

Mr. William Marriott read a paper on "Some Occasional Winds and their Influence on Health." After referring briefly to the causes of winds, Mr. Marriott spoke of the East wind, the Mistral, the Sirocco, and other well-known occasional winds. Of the East wind, Mr. Marriott said it was the most dreaded in this country. It is usually dry, cold, and very penetrating, and is well described in the old saying—

"When the wind is in the East
'Tis neither good for man nor beast."

Dr. Arthur Mitchell, in a "Note on the Weather of 1867, and on some effects of East winds," says, "Such winds blowing over a moist surface, like that, for instance, of the human body, tend to reduce the temperature of that surface to the temperature of evaporation, which in this case is much below that of the air itself. In licking up the moisture — that is, in causing its evaporation — a large amount of heat is rendered latent. This heat must be taken from something, and, in point of fact, our bodies are, and must be, atmost its entire source. A cold and dry wind, therefore, cools the surface of our bodies, not simply by enveloping them in a cool medium, and warming itself by conduction at their expense. It does this of course; but, being dry as well as cold, it does it with less activity than it would if moist and cold—damp air being a better conductor than dry air. It is chiefly, however, by the other mode that dry cold winds abstract heat from our bodies,—that is, by using their heat in the conversion of moisture into vapour. The heat so used becomes latent, and is for the time being lost. It does not raise the temperature of the air in immediate contact with the body. On the contrary, that air itself, low as its temperature may be, gives up some of its heat to become latent in the vaporised moisture, and probably gives up more than it gains from our bodies by conduction, so that the temperature of the film of air actually in contact with our bodies may be, and probably is, a little lower than the temperature of the bulk. The quantity of heat which our bodies lose in this way is far from insignificant, and the loss cannot be sustained without involving extensive and important physiological actions, and without influencing the state of health. In feeble and delicate constitutions, the resources of nature prove insufficient to meet the demand made on them, and a condition of disease then ensues."—(*Journal* of the Scottish Meteorological Society, vol. ii. p. 80.)

SCIENTIFIC SERIALS

Proceedings of the Linnean Society of New South Wales, vol. viii. part iv. contains:—Occasional notes on plants indigenous in the neighbourhood of Sydney, by E. Haviland.—Temperature of the body of *Echidna hystrix*, by N. de Miklouho-Maclay.—Plagiostomata of the Pacific, part 2, by N. de Miklouho-Maclay and W. Macleay, F.L.S.—Notes on some reptiles of the Herbert River, by W. Macleay, F.L.S.—Notes on some customs of the aborigines of the Albert district, by C. S. Wilkinson, F.G.S., F.L.S.—On the brain of Grey's whale, by W. A. Haswell, M.A., B.Sc.—On a new genus of fish from Port Jackson, by W. Macleay, F.L.S.—Fishes from the South Sea Islands, by Charles De Vis, M.A.—Some results of trawl-fishing outside Port Jackson, by W. Macleay, F.L.S.—The "Barometro Araucano" from the Chiloe Islands, by N. de Miklouho-Maclay.—Far southern localities of New South Wales plants, by Baron Sir F. von Müller, K.C.M.G., F.R.S.—Description of Australian Micro-lepidoptera, part 10, by E. Meyrick, B.A.—Notes on the geology of the southern portion of the Clarence River basin, by Prof. Stephens, M.A.—Dimensions of some gigantic land-tortoises, by J. C. Cox, M.D., F.L.S.

THE *Zeitschrift für wissenschaftliche Zoologie*, vol. xl. part 1, contains:—P. M. Fischer, upon the structure of *Opisthotrema cochleare*, nov. genus et spec.: a contribution to the anatomy of the Trematoda.—F. Blochmann, remarks upon some Flagellates.—A. Korotneff, the budding of Anchinia.—L. Döderlein, studies of Japanese Lithistidæ.—J. Brock, the male of *Sepioloidea lineolata*, d'Orb. (*Sepiola lineolata*, Quoy and Gaim.), with general remarks upon the family of Sepioladæ.—A. Gruber, upon the nucleus and nuclear-fission in the Protozoa.—O. E. Imhof, results of a study of the pelagic fauna of the Swiss fresh-water lakes and tarns.

Part 2 contains:—A. Kölliker, the embryonic germinal layers and tissues (with a postscript).—C. R. Hoffmann, contribution to the history of the development of reptiles.—P. Langerhans, the worm-fauna of Madeira.—F. Ahlborn, (1) upon the origin and exit of the cerebral nerves in Petromyzon; (2) upon the segmentation of the body in Vertebrates; (3) upon the importance of the pineal gland (conarium, epiphysis cerebri).—C. Emery, study of *Luciola italica*, L.

THE *Morphologisches Jahrbuch*, vol. ix. part 3, contains the following:—G. Ruge, contributions to the study of the hæmal system in man.—J. E. V. Boas, a contribution to the morphology of the nails, claws, and hoofs of the Mammalia.—M. Davidoff, on the variations of the plexus lumbosacralis of *Salamandra maculosa*.—O. Bütschli, remarks upon the gastræa theory.—C. Gegenbaur, on the accessory tongue (*Plica fimbriata*) of man and other mammals.

Vol. ix. part 4 contains:—M. Sagemehl, contributions to the comparative anatomy of fishes, ii., some remarks upon the membranes of the brain in bony fishes.—P. Lesshaft, upon the muscles and fasciæ of the female perineum.—H. Klaatsch, contributions to a more exact knowledge of the Campanularia.—G. Baur, the carpus of the Artiodactyles: a morphogenetic study.—G. Gegenbaur, contributions to the anatomy of the mammary organs in Echidna.

SOCIETIES AND ACADEMIES

EDINBURGH

Mathematical Society, July 11.—Dr. R. M. Ferguson in the chair.—Prof. Chrystal contributed three papers on the application of the multiplication of matrices to prove a theorem in spherical geometry, on the discrimination of conics enveloped by rays joining the corresponding points of two projective ranges, and on the partition of numbers; in connection with the second of these he indicated a solution he had received in a note from Signor Cremona of Rome.—Dr. Alexander Macfarlane gave illustrations of a common error in geological calculations; and Mr. A. Y. Fraser explained two solutions (by himself and Mr. R. E. Allardice) of a problem of arrangements entitled La Tour d'Hanoï, which appeared in the *Journal des Débats* for December 27, 1883.

PARIS

Academy of Sciences, July 28.—M. Rolland, President, in the chair.—On the rule of Newton as demonstrated by Sylvester; a sequel to the two previous communications, by M. de Jonquières. Here two cases of indeterminants are dealt with: (1) That in which several consecutive terms are wanting in the equation, the absence of one or more non-consecutive terms giving rise to no uncertainty; (2) that in which one or more of the quadratic functions intervening in the operation are identically nul.—A study of the deviations of the pendulum at Fort Loreto, Puebla, Mexico, two illustrations, by M. Bouquet de la Grye. These observations were conducted by means of a multiplying seismograph set up in connection with the expedition sent out to observe the transit of Venus. Their object was to ascertain how far the oscillations of the ground and the phenomenon of tides may be determined by the vibrations of the pendulum in volcanic and mountainous regions.—Report of the Commissioners, MM. Gosselin, Pasteur, Marey, Bert, and others on various recent communications received in connection with the present outbreak of cholera in the South of France. The Commission has examined altogether 240 communications, mostly from Spain, and either suggesting "infallible nostrums," or such remedies as are already in practice. Others recommend hypodermic injections of the nitrate of pilocarpine, arsenic, copper, phenic acid, salicylic acid, vapour of hyponitric acid, intra-venous injections of pure water, or mixed with chloride of calcium or other salts. All these methods have been tried, mostly with indifferent results, although phenic acid and the intra-venous injections seem to call for further consideration. But, speaking generally, the Commission regrets to have to report that none of the communications contain any really useful suggestions.—On a new application of electricity to the treatment of fibrous tumours of the womb, by M. G. Apontoli.—Researches on wheaten and other flours; distribution of the acid and saccharine elements in the various products of the corn-mill, by M. Balland.—Note on the analytical calculating machine invented by Charles Babbage, by General F. L. Menabrea. The author gives a full description of the machine left incompleted by the inventor. He also gives an unpublished letter of Mr. Babbage, dated August 28, 1843, and certifying that the anonymous English translation of Signor Menabrea's original account of the machine, which appeared with some brilliant accompanying explanations in the third volume of the *Scientific Memoirs*, was by Lady Ada Lovelace, only daughter of Lord Byron.—Note on the exact number of the variations gained or lost in the multiplication of the polynome $f(x)$ by the binome $x^h \pm a$, by M. D. André.—Note on the temperature and critical pressure of the atmosphere. Relation between atmospheric temperature and the pressure of evaporation, by M. K. Olzewski.—Description of a new method of directly measuring absolute magnetic intensities, by M. A. Leduc. This method, which is an application of M. Lippmann's discovery, is extremely simple and expeditious. It enables magnetic intensities to be measured in absolute unities, and is now being applied by the author to the study of a magnetic field.—Note on the combustion of explosive gases in various states of dilution, by M. A. Witz.—Note on the quantitative analysis of nitric acid by precipitation in the state of nitrate of cinchonamine. Application of this process to the quantitative analysis of the nitrates contained in natural waters and in plants, by M. Arnaud.—Note on the triacetic ether of a butylic glycerine, by M. L. Prunier.—Note on a new method of making a quantitative analysis of the dry extract of wines, by M. E. H. Amagat.—Anatomical and physiological description of *Convoluta Schultzii*, a curious animal of relatively high organisation, but in which the association with chlorophyll elements has produced some interesting physiological phenomena, by M. A. Barthélemy. Although deprived of eyes even in the rudimentary state, these worms appear to possess a sort of visual sensation. The act of breathing by absorption of carbonic acid through the cuticle also presents a striking analogy to that of submerged aquatic plants.—Fourth contribution to the history of the formation of coal, isolated carboniferous blocks, from Commentry, by M. B. Renault.—Note on the microscopic organism associated with the zooglæic tuberculosis, by MM. L. Malassez and W. Vignal.—Note on a hitherto unobserved portion of the sting of melliferous insects, and on the mechanism employed by them in expelling the venom, by M. G. Carlet.—Memoir on the geology of the Kepp district, Tunisia, one illustration, by M. P. Marès. The author determines in this district a regular superposition of the Upper Cretaceous, Eocene, and Miocene formations, a detailed study of which promises to be of great interest.—Note on the relations existing between the crystalline systems of various substances, by M. E. Mallard.

BERLIN

Physical Society, June 27.—Dr. König described a subjective optical perception of which he had repeatedly become conscious in the morning on waking from sleep and while his eyes were yet shut. On a blue-gray background he saw regular closely adjoining hexagons, like the cells of a beehive, the contours of which appeared black, while the upper sides and the outwardly adjoining sides of the hexagons had a yellow appearance interiorly, an effect produced perhaps by way of contrast to the bluish background. In the interior of each hexagon, but not exactly in the centre, and just as little uniformly in the different fields, a black point was visible. The radius of each figure was about the length of the diameter of the moon's image. In endeavouring to explain this phenomenon Dr. König thought first of the epithelial cells of the eye, which formed a similar mosaic behind the retina, and calculated the visual angle under which such a phenomenon was produced. From this calculation it appeared that these hexagons were considerably less than the subjective ones, as many as twelve epithelial cells being needed to tally with the field of the subjective figure. No other explanation of the phenomenon had yet been come upon by Dr. König.—Prof. Neesen gave a short survey of the methods that had hitherto been proposed with a view to regulating the electric current in its technical application. No method, it appeared, had yet been introduced into practice, and for the present the question turned only about proposals on points of principle. These were divisible into such as sought to regulate the energy by changing the resistance, and into such, on the other hand, as attempted this object by changing the electromotive force. The change in resistance was effected at first by means of the hand, and later in different ways automatically. The change of electromotive force in the case of dynamic machines was sought in part by regulation of the propelling steam-engine, in part by change of the magnet, in part by means of a second counteracting engine, in part by changing longitudinally the wire pulleys, and in part by opposed windings of the rolling wires. Thirdly, and lastly, it was proposed as a means towards regulating the electric current, that when the dynamic machine delivered more electricity than was used, the surplus should be diverted to the supply of an accumulator where, when the machine yielded too feeble a current, the supplementary energy required could be drawn. Prof. Neesen gave a more detailed account of some of these proposals, and concluded in favour of the last or third method, that, namely, of the transference and storage of surplus energy in an accumulator, as the most advisable of all the plans proposed from a practical point of view.

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