THURSDAY, JULY 21, 1887.

THE MINING INDUSTRY OF NEW ZEALAND.

Report on the Mining Industry of New Zealand. (Papers laid before Parliament, Session 1886.) 8vo, pp. 334. (Wellington, New Zealand, 1887.)

The Hand-book of New Zealand Mines. With Maps and Illustrations. 8vo, pp. 519. (Wellington, New Zealand, 1887.)

THESE volumes, which cover the same ground, and to some extent reproduce the same information, are in great part the result of a personal investigation of the mining districts of our great antipodean colony, made by the Hon. Mr. W. J. M. Larnach, C.M.G., the Minister of Mines. From the Report, which is about six months older than the Hand-book, we learn that the latter has been compiled by the officers of the Mining Department, under the direction of the Minister, in order to furnish systematic information as to the area of mining claims, and as to other particulars concerning the working of mines, which has not hitherto been available. This result has been fairly well attained in the volume before us, which is a valuable summary, arranged topographically, of the condition of the mines actually at work, the description of each district being preceded by an historical sketch of the early explorations. Among these, that describing the progress of discovery on the west coast of the Middle Island is especially interesting, as it goes back as far as 1836, when an early settler, named Toms, "on one occasion was caught and thrown down by a large seal, receiving a severe bite on the thigh, but he escaped death by dealing it some hard blows with his fist on the nose." Other and more serious difficulties were encountered from the opposition of the native inhabitants, whose interests were finally purchased by Sir George Grey and the successive Governors, subject to certain reserves, which at the present time produce an income of about £4000 per annum, and as there are only about a hundred natives on the west coast, they are comfortably fed, housed, and clad, peaceable and sober, and generally respected by their European neighbours. From this part of the colony gold was exported of the value of nearly £12,000,000 sterling between 1864 and 1873, and the yield, though diminished, still continues, with the prospect that the product of alluvial rocks will be more than eclipsed by that of the quartz reefs, some of which have been proved to be extraordinarily rich. The total produce of gold in New Zealand between 1853 and the end of 1885, according to the Report, is 10,789,560 ounces, valued at £42,327,907 sterling, and the Hand-book gives the area of country proved to be auriferous in the three islands as about 21,000 square miles.

The product next in importance to gold, although perhaps it is scarcely to be classed as a mineral, is kauri gum, which is produced at the rate of about 6000 tons annually from deposits in the North Island, which have already yielded upwards of £3,500,000 sterling to the wealth of the colony. The prosperity of Auckland has been largely aided by its kauri gum fields, and the valuable kauri tree, which is only found in the northern forests of the North Island.

The coal of New Zealand seems to be largely of the character of lignite, though some portion is of a more highly carbonaceous character. The output at present is little in excess of 500,000 tons, which suffices for about three-quarters of the consumption of the colony. Several other minerals have been produced in small quantities, but their aggregate value is insignificant when compared with that of the three staples noticed above.

In going over the detailed accounts of the different gold-mines, given in both volumes, we cannot but be struck by the great diversity of the character of the deposits, and this, as might be expected, has led to several interesting modifications in the method of working. Among the more remarkable of these are, the use of a steam dredger for working auriferous alluvial gravels in the channel of the Molyneux River, and a method of lifting similar materials by a water-jet aspirator applied at Gabriel's gully in the Tuapeka district. These are described at some length, but the descriptions and illustrations are not as full and precise as they might be, considering the interest of the subjects. Another novelty is the use of electricity on the large scale for driving a stamping mill at the Phenix Mine, in Otago. The current produced by a pair of turbines of about 100 horse-power and two Brush dynamos is transmitted to a distance of about two miles to the crushing battery, which contains thirty heads of stamps and is driven by a Victoria electromotor and a Leffel turbine conjointly. This is probably the largest application of electric power to mining purposes that has yet been made.

Mining in New Zealand appears to receive greater support from the State than is customary in most other countries, as not only are large sums devoted to the opening up of roads and pack trails through the country, but contributions are made towards the construction of water races and channels for tailings, and subsidies are paid towards prospecting in different localities. These grants are made contingently upon much larger sums being furnished by local or individual effort, and, according to the testimony of the Reports, have been of great value in encouraging discoverers.

A point of interest in connexion with the economics of New Zealand mining is the general establishment of local schools of mines, or, as they are called in some localities, chemistry clubs, in the different mining centres. These are organized apparently on a system somewhat similar to that of the science classes of the Science and Art Department, the instruction being given to the members by means of a staff of seven teachers under the charge of Prof. J. G. Black, of the University of Otago, who travels through the different districts giving lectures and laboratory demonstrations, for periods varying from two to five months at each, according to its size and importance. The course of instruction includes mineral chemistry and assaying, mineralogy and metallurgy, and provision is being made for the addition of the subjects of mining engineering and surveying. The results expected from the scheme are set forth in full, from which it appears that miners will be able to assay ores and metals of every kind, be able to assay their own bullion, and become generally familiar with the metal-

lurgy of the precious metals. Such results will probably not be realized in their entirety, neither is it desirable that they should be, as the presence of a well-educated specialist, an assayer or smelter, for example, may often be of more permanent value to a district than the necessarily superficial knowledge of subjects not immediately connected with their own occupation that the local miners are likely to acquire under the scheme; but there can be no doubt that great good will result from giving them an intelligent interest in mineralogy, and the observation of the phenomena brought under their notice when at their own particular work.

The Hand-book concludes with a description of the principal forest trees of New Zealand, taken from Dr. Hector's "Hand-book of New Zealand." It has also several maps, supplied by Dr. Hector and Mr. Gordon, of the Mines Department. The greater part of the material has been collected by Mr. Patrick Galvin, of Wellington.

We are sorry to see that in the final paragraphs of the preface, Mr. Larnach appeals to the honourable gentleman who may succeed him to improve the work in a second edition; from which we infer that the author has fallen a victim to a Ministerial crisis. If it be so, we have to thank him for what he has done, but if not, we hope that he may have the opportunity of extending and improving the work which he has so worthily begun, instead of leaving it to his successor. H. B.

A CENTURY OF ELECTRICITY.

A Century of Electricity. By T. C. Mendenhall. (London: Macmillan and Co., 1887.)

IN this readable little work, Prof. Mendenhall has striven to depict the origin and growth of many of the modern electric appliances—the telegraph, the dynamo, the telephone, and the electric lamp. He opens with a felicitous quotation from Benjamin Franklin describing with characteristic humour a proposal to hold an electrical party of pleasure on the banks of the Skuylkil, when the healths of all the famous electricians in England, Holland, France, and Germany are to be "drank" in electrified bumpers, under the discharge of guns from the electrical battery. This is followed by a very interesting account of the early development of the experimental science, and in particular of the work of Gilbert and of Franklin. It is satisfactory to note that for once Gilbert's just fame as the creator of the double science of electricity and magnetism is recognized, and his pre-Baconian use and development of the experimental and deductive methods of philosophizing acknowledged. The discoveries of Galvani, Volta, Oersted, and Ampère are set forth in a style which, while losing nothing in accuracy of description, is enlivened by pleasant biographical touches. Speaking of the week during which Ampère wrought out to such brilliant conclusions the train of ideas suggested by Oersted's discovery of the electric deflexion of the magnet, Prof. Mendenhall observes: "It is safe to say that the science has at no other time advanced with such tremendous strides as during that memorable week." The work of Sturgeon in inventing, and of Henry in perfecting, the electro-magnet is duly noted; but we miss, in connexion with electro-magnetic subjects, the name of Prof. Cumming, who did so much to expand and define the growing science.

The vexed question, Who invented the electric telegraph? is here reached, and is very carefully handled. Prof. Mendenhall's frank impartiality in touching on this and sundry other delicate topics of contested priority is worthy of praise. *A propos* of the part taken by Henry in the invention of the electric telegraph, the author gives a sketch of Henry's arrangement of a bell for receiving electric signals, with a polarized lever to strike the bell, as it was exhibited in Albany in 1832. The most technical part of the work is that dealing with duplex and multiplex telegraphy, which is very fully treated, though here we miss the name of La Cour, who preceded Delany in the synchronous distribution of currents. Sir William Thomson's labours in submarine telegraphy, and those of Gaston Planté on accumulators, are emphasized, but not unduly. Respecting the telephone, after noting the early work of Page and the similarity between Reis's telephone transmitter and those used to-day, the author turns to the work of Elisha Gray and Graham Bell in the following terms:—"By a curious coincidence Mr. Gray deposited his specifications and drawings for a speaking-telephone in the United States Patent Office, in the form of a caveat, on February 14, 1876; and on the same day Mr. Bell filed his application for a patent, the latter being received a few hours earlier than the former. The coincidence becomes more interesting when it is remembered that it was also on February 14, 1867, that Wheatstone and Siemens simultaneously presented to the Royal Society their independent discovery of the important fact that dynamo-electric machines could be constructed and operated without the use of permanent magnets." The double coincidence of dates is certainly curious; but the significance of it is marred when we remember, first, that both Wheatstone and Siemens must yield priority of date to Varley, who patented the same discovery on December 24, 1866; and, secondly, that the apparatus described by Bell in the patent application of February 14, 1876, was one in which a separate instrument was employed for every pitch, "each instrument being capable of transmitting or receiving but a single note," and therefore did not describe a speaking-telephone at all. Bell's patent for "the transmission by the same means of articulate speech" was only applied for some ten months later. Due credit is given to Hughes for his well-known research on the microphone, to Edison for his button of lamp-black, and to Dolbear for the invention of the electrostatic receiver. The chapter on the electric light is all too short, and might with advantage be expanded. Faraday's splendid discovery of magneto-electric induction, leading to the invention of the dynamo, is admirably recounted, and the important part played by modern American constructors of powerful machines is modestly narrated. A similar remark will apply to the paragraphs upon electric motors, a department of electro-technics which America is likely to make peculiarly her own.

When we reflect that the rapid introduction into British industries of the gas-engine is slow compared with the tremendous rate at which electric motors are being everywhere brought into use in the States, we think that Prof. Mendenhall has under-rated rather than over-rated the importance of this item in his account of the

developments of the century. Strangely enough, there is in the whole work no mention of that most widely-spread of all electric inventions, the domestic electric bell, nor of its almost forgotten inventor, John Mirand. Prof. Mendenhall has added to the interest of his sketch by supplying a number of illustrative cuts of objects of historic interest, such as Faraday's first magneto-electric machine, and his first transformer or induction-coil. We should have welcomed some account of the great theorists, Coulomb, Laplace, and Weber, who, with Sir William Thomson and Clerk Maxwell, have, by their calculations and mathematical developments, played so leading a part in the progress of the century; but the author would probably have found it impracticable with the plan of his sketch to deal with the labours of these intellectual giants. In his less ambitious aim of popularizing the experimental development of the subject he has succeeded admirably.

OUR BOOK SHELF.

The Fungus Hunter's Guide and Field Memorandum Book, with Analytical Keys to the Orders and Genera, illustrated, and Notes of Important Species. By W. Delisle Hay, F.R.G.S. (London: Swan Sonnenschein, Lowrey, and Co., 1887.)

A FIELD guide and mentor is a welcome companion for the practical botanist, provided it is so compiled as to meet all the requirements of field work, otherwise it is merely "a delusion and a snare." This little volume, unfortunately, belongs to the "otherwise," for it is insufficient, antiquated, and misguiding: insufficient, because it includes only a few species under each genus or sub-genus, and these have been selected without manifest reason; antiquated, because, although dated 1887, it is based upon the state of this branch of science in 1871, and might have been published at that date, for all internal evidence to the contrary; and misguiding, because the errors of 1871 are not corrected, the illustrative figures are entirely without names of the species intended to be represented, and more important or essential species are excluded than many of those included in the lists.

Under each genus or sub-genus in the volume a list is given of "common or notable species,"—each with its scientific name (but without the authority for the specific name, which any botanist would regard as essential); an imaginary popular name, which is useless because imaginary and not real; a short description, rarely sufficient; and letters indicating esculent or poisonous qualities. As only one or two species are given under a genus or sub-genus which has a dozen or more other British representatives, it should have been stated distinctly that there are so many more species which are not named, any of which the collector might meet with in his rambles. Unfortunately the selection of the species favoured with a place has been made with very little judgment. Some are included which are so rare that they have only been found once or twice in this country, whilst others are excluded which are almost sure to be met with in any moderately successful ramble. The fact is patent that the "Hand-book" issued sixteen years ago is accepted as the authorized record for to-day, whereas it is absolutely out of date, and all the great advances made during the intervening period are studiously ignored. The volume is interleaved with ruled paper for notes and memoranda, and we venture to affirm that this is the only useful and unexceptionable portion of the work. The purchaser must judge whether it would not have been more economical to secure a blank memorandum book, since the numerous figures are valueless without names, and the analytical keys ought to have been more accurate and better constructed. M. C. C.

My Hundred Swiss Flowers: with a Short Account of Swiss Ferns. By Mary A. Pratten. (London: W. H Allen and Co., 1887.)

THIS is a very unpretending book, and should be of considerable service to beginners in botany who may wish to carry on botanical studies among the Alps during the month of July or early in August. The writer has selected those Swiss flowers which seem to her "most remarkable, most characteristic of the country, or most commonly seen," and she is, of course, right in thinking that a great many of them will be new to such as make a first visit to the Alps. Her descriptions are clear and sufficiently full, and the illustrations are very good.

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.*]

The Carnatic Rainfall.

MR. H. BLANFORD'S authority is so deservedly high, that I have had some hesitation in writing to controvert the conclusions he has adopted in the paper published in NATURE of July 7 (p. 227), entitled "The Eleven-Year Periodical Fluctuation of the Carnatic Rainfall"; and to state my reasons for thinking that there is no real validity in the arguments he uses in favour of "the very high probability that the apparent undecennial fluctuation is no chance phenomenon."

Mr. Blanford brings forward a series of figures which show the mean annual variation of the rainfall during twenty-two years, at a number of stations in that part of Southern India locally known as the Carnatic, from the mean annual rainfall for the Carnatic generally. From these figures he has inferred the appearance of two complete cycles of eleven years, with a dominant periodical fluctuation.

To test the character of this apparent periodicity he obtains from these figures the two first terms of an harmonic expression that shall represent the observed facts for an assumed eleven-year period; and he finds the mean difference between the observed values and those calculated from the adopted harmonic expression to be $\pm 3{\cdot}5$ inches, from which the mean probable error of any of the calculated periodical values is found to be $\pm 0{\cdot}70$ inch.

Now it is apparent that such a series of calculated values has no physical signification whatever. The greater or less degree of difference between the observed and calculated quantities only indicates how far the sums of the terms of the harmonic series employed coincide with the series of observed quantities which the calculated series was designed to represent. It is also obvious that by a sufficiently extended series of terms the calculated quantities might be brought to agree, within any desired degree of approximation, with those observed. No conclusion whatever, therefore, can be based on the amount of the differences above alluded to, so far as any question of periodicity is concerned, and the so-called "probable error" is merely an arithmetical result of the particular form of calculation adopted.

Mr. Blanford goes on to remark that the mean difference between the observed series of values of the annual variation of rainfall and the mean of the whole of them, is $\pm 5{\cdot}2$ inches, with a probable error of the general average of $\pm 0{\cdot}94$ inch.

And here again I am unable to see that any weight can be attached to these figures in connexion with the main point at issue. The mean variation of the series of observed values, from the mean of all of them, will of course be greater than the mean variation of those observed values from a series deliberately calculated so as to correspond with them, such as that obtained by aid of the harmonic series. The introduction of the expression "probable error" of the general average is also

likely to be misleading. This too only represents an arithmetical result, and signifies that as in the series of twenty-two observations there is an average departure of ±5·2 inches from the mean of all the measurements, the probability is that this mean will be within ± 0·94 inch of the truth, so far as those measurements are to be trusted.

For these reasons I am quite unable to follow the arguments by which it is sought to connect the amounts of these two "probable errors," or to see how they can in any way indicate "the relative probability of this particular variation being the result of a periodic law, and of its being a mere fortuitous series of variations from a constant average."

Neither does there appear to be any justification for assuming that the relative probability of the truth of two hypotheses is represented by the inverse ratios of the probable errors of results derived from them. Still less is there any ground for saying that because the particular series of quantities under discussion relates to a period of twenty-two years, the relative probability just alluded to is thereby increased to the twenty-second power of that ratio, or from about $1\frac{1}{3}$ to 1, to 655 to 1. It is no doubt true that if the probability of an event occurring once be represented by the fraction $\frac{1}{x}$, the probability of its recurring n times in succession will be represented by $\left(\frac{1}{x}\right)^n$; but I fail to see how this affects the question at issue.

RICHARD STRACHEY.

July 11, 1887.

Is Cold the Cause of Anticyclones?

IN a review of Loomis's papers in this volume of NATURE, p. 2, occur the following sentences:—"While all, or nearly all, of the high pressure of anticyclones may be accounted for by the very low temperatures which overspread the same region at the same time along with the resulting upper currents concentrating upon them from adjoining cyclonic regions, it is quite different with the low pressures of cyclones. In the case of cyclones the problem is complicated by the strong winds, the copious precipitation, and the ascending currents, which affect the results in ways which no physicist has yet been able to explain."

This induction of Loomis's, that anticyclones are largely the result of cold, which the reviewer here repeats, is in entire opposition to the deductive views of Ferrel, and I think the discrepancy is to be found in the method used by Loomis in drawing his inductions. In order to investigate the cause of anticyclones, Loomis selected only decided areas of high pressure, and as a consequence his data were almost entirely confined to the winter months, when the temperature accompanying anticyclones is always low. If, however, he had selected more moderate anticyclones, he would have found that in summer anticyclones in the United States are sometimes accompanied by intense heat (90° F. or more). This is especially so in periods of drought. Under these conditions the approach of a cyclone with rain brings a most refreshing cooling. Furthermore, Hahn, attacking the problem by a different method, has obtained results apparently directly opposed to this induction of Loomis. Hahn made a careful study and comparison of the observations obtained last autumn and winter on the Sonnblick and at adjacent mountain and valley stations (see *Meteorologische Zeitschrift*, February and April 1887). One of the most marked results found was that at heights exceeding 1000 metres above sea-level there was an increase of temperature during anticyclones, while a decreased temperature was only found in valleys and near the general level of the earth's surface. Hahn's average results show that the temperature on the Sonnblick, height 3090 metres, rose from an average of − 16°·4 C. at the average barometric pressure of 509·1 mm. to − 7°·7 C. at the barometric pressure of 529·3 mm.; while at the same time the average temperature at Schafberg, height 1776 metres, rose from − 9°·0 C. to + 1°·4 C.; but on the contrary at Zell-a-See, height 754 metres, the average temperature fell from − 5°·9 C. to − 8°·9 C. These results, which show that the larger portion of the atmosphere is warmed instead of cooled within the area of an anticyclone, seems entirely destructive of Loomis's hypothesis that the cooling of the air near the earth's surface is the chief cause of the anticyclone. Hahn's results, however, indicate that the cooling of the air near the earth's surface does increase the pressure somewhat. Thus in October 1886 the barometric minimum occurred at all the stations, both mountain and valley, on the 17th; while the barometric maximum occurred at all of the stations on the 30th. When the difference in pressure between the mountain stations at the time of barometric minimum was compared with the difference in pressure between the same stations at the time of barometric maximum, it was found almost exactly the same; but the difference in pressure between the valley stations and the mountain stations was about 5 mm. greater at the time of maximum pressure than at the time of minimum pressure. Hahn refers this greater range of pressure at the valley stations to the decreased temperature at valley stations during anticyclones, but this still leaves a range of pressure of nearly 20 mm., which the decreased temperature entirely fails to explain. These results of Hahn are in entire accord with the results obtained at Blue Hill Observatory (640 feet above sea), as compared with Mount Washington and with stations near sea-level, which indicate that the cooling in anticyclones is almost entirely confined to within a few hundred feet of the earth's surface (see *Science*, vol. viii. pp. 233 and 281).

In the light of these facts, it seems more reasonable to assume that the warmth found on mountains and the cold in valleys, accompanying anticyclones, are the result, rather than the cause, of anticyclones. Such researches as those of Langley on the solar heat, and of Hahn on the distribution of temperature pressure, &c., in different planes of the atmosphere, indicate that the effect of the sun's heat on the atmosphere is far more complex than some of our text-books on meteorology would have us believe; and instead of the cause of anticyclones being as simple as the reviewer of Loomis's article states, it seems probable that we shall understand the phenomenon of the anticyclone only when we master the problem of the cyclone.

H. HELM CLAYTON.

Blue Hill Observatory, Boston, Mass., U.S., June 28.

Physiological Selection.

I AM perhaps in a position to contribute something practical to the discussion upon Mr. G. J. Romanes's proposal of physiological selection as an improvement upon Darwin's natural selection.

I failed to meet with Mr. Romanes's paper in the Journal of the Linnean Society, and I confess that I did not gain a very clear idea of what he meant by physiological selection, until I read his article in the *Nineteenth Century* for January. His main difficulty appears to be the intercrossing with parent stock, which he thinks would prevent the survival of any varieties naturally selected to become species. Now, my Australian bush experience of the habits of animals and birds satisfies me that this difficulty is mainly, if not entirely, imaginary, and that Nature amply provides against the supposed intercrossing. Any person who has observed the habits of semi-domesticated stock, such as horses and cattle, can scarcely fail to know that migration is a general practice of one sex, and a frequent one of the other. The old always hunt the young males and strangers entirely away to form herds and families of their own, and thus the supposed intercrossing is by one sex at least effectually obviated. But it is also frequently the case that young fillies and heifers, at the same season, take to wandering, for less evident reasons, far from their accustomed haunts, scores of miles, after which they will stop, and attach themselves to another herd and locality as tenaciously as their parents remain in theirs. This of course further tends to prevent intercrossing with parent stocks.

I cannot but think that Mr. Romanes's anxiety to find a solution of his difficulty has led him into serious mistakes, which vitiate his treatment of the subject. For instance, he says (page 59, *Nineteenth Century* for January), "The hypothesis of physiological selection sets out with an attempted proof of the inadequacy of natural selection, *considered as a theory of the origin of species*." I was out walking yesterday when I read this, and I wrote in the margin, "The theory of natural selection is one, not of the origin of species at all, but of the *preservation* of *particular varieties*." On reaching home, I referred to the "Origin of Species" (4th edition, 1866), and was certainly pleased to find that I had adopted Darwin's precise words repeated in several places (see pages 71, 91, 123, &c.). At page 91 he says:—"Some writers have misapprehended or objected to the term natural selection. Some have imagined that natural selection induces variability; whereas it implies only the *preservation* of *such varieties as occur*, and are beneficial under

the conditions of life." Was not this a prophet? Yea, I say unto you and more than a prophet! Of course if the conditions of life are unfavourable, the incipient variations cannot become species. But surely it is obvious that in *variation* is the real *origin* of species. Variations must occur before the selection of some of them in preference to others. To consider the theory of natural selection as a theory of the origin of species, is therefore clearly an error. In his "Origin of Species" Darwin certainly expounded variation, and I might have ventured to think that as the book deals more largely with the subsequent selection of a few varieties to survive as species at the expense of many extinguished, a more exact title for it would have been "The Evolution of Species." But what says the great master? See page 71:—"Owing to this struggle for life, any *variation*, however slight . . . will tend to the *preservation* of *that individual*, and will generally be inherited by its offspring. . . . I have called this principle by which each slight *variation*, if useful, is *preserved*, by the term natural selection, in order to mark its relation to man's power of selection." And who will not recognize the wisdom of his selection of the term? It has been before observed that the "*Ascent* of Man" would seem a more accurate title than the "*Descent* of Man." But I have no doubt that his reasons for preferring the latter were equally cogent.

But Mr. Romanes proceeds:—"This proof is drawn from three distinct heads of evidence. (1) The inutility to species of a large proportional number of their specific characters. (2) The general fact of sterility between allied species, which admittedly cannot be explained by natural selection, and therefore has hitherto never been explained. (3) The swamping influence of even useful variations of free intercrossing with the parent form." I have advanced, I think, ample reasons why No. 3 may be regarded as imaginary, and which therefore reduce the value of No. 2 to a minimum. No. 1 depends entirely upon the definition of "*utility*." Has this word any real significance outside human interests and considerations? The idea of utility, if extended to Nature's operations, may, it seems to me, apply to the interests of any other variation than the one whose specific characters are in question, which may therefore be, without compunction or regret, sacrificed to the most fit, as we know that innumerable species have been extinguished in the interest of those that supplanted them. But utility to Nature may be the extinction of one variation and the preservation of another. As Mr. Romanes's whole paper is built upon what I have already quoted from it, I need scarcely follow it any further. With your permission, however, I have another remark to make.

Mr. Romanes seems to me to have been much exercised by the consideration of the intercrossing with parent forms, and, not knowing of the simple solution given above, to have cleverly invented his physiological selection to escape from the dilemma. Of course Nature is not clever, but simple in its operations. I was always much impressed with what appeared to me a greater difficulty, which might be thought to have a clearer title to be called "physiological selection." I allude to a general tendency in the (human at least) sexes to prefer a mate with opposite characteristics, with the apparent result of insuring mediocrity in the progeny. Thus, as a general rule, the tall prefer the short; the dark, the fair; the wise, the silly; &c., and *vice versâ*. Variation is, on the other hand, apparently insured to a large extent by the differences between parents, but still it would seem that the tendency should, *cæteris paribus*, be inevitably towards a mean in the progeny. The general migration, however, as above indicated, of young males and females, gives plainly ample opportunity for the preservation of viable variations, besides others which experience and care will doubtless discover.

Melbourne, April 11. H. K. RUSDEN.

Weight, Mass, and Force.

APPLICATIONS of the data previously given, in the extract from the American journal, to the dynamical principles of varied motion are easily provided for Mr. Hayward. Take the following: "Determine the weight of the greatest train the Strong locomotive can take up a 96-feet grade from rest at one station to stop at the next station a mile off in four minutes, taking the brake power as a resistance of 400 lbs. to a ton."

The main points at issue, however, are whether the language of the engineer, and in fact the usage of our own and other languages, is scientifically correct or incorrect in its use of the words *weight* and *weighing;* and whether the mathematician is to be allowed to restrict the word weight to the subsidiary sense of force of attraction by the earth.

It is of great importance that this question of dynamical terminology should be thoroughly thrashed out now, before Mr. Hayward's Committee on Dynamics, of the Association for the Improvement of Geometrical Teaching, prepare their final report on the subject. A. G. GREENHILL.

Woolwich, July 11.

The Sky-coloured Clouds.

ON the evenings of June 14, 18, and 19 there was a feeble reappearance in Sark of the sky-coloured clouds, as I may call them in default of a better name, which were so brilliant in the twilights of the last two summers. Though the display this month has been comparatively faint, it has been unmistakably of the same character. I have seen nothing of these clouds since the 19th in travelling in the Channel Islands and through France.

Geneva, June 29. T. W. BACKHOUSE.

P.S.—*Chamounix, July* 13.—I have seen one more display—a brilliant one seen from this neighbourhood on the 6th inst.—T. W. B.

The Migrations of Pre-Glacial Man.

THE question raised by "Glaciator" has been treated by me in a paper entitled "The Faunas of the Ffynnon Beuno Caves and of the Norfolk Forest Bed" in the *Geological Magazine* for March 1887. I there stated that, "Although man probably reached this country from the east, it seems to me equally clear that he must also have arrived here with the reindeer from some northern source during the advance of glacial conditions." Though the Norfolk Forest Bed fauna contains abundant remains of deer and of other animals suitable as food for man, it is curious that so far no implements or other traces of man have been found there. The Forest Bed contains in the main the fauna of an eastern area, as the river on the banks of which the animals roamed flowed from the south-east. If pre-glacial man arrived in this country from the east or south, we should therefore expect to find evidences of this in the Forest Bed. On the other hand, wherever the remains of northern animals, such as the reindeer, mammoth, and rhinoceros, occur in any abundance, there we almost invariably find traces of man. Now that we know that man arrived in this country before the climax of the Ice age, as proved by the explorations carried on for several years at the Ffynnon Beuno Caves (amply confirmed also by this year's researches), it seems but natural to infer that man arrived in this country with the northern animals as they were compelled to migrate southwards by the gradually advancing glacial conditions, and that he kept mainly with the reindeer near the edge of the advancing ice. HENRY HICKS.

ABSTRACT OF THE RESULTS OF THE INVESTIGATION OF THE CHARLESTON EARTHQUAKE.[1]

I.

THE amount of information now in possession of the United States Geological Survey, relating to the Charleston earthquake, is probably larger than any of similar nature ever before collected relating to any one earthquake. The number of localities reported exceeds 1600. The sources of information are as follow: (1) we are deeply indebted to the U.S. Signal Service for furnishing us the reports of their observers; and (2) equally so to the Lighthouse Board, which has obtained and forwarded to us the reports of keepers of all lighthouses from Massachusetts to Louisiana, and upon the great lakes; (3) to the Western Union Telegraph Company, which instructed its Division superintendents to collate and transmit many valuable reports; (4) to the associated Press, which has given us access to the full despatches (with transcripts thereof) which were sent over the wires

[1] Paper read before the National Academy of Sciences at Washington, on April 19, 1887, by C. E. Dutton, U.S.A., and Everett Hayden, U.S.N., U.S. Geological Survey.

centering at Washington during the week following the earthquake; (5) to geologists and weather bureaus of several States, who have kindly exerted themselves in this matter and collected much important information; (6) to a considerable number of scientific gentlemen who have distributed for us our circular letters of inquiry in special districts,—notably, Profs. W. M. Davis, C. G. Rockwood, J.P. Lesley, T. C. Mendenhall, and Messrs. W. R. Barnes, of Kentucky, and Earle Sloan, of South Carolina; (7) to a large number of postmasters in the Eastern, Central, and Southern States; and, finally, to hundreds of miscellaneous correspondents throughout the country.

In collecting this information, a printed list of questions was prepared. This practice has been resorted to in Europe and in Japan with considerable success, and the questions which have been devised for distribution in those countries have been prepared with great skill by some of the ablest investigators of earthquakes. Prof. C. G. Rockwood, of Princeton, has also been in the habit of distributing formal questions of this character in this country whenever apprised by the newspapers of a notable shock. Availing ourselves of his advice and assistance, questions prepared by him were printed and widely distributed. They were much fewer and more simple than those employed in Europe, because European investigators depend almost wholly upon the educated classes to answer them, while in this country the uneducated but intelligent and practical classes of the people must be the main reliance. These questions were designed to elicit information: (1) as to whether the earthquake was felt, (2) the time of its occurrence, (3) how long it continued, (4) whether accompanied by sounds, (5) the number of shocks, (6) general characteristics which would serve as a measure of its intensity and indicate the kind and direction of motion.

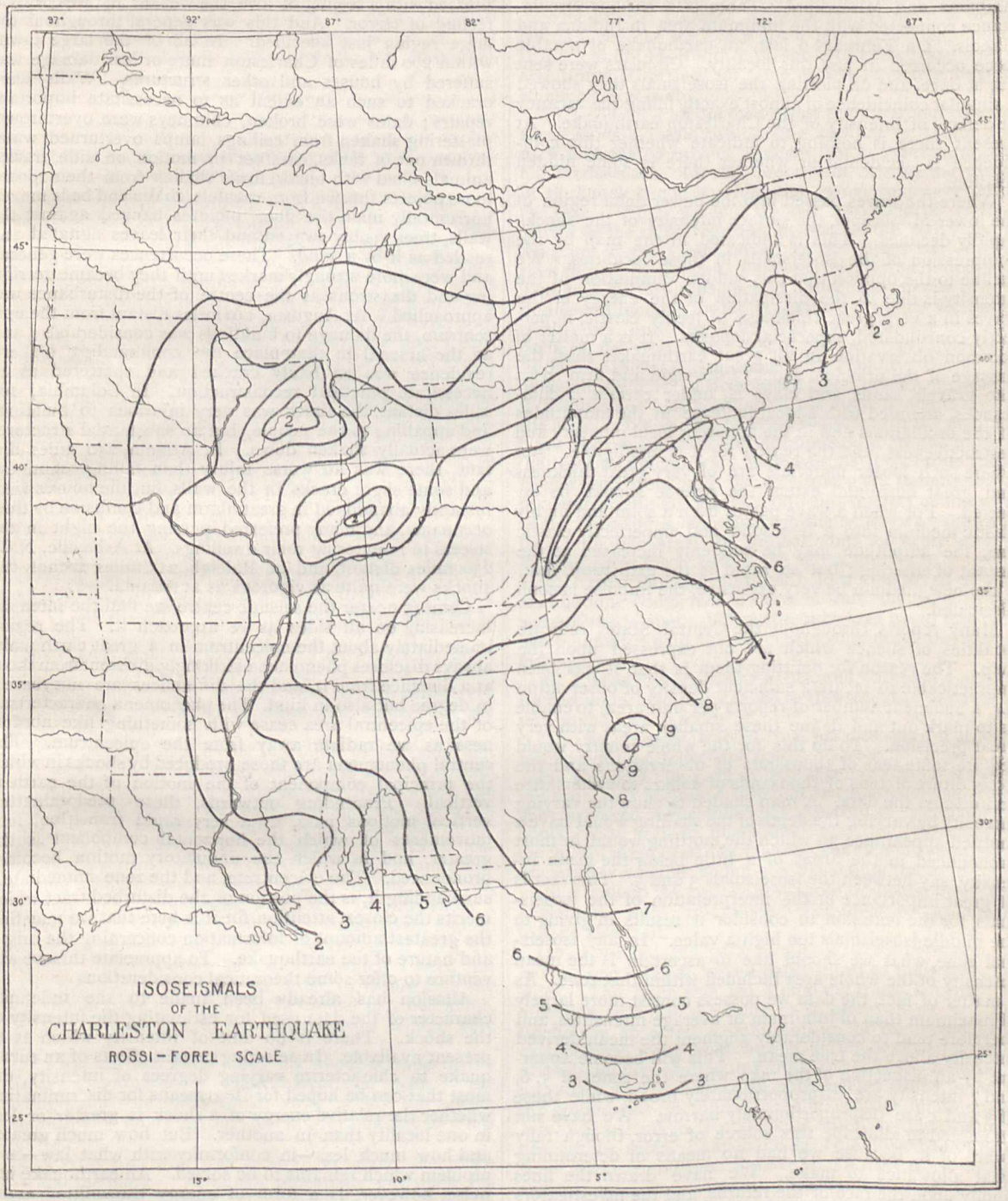
It is to be observed that the only information to be hoped for which can have even a roughly approximate accuracy is the time of transit of the shock. The degree of approximation in the time data actually obtained will be adverted to later. Special effort was made to obtain information as to the relative intensity of the shocks in all parts of the country. At the very outset a serious difficulty presents itself. In the estimates of intensities there is no absolute measure. What is really desired is some reliable indication which shall serve as a measure of the amount of energy in any given portion of the wave of disturbance as it passes each locality. The means of reaching even a provisional judgment are very indirect, and qualified by a considerable amount of uncertainty. To estimate the force of a shock, we have no better means than by examining its effects upon buildings, upon the soil, upon all kinds of loose objects, and upon the fears, actions, and sensations of people who feel it. In view of the precise methods which modern science brings to bear upon other lines of physical research, all this seems crude and barbarous to the last degree. But we have no other resource. Even if it were possible to obtain strictly comparative results from such facts, and decide with confidence the relative measure of intensity which should be assigned to each locality, we should have gained measures only of a series of local surface intensities and not of the real energy of the deeply-seated wave which is the proximate cause of the surface phenomena. Notwithstanding the indirect bearing of the facts upon the real quantities we seek to ascertain, and their apparently confused and distantly related character, they give better results than might have been supposed. When taken in large groups, they give some broad indications of a highly suggestive character, and though affected with great inequalities which for the time being seem to be anomalous, these anomalies are as instructive as the main facts themselves.

We have given the preliminary plotting of the intensities in the map before you. The first point to which we shall invite attention is the magnitude of the area affected by the shocks. It was sensibly felt in Boston, which is the most distant point on the Atlantic coast from which affirmative reports have been received. From Maine the answers are all negative. Most of those from New Hampshire are negative, but two or three positive ones show clearly that it was felt in sensitive spots. In Vermont, affirmative reports come from St. Johnsbury and Burlington on Lake Champlain. No positive reports come from the province of Quebec. In New York State it was felt in the vicinity of Lake George, and at Lake Placid and Blue Mountain Lake in the Adirondacks. In Ontario, it was quite noticeable in several localities, though the great majority of reports from that place are negative. In Michigan, it was noted in several places, and at Manistee Lighthouse, on Lake Michigan, the trembling was strongly marked. In Winconsin, though most of the reports are negative, it was felt quite strongly at Milwaukee, and was also noticed at Green Bay, and at La Crosse on the Mississippi, 967 miles from Charleston, the remotest point in the United States which gives a positive answer. In Central Iowa and Central Missouri, it was unmistakably felt. In Arkansas, the eastern portion of the State, from sixty to seventy-five miles west of the Mississippi, gives numerous favourable reports. In Louisiana, the reports are mostly negative, but numerous persons in New Orleans felt the shocks and recognized their nature. In Florida, it was universally felt, and in the northern part of the State was severe and alarming. From the Everglade region, of course, no reports have been received, as it is uninhabited; but in some of the Florida Keys it was felt in notable force. From Cuba a few reports have come, and the most distant point in that island which was shaken was Sagua la Grande, where the vibration was very decided. Lastly, a report comes from Bermuda, 1000 miles distant from Charleston, which leaves little doubt that the tremors were sensible there.

The area within which the motion was sufficient to attract the attention of the unexpectant observer would be somewhat more than circumscribed by a circle of 1000 miles' radius, and the area of markedly sensible shaking would, including the oceanic area, be somewhere between two and a half and three million square miles. In this estimate, however, only well-defined seismic movement of notable force is considered. There are reasons for believing that by proper instrumental observation the movement could have been detected over a much greater area. In the first place it is to be noted that the peripheral portions of the observed area lie in districts which are rather thinly populated, sometimes, also, in districts which from the nature of the ground do not disclose forcibly the passing shock. Furthermore, the passing wave in the outer portions of the area was almost everywhere of an undulatory character and of great wave-length, and while still retaining a large amount of energy, did not often dissipate itself into those smaller and shorter tremors which are very much more likely to attract attention, though really possessing very much less energy. Six hundred miles from the origin the long swaying motion was felt, and was often sufficient to produce sea-sickness, yet was unaccompanied by sound or by the tremulous motion due to short waves.

It will be observed upon the map that there are several large tracts which show a comparatively feeble intensity, while completely surrounding them is the general area of greater intensity. The most conspicuous of these areas of silence is the Appalachian region. The facts here are extremely interesting and suggestive. It has been generally supposed that a mountain-range serves as a barrier to the propagation of earthquakes—not from any known relation of cause and effect, but merely as the result of observation. In Japan it is universal testimony that the central range of the island marks the dividing line between earthquake and no earthquake. The shocks so frequent there are seldom or never felt beyond the mountains. A

similar conclusion has been drawn from South American earthquakes, and also from those which have visited Southern Italy. As soon as the data in the earlier stages of the inquiry began to indicate insulated areas of minimum action, they were completely investigated, and every effort has been made to secure full data from them. The result has been to show satisfactorily that such was the case. The Appalachian belt south of Middle Pennsylvania disclosed a few spots where the shaking was considerable, but in the main it was but slightly affected



until we reach the extreme southern portion of this range, where the shocks begin to be somewhat vigorous, even in the mountains. West and north-west of the range, however, the force of the undulations resumes even more than its normal vigour. In Eastern Kentucky and South-Eastern Ohio, the force of the shocks was very considerable, causing general alarm. Chimneys and bricks were shaken down, and the oscillation of the houses was strongly felt. In South-Eastern Ohio, nearly every theatre, lodge, and prayer-meeting, was broken up in confusion. It does not

appear that the Appalachians offered any sensible barrier to the progress of the deeper waves, but it does appear that they affected in a conspicuous degree the manner in which the energy of the waves was dissipated at the surface. Another minimum area was found in Southern Indiana and Illinois, and also in Southern Alabama and Mississippi. There is a curious circumstance connected with the minimum area in Indiana and Illinois. On February 6 last, an earthquake of notable force occurred in just this locality. Circulars were sent out at once, and on plotting the isoseismals they showed a singular coincidence in almost exactly filling the vacancy or defects of intensity of the Charleston earthquake. At present there is nothing to indicate whether this coincidence is accidental or whether there is some hidden relation.

Where the waves passed into the newer delta region of the lower Mississippi, the surface intensity of the shocks rapidly declined. This is indicated in the map by the compression of the isoseismals in those localities. We incline to the opinion that this sudden diminution of the intensity is due to the dissipation of the energy of the waves in a very great thickness of feebly elastic, imperfectly consolidated, superficial deposits. It is a matter of common observation in all great earthquakes that the passage of the principal shocks from rigid and firm rocks into gravels, sands, and clays is, under certain circumstances, attended with a local increase in the amplitudes of the oscillations and in the apparent local intensity and destructiveness, and the reason for it is intelligible. But where such looser materials are of very great thickness and great horizontal extent the reverse should be expected. For when a wave passes from a solid and highly elastic medium into a less solid and imperfectly elastic one, the amplitude may be suddenly increased at the instant of entering ; but so rapid is the extinction, that, if the new medium be very extensive, the impulse is soon dissipated.

Many reports throughout the Central States indicate localities of silence which are not expressed upon the map. The reason for omitting them is that it has been impracticable to secure a sufficient density of observation (*i.e.* a sufficient number of reports per unit area) to enable us to mark out and define these smaller areas with very great precision. To do this for the whole country would require some tens of thousands of observations and the expenditure of tens of thousands of dollars to systematize and discuss the data. A map shaded to show the varying intensity by varying the depth of the shading would have a mottled appearance, in which the mottling would be most pronounced in the areas of a little below the mean intensity, say between the isoseismals 3 and 5. This fact is of great importance in the interpretation of the isoseismals, for the omission to consider it results in giving to the middle isoseismals too high a value. In any isoseismal zone, what we should like to ascertain is the mean intensity of the whole area included within that zone. As a matter of fact, the data we possess consist more largely of maximum than of minimum or average intensities, and therefore tend to considerably augment the mean derived intensity above the true mean. This will become apparent by an inspection of the map where the zones of 5, 6, and 7 intensity are disproportionately broad, while those of 3 and 4 are disproportionately narrow. We have not attempted to allow for this source of error, though fully aware of it, because we had no means of determining what allowance to make. We have drawn the lines wholly upon the face of the returns, and the investigators who may attempt to utilize our results must grapple with the corrections as best they may.

Throughout the States of North Carolina, South Carolina, Georgia, and North-Eastern Florida, and in general anywhere within about 250 miles of the centre, the energy of the shocks was very great. At Columbia, Augusta, Raleigh, Atlanta, and Savannah, the consternation of all the people was universal. The negroes and many of the poor whites were for a week or two not exactly demoralized, but intensely moralized, giving themselves to religious exercises of a highly emotional character, the stronger and deeper natures among them being impressed with a feeling of awe, the weaker natures with a feeling of terror. And this was general throughout the large region just specified. In all of the large towns within 200 miles of Charleston more or less damage was suffered by houses and other structures. Walls were cracked to such an extent as to necessitate important repairs ; dams were broken, chimneys were overthrown, plastering shaken from ceilings, lamps overturned, water thrown out of tanks, cars set in motion on side tracks, animals filled with terror, fowls shaken from their roosts, loose objects thrown from mantels, chairs and beds moved horizontally upon the floor, pictures banged against the walls, trees visibly swayed and their leaves agitated and rustled as if by a wind. These occurrences were general, and were more strongly marked until they became terrifying and disastrous as the centre of the disturbance was approached. At Augusta, 110 miles distant from the epicentrum, the damage to buildings was considerable ; and at the arsenal in that place the commanding officer's residence was so badly cracked and shattered as to necessitate practical reconstruction. In Columbia, 100 miles distant, the shock was very injurious to buildings and appalling to the people, but no substantial structures were actually shaken down. In Atlanta, 250 miles distant, there was no worse injury than falling chimneys and some slight cracks in the walls, but the houses were instantly abandoned in great alarm and confusion by their occupants, and many preferred passing the night in the streets to re-entering their dwellings. At Asheville, N.C., 230 miles distant, and at Raleigh, 215 miles distant, the shocks were quite as vigorous as at Atlanta.

Coming nearer the seismic centre we find the intensity increasing on all sides as we approach it. The region immediately about the epicentrum in a great earthquake always discloses phenomena strikingly different from those at a distance from it, and the differences are not merely in degree but also in kind. The phenomena characteristic of the epicentral area cease with something like abruptness as we radiate away from the epicentrum. The central phenomena are those produced by shocks in which the principal component of the motion of the earth is vertical. Proceeding outwards, these predominating vertical motions pass, by a very rapid transition, into movements of which the horizontal component is the greater, and in which the undulatory motion becomes pronounced. The epicentrum, and the zone immediately surrounding it, is the portion of the disturbed tract which merits the closest attention, for it is here that we may find the greatest amount of information concerning the origin and nature of the earthquake. To appreciate this we will venture to offer some theoretical considerations.

Allusion has already been made to the indefinite character of the data used for estimating the intensity of the shock. There is no unit of intensity which is at present available. In selecting certain effects of an earthquake to characterize varying degrees of intensity, the most that can be hoped for is a means for discriminating whether the relative energy of a shock is greater or less in one locality than in another. But how much greater and how much less—in conformity with what law—is a problem which remains to be solved. An earthquake impulse, however, is a form of energy transmitted as an elastic wave through the deeply-seated rocks, and its propagation and varying intensity are subject to the laws of wave-motion There must be, therefore, some typical law governing the rate at which such a wave diminishes the intensity of its effects as it moves onward. To anticipate the objection that this typical law would apply only to a

medium which is perfectly elastic, homogeneous, and isotropic, while the rocks are far from being so, we reply that we have investigated the objection, and are satisfied that while it has some validity, the effect of these inequalities is not great enough to seriously impair the applicability of the law, nor to vitiate greatly the results to be deduced from it. The analysis we offer is a novel one. We attach considerable importance to it, and the consequences which flow from it are somewhat remarkable.

(*To be continued.*)

EXPERIMENTS ON THE SENSE OF SMELL IN DOGS.[1]

I ONCE tried an experiment with a terrier of my own, which shows, better than anything that I have ever read, the almost supernatural capabilities of smell in dogs. On a Bank holiday, when the Broad Walk in Regent's Park was swarming with people of all kinds, walking in all directions, I took my terrier (which I knew had a splendid nose, and could track me for miles) along the walk, and, when his attention was diverted by a strange dog, I suddenly made a number of zigzags across the Broad Walk, then stood on a seat, and watched the terrier. Finding I had not continued in the direction I was going when he left me, he went to the place where he had last seen me, and there, picking up my scent, tracked my footsteps over all the zigzags I had made, until he found me. Now, in order to do this, he had to distinguish my trail from at least a hundred others quite as fresh, and many thousands of others not so fresh, crossing it at all angles.[2]

The object of the experiments about to be described was that of ascertaining whether a dog, when thus distinguishing his master's trail, is guided by some distinctive smell attaching to his master's shoes, to any distinctive smell of his master's feet, or to both these differences combined.

I have a setter-bitch, over which I have shot for eight years. Having a very good nose, she can track me over immense distances, and her devotion to me being very exclusive, she constituted an admirable subject for my experiments.

These consisted in allowing the bitch to be taken out of the kennel by someone to whom she was indifferent, who then led her to a pre-arranged spot from which the tracking was to begin. Of course this spot was always to leeward of the kennel, and the person who was to be tracked always walked so as to keep more or less to leeward of the starting-point. The district—park-lands surrounding a house—was an open one, presenting, however, numerous trees, shrubberies, walls, &c., behind which I could hide at a distance from the starting-point, and so observe the animal during the whole course of each experiment. Sundry other precautions, which I need not wait to mention, were taken in order to insure that the bitch should have to depend on her sense of smell alone, and the following are the experiments which were tried :—

(1) I walked the grass-lands for about a mile in my ordinary shooting-boots. The instant she came to the starting-point, the bitch broke away at her full speed, and, faithfully following my track, overtook me in a few minutes.

(2) I set a man who was a stranger about the place to walk the park. Although repeatedly put upon his trail by my servant, the bitch showed no disposition to follow it.

(3) I had the bitch taken into the gun-room, where she saw me ready to start for shooting. I then left the gun-room and went to another part of the house, while my gamekeeper left the house by the back door, walked a certain distance to leeward in the direction of some partridge-ground, and then concealed himself. The bitch, who was now howling to follow me, was led to the back door by another servant. Quickly finding the trail of the gamekeeper, she tracked it for a few yards ; but, finding that I had not been with him, she left his trail, and hunted about in all directions for mine, which, of course, was nowhere to be found.

(4) I collected all the men about the place, and directed them to walk close behind one another in Indian file, each man taking care to place his feet in the footprints of his predecessor. In this procession, numbering twelve in all, I took the lead, while the gamekeeper brought up the rear. When we had walked two hundred yards, I turned to the right, followed by five of the men ; and at the point where I had turned to the right, the seventh man turned to the left, followed by all the remainder. The two parties thus formed, after having walked in opposite directions for a considerable distance, concealed themselves, and the bitch was put upon the common track of the whole party before the point of divergence. Following this common track with rapidity, she at first overshot the point of divergence ; but, quickly recovering it, without any hesitation chose the track which turned to the right. Yet in this case my footprints in the common track were overlaid by eleven others, and in the track to the right by five others. Moreover, as it was the gamekeeper who brought up the rear, and as in the absence of my trail she would always follow his, the fact of his scent being, so to speak, uppermost in the series, was shown in no way to disconcert the animal when following another familiar scent lowermost in the series.

(5) I requested the stranger before mentioned to wear my shooting-boots, and in them to walk the park to leeward of the kennel. When the bitch was led to this trail, she followed it with the eagerness wherewith she always followed mine.

(6) I wore this stranger's boots, and walked the park as he had done. On being taken to this trail, the bitch could not be induced to follow it.

(7) The stranger walked the park in bare feet ; the bitch would not follow the trail.

(8) I walked the park in bare feet : the bitch followed my trail ; but in quite a different manner from that which she displayed when following the trail of my shooting-boots. She was so much less eager, and therefore so much less rapid, that her manner was suggestive of great uncertainty whether or not she was on my track.

(9) I walked the park in new shooting-boots, which had never been worn by anyone. The bitch wholly refused to take this trail.

(10) I walked the park in my old shooting-boots, but having one layer of brown paper glued to their soles and sides. The bitch was led along my track, but paid no attention to it till she came to a place where, as I had previously observed, a small portion of the brown paper first became worn away at one of my heels. Here she immediately recognized my trail, and speedily followed it up, although the surface of shoe-leather which touched the ground was not more than a few square millimetres.

(11) I walked in my stocking-soles, trying first with new cotton socks. The bitch lazily followed the trail a short distance and then gave it up. I next tried woollen socks which I had worn all day, but the result was the same, and therefore quite different from that yielded by my shooting-boots, while more resembling that which was yielded by my bare feet.

(12) I began to walk in my ordinary shooting-boots, and when I had gone fifty yards, I kicked them off and carried them with me, while I continued to walk another three hundred yards in my stocking-soles ; then I took off

[1] Paper read by Mr. George J. Romanes, before the Linnean Society, on December 16, 1886. Reprinted from the Linnean Society's Journal—Zoology, vol. xx.

[2] "Mental Evolution in Animals," pp. 92-93 ; where also see for additional remarks of a general kind on the sense of smell in different animals.

my stockings, and walked another three hundred yards on my bare feet. On being taken to the beginning of this trail, or where I had started in my shooting-boots, the bitch as usual set off upon it at full speed, nor did she abate this speed throughout the whole distance. In other words, having been once started upon the familiar scent of my shooting-boots, she seemed to entertain no doubt that the scent of the stocking-soles and of the bare feet belonged to me; although she did not clearly recognize them as belonging to me when they were not continuations of a track made by my shooting-boots (10 and 11).

(13) I requested a gentleman who was calling at the house, and whom the bitch had never before seen, to accompany me in a conveyance along one of the carriage-drives. At a distance of several hundred yards from the house I alighted in my shooting-boots, walked fifty yards beside the carriage, again entered it while my friend alighted and walked two hundred yards still further along the drive. The bitch ran the whole 250 yards at her full speed, without making any pause at the place where the scent changed. This experiment was subsequently repeated with other strangers, and with the same result.

(14) I walked in my ordinary shooting-boots, having previously soaked them in oil of aniseed. Although the odour of the aniseed was so strong that an hour afterwards the path which I had followed was correctly traced by a friend, this odour did not appear to disconcert the bitch in following my trail, for she ran me down as quickly as usual. It was noticed, however, by the friend who took her to the trail that she did not set off upon it as instantaneously as usual. She began by examining the first three or four footsteps with care, and only then started off at full speed.

(15) Lastly, I tried some experiments on the power which this bitch might display of recognizing my individual odour as emanating from my whole person. In a large potato-field behind the house, a number of labourers had been engaged for eight or ten hours in digging up and carrying away potatoes all the way along half-a-dozen adjacent "drills." Consequently, there was here a strip of bared land in the field about twenty yards wide, and a quarter of a mile long, which had been thoroughly well trampled over by many strange feet. Down this strip of land I walked in a zigzag course from end to end. On reaching the bottom I turned out of the field, and again walked up a part of the way towards the house, but on the other side of a stone wall which bounded the field. This stone wall was breast high, and was situated nearly a hundred yards to windward of my previous course through the potatoes. The bitch, on being led out of the house, was put upon my trail at the top of the field, and at high speed picked out my trail among all the others, following roughly the various zigzags which I had taken. But the moment she gained the "wind's eye" of the place where I was standing behind the wall, she turned abruptly at a right angle, threw up her head, and came as straight as an arrow to the spot where I was watching her. Yet while watching her I had allowed only my eyes to come above the wall, so that she proved herself able to distinguish instantly the odour of the top of my head (without hat) at a distance of two hundred yards, although at the time she was surrounded by a number of over-heated labourers.

(16) On another day, when it was perfectly calm, I tried the experiment of standing in a deep dry ditch, with only the top of my uncovered head above the level of the surrounding fields. When she was led within two hundred yards of the place, she instantly perceived my odour, and ran in a straight line to where I had then ducked my head, so that she should receive no assistance from her sense of sight. This experiment shows that, in the absence of wind, the odour of my head (and no doubt, in a lesser degree, that of my body) had diffused itself through the air in all directions, and in an amount sufficient to enable the setter to recognize it as my odour at a distance of two hundred yards.

From the above experiments I conclude that this bitch distinguishes my trail from that of all others by the peculiar smell of my boots (1 to 6), and not by the peculiar smell of my feet (8 to 11). No doubt the smell which she recognizes as belonging distinctively to my trail is communicated to the boots by the exudations from my feet; but these exudations require to be combined with shoe-leather before they are recognized by her. Probably, however, if I had always been accustomed to shoot without boots or stockings, she would have learnt to associate with me a trail made by my bare feet. The experiments further show that although a few square millimetres of the surface of one boot is amply sufficient to make a trail which the animal can recognize as mine, the scent is not able to penetrate a single layer of brown paper (10). Furthermore, it would appear that in following a trail this bitch is ready at any moment to be guided by inference as well as perception, but that the act of inference is instantaneous (12 and 13 as compared with 2, 8, and 11). Lastly, the experiments show that not only the feet (as these affect the boots), but likewise the whole body of a man exhales a peculiar or individual odour which a dog can recognize as that of his master amid a crowd of other persons (15); that the individual quality of this odour can be recognized at great distances to windward (15), or, in calm weather, at great distances in any direction (16); and that it does not admit of being overcome by the strong smell of aniseed (14), or by that of many other footprints (4).

FOSSIL WOOD FROM THE WESTERN TERRITORIES OF CANADA.[1]

SILICIFIED wood occurs in the country west of Manitoba in the Upper Cretaceous beds, in the Laramie and in the Miocene of the Cypress Hills, and has found its way into the drift. The numerous specimens in our collections, picked up on the plains, are thus of little palæontological value, as their sources are uncertain, and it has become desirable to obtain specimens found *in situ*. A small collection of this kind was made by Dr. G. M. Dawson in the course of the Boundary Survey, and was described in the Report on the 49th Parallel, in 1875. In 1880, Schrœter, in an appendix to Heer's paper on the plants of Mackenzie River, described a few species from the Laramie of that district. More recently, numerous specimens have been collected from beds of known geological age by Dr. G. M. Dawson, Mr. J. B. Tyrrell, and Mr. T. C. Weston, of the Geological Survey, and slices have been prepared by the latter. They include species from the Belly River and Fort Pierre groups, which are Upper Cretaceous; from the Lower Laramie, apparently a transition group between the Cretaceous and Eocene; and from the Upper Laramie, which is probably Lower Eocene, though at one time regarded as Miocene. These woods are mostly coniferous, but there are also angiospermous exogens of several kinds. In describing them in detail, they are not named as species, but merely referred to the modern genera which they most closely resemble. We thus find in the Belly River series two types of *Sequoia* corresponding to the wood of the two modern species, and woods of the types of *Taxus Salisburia* or *Ginkgo*, *Thuja*, and possibly *Abies*, along with exogens referable conjecturally to the genera *Betula*, *Populus*, *Carya*, *Ulmus*, and *Platanus*. In the Laramie we have a similar assemblage of conifers and exogens, with forms referable to *Pinus* and *Abies*, and to *Juglans* and *Acer* among the exogens.

[1] Abstract of a Paper by Sir William Dawson, read before the Royal Society of Canada, May 1887.

Some fruits and other fragments from the Belly River series appear to indicate the presence of a species of *Podocarpus*. Appended to the descriptions of the woods are notices of new species and localities in connexion with the Laramie flora, and remarks on the grand coniferous fruits of the period, as connected with the formation of coal and lignite. The concluding remarks are given in full, as of interest in connexion with the British Eocene flora :—

Concluding Remarks.—While studying the specimens described in this paper, I received the volume of the Palæontographical Society for 1885, containing the conclusion of Mr. Starkie Gardner's description of the Eocene Coniferæ of England. The work which he has been able to do in disentangling the nomenclature of these plants, and fixing their geological age, is of the greatest value, and shows how liable the palæobotanist is to fall into error in determining species from imperfect specimens. Our American species no doubt require some revision in this respect.

I have also, while writing out the above notes for publication, received the paper of the same author on the Eocene beds of Ardtun in Mull, and am fully confirmed thereby in the opinion derived from the papers of the Duke of Argyll and the late Prof. E. Forbes (Journ. Geol. Soc. of London, vol. vii.), that the Mull beds very closely correspond in age with our Laramie. The *Filicites hebridica* of Forbes is our *Onoclea sensibilis*. The species of *Gingko*, *Taxus*, *Sequoia*, and *Glyptostrobus* correspond, and we have now probably found a *Podocarpus* as noted above. The *Platanites hebridicus* is very near to our great *Platanus nobilis*. *Corylus Macquarii* is common to both formations, as well as *Populus arctica* and *P. Richardsoni*, while many of the other exogens are generically the same, and very closely allied. These Ardtun beds are regarded by Mr. Gardner as Lower Eocene, or a little older than the Gelinden series of Saporta, and nearly of the same age with the so-called Miocene of Atanekerdluk in Greenland. I have ever since 1875 maintained the Lower Eocene age of our Laramie, and of the Fort Union group of the North-Western United States, and the identity of their flora with that of Mackenzie River and Greenland, and it is very satisfactory to find that Mr. Gardner has independently arrived at similar conclusions with respect to the Eocene of Great Britain.

An important consequence arising from this is that the period of warm climate which enabled a temperate flora to exist in Greenland was that of the later Cretaceous and early Eocene, rather than, as usually stated, the Miocene. It is also a question admitting of discussion, whether the Eocene flora of latitudes so different as those of Greenland, Mackenzie River, North-West Canada, and the Western States, were strictly contemporaneous, or successive within a long geological period in which climatal changes were gradually proceeding. The latter statement must apply at least to the beginning and close of the period ; but the plants themselves have something to say in favour of contemporaneity. The flora of the Laramie is not a tropical but a temperate flora, showing no doubt that a much more equable climate prevailed in the more northern parts of America than at present. But this equability of climate implies the possibility of a great geographical range on the part of plants. Thus it is quite possible, and indeed highly probable, that in the Laramie age a somewhat uniform flora extended from the Arctic seas through the great central plateau of America far to the south, and in like manner along the western coast of Europe. It is also to be observed that, as Gardner points out, there are some differences indicating a diversity of climate between Greenland and England, and even between Scotland and Ireland and the south of England ; and we have similar differences, though not strongly marked, between the Laramie of Northern Canada and that of the United States. When all our beds of this age, from the Arctic Sea to the 49th parallel, have been ransacked for plants, and when the palæobotanists of the United States shall have succeeded in unravelling the confusion which now exists between their Laramie and the Middle Tertiary, the geologist of the future will be able to restore with much certainty the distribution of the vast forests which in the early Eocene covered the now bare plains of interior America. Further, since the break which in Western Europe separates the flora of the Cretaceous from that of the Eocene does not exist in America, it will then be possible to trace the succession of plants all the way from the Mesozoic Flora of the Queen Charlotte Islands and the Kootanie series, described in previous papers in these Transactions, up to the close of the Eocene ; and to determine, for America at least, the manner and conditions under which the angiospermous flora of the later Cretaceous succeeded to the pines and cycads which characterized the beginning of the Cretaceous period.

THE LIVERPOOL MARINE BIOLOGY STATION ON PUFFIN ISLAND.

THE Liverpool Marine Biology Committee was formed in the spring of 1885 for the purpose of working up thoroughly the fauna and flora of that large rectangular area of the Irish Sea which lies around Liverpool Bay, and is bounded by the Isle of Man and the coasts of Anglesey, North Wales, Cheshire, and Lancashire. During the last three seasons the members of the Committee have conducted a large number of dredging, tow-netting, and other investigating expeditions in various parts of the Liverpool Marine Biology Committee district, and, as a first result of their labours, they published, in the summer of 1886, a "First Report upon the Fauna of Liverpool Bay and the Neighbouring Seas." It became evident at an early stage in these investigations that, as the sand-banks and channels in the immediate neighbourhood of the estuary of the Mersey are comparatively barren, it would be

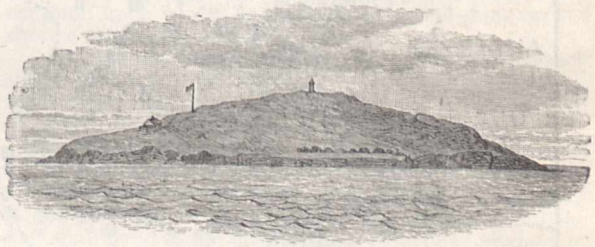


FIG. 1.—Puffin Island from the north.

necessary, in order to carry on the work of the Committee satisfactorily, to establish a small marine laboratory somewhere on the coast of North Wales or Anglesey. Such a station, close to the region where there is a rich and varied fauna, and yet within easy reach of Liverpool, would enable the members of the Committee, and other biologists who were working with them, to pay frequent and regular visits to the best ground for the purpose of collecting specimens ; and also to carry on observations on the habits of the animals, and to investigate their structures and life-histories. The Liverpool Marine Biology Committee have been aided in their work by small grants this year and last year from the Government Grant Committee of the Royal Society, and have received most important and generous assistance, by the loan of steamers for the dredging expeditions and in other ways, from some of the Liverpool ship-owners—amongst others, from the present Mayor, Sir James Poole, from Mr.

George Holt, and from the Liverpool Salvage Association —and now they owe the attainment of their desire for a marine laboratory to the kindness of Sir Richard Williams Bulkeley, Bart., of Beaumaris, in allowing them to make use, for scientific purposes, of the former Dock Board Telegraph Station on Puffin Island (Fig. 1).

Puffin Island, or Priestholme, is a small uninhabited island close to the north-east corner of Anglesey, and lying with its longer axis north-east and south-west. It is composed mainly of beds of limestone, and has precipitous sides, which have been worn into caves, crevices, and innumerable pools. The best landing-place is on the end nearest to Anglesey, where there is a beach of shingle. The shores all round the island support an abundant fauna, and some of the best dredging-grounds in the Liverpool Bay district lie close to Puffin Island, and a little further to the west along the coast of Anglesey. A glance at the accompanying chart will show the diversity in the depth of water off the north and east ends of the island (Fig. 2).

The house which the Liverpool Marine Biology Committee have now taken possession of as a centre for their further operations was built by the Liverpool Dock Board, and used as a signalling station, but has been uninhabited for some years. It contains four good rooms, besides lofts and out-houses, and a long observatory

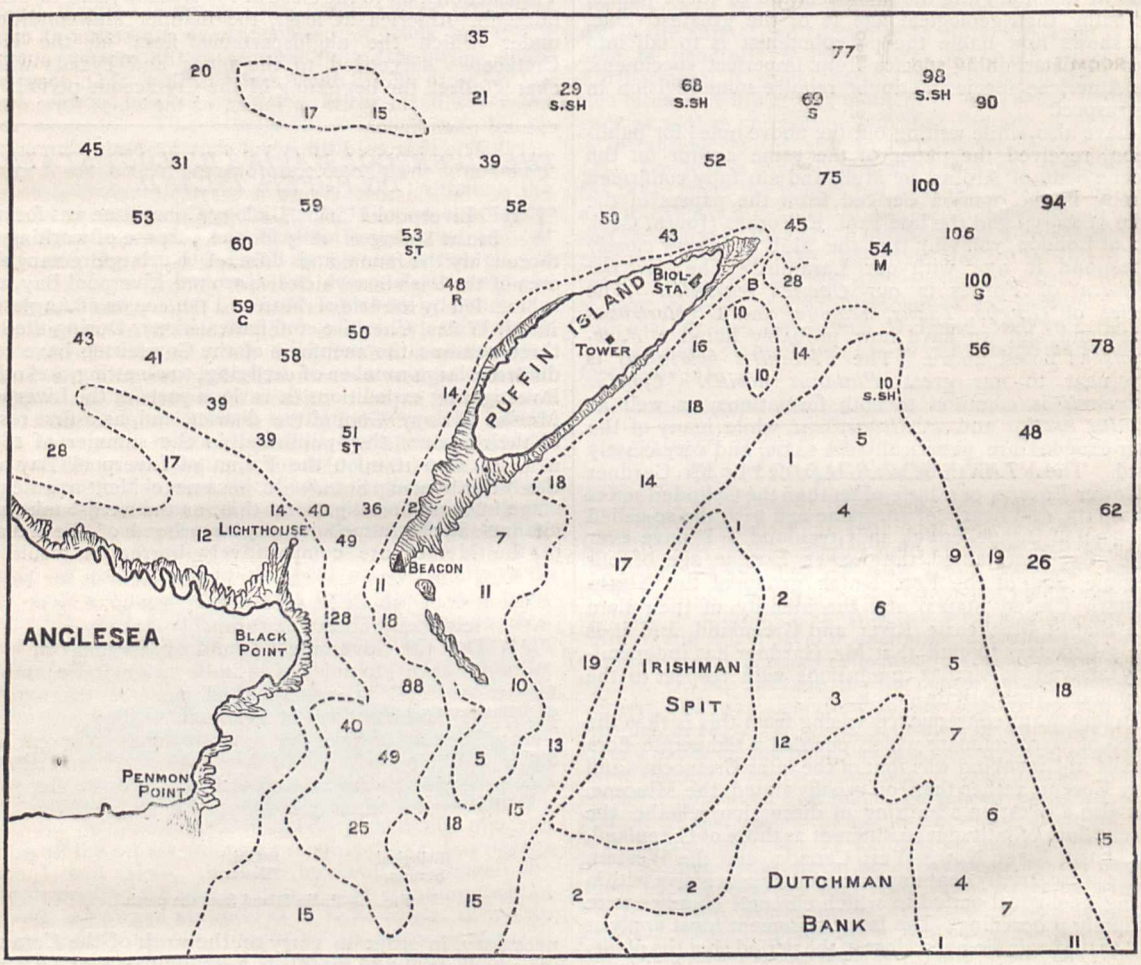


FIG. 2.

running towards the sea (north-east), and lighted by a series of seven windows round the outer end (Fig. 3). This observatory will make a well-lighted, convenient laboratory, while the other four rooms serve as kitchen and sleeping rooms for the naturalists and the keeper of the station.

At the end of May the new doors and windows, shutters, tables, and other fittings, which had been prepared in Liverpool, were ready for transference to the station, and a number of the Liverpool Marine Biology Committee, along with some workmen, were taken down to Puffin Island by the ss. *Hyæna*, which had been lent for the purpose by the Liverpool Salvage Association. The house was rapidly made weather-tight and put in working order, and is now under the charge of a keeper and his assistant. Tanks will soon be erected, and some of the shore-pools are being converted into natural aquaria. A small sailing-boat has been obtained, by which dredging and tow-netting in the neighbourhood of the island can be carried on, and by means of which communication can be kept up with the Liverpool steamers at Beaumaris and the railway at Bangor.

Since the establishment of the station some of the members of the Liverpool Marine Biology Committee have already had half a dozen expeditions to the island, and the following naturalists have commenced

work on their respective groups of animals: Mr. I. C. Thompson, on the Copepoda; Mr. J. Lomas, on the Polyzoa; and Prof. Herdman, on the Tunicata. Various other scientific men have come as visitors to see the station, including: Prof. Lodge, F.R.S., Prof. Hele Shaw, Mr. Reginald Phillips, of Bangor, Mr. I. Roberts,

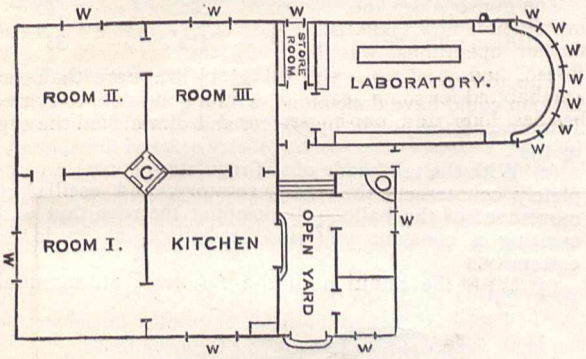


FIG. 3.—Plan of Liverpool Marine Biological Station on Puffin Island. W, windows; C, chimneys.

and Mr. Mellard Reade; and it is hoped that if the weather is favourable on Sept. 3, the biologists taking part in the British Association dredging expedition, arranged by the Liverpool Marine Biology Committee, will have an opportunity of visiting Puffin Island and its Biological Station. W. A. HERDMAN.

ANTARCTIC EXPLORATION.

IN June 1886, an Australian Antarctic Exploration Committee was appointed at Melbourne. It consisted of five members each from the Royal Society of Victoria and the Royal Geographical Society, Victoria Branch. This Committee has collected a quantity of information respecting the islands lying south of Tasmania as well as respecting lands lying nearer the Pole.

The prospect of obtaining a Government grant for an expedition having scientific purposes only, though the preferable course, was thought to be hopeless. The Committee therefore has recommended the Government of Victoria (which had expressed itself favourably to the project) to offer to steam-whalers, for carrying a scientific staff to certain high latitudes, bonuses, graduated to degrees of southing. We print the conditions, but no tenders can be invited till a grant is assured, and the Government of Victoria is indisposed to act in the matter without other colonies, whose co-operation is doubtful, though Tasmania will most probably offer a small contribution.

Many offers of steam-whalers have been sent from England, Scotland, and Norway, where the owners seem anxious to dispose of their ships and gear. Most important and valuable information and advice have been received from Capt. Gray, of Peterhead.

The following are the recommendations of the Antarctic Committee to the Honourable the Premier of Victoria:—

(1) The Antarctic Committee begs respectfully to recommend to the Honourable the Premier the propriety of stimulating Antarctic research by the offer of bonuses.

(2) That a sum of £10,000 be placed upon the Estimates, to provide for the amount of the bonuses, and for the expenses of the equipment and of the staff.

(3) The amount of the bonuses to be paid to the shipowners for the hereinafter mentioned services is to be decided by tender, and the same, together with the cost of equipment and the staff, not to exceed the sum of £10,000.

(4) That the Government invite tenders from shipowners willing to perform the services required.

(5) That the tenders be sent to the Treasury direct, or through the Agent-General, not later than June 1.

(6) That tenderers must provide two fortified steamships, each of not less than 175 tons register, 60 horse-power nominal, and A1 at Lloyd's, or of an equivalent class.

(7) That tenderers must supply full descriptions of the ships and their equipments.

(8) That the master and chief mate of both ships shall have held similar positions in Arctic steam-ships.

(9) That the tenderer shall provide, free of charge, cabin accommodation in each ship for two gentlemen, who will sail as the scientific staff; also a separate cabin, of a size to be specified, as instrument-room and office.

(10) The scientific staff will have the status of cabin passengers, and be subordinate to the master, but the master must afford them every facility, that does not interfere with the work or safety of the ship, for noting natural phenomena.

(11) The chartered ships will earn a special bonus (to come out of the £10,000 appropriated) upon their entering at the Custom House a cargo of 100 tons of oil, being the produce of fish caught south of 60° S. The special bonus to be paid as follows, viz.:—To ships owned and registered in Australia, £1,000; to ships owned and registered elsewhere, £800.

(12) The services desired are as follows, viz.:—A flying survey of any coast-lines lying within the Antarctic Circle, and not now laid down upon the Admiralty charts. The discovery of new waterways leading towards the South Pole, and of harbours suitable for wintering in. Opportunities to be afforded to the scientific staff to add to our knowledge of the meteorology, oceanography, terrestrial magnetism, natural history, and geology of the region. The discovery of commercial products.

(13) The tenderer must specify the bonus he demands for passing 70° S. with either one or two ships; also the bonus he demands for each degree attained beyond 70° S. by one ship; also the bonus he demands for every occasion upon which he succeeds in establishing on the shore a temporary observing camp.

(14) That the Government should pay for only one such station for each 120 miles of latitude or longitude, unless the master shall have established more at the written request of both members of the staff.

(15) The staff to have the right to refuse to accept the site of any camp selected by the master, and such refusal shall be logged by the master, and read over to the staff in the presence of the mate and the surgeon; and the staff shall hand to the master their objections thereto in writing, and the same must be signed by both of them.

(16) The tenderer will not receive any more bonus for two ships than for one after passing the 70th parallel. The Committee would prefer that one of the ships should remain fishing in the neighbourhood of North Cape, Victoria Land, whilst the other pushed into higher latitudes. In case of accident to the latter, the former would serve as a depot and relief for the shipwrecked crew to fall back upon.

(17) Should the master of either ship despatch an exploring party from his vessel, the contractor will be entitled to a bonus for each sixty miles of latitude or longitude traversed by such party, but the tenderer must specify what sum he will require for each sixty miles so traversed.

(18) That the ships should proceed direct to the bight situated on the meridian of 180°, with a view of one of them getting beyond Ross's furthest, and especially of observing the conditions of the volcanoes at the head of the bight.

(19) The contractor will be liable to no penalty should he fail to reach to any latitude tendered for.

(20) The contractor will have the right to employ his ships in whaling or sealing, and in loading guano or other cargo.

(21) Should the masters be unable to get right or sperm whales to enable them to compete for the bonus offered under the 12th proviso, they will nevertheless be entitled to the bonus should they return with a cargo of any merchantable commodity obtained within the Antarctic Circle, and having a value equivalent to that of 100 tons of whale oil.

(22) Both ships must be in Port Phillip Bay and ready to start on October 15.

(23) That in case of any difficulty arising in England between the Agent-General and the contractor, it shall be referred to the British Antarctic Committee for decision.

THE CAPTIVE KITE-BALLOON.

IT has always been an objection to the extensive use of captive balloons for scientific or military purposes, that a wind of moderate strength suffices not merely to depress them considerably from the vertical, but to cause them to jerk, rotate, and oscillate vertically and horizontally in such a manner as to render them either partially ineffective or totally useless.

During the recent military manœuvres at Dover, it was stated that the captive balloon under the charge of Major Templer was not allowed to ascend beyond the shelter of the surrounding downs, owing to the strong wind then prevailing. It was thus *hors de combat* as far as the enemy was concerned, and this seems to be a common experience of military balloonists.

The jerking, as a balloon after a freshening of the wind suddenly reaches the end of its tether, is, I am told by an experienced member of the Balloon Corps, very trying to the nerves, while the rotation on its axis is a serious obstacle to steady observation.

The depression of a captive balloon in a wind of any sensible strength is also more than most persons would imagine, and as the velocity of the wind generally increases with the height (very rapidly for the first few hundred feet), while the buoyancy of the balloon, owing to several causes, diminishes, this condition becomes more pronounced at the higher levels.

The depression is obviously due to the fact that a captive balloon, as at present employed, can only be secured at its *base*, and thus the normal component of the wind is resolved in a downward direction, pressing the balloon towards the earth. If the fastening could be made two-thirds of the way up its side, this normal component could be resolved in an upward direction, and utilised so as to add to the elevating power of the balloon. The fragile nature of the balloon fabric, however, renders it impossible to do this except by interposing a kite-surface between it and the wind.

All the preceding defects are remedied and several positive advantages are gained by attaching a balloon to a kite in the manner indicated in the accompanying diagram.

(1) The addition of the kite with the fastening at the side instead of the base counteracts the depression produced by the wind, and not only raises its own weight, but even in a light anticyclonic breeze elevates the whole apparatus to a higher level than that which could be attained by the balloon alone.

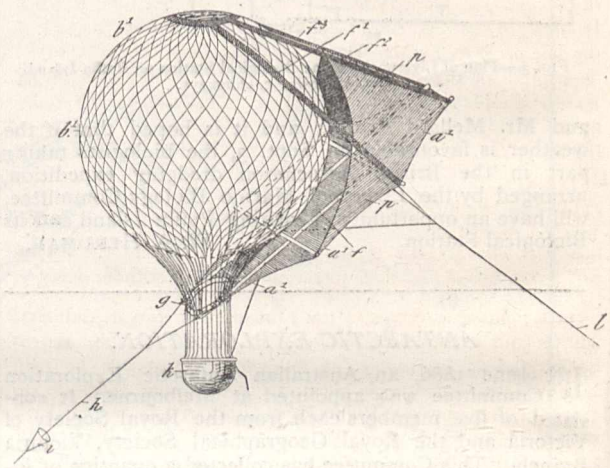
Thus, in an experiment here on Friday, June 10, in the presence of Mr. Eric S. Bruce and others, with a very light wind,[1] the balloon of 113 cubic feet capacity and with 1200 feet of wire out attained *alone* a mean vertical height of 693 feet, while when attached to a kite of 9 feet by 7 feet and the same length of wire it kept steadily at 789 feet. The lifting power in the second case was also greatly increased, as shown by the following comparison of the angles of the kite and wire in the two cases[1]:—

	Angle of Balloon.	Wire near the ground.
Balloon alone	38° ...	18°
Balloon with kite	41½° ...	35°

The addition of the kite raised 1¼ lbs. more than the balloon could have done alone, with a good deal to spare. It increased the height by 96 feet and diminished the sag by 13½°.

(2) With the tail (made of self-regulating cones) it completely counteracts the jerky, rotatory, and oscillatory movement of the balloon, by keeping the wire taut and exerting a constant pull on the balloon at its lower extremity.

(3) With the addition of the *top hood*, an essential



Archibald's Captive Kite-Balloon. a^1, octagonal kite, with frame of four pieces of bamboo; b^1, spherical balloon; f, covering of kite (preferably silk); p, extra or top hood; $f^1 f^2$, &c., bands connecting kite and hood with top of balloon; g, ring connecting lower end of kite with the converging net cords of balloon; h, tail of cones (i); l^1, earth-line connected with kite, one branch passing through a pulley to the car (k).

feature of the combination, the kite shields the balloon fabric from the destructive action of the wind.

(4) The combination can be flown on a much larger percentage of days than the balloon alone.

(5) In a large balloon with car attached the occupant can alter his altitude and azimuth by pulling the lower or side attachments of the kite, and thus extend his area of observation.

(6) With the kite, and except in the rare case of a dead calm, a much smaller balloon is needed to raise a given weight.[2]

(7) The use of wire (a suggestion which I owe to Sir William Thomson) greatly increases the strength, and lessens the weight, of the earth-line.

I arrived at the idea of uniting the two apparatuses while conducting my kite anemometrical observations in 1884, owing to my desire to prevent my kites from coming down suddenly when the wind dropped. I found the balloonists equally desirous of some means for shielding their balloons from damage and keeping them *up* in a *wind*. The kite-balloon satisfies both requirements, and will, I trust, be of use both to scientific as well as military observation.

E. DOUGLAS ARCHIBALD.

Tunbridge Wells, June 25.

[1] I have since ascertained that during the trial the mean velocity at Greenwich [211 feet above the sea with a good exposure for the wind (N.E.)] was 12 miles per hour. The present locality was in a valley 260 feet above sea-level, surrounded by hills rising to 500 feet above the sea.

[1] The lifting power of the balloon with hydrogen was about 5 lbs., the wire weighed about 4 lbs. and the kite 2¾ lbs.

[2] The kite portion is portable and easily detachable in the event of a calm.

NOTES.

A BILL dealing with the question of technical education was submitted to the House of Commons on Tuesday, and read a first time. We print elsewhere the speech delivered by Sir W. Hart Dyke in introducing the measure.

THE Report for 1886 of the Science and Art Department has just been issued.

THE summer meeting of the Institution of Mechanical Engineers will be held in Edinburgh, on Tuesday morning, August 2, and Wednesday morning, August 3, in the University. The chair will be taken at half-past nine o'clock by the President, Mr. Edward H. Carbutt, in the Natural History Lecture Theatre. The following papers have been offered for reading and discussion, not necessarily in the order here given:—On the structure and progress of the Forth Bridge, by Mr. E. Malcolm Wood, of London; notes on the machinery employed at the Forth Bridge works, by Mr. William Arrol, of Glasgow; on the paraffin oil industry in Scotland, by Mr. St. John V. Day, Honorary Local Secretary; description of the electric light on the Isle of May, by Mr. David A. Stevenson, of Edinburgh; description of the new Tay Viaduct, by Mr. Fletcher F. S. Kelsey, Resident Engineer; on electro-magnetic machine-tools, by Mr. Frederick John Rowan, of Glasgow; on the dredging of the lower estuary of the Clyde, by Mr. Charles A. Stevenson, of Edinburgh; on the position and prospects of electricity as applied to engineering, by Mr. William Geipel, of Edinburgh. Various excursions are being arranged, and it is desired that members who propose to be present, and to accept the several invitations, should let their intention be known without delay.

THE summer meetings of the Institution of Naval Architects will be held at Newcastle-on-Tyne on July 26 and 28, and at Sunderland on July 27. The following papers will be read at Newcastle: on the application of hydraulic pressure to naval gunnery, by the Right Hon. Lord Armstrong, F.R.S. Vice-President, and Mr. J. Vavasseur, Associate; recent developments in marine engineering, by Mr. Frank C. Marshall, Member of Council; Tyne improvements, by Mr. P. J. Messent, Engineer to River Tyne Commissioners. At Sunderland the following papers will be read: on some recent experiments with basic steel, by Mr. W. H. White, Director of Naval Construction, Vice-President; on the present position occupied by basic steel for ship-building, by Mr. B. Martell, Chief Surveyor to Lloyd's Register of British and Foreign Shipping, Vice-President. There will be excursions to places of scientific interest in the neighbourhoods.

MR. THOMAS HUDSON BEARE has been unanimously appointed by the Governors of the Heriot-Watt College, Edinburgh, Professor of Mechanics and Engineering in that institution. Mr. Beare came over to this country from Australia in 1880, having gained the South Australian Scholarship at the University of Adelaide. He then became a student at University College, London, to which he afterwards returned about three years since to be one of the principal demonstrators under Prof. Kennedy in the Engineering Laboratory.

THE Geographical Society of St. Petersburg has decided to send an Expedition to Turkestan for the scientific investigation of the earthquake at Werny. Prof. Muschketoff, the head of the Expedition, will be accompanied by five other men of science, including the St. Petersburg geologist, M. W. S. Dmitrewski.

THE seventh Bulletin of Miscellaneous Information, issued from the Royal Gardens, Kew, contains a careful and interesting paper on annatto, a colouring substance obtained from the seeds of *Bixa Orellana*. This colouring substance has long been known and used for various purposes. It is, however, liable to so many fluctuations, and the prices generally are so low, that it has never received serious attention in British colonies, and hence few, if any, plantations have been exclusively devoted in such colonies to the annatto plant. The annatto of commerce is practically a forest product obtained from wild or semi-wild plants, and the supply has only kept pace with the demand. Of late years a slight revival has taken place in the use of annatto, especially in America, and inquiries have in consequence been made for information as regards culture and preparation. This information the writer of the paper in the Bulletin supplies, and his notes will be of great service to all who may wish to become growers of annatto.

ON May 9 the Governor of Jamaica addressed to the Governors of Barbados, the Leeward Islands, the Windward Islands, and British Honduras, a letter relating to the scheme for the establishment of botanical stations in some West India Islands in connexion with the Botanical Department in Jamaica. From this letter, which is printed in the seventh Kew Bulletin of Miscellaneous Information, we are glad to learn that the Government of Jamaica is prepared to adopt the proposed scheme from August 1, or from any subsequent date.

BEFORE the end of the year the great Tweeddale collection and library will, it is hoped, be safely housed in the Natural History Museum. This princely donation to the national collection is the gift of Capt. R. G. Wardlaw Ramsay, to whom it was bequeathed by his uncle, the late Marquess of Tweeddale. With the exception of the Hume Collection it is the finest series of Indian birds in existence, and is especially rich in species from the Philippine Archipelago, where Mr. Alfred Everett collected for some years for Lord Tweeddale. Capt. Ramsay's collections from the Karen Hills, in Burmah, are also most important, this being one of the few localities unworked by Mr. Hume's collectors.

THE American Museum of Natural History, New York, has just acquired the ornithological library of Mr. D. G. Elliot, a well-known American naturalist. This library consists of about 1000 volumes, and is one of the most important in America. Mr. Elliot has at the same time presented his collection of humming-birds to the above Museum. It is, according to the *Auk*, "represented by about 2000 specimens, and includes some fifty or more types. Its importance is further enhanced from its having formed the basis of Mr. Elliot's recent monograph of the family. It doubtless ranks as second in the world in point of completeness, or next to that of the British Museum." The latter collection, however, must now contain at least 10,000 skins, irrespective of the Gouldian series of mounted specimens. Another important addition to the American Museum is that of the large ornithological collection of Mr. G. N. Lawrence, which contains some 300 types. This has been purchased, and is one of the chief of the private collections in America.

THE special groups, illustrating the nesting habits of British birds, which have proved so attractive in the Natural History Museum at South Kensington, have now been introduced into the galleries of the American Museum of Natural History, and twelve cases of American birds have already been mounted. The cost of these effective, but expensive, groups will be defrayed by Mrs. Robert E. Stuart, and the Museum has secured the services of Mrs. Mogridge, who executed the artificial flower-work for the British Museum. Mrs. Mogridge is without a rival in this branch of decorative art.

THE expedition made by Mr. John Whitehead to the great mountain of Kina Balu, in Northern Borneo, has turned out more successful than could have been foretold. In addition to

the splendid new Broadbill, described by Mr. Bowdler Sharpe as *Calyptomena whiteheadi* at the last meeting of the Zoological Society, there are nearly twenty other new species, including some very remarkable forms of *Arachnothera*, *Chloropsis*, *Cryptolopha*, and an apparently new genus of *Campophagidæ*. These will all be described in the October *Ibis*, by Mr. Sharpe.

DEALING with the question as to the influence of small birds in assisting the extinction of *Aporia crataegi*, Mr. A. G. Butler, in the current number of the *Entomologist's Monthly Magazine*, says he has collected in Kent for at least thirty years, and during the whole of that time he has never seen any bird but a sparrow attempt to catch a butterfly. Nor has he ever known a small bird to eat a large caterpillar if it could get one that could be more easily swallowed. "Of our indigenous species," he says, "the robin and the great tit certainly select green caterpillars in preference to others, and, when feeding their young, I have watched both these birds with their mouths full of the green pests of the gooseberry and currant. From observation of cage-birds I should say that the finches certainly show a similar preference, the green larvæ of *Mamestra* being chosen before the brown, though all are greedily devoured."

A BOLD attempt has recently been made to penetrate the darkness surrounding the subject of the inter-molecular arrangement of atoms, and to raise our ideas of the constitution of chemical compounds beyond what is expressed by the orthodox chemical formulæ. It has long been felt that the chemical formula of a substance as expressed in one plane on paper, although invaluable as far as it goes, must of necessity be a very misleading one, inasmuch as it in no way indicates the probable position of the various atoms in space. This insufficiency has been especially felt in the case of substances like tartaric acid, where we have several distinct isomers acting quite differently upon polarized light, and frequently forming right- and left-handed hemihedral crystals, although expressed by the same constitutional formula. Since the year 1874, when Van t' Hoff and Le Bel published their celebrated theory of the "asymmetric carbon atom," the idea has been gaining ground that this kind of isomerism must be due to different spacial arrangement, and Van t' Hoff gave impetus to the theory by showing that the existence of four isomeric tartaric acids could be explained by imagining the four radical-groups to be variously placed at the four corners of a regular tetrahedron, of which an asymmetric carbon atom occupied the centre. During the last few days a comprehensive paper has been issued by Prof. J. Wislicenus, on the "Spacial Arrangement of Atoms in Organic Molecules, and its Determination in Geometrically Isomeric Compounds," further expanding Dr. Van t' Hoff's somewhat sceptically received ideas, proceeding to build up the spacial constitution of a large number of unsaturated organic compounds, and giving nearly 200 figures, of which the regular tetrahedron representing CH_4 is the base. Prof. Wislicenus practically demonstrates that the cases of so-called abnormal isomerism may be completely cleared up, and that existing experimental data are generally sufficient to enable spacial constitution to be determined. This remarkable paper will doubtless give rise to much discussion, and appears likely to lead to results which will mark a genuine advance in chemical philosophy.

IN a paper to the Berlin Academy, Herr Liebreich lately called attention to what he calls the "dead space" in chemical reactions: a space, *i.e.*, in which the reaction going on in other parts of a uniformly mixed liquid does not occur, or occurs late, or in less degree. It may be very well observed, *e.g.*, in decomposition of chloral hydrate by sodium carbonate (yielding chloroform) in a test-tube. A layer of 1 to 3 millimetres' depth under the surface remains clear, and separate by a convex surface from the "reaction space," where the solution is turbid from droplets of chloroform. Even after twenty-four hours' rest of the mixture the two spaces can be distinguished; and after mixture by shaking again, the surface of separation is reproduced in a few minutes. In horizontal capillary tubes the dead space appears on both sides, and, if the liquid columns introduced are short, no reaction occurs, as the dead spaces unite. Thus is explained the absence of reaction in the case of liquid absorbed in vessels by glass pearls; there is dead space everywhere. Contact with air seems essential to the formation of dead space. Thus if a vessel closed at one end, and holding the liquids above named, be inverted, so that there is no air space above the mixture, the reaction occurs uniformly throughout. But if the upper end be closed with a fine animal membrane, the dead space appears as in the former case; and if the lower end be also closed with fine membrane the dead space appears there too. Herr Liebreich is studying the phenomena further.

SOME instructive experiments on atmospheric electricity are described by Herr Nahrwold in *Wiedemann's Annalen*, No. 7; one being a suitable lecture experiment, showing the action of electricity from points on finely divided matter in the air. He thinks it established that such a stream of electricity does not electrify the air itself statically (indeed that air and other gases probably cannot be statically electrified), but only dust particles in it. Further, a glowing platinum wire sends out particles which diffuse in air that has been electrically freed from dust, making a fresh charge possible. Here, too, the electricity streaming from such wire does not statically electrify the air, but the charges which are observed as atmospheric electricity belong to fine non-gaseous particles given out by the wire, or already present in the air. An experiment is also adduced to show that at ordinary temperature negative electricity of high potential streams more readily from solid conductors into atmospheric air than positive.

ELECTRICITY in the house has some important bearings on hygiene. One of these M. Sambuc has recently called attention to (*Revue d'Hygiène*), in the liberation of hydrogen, where strong batteries are used in which zinc is dissolved by sulphuric acid. Besides the danger of shattering of the vessels, the hydrogen spreading in the air may form an explosive mixture; and it may have a cooling effect through its great conductivity for heat. It also deadens the voice and alters its timbre. Further, if, as may be, the hydrogen is charged with sulphur, arsenic, phosphorus, carbon, or silicium, there are other and greater dangers. A chemist is known to have died from breathing a little arsenietted hydrogen. These facts are not cited against the use of the electric light, but to induce proper care in those who use it.

THE twenty-sixth volume of the magnetical and meteorological observations made at the Government Observatory, Bombay, containing the results for the year 1885, has just been published, under the superintendence of Mr. C. Chambers, F.R.S. Continuous registrations are obtained by means of self-recording instruments (although not published), and eye-observations are taken five times a day, as a check upon the automatic records. The following is a summary of the principal meteorological results:—The mean barometric pressure for the year was 29·826 inches, the difference of the greatest and least mean daily pressure amounting to 0·581 inch. The mean annual temperature was 79°·2, and the greatest daily mean was 87°·3 on June 6. The absolute maximum was 91°·8 in June (being slightly *lower* than the maximum in the shade at Greenwich on the 4th inst.), and the minimum 62°·1 in February, giving a range of 29°·7. The rainfall measured by a gauge 4½ feet above the ground was 67·91 inches; rain fell on 113 days, and mostly occurred between June and September; the greatest fall was 10·29 inches on August 15.

The Observatory does not appear to possess a sunshine-recorder. Observations for a few selected hours for Bombay and five other stations for the years 1885–86 have already been published separately by the Indian Meteorological Office.

METEOROLOGICAL observations have been regularly made at the Khedivial Observatory at Cairo (Abassieh) during the past five years, and have been published in various forms. The publication has now assumed a more definite shape, under the title, *Résumé Mensuel*, and is issued by the Ministry of Public Instruction. The observations are taken every three hours during the day and night. Yearly summaries are not given, but we find from the monthly values that the mean shade temperature for the year 1886 was 69°·6. The absolute maximum in the shade was 113°·4 in June, and the minimum, 36°·7, in December; giving a yearly range of 76°·7. The thermometers are placed much too high, being about 33 feet above the ground, instead of about 4 feet. The amount of rainfall is not regularly published.

THE Jahrbuch of the *Magdeburgische Zeitung* for the year 1885 (Magdeburg, 1887, 88 pp. 4to) contains, in addition to the usual observations and reproductions of the continuous registrations of barometer and sunshine-recorder, a table showing the extremes of temperature on the surface of the earth observed by means of five maximum and five minimum thermometers, one pair lying flat and the other four pairs being inclined about 45° under the four principal points of the compass, between May 1885 and April 1886; but there is no discussion of the results. There is also an interesting appendix relating to the choice of hours that will give the nearest approach to the mean daily temperature. The author has used the continuous records for Berne, Vienna, Magdeburg, Pawlowsk (near St. Petersburg), and Upsala for a year, and has found the following to be the mean values of the corrections to be applied to the various yearly means:—For 8h., 2h., 8h., 0°·040; for 7h., 2h., 9h., −0°·092; for 6h., 2h., 10h., 0°·104; and for max. and min. 0°·084. The best combination according to this investigation is therefore 8h., 2h., 8h., whereas in this country 9h. a.m. and 9h. p.m. are found to give a good mean. The combination of max. and min. also gives a fairly approximate value for mean latitudes. The author has also investigated the epoch of the maximum and minimum temperature for the same places, and shows how the highest daily temperature occurs later as the summer advances, being at about 3h. p.m. in June and July and between 12h. and 1h. in January and December; and further, that the lowest temperature does not always take place at about sunrise, as is generally supposed, but only during summer, while in winter the minimum is near midnight. The present Director of the Observatory is A. Grützmacher; the former Director, Dr. Assmann, having been appointed to the Meteorological Office at Berlin.

MR. A. L. ROTCH has published the results of the observations made at the Blue Hill Meteorological Observatory, Norfolk County, Massachusetts, U.S., in the year 1886 (NATURE, vol. xxxv. p. 472). This Observatory, which was established by Mr. Rotch in 1885, is now one of the best-equipped stations in the United States, and the current expenses amount to about 2500 dollars a year. An auxiliary station has also been established at the foot of the hill, 440 feet below the Observatory, and some curious variations of temperature and precipitation have been noted between the two stations, but enough data have not yet been accumulated for publication. Among the special instruments in use may be specified a Campbell-Stokes bright-sunshine recorder, which is believed to be the only one in the United States; a Jordan sunshine-recorder, which registers both bright and faint sunshine photographically; and a mirror for the measurement of the azimuth and altitude of clouds, but these results are not yet ready for publication. The mean temperature for the year was 45°·6. The absolute maximum in the shade was 91°·0 in July, and the minimum −15°·0 in January, giving a yearly range of 106°. The greatest daily range was 38°·2 on December 25, and the least 1°·7 in February. The total rainfall and melted snow was 46·99 inches, measured on 132 days; the greatest monthly fall being 8·29 inches in February, and the least 1·52 inch in June. The work is accompanied by tracings from the self-recording instruments, selected to illustrate certain phenomena during the year, with explanatory text, a practice which is both inexpensive and very instructive. The hourly tabulations of atmospheric pressure and wind velocity have been published *in extenso*.

ON February 5 last there was a shower of ashes, lasting from 7 a.m. to 11 a.m., at Finschhafen in Kaiser Wilhelm's Land. It covered the surrounding district with a layer of pale grey volcanic ashes. As the condition of the winds at the time was abnormal, it is impossible to say in what locality the volcanic eruption took place. Dr. Schrader reports that on February 2 a bright red halo, as if produced by smoke at a great elevation, was noticed around the sun; a few evenings before, similar halos had been noticed around the moon. Samples of the ashes have been sent to Dr. Neumayer, of Hamburg, for analysis.

SOME time ago, Mr. F. W. Putnam, the American archæologist, wrote a letter to the newspapers, pointing out that the Serpent Mound in Adams County, Ohio, had lately been much damaged by "wash-outs," and begging that steps might be taken for its preservation. Thereupon three Boston ladies took the matter in hand. The money they asked for was soon obtained, and now the ground upon which the mound is situated has been bought, and handed over to the guardianship of the Trustees of the Peabody Museum of American Archæology and Ethnology. Mr. Putnam, through whom the purchase was effected, proposes to spend the approaching autumn in the neighbourhood of the mound, restoring it where it has been injured, transforming wheat-fields into grass lawns, making paths and fences, and planting trees. "So long as the place is respected and guarded by all who visit it," he says in a letter to a Cincinnati newspaper, "the park will be free to all, but should any vandalism be committed, an arrangement would at once be made to put a keeper at the place, and possibly entrance fees would have to be charged in order to pay the expenses."

PROF. A. H. KEANE'S translation of "The Necropolis of Ancon, in Peru," a German contribution to our knowledge of the culture and industries of the empire of the Incas, presenting the results of excavations made on the spot by W. Reiss and A. Stübel, has been issued in fourteen parts by Messrs. A. Asher and Co. during the years 1880–87. The work is now ready in three volumes, which contain, besides a comprehensive text, 141 coloured plates in folio. A separate volume, complete in itself, but at the same time forming a supplement to the present work, is in course of preparation. It will contain treatises by Herren W. Reiss, A. Stübel, L. Wittmack, R. Virchow, and A. Nehring.

WE have received Part I. of the Annual Report of the Board of Regents of the Smithsonian Institution, showing the operations, expenditures, and condition of the Institution, to July 1885. In addition to the Secretary's Report, there is a general appendix containing some valuable scientific papers. In one set of these papers an account is given, by eminent writers, of the progress made during the year 1884 in astronomy, geography, physics, chemistry, and other sciences. Other papers deal with various problems in anthropology.

THE Clarendon Press is publishing a fourth edition of "Exercises in Practical Chemistry," by Mr. A. G. Vernon Harcourt,

F.R.S., and Mr. H. G. Madan. The first volume, containing elementary exercises, has been issued. In the preface to this new edition, Mr. Madan, who has undertaken the task of revision, explains that he has made some verbal alterations, introduced additional experiments and exercises, and somewhat altered the course of analysis of a single substance. In many cases the preparation of useful compounds of the radicle is more fully dealt with than in former editions.

THE "Flora of West Yorkshire," a volume of about 800 pages, by Mr. Frederick Arnold Lees, will be ready in August. It will be published by the Yorkshire Naturalists' Union, by subscription, and will form an extra volume of the Botanical Series of the Transactions of the Union. The work is divided into four sections—(1) Climatology; (2) Lithology; (3) the Botanical Bibliography of the Riding; (4) the Flora proper. With regard to the fourth section, it is claimed that "such a complete flora for any district in the world has never before been published, more than 3000 species being dealt with."

AN interesting volume relating to the "Grand Concours International des Sciences et de l'Industrie," which is to be held at Brussels in the year 1888, has just been issued. It consists of reports drawn up by the Committees which have been appointed to make preparations for the Exhibition. Each of these reports includes a letter addressed to producers, a general and detailed classification of objects, a list of sub-committees, and a series of desiderata in the department to which the report relates. If the "Grand Concours International" corresponds to the scheme which the Committees have worked out, it will be one of the most complete and suggestive Exhibitions that have yet been held.

ON August 7 the University of Göttingen will celebrate the 150th anniversary of its foundation.

THE annual *conversazione* given by the students of the Finsbury Technical College was held on Friday the 15th inst., and was remarkably successful. The College was tastefully decorated with flowers and flags, and a large fountain, illuminated by powerful coloured arc and incandescent lamps, played during the evening. All the rooms were thrown open to visitors, and exhibitions of chemical, electrical, and mechanical apparatus and manufactures were arranged in the laboratories. Over fifty of the leading scientific firms lent exhibits, and one electrical firm sent over £500 worth of apparatus. In the workshops specimens of the work of the students during the session were shown. Two concerts, both attended by crowded audiences, were given; and Prof. Ayrton lectured on "Church Bells," and Prof. Meldola on "Spectrum Analysis." Over four hundred visitors were present, including many distinguished men of science and commerce; and the students are to be congratulated on having provided a very pleasant entertainment for their friends.

THE additions to the Zoological Society's Gardens during the past week include a Pig-tailed Monkey (*Macacus nemestrinus*) from Java, presented by Mrs. Lewis; a Tiger (*Felis tigris* ♂) from India, presented by Mr. Sandford Kilby; a Turtle-Dove (*Turtur communis*), British, presented by Mr. R. Humphries; a Bonnet Monkey (*Macacus sinicus* ♀) from India, two Booted Eagles (*Nisaetus pennatus*) from Spain, a Golden-crowned Conure (*Conurus aureus*) from Brazil, two Alligators (*Alligator mississippiensis*) from the Mississippi, two Common Toads (*Bufo vulgaris*) from North Africa, deposited; a Ruffed Lemur (*Lemur varius*) from Madagascar, an Elate Hornbill (*Ceratogymna elata*) from West Africa, two Common Boas (*Boa constrictor*) from South America, purchased; a Squirrel-like Phalanger (*Belideus sciureus*) born in the Gardens; two Diuca Finches (*Diuca grisea*), an Auriculated Dove (*Zenaida auriculata*) bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE NICE OBSERVATORY.—M. Faye has published in the *Comptes rendus*, tome cv. No. 1, a note on the work of the Nice Observatory, from which the following particulars are extracted:—As soon as a small meridian circle by Gautier had been erected at the new Observatory, M. Perrotin, the Director determined the difference of longitude telegraphically from Paris and from Milan. These operations gave for the difference: Paris–Milan, 27m. 25·325s., whilst a direct determination previously made by MM. Perrier and Celoria gave 27m. 25·313s. The value 43° 43′ 16″·9 has been provisionally adopted for the latitude. With the equatorial of 0·38 m. aperture M. Perrotin has undertaken an extensive series of double-star measures, which have already proved of great excellence and value. It is proposed to continue these measures on a more extended scale with the large telescope of 0·76 m. aperture. A large number of observations of comets and of minor planets have been made by M. Perrotin and by M. Charlois, his assistant. The latter has also quite recently discovered a new asteroid (No. 267). M. Faye goes on to speak of the spectroscopic researches carried out at Nice by the late M. Thollon, particularly those connected with the investigation of the telluric lines in the solar spectrum. As our readers will remember, M. Thollon showed that in the regions B and α of the solar spectrum some of the telluric lines are due, not to an element varying with the temperature, such as aqueous vapour, but to a constituent of the atmosphere, such as oxygen, the influence of which varies with the altitude of the Sun only. M. Egoroff afterwards confirmed this by showing that the lines referred to are due to the oxygen present in our atmosphere.

The instrumental equipment of the Nice Observatory is now all but complete, and M. Faye speaks with enthusiasm of the career of usefulness before it—favoured as it is with a splendid climate, and, thanks to the munificence of M. Bischoffsheim, with instruments which suffice to place it in the front rank of modern Observatories.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 JULY 24–30.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on July 24

Sun rises, 4h. 14m.; souths, 12h. 6m. 14·3s.; sets, 19h. 59m.; decl. on meridian, 19° 54′ N.: Sidereal Time at Sunset, 16h. 8m.

Moon (at First Quarter on July 27) rises, 8h. 38m.; souths, 15h. 26m.; sets, 22h. 0m.; decl. on meridian, 5° 53′ N.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Decl. on meridian. ° ′
Mercury ...	5 20	12 33	19 46	13 24 N.
Venus	8 33	15 1	21 29	4 47 N.
Mars	2 8	10 28	18 48	23 53 N.
Jupiter... ...	12 20	17 35	22 50	9 29 S.
Saturn... ...	3 48	11 48	19 48	20 57 N.

Occultation of Star by the Moon (visible at Greenwich).

July.	Star.	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image. ° °
25 ...	B.A.C. 4277 ...	6 ...	20 20 ...	20 45 ...	34 350

July.	h.	
24 ...	4 ...	Venus in conjunction with and 3° 8′ south of the Moon.
27 ...	1 ...	Jupiter in conjunction with and 3° 59′ south of the Moon.
29 ...	5 ...	Mercury in inferior conjunction with the Sun.

Meteor-Showers.

The Aquarids, R.A. 340°, Decl. 13° S., near δ Aquarii, form the principal meteor-shower at this season of the year; the meteors from this radiant are slow, in marked contrast to those from Perseus, radiant at R.A. 32°, Decl. 55° N., at the same time, which are swift.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·3	81 16 N.	July 27,	21 51	*m*
Algol	3 0·8	40 31 N.	,, 30,	2 5	*m*
δ Libræ	14 54·9	8 4 S.	,, 29,	22 50	*m*
S Ophiuchi	16 27·8	16 55 S.	,, 30,		*M*
U Ophiuchi	17 10·8	1 20 N.	,, 26,	3 16	*m*
			26,	23 24	*m*
U Sagittarii	18 25·2	19 12 S.	,, 25,	0 0	*M*
β Lyræ	18 45·9	33 14 N.	,, 25,	8 30	*M*
T Sagittarii	19 9·7	17 10 S.	,, 28,		*M*
S Vulpeculæ ...	19 43·8	27 0 N.	,, 25,		*M*
η Aquilæ	19 46·7	0 43 N.	,, 25,	22 0	*M*
R Vulpeculæ ...	20 59·4	23 22 N.	,, 28,		*M*

M signifies maximum; *m* minimum.

GEOGRAPHICAL NOTES.

THE new supplementary part of *Petermann's Mitteilungen* (No. 87) is devoted to Dr. R. von Lendenfeld's explorations in the Australian Alps in 1885–86. The region explored by Dr. Lendenfeld covers the greater part of the mountain districts of Victoria and New South Wales, and already in NATURE and elsewhere he has given some details concerning the geological and glacial results of his work. In the present memoir he gives a sketch of the Australian Alps in general, their geology, physiography, meteorology, flora, and fauna; he indicates the general physiognomy of the mountain system, its leading ranges, its valleys, and its river systems. He then devotes separate sections to the Kosciusko group and the Bugong group, and to a discussion of the Australian Ice period. There can be no doubt, Dr. Lendenfeld maintains, that at one time the Australian highlands were deeply glaciated, and that during the Tertiary the climate of the country must have been far richer in moisture than it is at the present day.

IN the new number (vii.) of *Petermann's Mitteilungen* Dr. Gerhard Rohlfs describes in a letter to Dr. Schweinfurth the results of his recent exploration of the limestone plateau which borders each side of the great Wadi Arabah, in Central Egypt. General Tillo brings together elaborate data bearing on the variation of the mean sea-level above or below a normal zero in the various seas of Europe; and Nikolaus Latken contributes a short paper on mining in East Siberia for 1874–85. There is an excellent map of the Khuriseb Valley, extending south-east from Walfisch Bay, West Africa, by Dr. Stapff, which, with the accompanying paper, gives a very full idea of the geology of the region.

A NUMEROUS and carefully-equipped Expedition is being sent out this summer by the Finnish Society of Botany and Zoology for the exploration of the interior of the Kola Peninsula. Another Expedition, organized by the St. Petersburg Society of Naturalists, set out last month to Petropaulovsk, to explore the White Sea and the Mediterranean coast.

UNDER Prof. O. Doering, the Government of the Argentine province Cordoba is establishing a network of meteorological stations which will begin work in January 1888. It is intended to form and equip 40 stations of the first order, 15 of the second, 10 of the third, and 10 of the fourth order. The instruments are being obtained from Berlin.

DR. L. BRACKEBUSCH, Professor of Geology and Mineralogy in the University of Cordoba, has recently returned from a five-months' excursion in the Cordilleras, bringing with him rich collections of minerals, and a mass of geological, geographical, and hypsometrical data.

THE Venezuelan Government has, it is stated, organized an Expedition for the geological and anthropological exploration of the territory on the Upper Orinoco and the Amazons.

AT a recent meeting of the Geographical Society of the Pacific, Prof. Davidson stated that his study of the ocean currents had brought him to the conclusion that a branch of the Japanese warm current, the Kuro Siwo, does pass into the Arctic Ocean through Behring Strait; and he promised to lay before the Society, at a future meeting, some information on the subject.

ACCORDING to the last mail from Zanzibar Lieut. Wissmann has arrived at the Kavala mission station on Lake Tanganyika. The explorer left Luluaburg on the Sankuru in November last, to traverse the unknown country in which are the sources of the Lulongo, the Chuapa, and the Lomami. He then meant to reach Lake Tanganyika by Nyangwé.

TO the last part of the *Verhandlungen* of the Vienna Geographical Society (Nos. 5 and 6 of Band xxx.) Herr W. Putick contributes a valuable paper on the subterranean district of Inner Carniola, the curious region known as the Karst.

THE TECHNICAL EDUCATION BILL.

THE following is the speech delivered by Sir W. Hart Dyke on Monday in introducing the Technical Education Bill into the House of Commons:—

"In the observations that I am about to make I shall be as concise as possible, because I know that members are waiting to deal with other important matter. I feel that I am guilty of something like cruelty in introducing at this period of the session, after all we have gone through and with the labours still before us, any further legislation, but I plead in extenuation the fact that this is no new topic. It is one which has for some time past stirred up among the artisan classes considerable interest. Voluntary efforts have for some time past been made in this country in regard to technical instruction, and if I am asked why it is that we are going to endeavour to supplement by legislation what has been done the answer is that it is because we believe in the reality of this movement. For some years, not only among our artisan classes, but among our large employers of labour in industrial centres, it has been recognized that, though the commercial depression cannot be traceable to the lack of technical and commercial education in this country, yet that some part of it is due to the fact that Continental nations have had great advantages over us in regard to technical training for their youths, and that this has given them considerable commercial advantages over us. I am encouraged to hope that these proposals will meet with some acceptance from the House. If they enable the best material which is now turned out by our schools to continue longer in their school life and to start into some new educational groove for the benefit of themselves and of the industrial localities in which they live, and for the benefit also of the community at large, I think I may venture to urge that the time of the House will not be wasted in discussing these proposals. It is perfectly true that it may be urged that as I have not long held my present office I am rather rash in introducing this subject, and still more so considering that a Royal Commission has been sitting for some time and dealing with this great educational question. But I think that the House will agree with me that this is somewhat outside the scope of the Commission which is now sitting. There was a Royal Commission on Technical Education which reported in 1884. That Commission let in a flood of light on the question of technical instruction, and I should like for one instant to refer to their special recommendation as regards this country. As the House is aware, that Commission extended its labours to Continental countries, and conducted an exhaustive inquiry in connexion with this subject. The Commission pointed out that there was a considerable difference in respect of our treatment of the educational question and its treatment in countries abroad. They also pointed out that with the exception of France there was no European country of the first rank that has an educational Budget so large in amount as our own. They say that all our existing educational institutions will not alone accomplish the object aimed at, and that the localities must rely more than they have done hitherto upon their own special exertions. I may quote further from the Report of the Commission in reference to the advisability of introducing technical instruction into our schools. The Commissioners state that in Manchester, Sheffield, Birmingham, and other great centres, a considerable step has already been made in this direction, and they ask this pertinent question: "If we introduce needlework into girls' schools, why should not grants be made for manual instruction in boys' schools?" The Commissioners also recommended that rudimentary drawing should be continued through-

out the standards. These are some of the recommendations with which the present Bill proposes to deal. I think I am not taking too sanguine a view of this scheme when I say that it will carry out all those proposals. The object of the Bill is to enable local authorities to provide for the establishment of technical schools or to assist in providing them, and also to give local authorities power to supplement existing teaching in elementary schools by technical instruction, whether by day or evening classes. There will also be a proposal in the Bill with regard to the ratepayers, to whom a power of vetoing any proposal under the Bill will be given. We propose that the Bill should be administered by the Science and Art Department—that is to say, that it should be administered subject to the directorate of that Department. We also propose that the Bill should have the limitation that no scholar should come under its operation until he has reached the sixth standard. The authorities for administering the powers conferred by the Bill will be School Boards where they exist, and where they do not exist town councils. I should just like to refer to Clause 4 of the Bill. To make the Bill acceptable to the ratepayers you must show that it is a cheap Bill and that consideration has been shown for them. Clause 4 is what I may call the operative clause of the Bill, and it enables local authorities to provide technical schools. Of course that would involve expense in building; but there is a sub-section of Clause 4 which enables the local authority to combine with any other local authorities. This will enable a system of combination to be adopted which will prove a great saving to the ratepayers; and, further, the next sub-section provides that the local authority may contribute towards the maintenance or provision of any technical school which has been established by any other local authority. It is further intended to include a provision that local authorities shall be empowered to rate for the purpose of supplementing any existing institution. These, I think, the House will admit are provisions which will enable this Bill to be worked cheaply. A further sub-section gives the local authority power to make any arrangements it may deem necessary or expedient for supplementing the technical instruction at present given in the schools. This provision I consider one of the most valuable in the Bill. It will enable technical instruction to be at once given without putting the ratepayers to any expense in building. I should like to refer for a moment to the limitation to the sixth standard. Though this will necessarily exclude many children, I think all interested in education will admit that the Bill should apply to the pick of our scholars, and that a good educational foundation should be required. With regard to the question of agricultural instruction, I am free to admit that the Bill, as drawn, can extend that instruction only to a very small extent, but I believe that the measure is capable of very considerable development, and that under certain of its sub-sections agricultural instruction may be afforded to a satisfactory extent. It is proposed to insert a provision in the Bill that where any local authority passes a resolution to establish a technical school a certain proportion of the ratepayers may demand a poll, but I am here at once met with a difficulty with regard to the metropolis—namely, that it is very wrong to propose to bring into existence the enormous voting power within the metropolis for such a purpose by this Bill. It may be asked how I propose to protect the ratepayers of the metropolis in regard to this matter. I have a proposal on the subject which has been drawn up by the Vice-Chairman of the London School Board, the hon. member for Worcestershire, and which has received the approval of the Chairman of that Board. I believe, from all I can gather, that that proposal will be popular with the present London School Board, and that it has been accepted by the hon. members for the metropolis who have been consulted in this matter, on the understanding that this policy alone will be carried out by the London School Board until the next election. I believe, also, that this proposal will be approved by the ratepayers of the metropolis. I have been asked by the hon. member for Worcestershire whether the scheme would not involve an extra charge for building, and I have been able to assure him that it will not do so. Therefore, Sir, I am prepared to admit that the members for the metropolis must be considered in this matter. Of course, if they think that further security to the ratepayers will be necessary it will be possible to insert an addition to this clause in the Bill to the effect that no action with reference to this Bill shall take place until after the next School Board election. I believe it would be a mistake to do anything of the kind; I believe that the interest of the ratepayers and of the great mass of working men in the metropolis may be safely trusted in the manner proposed by the Bill. Then, Sir, I may be asked this question, which, I think, is a very pertinent one. It is true that a vast amount has already been expended in the cause of technical instruction, and I may be asked: "If you once establish the principle of rating, will you not check the principle of voluntary effort?" I believe we shall do nothing of the kind, for several reasons. I believe that this will be an essentially popular measure among the working classes. I believe it will be impossible to check voluntary effort in a cause such as this where you supplement it by rates, for I believe that those who are spending money voluntarily are doing it in a cause which they know to be a very vast one, and that for all sums of money whenever spent in this cause more than compound interest will be repaid as the result. There are numerous instances in regard to this matter. It was only the other day I noticed that in Lambeth the Public Libraries Act was adopted. That is a case in point. What was the result there of adopting the principle of rating? I noticed that at the concluding meeting held, when arrangements were to be made for this new library under the system of rating, the hon. member for Barrow-in-Furness, who was in the chair, announced that a friend of his had not only given the ground but was going to build the whole library at his own cost. Numerous instances of the same type have come under my notice. Therefore I do not think we ought to dread that the establishment of voting power will check in any degree voluntary effort. I have only one other point to deal with—the administration of this Bill. We propose that this Bill shall be administered by the Science and Art Department at South Kensington. I have been anxious that the Bill should be so administered, for there we have a Department whose educational capacity has been thoroughly well tested. I have heard some hon. members attack the results of South Kensington as rather expensive. I am anxious that the House should be in a position to judge of the actual yearly expenditure at South Kensington, not only as regards administrative expenditure, but as regards its results. By the leave of the House, I shall therefore lay upon the table a document that will show in a concise form the actual expenditure at South Kensington for five years, both as regards administration and as regards results. Hon. members will then see how vast an increase there has been as regards payment by results and how small has been the increase of administrative expenditure. I should like to read to the House what that Department is now doing with regard to science and art. During 1886-87 there were 1936 schools or separate institutions in which instruction was given in one or more branches of science. There were 6976 classes in different branches of science, and the number of individual students under instruction was 100,419. At the May examination 127,900 papers were sent up for examination to South Kensington. I should like also to give some more instances to show the vast strides made in chemical instruction. In chemistry, 21,085 papers were worked at examinations. To show the advance made of late years in the facilities afforded for instruction in science of a thoroughly practical and experimental character, it may be mentioned that thirty years ago there were only one or two places where students could obtain laboratory instruction in chemistry, and that at very high fees. The Royal College of Chemistry, established in 1845, was one of these. Another was soon after started in Craig's Court. Now there are 234 chemical laboratories in connexion with the Science and Art Department in which students can obtain laboratory instruction at very low fees. There were 4257 separate benches at the last examination which afforded accommodation for 16,155 candidates. In the last session there were in operation 234 schools of art and 626 art classes, with 71,132 students in them; 50,000 were examined in May last, and the number of papers worked was 75,678. I should not for one moment have attempted to put the administration of this Bill under the Department of Science and Art at South Kensington if I had any doubt of its ability to work it with efficiency and economy. I thank the House for the attention with which it has heard me. I need not go again through the details. Happily this cannot be regarded as a party question. It is one which interests members on each side of the House, and although I do not submit the Bill as covering all the ground of technical instruction, I do believe that it is a measure which will do an enormous amount of good to our industrial population. In conclusion I would urge that, if it were only for the two provisions alone with

regard to continuation classes and to evening classes, this Bill is worthy of the serious consideration of the House. I hope that hon. members will not at this time of the session overload the Bill with amendments.

SCIENTIFIC SERIALS.

Bulletin de la Société des Naturalistes de Moscou, 1886, No. 3.—On two great comets (41 and 42) of 1886, by Th. Bredichin (in French).—On the *Agromyza lateralis* and its metamorphoses, by Prof. Lindeman (in German).—On the iron-bearing mud of Lipetzk, by E. Kislakovsky. It appears much like that of Franzensbad in Germany, and especially that of Ciechocinek in Poland.—On the Ammonites of the group *Olcostephanus versicolor* (Trautschold), by Mary Pavlow (in French, with two plates). Studying a rich collection of *Ammonites versicolor*, some of which reach 8 inches in diameter, while others have the size of a pin's head, the author considers them as belonging to the genus *Olcostephanus*, and establishes the following species, of which the last three are new: *O. versicolor*, *elatus*, *subinversus*, *inversus*, and *coronatiformis*.—On the importance of oxygen for plants, by W. Palladin (summed up in German). An elaborate research into the amount of matter destroyed in consequence of fermentation in an atmosphere devoid of oxygen, as also into the relations between the breathing of plants and their growth.—On the dynamic centra of a rotation-ellipsoid, with relation to earth, by K. Weihrauch, being a mathematical inquiry (in German) from which it results that the centres of attraction are situated in the earth nearer to the centre of figure than would be the case in an homogeneous ellipsoid of the same average density.—On the Algæ of Moscow, by A. Artari (in French), being a continuation of a former publication, and containing a list of eighty-five more species, chiefly Bacillariaceæ.—On the fauna of the lakes of the Slavyansk mineral waters, by P. Stepanoff. The fauna is mixed and contains representatives both of fresh-water and marine species, these latter being chiefly found amidst the Infusoriæ.—The annual report of the Society contains obituary notices of the late President of the Society, Dr. Renard.

No. 4.—Vascular plants of Caucasus, by M. Smirnoff. In this second paper (in French) the nebulosity of different parts of Caucasus is discussed, and data given.—Wild plants of the Government of Tambof, by D. Litvinoff, continued.—The species of *Thrips* living on corn in Middle Russia, by Prof. Lindeman (in German). The new species *Thrips secalina* and *Phlocothrips armata* are described together with former ones.—Zoological researches in the Kirghiz Steppe, by P. Nazarow, being a most valuable review of the fauna of the steppe, especially of its avi-fauna (with a map).—Speeches pronounced at the death of Dr. Renard.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 16.—"Experiments on the Discharge of Electricity through Gases." (Second Paper.) By Arthur Schuster, F.R.S.

In thinking over the phenomena presented to us in vacuum tubes, I always felt a difficulty owing to our ignorance of the conditions which hold at the surface of bodies, either suspended in or near the discharge, or even at the boundary of the vessel through which the discharge is passing. It is evident enough that if there is a flow of electricity on the surface of a non-conductor that flow must be tangential, but it is not so clear whether we are justified to conclude from this that there can be no normal forces at such surfaces, for it is not necessary that the flow should always take place along the lines of force.

Supposing we suspend two pieces of gold leaf, as in an electroscope, at any place in a partially exhausted vessel, and render them divergent by electrification, they should collapse as soon as the discharge begins to pass, if tangential forces only can permanently exist at their surface. This I have tested by experiment, and found to be the case.

A cylindrical glass vessel 38 centimetres high and 15 centimetres wide, was divided into two approximately equal compartments by a vertical metallic screen. There was an open space of about 5 millimetres between the screen and the sides of the vessel, a space of about 4 centimetres above, and 2·5 centimetres below the screen. One compartment contained two pieces of gold leaf, which could be charged from the outside. The other compartment contained two electrodes about 5 centimetres apart, and 2 centimetres from the screen; these distances could be varied during the experiment. The screen was always conducted to earth, and the electric fields on the two sides of the screen were therefore nearly independent of each other. When the gold leaves were electrified and divergent, and discharges from the induction-coil passed between the electrodes on the other side, no effect could be observed at atmospheric pressure: the gold leaves remained divergent.

At a pressure of about 4·3 centimetres of mercury, the effect I was looking for first appeared; when the discharge passed, the divergent leaves slowly collapsed, and as the pressure was further diminished the collapse took place more and more quickly.

We have here, then, even with the discontinuous discharge, a neutralization of all normal forces at the surface of the gold leaf.

It seemed to me to be interesting to observe more particularly the effects of the ordinary discharges we have at our command, at atmospheric pressure. I took two light balls, and suspended them so that they could be made to diverge by electrification. The electrodes (either spheres or points) of a Voss machine were placed at a distance of 3 inches from each other, and the electrified balls were placed at a distance of 9 inches from the discharge. The results are contained in the following table, in which the first two columns indicate whether the electrodes of the Voss machine were points or spheres. The third column gives the electrification of the balls, and the fourth column the results.

Negative electrode.	Positive electrode.	Balls.	Result.
Sphere	Sphere	Positive	Balls collapse slowly
,,	,,	Negative	,, remain divergent
Point	Point	Positive	,, collapse quickly
,,	,,	Negative	,, remain divergent
Sphere	,,	Positive	,, ,, ,,
,,	,,	Negative	,, collapse slowly
Point	Sphere	Positive	,, ,, quickly
,,	,,	Negative	,, remain divergent

It will be seen that when the two electrodes are similar, whether spheres or points, the balls collapse when they are electrified positively only; but that when one electrode is a sphere and another a point, the balls collapse if their electrification is of the opposite nature to that supplied by the point.

The conclusion thus arrived at, which will be proved beyond possibility of doubt in the second part of this paper, is this: we can only have tangential forces at the surfaces of vessels inclosing a gas through which a discharge is passing, provided no current crosses the surface.

After I had convinced myself that an electrified body placed in a partial vacuum through which an electric current is going, has its electricity quickly neutralized, it was doubtful still whether this neutralization was due to an actual discharge or merely to a covering of electrified particles of an opposite sign. The question is a vital one in all cases where potentials have to be measured. For we can only measure potentials of a gas by measuring the potential of a metal in contact with it; and if an electrified body is covered by electrified particles of a different sign, there is a finite difference of potential between the metal and the gas, and we should have to inquire carefully, in each particular case, how far such a difference would affect our conclusions.

The question is settled by the principal result of this paper:

A steady current of electricity can be obtained in air from electrodes at the ordinary temperature which are at a difference of potential of one-quarter of a volt only (and probably less); provided that an independent current is maintained in the same closed vessel.

In other words, a continuous discharge throws the whole vessel into such a state that it will conduct for electromotive forces which I believe to be indefinitely small, but which the sensitiveness of the galvanometer I used has prevented me from tracing with certainty below a quarter of a volt. There cannot be therefore a finite difference of potential between a gas and a metal in contact greater than that amount.

The same vessel was used as in the previous experiment.

On one side of a screen conducted to earth, were the two main electrodes, from which the current of the large battery passed. On the other side were two auxiliary electrodes connected to the two poles of a small battery. Whenever the main current passed, the small battery was found to send a steady current which could be measured. The smallest electromotive force which was observed to send a current under these conditions was one-sixth of a Leclanché.

An electromotive force of one-sixth of a Leclanché is about one-quarter of a volt, and a current has thus been obtained in a gas from an electromotive force which could not maintain a current through water.

An electromotive force of 0·1 volt gave doubtful results, but this was probably due to the experimental difficulty of detecting the current.

In some previous experiments, which, however, were not quite free from objection on other grounds, the lowest electromotive force for which the currents could be measured was 0·2 volt.

The experimental arrangement which is the best for the qualitative investigation of the effect is not the best for quantitative measurements, and I have therefore not endeavoured to follow out to any great extent the quantitative laws of these currents produced by low electromotive forces. I may give, however, some facts which I have observed. The intensity of the current depends on a great many circumstances.

(1) It increases rapidly with the intensity of the main discharge, and also with a reduction of pressure, as far as I have tried it (that is about half a millimetre).

(2) The intensity of the current from the auxiliary battery increases less rapidly than the electromotive force.

(3) In some experiments, in which one of the electrodes of the auxiliary battery was a copper wire and the other a copper cylinder, the current was nearly always considerably stronger when the larger surface was the kathode.

(4) Anything that facilitates the diffusion of gas from the main current to the auxiliary electrodes will increase the strength of the current observed. In some experiments, in which the screen separating the two fields was made of wire gauze instead of tinfoil, the currents were stronger than those given above.

These experiments show conclusively that there is nothing peculiar in the gaseous state of a body to prevent any electromotive force, however small, to produce a current. If a finite electromotive force is required under ordinary circumstances, the fact cannot be accounted for, as Edlund and others have done, by a special surface resistance which has to be overcome by a finite difference of potential at the surface.

I think the facts are very well accounted for by the theory which I have proposed in my last paper. If the two atoms of a gas making up the molecule are charged with opposite electricities, but are held together in addition by molecular forces, a finite force is required to overcome the latter. But as soon as that force is overcome and the atoms themselves are set free to diffuse and constitute a current, these atoms will be able to follow any electromotive force which we may apply. If, then, we have auxiliary electrodes, these electrodes will establish their electric field, which we can never screen off completely from any other part of the vessel except by closed surfaces. The atoms, with their positive and negative charges, will diffuse across to the auxiliary electrodes and give off their electricity to them. No finite difference of potential is required in the auxiliary electrodes, because, even if there is work done in making an atom interchange its positive for negative electricity, that work is undone again at the other pole, where atoms of a similar kind interchange negative for positive electricity.

I should like, in conclusion, to point out an important application of these results. I have last year obtained by calculation results which seem to show that the principal cause of the diurnal variation of terrestrial magnetism is to be looked for in the upper regions of the atmosphere. Prof. Balfour Stewart at various times suggested that the air-currents in these regions may, owing to the lines of force of terrestrial magnetism, have electric currents circulating in them.

The difficulty against this supposition always seemed to me to lie in the fact that the electromotive forces required to start a current were larger than those which could possibly exist in the atmosphere. But as there are very likely continuous electric disturbances going on, such as we observe in auroræ and thunderstorms, the regions within which these discharges take place would act as conductors for any additional electromotive force however small, so that any regular motion, such as tidal motions, could very well produce periodic effects affecting our magnetic needles.

If these original discharges increase in importance, then, according to the results obtained in this paper, the currents due to the smaller periodic causes would increase also, and they may increase in a very rapid ratio. We know that the electric discharges in the upper regions of the atmosphere are considerably stronger at times of many sunspots, and this may account for the fact that at those times the amplitude of the daily oscillation of the magnetic needle is considerably increased.

I have had considerable assistance in these experiments from my assistant, Mr. Stanton, to whom my best thanks are due.

Geological Society, June 23.—Prof. J. W. Judd, F.R.S., President, in the chair.—The following communications were read:—On nepheline rocks in Brazil, with special reference to the association of phonolite and foyaite, by Mr. Orville A. Derby. The author refers to the phonolites and associated basalts of Fernando Noronha, a deep-sea island off the north-eastern shoulder of the continent of South America. Nepheline rocks of a somewhat different character are abundantly developed on the mainland, and under conditions favourable for throwing light on the relations existing between the granitic type, foyaite, and the other members of the group. There are some mountains near Rio de Janeiro composed of these rocks, as is also the peak of Itatiaia, 3000 metres high, the loftiest mountain of eastern South America. A cursory examination of some of these localities having shown an apparent relation between foyaite, phonolite, trachyte, and certain types of basalt, Mr. Derby determined to visit the Caldas region, where a railway under construction gave unusual facilities for examining this series. A fine development of foyaite, phonolite, and tuff was found, associated with several types that have not yet been met with in the other localities. The existence of a leucite basalt was recognized. The bulk of the paper was devoted to a detailed description of these railway-sections, and the following deductions are drawn:—(1) The substantial identity, as regards mode of occurrence and geological age, of the Caldas phonolites and foyaites. (2) The connexion of the latter through the phonolites with a typical volcanic series containing both deep-seated and aërial types of deposits. (3) The equal, if not greater, antiquity of the leucite rocks as compared with the nepheline rocks, whether felsitic, as phonolite, or granitic, as foyaite. (4) The probable Palæozoic age of the whole eruptive series. The President said it was seldom that a paper containing such important facts was presented to the Society. It was reserved to Mr. Derby to have proved that plutonic rocks containing nepheline (foyaite) passed into volcanic masses which were true phonolites. This Mr. Derby had clearly established by observations in the field. He had also shown that leucite existed in rocks of Palæozoic age, thus rendering untenable the last stronghold of those who insisted on making geological age a primary factor in petrographical classification. He alluded also to the value of the independent determinations of Prof. Rosenbusch. Mr. Bauerman said he had been over portions of the ground with the author, and was glad to add his testimony to the value of the paper. He spoke of the importance, in a geological sense, of these generalizations. It was remarkable how highly crystalline masses of rock pass over into a sort of phonolite. These were associated with Palæozoic masses, which were pre-Permian, or at least pre-Triassic. He alluded to the difficulty of investigating Fernando Noronha, and also to the difficulties attendant upon the investigation of rocks in Brazil, which were subject to such an enormous amount of local alteration. Prof. Bonney also expressed his sense of the value of the paper. He alluded to the comparative rarity of nepheline and leucite rocks, and to the confusion in the nomenclature. He was reminded of the nepheline rocks near Montreal, where dolerite was broken through by nepheline syenite, associated with tephrites and phonolites. Although there might be a doubt here, these rocks were most probably of Silurian age; but the evidence in Brazil was still clearer as to the Palæozoic age, and he believed that, in the case of some other masses, the evidence had satisfied the Canadian geologists. He alluded also to the nepheline rocks in the Katzen-Buckel, where there was a similar passage from coarse-grained to fine-grained. Dr. Hatch said that in this case leucite was clearly shown to be of Palæozoic age, and regarded the paper as a step towards the better classification of this group of rocks. Prof. Seeley asked for evidence as to the identification of the leucite. The President thought there was no possibility of a mistake in this respect. As regards the rocks of the

Katzen-Buckel, none were truly holocrystalline, and hence they could not be compared with foyaite or elæolite-syenite.—Notes on the metamorphic rocks of South Devon, by Miss Catherine A. Raisin, B.Sc. Communicated by Prof. T. G. Bonney, F.R.S.—On the ancient beach and boulders near Braunton and Croyde in North Devon, by Prof. T. McKenny Hughes.—Notes on the formation of coal-seams, as suggested by evidence collected chiefly in the Leicestershire and South Derbyshire coal-field, by Mr. W. S. Gresley.—Note on some Dinosaurian remains in the collection of A. Leeds, Esq.; Part I. *Ornithopsis leedsii*, Part II. *Omosaurus*, sp., by Mr. J. W. Hulke, F.R.S.—Notes on some Polyzoa from the Lias, by Mr. Edwin A. Walford.—On the superficial geology of the southern portion of the Wealden area, by Mr. J. Vincent Elsden. Communicated by the President.—Report on palæobotanical investigations of the Tertiary flora of Australia, by Dr. Constantin Baron von Ettingshausen.—On some new features in *Pelanechtnus coralinus*, by Mr. T. T. Groom. Communicated by Prof. T. McKenny Hughes.—On boulders found in seams of coal, by Mr. John Spencer.

EDINBURGH.

Royal Society, June 6.—Mr. J. Murray, Vice-President, in the chair.—Mr. J. B. Readman read a paper on a furnace capable of melting nickel and cobalt.—Mr. R. Kidston communicated the last part of his paper on the fossil flora of the Radstock series of the Somerset and Bristol coal-fields.—Prof. Grainger Stewart read a paper on investigations into the discharge of albumen from the kidneys of healthy people.—Dr. H. R. Mill communicated the result of his investigations on the salinity and temperature of the Firths of Inverness, Cromarty, and Dornoch, and of the North Sea.—Prof. Ewart discussed the existence of Bacteria in the lymph, &c., of fish and other vertebrates.

June 20.—Sheriff Forbes Irvine, Vice-President, in the chair.—Prof. Geikie communicated a paper by Prof. Frederico Sacco on the origin of the great Alpine lakes.—Dr. E. Sang read a paper on the minute vibrations of a uniform chain hung by one end, and on the functions arising in the course of the inquiry.—Dr. A. W. Hare read a note on the biological tests employed in estimating the purity of water.—Prof. Tait submitted a paper by Mr. A. H. Anglin on alternants which are constant multiples of the difference-product of the variables.

PARIS.

Academy of Sciences, July 11.—M. Janssen in the chair.—Presentation of the minutes of the International Astronomical Congress for the execution of the photographic chart of the heavens, by M. Mouchez. It was stated that although the Congress held in Paris last April concluded its labours before the end of the same month, the publication of its proceedings has been delayed till now, owing to the necessity of sending the proofs for revision to the members scattered over various parts of the world. Two main resolutions were arrived at, the first regarding the adoption of the photographic process, and of a uniform class of instruments, so as to secure the greatest possible degree of homogeneity in the results. The instrument unanimously adopted was that of Gautier, already in use for two years in the Paris Observatory. The second resolution regarded the period and extent of work to be carried out at the various international stations. It was decided that there should be two series of stellar photographs, the first comprising stars to the 11th magnitude approximately, the second to include all down to the 14th magnitude, or about 15,000,000 altogether. A permanent Bureau was also appointed, for the purpose of executing the decisions of the Congress and maintaining constant relations between the members and the Observatories taking part in the work of stellar photography. A special bulletin may also perhaps be issued from time to time, to report generally on the progress of this great astronomic undertaking.—Heat of formation of hydrotelluric acid, by MM. Berthelot and Ch. Fabre. Four determinations effected by the agency of the perchloride of iron in solution, give a mean of 29·12 calories.—On the presence of microscopic crystals of albite in various limestone rocks of the Western Alps, by M. Ch. Lory. The genesis of these crystals appears to have been generally favoured in the Western Alps by the conditions under which the Triassic formations have been developed. They occur somewhat exceptionally in association with the Middle Lias at Villette, and about the head of the long fjord of the Miocene sea, which flowed from the Maritime Alps to a point a little north of Saint-Jean-de-Maurienne. Hence the formation of these microscopic crystals appears to be connected with the special character of the deposits, and to be independent of the more or less intense local mechanical actions which affected the various stratified rocks at the time of the Alpine dislocations.—Presentation of M. Godefroy Malloizel's volume containing a complete list of M. Chevreul's writings issued between the years 1806-86, by M. de Quatrefages. The cost of this publication has been met by the balance of the sum subscribed by the youth of France to strike a medal in honour of M. Chevreul on his hundredth anniversary. Besides the titles and dates of everything issued by M. Chevreul during the last eighty years, careful tables of contents are appended to all memoirs and scientific papers of any considerable length. An introduction is added by M. Desnoyers, Librarian of the Museum, and a fine portrait of the illustrious *doyen* of the *savants* of the whole world, by M. Champollion.—On antipyrine as a substitute for morphine in subcutaneous injections, by M. Germain Sée. The continued experience of the author since his first communication on antipyrine as an anæsthetic (April 18, 1887), shows its decided superiority over morphine in all cases of rheumatic, hepatic, and cardiac affections. It is administered in the same way, but is more easily prepared, more efficacious, and entirely free from the dangerous consequences too often attending the use of morphine.—On a simple dynamic method of determining the degree of isotropy of an elastic solid body, by M. E. Mercadier. According to Saint Venant, in all true solid isotropes $\frac{\lambda}{\mu} = 1$, where λ and μ are two characteristic quantities of a solid body, by means of which may be expressed all the coefficients relative to its elasticity (Lamé). Hence, if this relation can be measured for different bodies, their degree of isotropy may be determined by the difference between the value of such relation and unity. M. Mercadier here supplies a simple method for making this determination based on the theory of the vibrations of circular plaques, the laws of which have recently been verified by him. He shows, for instance, that for glass $\lambda = \mu$; that is to say, that it is an isotropous body. This is an extremely simple confirmation, by a *dynamic* process, of the result of the beautiful experiments made by M. Cornu on glass by a *static* method.—On the alums formed by selenic acid, by M. Charles Fabre. Continuing the studies of Wohlwil, Wöhler, and Petterson, the author here describes a series of selenic alums with alumina or sesquioxide of chromium base, which he has succeeded in preparing. They comprise the alums of alumina corresponding to the general formula $Al_2O_3 . 3SeO_3 + MO . SeO_3 + 24HO$, and the alums of chromium corresponding to the general formula $Cr_2O_3 . 3SeO_3 + MO . SeO_3 + 24HO$.—Researches on the reactions of the vanadates considered from the stand-point of chemical analysis, by M. Ad. Carnot. In this paper the author completes the study of the reactions produced between the vanadates and the chief metallic salts under the ordinary conditions of analysis. Amongst the salts here treated are those of cobalt, nickel, zinc, cadmium, copper, mercury, lead, and bismuth.

BERLIN.

Physiological Society, June 17.—Prof. Du Bois-Reymond, President, in the chair.—Prof. Ewald spoke on the behaviour of salol (salicylate of phenol) in the stomach, a question which he has investigated in order to obtain information as to the movements of the stomach in relation to the time in which the contents of this organ are sent on into the intestine. Prof. Nencki had stated that salol is not acted upon by gastric juice, but is split up into salicylic acid and phenol by the action of pancreatic juice. Prof. Ewald's experiments confirmed the statement that salol undergoes no change in the stomach; thus, after administering salol, this substance could be detected in portions of the contents of the stomach examined at intervals of from one-half to three hours after it had been taken. Pancreatic juice was found to be similarly inert on salol, but on the other hand it was decomposed by most alkaline fluids. When injected into the intestine through a fistula, salol could readily be detected after half an hour, as salicyluric acid, in the urine. Since, therefore, salol undergoes no change in the stomach, but is readily decomposed in the intestine, and appears in half an hour as salicyluric acid in the urine, it was found to be extremely well suited to the purposes of the proposed experiments. When salol is given to healthy men whose gastric apparatus is in

a normal condition, whether on an empty stomach, or with food, or at different stages of gastric digestion, salicyluric acid was found in their urine on an average three-quarters of an hour after it had been taken. From the data given above, the salol must have remained one-quarter of an hour in the stomach. In the case of patients suffering from gastric dilatation, the salol remained much longer in the stomach. The time which elapses between the administration of salol and the appearance of salicyluric acid in the urine may hence be used as an important means of diagnosing cases of slight gastric dilatation. After prolonged electrical stimulation of the abdominal muscles, the passage of salol into the intestine was quickened.—Prof. Zuntz criticised a theory of the excretion of carbonic acid in the pulmonary alveoli which has been put forward by von Fleischl, according to which the shock given to the blood by the contraction of the heart is to be regarded as the chief cause of the diffusion of the carbonic acid through the alveolar walls. The speaker refuted this theory as being both unproved and unnecessary.—Dr. Goldschneider communicated the results of his experiments on the reaction-time of the perception of temperature. It has been known for a long time that cold is more quickly perceived than heat. As a starting-point, the speaker had first carried out some direct measurements. He sought out portions of the surface of the body which were equally sensitive to heat and cold; these parts were then stimulated as far as possible with equal intensity, and the results were as follows, taken as a mean of about two thousand separate measurements:—The reaction-time for cold as a stimulus is for the face 13·5, for the arm 18, for the abdomen 22, and for the knee 25 hundredths of a second. When an equally strong heat stimulus was applied, the numbers obtained were 19, 27, 62, and 79 hundredths of a second. The ratio of the reaction-times was found to be about the same when the stimuli were applied to such a nerve as the trigeminal which goes straight to the brain and to a spinal nerve. The experiments on thermal stimulation were made by bringing a metallic button in contact with the skin and recording electrically the moment of contact; the resulting sensation was indicated by a Beiss key. The degree of heat and cold employed as a stimulus was selected so as to differ by equal amounts from the temperature of the skin. From the results of the experiments, Dr. Goldschneider deduced some theoretical conclusions as to the nature of our sensations of heat and cold.

Physical Society, June 27.—Prof. von Helmholtz, President, in the chair.—Prof. von Bezold demonstrated the currents, which he has very fully investigated, which occur in a fluid as the result of varying temperatures or the rotation of the vessel in which the fluid is contained. These currents were made visible, as they occur in a large mass of water, by means of a few drops of hectograph ink, which at first spreads itself out in radiating lines over the surface, then sinks in the form of threads and columns, and, following the direction of the currents in the fluid, presents an extremely interesting appearance of rotatory formations.—Dr. Richarz has closely studied what takes place in an electrolyzing cell during the decomposition of water in the immediate neighbourhood of the electrodes during the passage of the currents of electrolytic convection. As is well known, an electromotive force of 1·5 Daniell is necessary in order that the current may pass electrolytically and the water be decomposed; if the electromotive force is less than the above, the water is not decomposed, but at the same time it can be shown that the electricity does traverse the fluid. According to Von Helmholtz's views on electrolysis, when the electromotive force is small, currents of electrolytic convection pass through the fluid, which are kept up by the occlusion of the positively charged hydrogen atoms at the kathode and by the neutral oxygen in solution. Starting from the work of Moritz Traube, who has proved the formation of hydrogen peroxide at the kathode in the electrolyzing cell, Dr. Richarz has been able to prove, both qualitatively and quantitatively, the formation of hydrogen peroxide at the kathode during the passage of convection currents. This formation of the peroxide takes place, according to the views of the speaker, by the union of two atoms of the occluded hydrogen with the neutral molecule of the dissolved oxygen, which has given up its positive charge to the kathode. As the result of this separation of the occluded hydrogen, fresh portions of hydrogen can be occluded by the metal of the electrode, and in this way a renewal of the electric current can take place.—Prof. Neesen described a vapour-calorimeter, consisting of a glass vessel into the centre of which projects a glass tube, closed at the lower end, for the reception of the substance under investigation. This tube is surrounded with a mass of lamp-wick, which is saturated with ether, and dips into a small quantity of liquid ether in the bottom of the outer vessel. Another glass vessel, exactly similar to the above, is joined to it by means of a capillary U-tube, in which a small drop of ether serves as an index. When a warm substance is dropped into the calorimeter, an amount of ether is converted into vapour proportional to the heat given up, and the volume of this vapour, as measured by the displacement of the ether index, gives the heat yielded by the substance. Prof. Neesen is still engaged in testing and improving the calorimeter, and only made the above preliminary communication as this was the last meeting of the Society before the summer vacation.—Dr. Grunmach exhibited a double quartz plate, which was not made of a right- and left-handed quartz plate, but was cut from a twin crystal, in which the fusion of the two crystals is so perfect that every slice cut from this twin crystal may be used as a double plate in the polarizing apparatus.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

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