THURSDAY, MAY 30, 1889.

INTERMEDIATE EDUCATION IN WALES.

IT does not often happen, in these days of slow Parliamentary progress, that two educational measures, having an important bearing on the industrial and the intellectual welfare of the country, are read a second time within a week of each other. In our last issue we gave some account of Sir Henry Roscoe's Bill for the provision of technical education, and expressed our strong hope that it would pass through the remaining stages this session. No less heartily do we wish success to Mr. Stuart Rendel's Bill for providing intermediate and technical education in Wales, which was read a second time on May 15, after a debate which practically resolved itself into a chorus of approbation. It is, indeed, high time that something should be done. Secondary education, both in England and Wales, stands sadly in need of organization, but the claims of the Principality (to which the present measure is confined) are far stronger than those of England, so far as the necessity of immediate action is concerned.

The main grounds on which the special treatment of Wales in this matter is based are to be found stated in the Report of Lord Aberdare's Committee on Intermediate and Higher Education in Wales, which was published in 1881. It is there pointed out that the aggregate income of the educational endowments of Wales and Monmouth amounted to little over £14,000, against a total of more than £600,000 for England (excluding Monmouth). Nearly a third of these scanty endowments were to be found in Monmouth. In the matter of these endowments Wales is no better off now than it was then. Since 1881, it is true, the educational resources of Wales have been increased by the grant of £12,000 a year to the three University Colleges of Aberystwith, Bangor, and Cardiff. But even including this sum, which is really intended for higher education, the educational income of Wales is not nearly so great in proportion to the population as in the case of England, and what there is is so unequally distributed as not to be available where the need is greatest.

The result is that in many counties of Wales intermediate education can hardly be said to exist. The Schools Inquiry Commission estimated that about sixteen boys in every thousand ought to be receiving intermediate or higher education. The following quotation from the Report to which we have referred will show the destitution which existed in Wales in 1881, and which unfortunately still exists to a great extent to-day :—"Taking the population of Wales and Monmouthshire to be about 1,570,000, and reducing the estimate in consideration of the exceptional conditions of Wales from sixteen to ten per 1000, intermediate school accommodation should be provided for 15,700 boys, and that number ought to be in attendance. In contrast to this, our returns show *accommodation* in the public schools for less than 3000, and that accommodation to a great extent unsatisfactory. They also show an *attendance* of less than 1600."

This estimate only applies to *boys*, and the state of the case as regards girls' education is still worse. Only from two to three hundred girls were in 1881 in schools under any kind of public supervision, and the Committee naturally found great difficulty in devising recommendations which should adequately meet a case where, as they say, "the unsatisfied requirements are so great and the available resources apparently so meagre." Probably, on the whole, intermediate school accommodation ought to be provided for at least fifteen children per 1000 of the population, making a total of 23,500 school places. Less than a fifth of this number were provided in 1881 in schools under any kind of public supervision or control.

So much for the state of the case. Lord Aberdare's Committee reported in favour of aid being given to Welsh intermediate education both from rates and Imperial grants. Progress, however, in these matters is so slow in England that nothing has hitherto been done to carry out these recommendations except the drafting of a Bill by Mr. Gladstone's Government in 1885. This measure was essentially the same as Mr. Stuart Rendel's Bill which is now before the public.

The Bill embodies most of the recommendations of Lord Aberdare's Committee. It proposes to create a Board of Education for Wales, consisting of representatives of County Councils. To this Board schemes are to be submitted by the Council of each county, to meet the educational needs of that district. The plans may include the establishment of new schools, the reorganization of endowments, and the provision of scholarships. The Board may approve or alter the plans, and the funds required to carry them into effect are to be raised by a rate not exceeding one halfpenny in the pound—a sum, by the way, which will produce about £14,000 a year for the whole of Wales. This sum may be met by a Parliamentary grant not greater than the amount raised from the rates, subject to favourable reports upon inspection. Powers are given to reorganize and utilize existing endowments, and there may no doubt be some difference of opinion as to the extent and nature of the powers in relation to this matter which the Bill proposes to give to the new Board of Education.

There are a few criticisms which may be made on points of detail. The Board of Education ought undoubtedly to include not only representatives of the County Councils, but a certain number of educational experts. The County Councils should likewise be empowered to co-opt men of special knowledge to help in the preparation of their schemes. But on such points the representatives of Wales—a country where, as all who know it well will admit, there is a sincere zeal for educational progress—will not be likely to offer unreasonable opposition.

On the whole, the Bill is a most important step in advance, leading, as we may hope, ultimately to the organization and supervision of secondary schools throughout the Kingdom. All interested in the advance of scientific and technical teaching know how higher institutions are crippled by want of better teaching in secondary schools. The teachers in technical schools and higher colleges in England constantly complain of the want of preparation of those who come to their institutions from private schools. In Wales much of the work which the University Colleges are now compelled to do ought to be done in intermediate schools. We hail the fact that the Bill was read a second time as a sign that the public are waking up to the very great importance of this side of the educational problem.

FLORA ORIENTALIS.

Flora Orientalis, sive Enumeratio Plantarum in Oriente a Græcia et Ægypto ad Indiæ Fines hucusque Observatarum. Auctore Edmond Boissier. Supplementum, editore R. Buser. (Genevæ et Basileæ apud H. Georg, Bibliopolam, 1888.)

A BRIEF notice of the eminent author of the monumental work which the present volume brings to a close appeared in NATURE (vol. xxxii. p. 540), a day or two after his decease, and it is there mentioned that he had for some time been engaged on a supplement to his "Flora Orientalis," the body of which was completed in 1881. That supplement is now fortunately in the hands of botanists, and an opportunity is offered for a more comprehensive notice of the author and his work, as a whole, than has hitherto been published in this country. Apart from the value of the work to the systematist and phytogeographer, it possesses an interest for a wide circle, inasmuch as it deals with the vegetation of those countries of the greatest historical attractions. As the title indicates, the eastern limit of the area of the "Flora Orientalis" is India, and now there are other works actually in progress, which, although they will not by any means exhaust the flora of the rest of Asia, will add vastly to what is known. Sir Joseph Hooker's "Flora of British India" has reached the sixth volume, and the indefatigable author is now engaged on the Orchideæ (the largest order in the British Indian flora, represented by upwards of 1000 species); and we may reasonably hope, now that he is free from official duties, that he will finish it in the course of four or five years. But the energy and perseverance required to get through such an amount of descriptive botany as that accomplished by such men as Bentham, Boissier, and Hooker, can be estimated by few except those similarly engaged.

Regel and Maximowicz's elaboration of the collections of Russian travellers in Central and Eastern Asia, Franchet's "Plantæ Davidianæ" and "Plantæ Yunnanenses," and Forbes and Hemsley's "Index Floræ Sinensis," are jointly bringing together the materials for a flora of Central Asia and China, so that it will soon be possible to survey and analyze the composition of the vegetation in its various aspects from the Atlantic across Europe and Asia to the Pacific.

The "Flora Orientalis" consists of five octavo volumes, with an aggregate of 5387 pages, independently of the present supplement of 499 pages, making a total of 5886 pages; and, on the authority of Dr. H. Christ, the author of a notice of the life and works of Boissier appended to the supplement, the number of species described amounts to 11,876! To these descriptions are added the localities of the plants within the limits of the "Flora," and the geographical area of each species. In giving the former, the author takes the countries in the following order: Greece, Macedonia and Thrace, Asia Minor and Armenia, Egypt and Arabia, Palestine, Syria, and Mesopotamia, Crimea and Caucasus, Persia, Turkestan, Afghanistan and Baluchistan.

Before proceeding to a further examination of the nature and quality of Boissier's "Flora Orientalis," I will extract some particulars of his life from Dr. Christ's memoir, more especially such as relate to his botanical career.

Pierre Edmond Boissier, a descendant of a Huguenot family, was born at Geneva in 1810, and early developed a love for botanical pursuits. This inclination was stimulated and cultivated by the eminent Augustine Pyramus De Candolle, whose admirable teaching resulted in Boissier's life-long devotion to botanical research. Boissier was a man of great mental attainments, of a most amiable disposition, and at the same time of noble stature and fine physique.

Botanizing in the field, which is undoubtedly the best of all training, was his great delight, and his home excursions subsequently extended into distant travels. He was a good walker and a good mountaineer, and retained his great physical power until quite late in life. On his first visit to the Maritime Alps in 1832, he walked the whole distance, some forty miles, from Nice to Tenda in a single journey, and as lately as 1871 he accomplished in one day on foot the longer and much more difficult journey from La Madone delle Finestre to Tenda. The distance is estimated at about forty-five miles, and entails an ascent from 1900 to 2336 metres, then a descent to 1500 metres, upwards again to 2600, and finally down to 750 metres. And this exertion was undertaken to rediscover the rare and singular *Saxifraga florulenta*, originally discovered by an English tourist. This, Boissier's fourth excursion for this object, proved successful.

After finishing his studies at Geneva, Boissier went to Paris, where he met with our countryman Philip Barker Webb, who had botanized extensively in Spain, chiefly in the Kingdom of Granada, though he had published almost nothing thereon. It is supposed that Webb influenced Boissier in his determination to make Spain the field of his next botanical work, and it is certain that he gave him the whole of the materials he had collected, having himself made the Canary Islands the scene of his future labours. Boissier went on his first voyage to Spain in 1836, and continued his investigations for several years, aided more or less by several persons, and greatly by his friend Reuter. Following several preliminary contributions to the botany of Spain, the first part of Boissier's "Voyage botanique dans le midi de l'Espagne" appeared in 1839; and this admirable publication was completed in 1845. It is a botanical work of the first rank, and an enduring monument of the industry and munificence of the author. It consists of two quarto volumes containing a most interesting narrative of his travels; an essay on the geographical distribution of the plants of the region under consideration; descriptions of all the plants, and last, though by no means least, upwards of 200 beautifully drawn, hand-coloured plates by Heyland, one of the most accomplished botanical artists of his time.

Previous to the appearance of this work, the flora of no country of Europe was so little known as that of Spain. The enumeration numbers nearly 2000 species, about one-eighth of which were previously unknown. Since its appearance the flora of the whole of Spain has been elaborated by Willkomm and Lange—by foreigners again, and not by Spaniards! As a noteworthy exception to the botanical lethargy of the Spaniards, the learned and valuable works on the botany and botanists of the Iberian Peninsula by Don Miguel Colmeiro deserve special mention in this connection. Boissier himself, although he soon afterwards became engaged upon a work of much greater magnitude, never lost interest in the flora of Spain, and he revisited the country many times. Even before the completion of his "Voyage en Espagne," he commenced travelling and collecting in South-Eastern Europe, subsequently visiting Egypt, Palestine, and Arabia, and other countries; the results of these journeys culminating in his *magnum opus*, the "Flora Orientalis." Preliminary to this work he published a vast number of new species in fascicles, from time to time, between 1842 and 1859, under the title of "Diagnoses Plantarum Orientalium Novarum." Another important contribution to systematic botany was his "Icones Euphorbiarum," a large quarto, containing figures and descriptive letter-press of 120 species of Euphorbia. This was published in 1866, and in the same year the author furnished descriptions of the seven hundred species of this genus for De Candolle's "Prodromus."

Apart from its size, the "Flora Orientalis" is incontestably one of the most masterly pieces of descriptive botany ever executed, and although many botanists will not agree with the illustrious author in his limitation of species, all will recognize the excellence of the descriptions, and admit that by their aid a botanist can actually "determine" his plants. On this point I can speak from successful personal experience. The analytical keys to the species of some of the larger genera are admirably constructed, and display a marvellously acute knowledge, as well as great power of discrimination Take such genera as *Campanula* (125 species), *Cousinia* (136 species), Centaurea (183 species), Silene (204 species), and Astragalus (757 species), as examples of the work, and it will be admitted that few approach it in quality.

With regard to his conception of species, Boissier rejected the Darwinian theory altogether, believing that species were not arbitrary congeries of individuals, but direct creations of God at different periods. And although he by no means carried subdivision to the absurd extent that some modern botanists have done, yet he went much farther in this direction than most authors who have dealt with the vegetation of so wide an area as that of the "Flora Orientalis."

The supplement, issued towards the end of last year, is brought down to a very recent date, and contains all Dr. Aitchison's additions to the Afghan flora, except those in his last paper, of course, which was not published till the spring of last year. It also includes an index to all the collectors' numbers cited throughout the work, which will be very useful to persons possessing these numbered collections. A portrait of the author late in life forms the frontispiece to this volume, and there are several views of the new building erected on the bank of the lake, not far from Geneva, to contain the fine herbarium amassed by Boissier.

Thus Geneva now possesses the remarkably rich herbaria of De Candolle, De Lessert, and Boissier.

W. BOTTING HEMSLEY.

A TREATISE ON MANURES.

A Treatise on Manures. By A. B. Griffiths, Ph.D. (London: Whittaker and Co., 1889.)

IN this substantial little volume of nearly 400 pages the author treats of natural and artificial fertilizers, with a decided leaning towards the latter. The work is intended to be useful to manure manufacturers as well as to farmers and students of agriculture, and must be regarded as a useful addition to our information. The subject is introduced by two chapters upon the soil and the plant, after which all the leading and the suggested fertilizers are reviewed, and analyses are furnished. It is convenient to have at hand a book written up to date in which the newest sources of phosphatic materials, guanos and alkalies, are brought under notice. The chief interest of Dr. Griffiths's book centres in his chapter upon the use of iron sulphate as a manure. It is well known that Dr. Griffiths first pointed out that the iron sulphate, used in small quantities of about half a hundredweight per acre, exerts a beneficial effect on many crops; and this fact is distinctly brought before the reader in the book before us. The value of sulphate of iron lies in the fact that many soils do not contain a sufficiency of iron in a form to be readily taken up by plants, and Dr. Griffiths considers that when added to such soils it tends to increase the amount of chlorophyll in the leaf, and that this is followed by increased vigour in the elaboration of starch, woody fibre, fats, carbohydrates, and albuminoids. The amounts of increase of crop in the cases cited are remarkable, and the greater percentage of iron in the ashes of plants top-dressed with this substance is decided. It would be unjust to Dr. Griffiths to detract from the value of this observation, which, as he tells us, has been the cause of hundreds of letters on the subject from all parts of the world. The results are indeed open to the criticism that they are almost too satisfactory, for an increase of 19,313 pounds per acre of mangel owing to the use of half a hundredweight of sulphate of iron seems almost too good to be true. Nine tons of mangel are worth something like £6 sterling to the farmer as food for stock, a sum which would effectually turn an unprofitable into a profitable crop. The season is still young, and it would be well if agriculturists would put Dr. Griffiths's results to the test of a simple experiment during the coming summer, upon root crops.

Dr. Griffiths is no great partisan of farmyard manure, and he is scarcely fair in his argument when he touches upon this important subject. We cannot agree with him that farmyard manure is "far from being a perfect manure," or that "the farmer who uses nothing but farmyard manure exhausts his land," or that "farmyard manure does not return to the soil all the nitrogen which was originally extracted from it by growing crops." In pursuing this argument he asks, "Whence comes the fertilizing matter contained in the dung of animals? An ox or a sheep cannot create nitrogen, phosphorus, or potash. All of these substances, which are to be found in its liquid and solid excrements, have been derived from its food. That food has been grown upon the farm."

This is doubtless true if the farm actually does produce all the food of the animals it supports; but every farmer knows that this is not the case. The believers in the value of farmyard manure know perfectly well that the sale of lambs, of young stock, and of dairy produce, as well as of beef, mutton, and wool, exhausts land; but, in order to counteract this tendency, they invariably (we speak of good farmers) purchase oil-cake, hay, and corn in large quantities, sometimes to the extent of from £1 to £2 per acre over the entire farm, and it is this fact which is ignored by Dr. Griffiths. As to whether farmyard manure is a cheap manure or the reverse depends greatly upon the skill of the farmer, but we may be sure that when it is produced by well-bred animals, of high value, or when purchases of stock are made judiciously, farmyard manure may be properly regarded as a by-product.

It is questionable teaching on the part of an agricultural chemist to run counter to the experience of practical men, and we fear that Dr. Griffiths will not carry his agricultural readers with him in his opinions regarding the exhausting nature and expensive character of farmyard dung. Warming with his subject, Dr. Griffiths asks, "Why will the farmer still go sinking in the Slough of Despond, while faithful and willing hands are continually being stretched out in every direction to help him? Let him take a word of warning. Be up and doing, and—whatever you (*sic*) do—be up to the times. Do not let German, French, Belgian, or American agriculturists, simply by dint of superior scientific knowledge and methods, outstrip you in that great competition which is now going on amongst the nations of the world." As in the previous quotation given, we see once more the learned Doctor arguing upon wrong premises. In what respects do German, French, Belgian, or American agriculturists outstrip the English farmer? The average yields of corn and the average results of stock-feeding obtained by British farmers are far superior to those obtained by German, French, and American farmers. The manner in which our farmers have stood the shock of rapidly falling grain prices is extraordinary. Farming has not ceased to be a profitable occupation, but times have recently been very difficult, partly on account of the fall in the value of corn, and partly because the seasons have been remarkably unfavourable for the last fifteen years.

Dr. Griffiths proceeds to point out that in 1884 Germany boasted 158 colleges and schools of agriculture, attended by 17,844 students, and contrasts this fact with the very few colleges and the 240 students of agriculture in England. "If, says he, "Old England is to hold her own, we must have these necessities. It may be said, Is not England already taxed enough? where is the money to come from to support the colleges, schools, and experimental farms? We all admit that England is the *richest* country in the world. Very well, then, if *poor* Germany can support at least 158 agricultural colleges, and give instruction to 17,844 students, surely England need not grumble or be so mean." Does not Dr. Griffiths know that the farmers, as a rule, in Germany and France, do not care about the agricultural colleges? that there is the greatest possible difficulty in inducing them to send their sons to them? that it is only by offering exemption from the galling military service exacted from all men in those countries, and by conferring upon students the rank necessary for serving as officers in the army, that the colleges and schools are filled at all? Does he not know that the colleges and schools are chiefly useful as a means of training the great army of professors and teachers in those countries? Does he not know that a certificate of proficiency gained at a college is, in those countries, absolutely necessary before a man can give evidence in a court of justice on an agricultural question? Does he wish to introduce artificial restrictions such as this into England, and to substitute a patriarchal system for that free enterprise which is the true reason of the wealth and the excellence of England?

A very short time ago £5000 was put aside by the Government for grants on account of agricultural education. No sooner was this offered than a struggle ensued for participation in this small sum. Share lists have been opened, in which one source of profit put before the investing public is a share of this same £5000 as a means of increasing the dividends of the promoters! It is more than likely that this same £5000 will do more harm than good, by encouraging bogus schemes and paralyzing the natural enterprise which is the life-blood of English supremacy.

Dr. Griffiths has issued his book, and farmers are free to read, mark, learn, and inwardly digest it. The agricultural press is open, and there is that great body of good practical farmers who are more fully alive to the situation than Dr. Griffiths imagines, who, if not "scientific" in their instincts, are shrewd men of business, and the possessors of a knowledge of rural matters which comes not from books, but through contact and experience.

Dr. Griffiths is a disciple of Ville, and the main object of his work is to substitute a system of artificial fertilizers for manuring through live stock. Farmyard manure, he says, is imperfect, full of seeds of weeds and germs of disease; it is expensive to produce and to apply; it exhausts the land; it is inferior to artificial manures; and its good properties, such as they are, are not easily recoverable. Such is Dr. Griffiths's indictment, which is calculated to make farmers rub their eyes, and, having made sure they had read aright, lay the book down. If experience is of any value at all in regulating practice, it teaches us that in our climate, and with our natural and acquired advantages in races of cattle, the strength of our position is our live stock; that the fertility of the soil is not only kept up but rapidly and durably increased by the importation of purchased foods; and that it is better for the farmer to pay a "cake" bill than a manure bill.

OUR BOOK SHELF.

Elementary and Synthetic Geometry of the Point, Line, and Circle in the Plane. By N. F. Dupuis, M.A. (London: Macmillan, 1889.)

THIS is a work which we have read with considerable interest. As the author states, "it is not an edition of Euclid's 'Elements,' in fact it has little relation to that celebrated ancient work except in the subject matter." Its alliances are with such treatises as Casey's "Sequel to Euclid" and McDowell's "Exercises on Euclid and in Modern Geometry," but it appears to us to be better adapted in some respects than either of these works to the use of junior students. These are too condensed for some readers, whereas the book before us, without being too diffuse, enters into greater detail, and leads the pupil up, by a course of sound teaching, so as to enable him to attack with success the subject of modern analytical geometry. Mr. Dupuis looks at a triangle not as "the three-cornered portion of the plane inclosed within its sides, but the combination of the three points and three lines forming what are usually termed its vertices and its sides and sides produced." His object is to lead up to the idea of a figure as a locus, with a view to preparing the way for the study of Cartesian geometry. Here the necessity for a careful distinction between congruence and equality arises. He introduces freely the principle of motion in the transformation of geometric figures, and devotes some space to the principle of continuity. Further, he connects geometry with algebraic forms and symbols, "(1) by an elementary study of the modes of representing geometric ideas in the symbols of algebra, and (2) by determining the consequent geometric interpretation which is to be given to each interpretable algebraic form." The subject of proportion is treated on the method of *measures*, and the term *tensor* is freely used. The first part (pp. 1–90) traverses the point, line, parallels, the triangle and circle. The second part (pp. 91–146) considers the measurement of lengths and areas: each part closes with a section devoted to illustrative matter drawn from constructive geometry. The third part (pp. 147–177) consists of two sections—the first on proportion amongst line-segments, and the second on functions of angles and their applications in geometry. Some instruments are described, as the proportional compasses, the sector, the pantagraph, and the diagonal scale. In the fourth part (pp. 178–251) there are seven sections, which are taken up with such matters as the centre of mean position, inversion and inverse figures, pole and polar, radical axis, and centres and axes of perspective. The closing part (pp. 252–290) introduces the student to harmonic and anharmonic properties, polar reciprocals and reciprocation, and to homography and involution. The author discusses all these points in a lucid style, and illustrates them with full store of carefully selected solutions: in addition there are a great number of unworked exercises in all the subjects. These good results are the outcome of many years' teaching of geometry to the junior classes in the University of Queen's College, Kingston, Canada. The book is closed with a full index, and clearly drawn figures accompany the text.

A Vertebrate Fauna of the Outer Hebrides. By J. A. Harvie-Brown, F.R.S.E., F.Z.S., and T. E. Buckley, B.A., F.Z.S. (Edinburgh: David Douglas, 1889).

THIS is a sister volume to "A Fauna of Sutherland, Caithness, and West Cromarty," which was published by the same authors in 1887, and reviewed in NATURE at that time. It may be remembered that in the preface to this work, the authors expressed their intention of following it up with others, dealing in a similarly exhaustive manner with the vertebrate faunas of other parts of Great Britain. We are glad to receive at so early a date so substantial a fulfilment of this intention; for we cannot give higher praise to "A Fauna of the Outer Hebrides" than by saying that it is in all respects worthy of its predecessor. Moreover, when we have regard to the immense amount of labour which the production of these volumes must have involved, we cannot refrain from congratulating the authors on the rapidity with which their works have followed one another. This second member of the series runs to over 250 pages, and, like the first member, is embellished by a few beautifully executed drawings of landscape scenery. Like the first member, also, it gives an exhaustive account of all the Vertebrata which occur within the area specified, together with several introductory chapters dealing with the topography of the district, and the relation (palæontological and otherwise) of its fauna to that of the rest of Great Britain. As the value of such a work consists mainly in the number and the accuracy of its details, little need be said of it in a review, save in general terms. And, as we have already indicated, the painstaking labour which has been bestowed upon this Fauna appears to us to leave nothing that can be desired in the way either of addition or subtraction. We heartily recommend both these Faunas to all systematic zoologists, and sincerely hope that their authors may be able to continue their researches through other areas of Great Britain. G. J. R.

Dictionary of Photography. By E. J. Wall. (London: Hazell, Watson, and Viney, Limited, 1889.)

THIS work is practically a complete encyclopædia o photography, and will form a very useful addition to photographic literature. It is written throughout in plain and straightforward language, each heading being thoroughly treated. The subject-matter under the heading of "Lens" is accompanied by excellent illustrations of the various forms of lenses, showing by shaded lines the different combinations of crown and flint glass. Developing, printing, &c., receive their full share in the work, and under "toning" no less than twenty-nine different baths are discussed. At the end there is a collection of miscellaneous tables that have not been inserted in the dictionary part of the book, such as sizes of French and Italian dry plates, a list of dry plates and sensitometer numbers, solubilities, freezing mixtures, &c.

For photographers in general this work ought to prove most useful. It will make it unnecessary for them to refer to other works for a hint or remedy, or anything else that may be wanted at a moment's notice.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Upper Wind Currents over the Equator in the Atlantic Ocean.

IN January last I addressed you a letter from the Straits of Magellan, with an account of the upper wind currents observed over the equator during a voyage to South America in the month of December. Then I described how the north-east and south-east trades both turned into a common light surface easterly current along the line of the doldrums; how low clouds from south-east drove over the north-east trade up to 15° N.; how the highest clouds moved from south-west, north of the equator; and how, from 300 miles south of the line, a very high current from north-west prevailed over the south-east trade. No high observations were obtained in that belt of 300 miles, nor were any middle-level clouds seen over the south-east trade.

Now, I have just crossed the same route in the month of May, under a somewhat different wind system. The north-east trade turned to north as it approached the doldrums, instead of towards the east, as in the previous voyage. In the calm belt, it met a light easterly current, without much conflict in the way of rain; while further south the regular south-east trade was experienced as far as 8° S., when the north-east monsoon of the Brazilian coast prevailed nearly down to Rio Janeiro.

No signs of south-east wind could be discovered at any level over the north-east trade, which wind, on the other side, blew at low or middle levels over the south-east trade, till surface, low, and middle currents combined to form the Brazilian monsoon.

Very few observations were obtained of the highest clouds, but in 6° S. a high north-west prevailed; from 2° S. to the equator, both the middle and highest clouds came from the east; and nothing more could be determined till a high south-west current was found over the north-east trade, in 7° N. latitude.

These results confirm in a most striking manner the discovery which I have announced from time to time in your columns, and which was most conclusively proved by the labours of the

Meteorological Section of the Krakatão Committee of the Royal Society—"that the highest air-current over the equatorial doldrums is from the eastward, lying between the south-west current which flows on one side over the north-east trade, and the north-west current which flows on the other side over the south-east trade." RALPH ABERCROMBY.

21 Chapel Street, London, May 27.

The Structure and Distribution of Coral Reefs.

I HAVE to thank Prof. Bonney for pointing out my error in assigning the "90-fathom reef" to Socotra instead of to Rodriguez. It arose from my having been accustomed to associate Prof. Balfour's researches with the former island.

With regard to the depths in which coral reefs can form, there has been without a doubt some little concurrence of testimony as far as the evidence goes. But I contend that all the observers were misled by supposing that the sand and reef *débris*, that nearly always prevent and repress the growth of corals in depths of 20 to 30 fathoms, necessarily represented the lower limit of reef-formation. We know little of the depths beyond this belt of sand and reef *débris*, inasmuch as the observers in question rarely extended their search beyond. The difficulties in examining these depths are much greater, and systematic soundings are greatly needed, being in fact only practicable in the case of a surveying-vessel.

Since writing my letter I have received, through the courtesy of Captain Wharton, a copy of a report of the examination, in 1888, by Commander Moore and Dr. Bassett-Smith, of H.M.S. *Rambler*, of the slopes and zoological condition of the Tizard and Macclesfield Banks. This report is, I believe, to be further extended by Dr. Bassett-Smith, so I will only quote here the suggestive remark of Commander Moore, respecting the Macclesfield Bank: "Coral was found living as far down the slope as 44 fathoms; it may extend further, but darkness put an end to the work." I should also add that a living specimen of an astræan coral was brought up from a depth of 45 fathoms in the lagoon of Tizard Reef.

Through the agency of the officers of Her Majesty's surveying-ships, Captain Wharton will have soon at his disposal a large amount of new material throwing considerable light on the origin of coral reefs. H. B. GUPPY.

Atmospheric Electricity.

IN NATURE of May 16 (p. 55), Mr. Bowlker describes some "curious" and, as he believes, "rare electrical phenomena" which occurred to him and a friend on the Welsh mountains. Such phenomena are rare only because competent observers are so. The effects described are by no means uncommon, and they may be classed under the brush discharge and the glow, the one being an interrupted, and the other a continuous, discharge to the air.

H. de Saussure gives the results of his observations in America, Switzerland, and other places. He remarks that the lighting-up of the rocks at night is analogous to the curious fact of electricity moving over the prairies. It is compared to a kind of miniature lightning discharge, resulting from the electrified cloud brushing over the earth, and discharging itself in thousands of sparks coursing over the meadows. In Mexico he noticed the crepitation of the stones due to electrical discharges, and in Switzerland he describes certain pricking and burning sensations, and sounds like that of simmering water, emitted from sticks laid against the rocks, and from the tops of the alpenstocks. This humming of the mountains is by no means rare, and it seems to indicate a flow of electricity from the ground into the air.

When Prof. James Forbes was at work on the glaciers of Switzerland, he noticed on one occasion, near Mont Cervin, a curious sound proceeding from his alpenstock. The guide referred it to a worm eating the wood; he reversed the stick, and the worm was already at the other end. He raised his hand above his head, and the fingers yielded a fizzing sound, while the angular stones all round were hissing like points near an electrical machine. There was hail at the time, and a thunderstorm soon set in.

M. Trécul relates in the *Comptes rendus* the following curious case:—While writing at an open window in August 1876, between 7 and 8 a.m., he noticed a number of small luminous columns descend obliquely on his paper, each about 2 metres long, and half a decimetre broad at the widest part, obtuse at the farther end, but gradually thinning towards the table. They had mostly a reddish-yellow tint, but near the paper the tints were more intense and varied. In disappearing they left the paper with a slight noise, like that produced by pouring a little water on a hot plate. Loud thunder was heard at the time of the observation.

In June 1880, at Clarens, near the Lake of Geneva, a cherry-tree was struck by lightning, and a little girl who was about thirty paces from the tree appeared to be wrapped in a sheet of fire, while six persons, in three groups, none of them within 250 paces of the cherry-tree, were enveloped in a luminous cloud. They said they felt as if they were being struck in the face with hailstones or fine gravel, and when they touched each other, sparks passed from their fingers' ends. At the same time a luminous column was seen to descend in the direction of Chatelard, and it is stated that the electricity could be distinctly heard as it ran from point to point of the railing of the cemetery.

Mr. Jabez Brown, while ascending one of the sharp hills near Boscastle, in November, at 9 p.m., was suddenly surrounded by a bright and powerful light, which passed him a little quicker than the ordinary pace of a man's walking, leaving it as dark as before. The light was seen by the sailors in the harbour, coming in from the sea, and passing up the valley in a low cloud. A similar one occurred in Scotland last year.

Highgate, N. C. TOMLINSON.

THE electrical phenomenon described by Mr. Bowlker in NATURE of May 16 was doubtless an instance of St. Elmo's Fire; and if it had been dark at the time it was noticed, the post, walking-stick, and other objects affected by it would have been seen to be capped with a glow resembling somewhat the *brush-discharge* of an electrical machine. It has been observed about fifteen times on the summit of Ben Nevis during the last five years, and these cases are described, and the accompanying weather discussed, in a paper by Mr. Rankin, of the Ben Nevis Observatory, published in the last number of the Journal of the Scottish Meteorological Society. When it occurs, all elevated points, whether metallic or not, glow; the light in the more intense cases being several inches in length. It is almost always accompanied by a heavy fall of conical-shaped snow-flakes about a quarter of an inch long, resembling hailstones in shape, but not hard or icy. At all times when it has been seen the barometric pressure has been high over the south or south-west of Europe, and low to the north of Scotland, thus giving steep gradients for westerly winds; and in most cases the temperature on Ben Nevis has been falling, while the barometer after falling considerably has begun to rise again, and the wind to veer from south-west towards north-west. R. T. OMOND.

Ben Nevis Observatory, May 24.

Sailing Flight of the Albatross.

MY attention has been drawn to some correspondence in NATURE, May 2 and 9, on the "Sailing Flight of the Albatross," in which reference is made to my father's letter to Sir William Thomson on the subject. At Sir William Thomson's suggestion, I am now about to condense the rest of my father's correspondence on the subject into a form convenient for publication. In the meantime I will only say that while Mr. Baines's very interesting letter, and his explanation of the phenomenon of "soaring," appear to me perfectly sound in principle (and indeed we have Lord Rayleigh's authority for this view), my father's statements seem to prove that his own solution is also the true explanation of the soaring under the (different) circumstances in which he observed it. It appears to me only reasonable to suppose that the birds instinctively learn to avail themselves of *all* the different natural conditions which under different circumstances may serve them to maintain their flight with the smallest exertion. R. E. FROUDE.

Gosport, May 25.

The Science and Art Examination in Physics.

THE paper set on May 17, in Sound, Light, and Heat, presents several features that must have created dissatisfaction alike among students and teachers.

First, the official Syllabus explicitly states that the paper "will be so arranged that a candidate can secure a first class in either stage by taking up *two* only of the subjects." This has been so for some years past, and there have always been *five* questions in each subject. As the maximum number of questions a candidate may attempt is eight, this gave a choice in each subject of four questions out of five. But this year, without any previous notice, the number of questions in each subject is reduced to *four*, so that a student who only takes up two of the subjects has absolutely no choice. He may be well prepared, yet if he happen to have overlooked *one* of the points dealt with in the questions, his chance of a first class is seriously diminished.

In making this unlooked-for change, the Department practically takes away with one hand what it gives with the other.

Secondly, in the advanced paper, the second question in Sound runs thus: "If a string 24 inches long weighs half an ounce, and is stretched with a weight of 81 pounds find its rate of vibration when bowed or struck."

Now this is a problem not on *comparative* measurements, which are fairly within the grasp of an advanced student, but on *absolute* measurements. To solve this question requires a knowledge not merely of the principles of sound, but also of theoretical mechanics and of numerous mathematical details, besides considerable dexterity in manipulating units, which is about the most perplexing thing a student ever encounters, and has hitherto never been called for except in the honours stage.

To set such a question as one of *four*, and offer no choice, is in effect to condemn the students at the outset, and must have a most depressing effect upon the classes in future years. At any rate, if the Department intended to introduce absolute measurements into the advanced stage, it is only fair that they should have given notice.

Thirdly, the last question in Heat (advanced) asks the student to "sketch an apparatus for determining the *coefficient of expansion* of a gas at constant *volume*." Perhaps the examiners will kindly inform us how a gas can expand, its volume at the same time remaining constant. Possibly the word "expansion" is a misprint for "increase of elasticity," in which case Balfour Stewart's apparatus should be sketched; or, possibly the word "volume" is a misprint for "pressure," in which case Gay-Lussac's apparatus is required; or, possibly there is an intentional confusion of phraseology in order to perplex the candidates.

Misprints occur in one or more papers nearly every year. Last year there was an error in Mathematics, Stage 3, when a certain equation was printed with the figure 4 instead of 1, thus causing candidates to waste time and become flurried, and here again we have the same kind of thing.

A SCIENCE TEACHER OF SEVEN YEARS' STANDING.

May 21.

DR. NANSEN'S JOURNEY ACROSS GREENLAND.

FROM a communication sent us by Dr. Nansen, we are able to give some details of the remarkable journey across Greenland which he accomplished last summer. We need only briefly recall the most important attempts which had previously been made to cross a country which is exactly in the condition of our own islands during the Glacial period. The first serious attempt was made in 1878 by Jensen and Steenstrup, who, from the west coast in lat. 62° 30′ N., managed to get some 40 miles into the interior, after many difficulties and dangers, ascending a mountain to a height of 5000 feet, from which they saw the inland ice rising gradually towards the interior. Then came the famous expedition of Baron Nordenskiöld in 1883. He, with a comparatively large party, started much further north than the previous expedition, a short distance south of Disco Island. The party succeeded in penetrating some 90 miles eastwards, to an altitude of 5000 feet. The Laplanders, however, who accompanied Nordenskiöld went in their snow-shoes 140 miles further, travelling over a continual snow desert to a height of 7000 feet. The next serious attempt was made by an American, Mr. R. E. Peary, in the summer of 1886. Mr. Peary started much further to the north than Nordenskiöld, and his course was due east. He reached 100 miles from the edge of the ice-blink, or inland ice, his highest elevation being 7525 feet.

Dr. Nansen felt sure that the only way to cross the ice was by means of *ski* (a special kind of long snow-shoe) and sledges. He had many applications to be allowed to accompany him; but he selected only five companions—a lieutenant in the army, a shipmaster, a Norwegian peasant, and two Lapps. The expenses of the expedition were generously supplied by Mr. Augustin Gamel, of Copenhagen. The party left Christiania early in May 1888 for Iceland, whence they embarked on board a sealer for the east coast of Greenland. Dr. Nansen's own account of his attempts to land is of interest as showing the condition of the ice and the currents off the East Greenland coast:—

"On June 4 we left Iceland in the *Jason* for Greenland. My hope was that early in June we should be able to reach the coast in the neighbourhood of Cap Dan, in latitude about 65° 30′ N.; but I was disappointed, as large masses of ice stopped us at a distance of 50 miles from the coast. At last, on July 17, we approached the land at the Termilik Fjord, west of Cap Dan, and I determined to leave the ship. In our two boats we had to force our way about ten miles through the ice. The current was, however, very strong, the ice-floes were thrown and pressed against each other, and during such a pressure of the ice one of our boats was broken. We were then very near to the coast, but the boat could not float, and some hours passed before the leak could be restored. In the meantime, the ice was very much pressed, and we went adrift, the speed with which the current carried us off from the coast being much greater than that with which we could advance on the ice. At the great rate of about 28 miles each twenty-four hours we were driven southwards along the coast. We tried to reach land three times, but by a rapid current we were again carried towards the sea.

"At last, on July 29, we succeeded, and reached land at Anoritok, 61° 30 N. lat. Originally, I had thought to land at Inigsalik, in 65° 30′ N. lat. We had consequently come 240 miles too far southwards. Our destination was Christianshaab, in Disco Bay, to reach which we should be obliged to go in our boats northwards, to cross the continent at a more northerly latitude. To get northwards was not, however, very easy. Masses of Polar ice were pressed towards the land, and very often the axe alone could break a way through the tightly pressed ice-floes."

Two parties of heathen Eskimo were met with, who were at first rather distrustful of the strangers, as they had scarcely ever before seen Europeans.

On August 10 (more than a month behind time) the party reached Umiavik, 64° 30′ N., whence the start was to be made across the inland ice. Dr. Nansen and Captain Sverdrup the next day made an excursion to examine the glacier. They got ten miles from the coast, and reached a height of 3000 feet. On August 15 a start was made, there being five sledges to pull, one loaded with 400 pounds, pulled by Dr. Nansen and Captain Sverdrup. Two days later they were stopped by a heavy gale which kept them in their tents for three days. At first the intense heat compelled them to travel only at night. Dr. Nansen goes on to say:—

"At some distance from the coast the snow became, however, very deep and bad for pulling. We were also met by a heavy gale from the north with snow-drift, so that we could advance only very slowly. I hoped that it would soon become better, but each day it became worse. It was only too clear that if it continued in this way we would not be able to reach Disco Bay till the middle of September, when the last ship left for Europe. Though I expected to find more difficult ice in this direction, I changed our route and turned towards Godthaab. That was on August 27. We had then reached about 64° 50′ N., about 40 miles from the coast, and a height of about 7000 feet. By this change of direction, the wind became so favourable that we could use sails on the sledges, and thus they became less heavy to pull. In this manner we advanced during three days, then the wind went down, and we were obliged to lower our sails.

"In the beginning of September we reached a quite flat and extensive plateau, which resembled a frozen ocean. Its height was between 8000 feet and 9000 feet, though towards the north it seemed to be considerably higher. Over this plateau or highland we travelled more than two weeks. The cold was considerable. I am not, however, able to give an exact statement of the temperature, as our thermometers did not go low enough. I believe that on some nights it was between −45° and −50° C. (between 80° and 90° F. below freezing point) In the tent where we (six men) slept, and where we cooked our tea and chocolate, it was even less than −40° C. (72° F. of frost). During one month we found no water. To get drinking-water we were obliged to melt snow either in our cooking apparatus or by our own warmth in iron bottles, which were carried inside our clothes on our bosoms. The sunshine on these white snow-fields was bad for the eyes, but no case of snow-blindness occurred. Only one day, September 8, we were stopped by a snowstorm; the next day, when we wanted to continue our journey, we found the tent was quite buried in the snow.

"On September 19, we got a favourable sailing wind, and then we advanced very rapidly. That day we got the first sight of the mountains of the west coast. In the night we were stopped by dangerous ice with many crevasses, after having very nearly lost several men and sledges in one of them. We met here with very difficult and uneven ice, where we advanced very slowly. At last on September 24, we reached land at a small lake to the south of Kangersunok, a fjord inside Godthaab. On September 26, we reached the sea at the inner end of the Ameralik fjord, in 64° 12′ N. latitude."

This really finished the journey across Greenland. With considerable difficulty the party reached Godthaab, where, as the last ship was gone, they had to spend the winter, reaching Copenhagen only last week. So far Dr. Nansen has not been able to tell us much more than we knew already about the interior ice of Greenland; though he will probably give us full details in the paper which he is to read at the Royal Geographical Society on June 24.

ON THE TELLURIC ORIGIN OF THE OXYGEN LINES IN THE SOLAR SPECTRUM.[1]

M. EIFFEL having very obligingly put the tower in the Champ-de-Mars at my disposal for any experiments and observations that I cared to make there, I decided to take advantage of the powerful electric light which had been installed, to make certain studies of the telluric spectrum, and, in particular ,that which relates to the origin of the lines of the spectrum of oxygen in the solar spectrum.

We know now that there exist in the solar spectrum many groups of lines that are due to the oxygen contained in our atmosphere; but one may ask himself whether these groups are due exclusively to the action of our atmosphere, and the solar atmosphere between counts for nothing, or whether their origin is double—in a word, Are these groups purely telluric or telluric-solar?

To settle this question, one may have recourse to a certain number of methods. One of the most trustworthy is that of displacement, the origin of which rose from the beautiful conception of M. Fizeau, and which has been applied by M. Thollon and perfected by M. Cornu.

[1] Translation of a paper read by M. J. Janssen before the French Academy of Sciences on May 20, 1889 (*Comptes rendus*, cviii. No. 20).

The application of this was too difficult in the present case.

We may also observe the diminution of intensity which the groups undergo when we ascend in the atmosphere, and by careful comparisons when possible, and especially by a great number of observations, we may judge if the diminution of the intensity of the lines would permit us to conclude that they would completely disappear at the limits of the atmosphere. This is the method employed in the last Mont Blanc expedition (Grands-Mulets). Or, we may again proceed with a comparison of the uniformity of the lines by installing a powerful light giving a continuous spectrum at such a distance that the thickness of atmospheric air traversed may have the same action as that of the terrestrial atmosphere on the rays of the sun, when it is near the zenith.

This last circumstance is very fortunately found realized in the respective situations of the Eiffel Tower and the Meudon Observatory. The tower is at a distance from the Observatory of about 7700 metres, which very nearly represents the thickness of an atmosphere having the same weight as the terrestrial atmosphere and a uniform density, and equal to that of the atmospheric layer traversed by the sun's rays.

In addition to this, the considerable power of the magnificent light actually installed on the summit of the tower permits the employment of the instrument that had served me at Meudon and at Grands-Mulets for the sun. I have, however, made use of a condensing lens in front of the slit in order to give the spectrum an intensity quite comparable to that of the solar spectrum in the same instrument.

Under these conditions the spectrum is shown with extreme vividness, and extends beyond A. The B group appeared to me as intense as with the sun on the meridian in summer. The A group was equally well defined. Other groups could be distinguished, and notably those of water-vapour, their intensity showing the hygrometric state of the column of atmosphere traversed.

I should have liked to study the oxygen groups with the great spectrometer of MM. Brunner and a Rowland's grating, but the limited time during which the light was turned on to me did not permit it. I hope to do so another time.

Not one oxygen band is seen in the visible spectrum, although the thickness of the layer of oxygen traversed was equivalent to a column of more than 260 metres of oxygen at a pressure of six atmospheres—that is to say, at the pressure under which the tube in our laboratory shows them with a length of only 60 metres, or four times as small. This well shows that, for oxygen, the lines follow an entirely different law from the bands.

Indeed, whilst for the lines the experiment of last Sunday shows us that it appears indifferent whether we employ a column of gas at constant density or a column equivalent in weight but with variable density; for the bands, on the contrary, the absorption taking place following the square of the density, the calculation shows that there would be required, at the surface of the sun, a thickness of atmosphere of more than 50 kilometres to produce them.

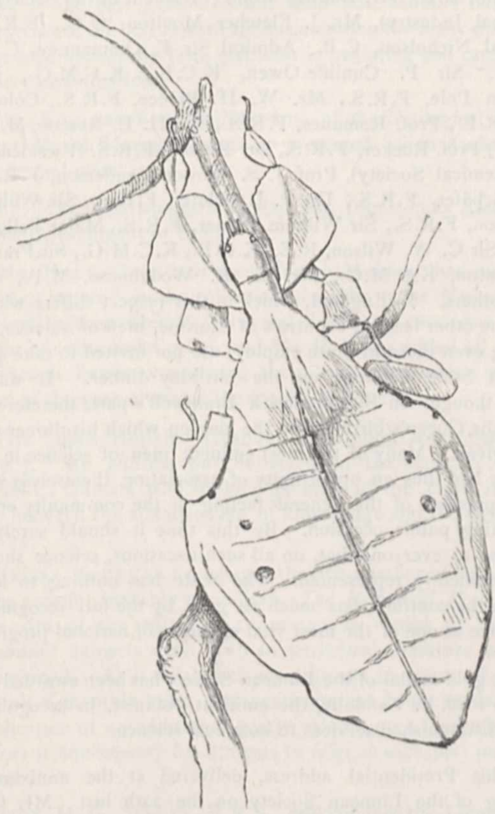
I do not look upon the experiment of last Sunday as more than bringing forward a fact more to a group of studies—a fact which requires to be exact and developed. But it is certain to myself, that the height at which the tower of the Champ-de-Mars makes it possible to place the light source, and its power, will enable me to make other similar experiments of higher interest.

Before concluding, I wish to thank M. Eiffel for the liberality with which he put his beautiful edifice at the disposal of science. I equally thank MM. Sautter and Lemonnier for their kindness.

THE ZOOLOGICAL SOCIETY'S INSECT HOUSE.

ALTHOUGH it has long been the practice of entomologists to keep private collections of the larvæ of insects, for the purpose of studying their metamorphoses and of obtaining perfect specimens of their fully-developed forms, there is, we believe, still only one place where the attempt is made to attract public attention to this most varied and wonderful group of animals by an exhibition of them and of the different stages of their life-history. This place is the Insect House of the Zoological Society of London in the Regent's Park Gardens, which has now been maintained with considerable success for several years.

At this season of the year the Insect House is generally at its best, and examples of the perfect insect are continually to be seen emerging from the chrysalis.



Leaf-insect of the Seychelles (*Phyllium gelonus*).

A very interesting and novel addition has just been made to the collection in the form of a specimen of one of the Leaf-insects, presented by Lord Walsingham, who received it from the Seychelles Islands through Colonel Larking. Though not yet fully developed, there can be no doubt it will prove to be an example of *Phyllium gelonus*, Gray. The insects of this remarkable genus are all Oriental, inhabiting the tropical regions of Asia, and extending to Mauritius and the Seychelles. It has hitherto proved impossible to induce them to continue their species in this country beyond a single generation, so that it is only occasionally that they can be seen alive here. So long ago as 1854 a living specimen of an Indian species, *P. scythe*, was exhibited in the Botanic Gardens at Edinburgh, where it attracted so much attention that it was found necessary to limit its exhibition to four days in each week. This restriction was (as stated by Murray) adopted because, in spite of the old saying that seeing is believing, it was found in the case of this insect that seeing was disbelieving. On those who inspected it insisting that there was no insect on the plant, but only a leaf, it had to be stirred up to convince them of the truth, and this process of continual provocation was found to be very injurious to the constitution of so peaceable a creature.

The resemblance of many of the species of this group of Orthoptera to portions of the plants on which they are found is so extreme that it has given rise to a firm conviction in the minds of the inhabitants of some of the regions in which they are found that they are portions of the actual plant transformed into living insects. There is certainly more to be said for the belief in this metamorphosis than there is for some of the transformations related by Ovid; and M. de Borre, in the *Comptes rendus* of the Belgian Entomological Society (1883), has explained the reasoning by which it is justified. The people having observed the gradual growth of the creature and the development of the appendages of the body, while they have failed to see it when very small and issuing from the egg, maintain stoutly that a young leaf gradually grows into a living insect. The species of the genus *Phyllium* all have a remarkable resemblance to leaves, but it appears as yet not to be known whether the different species have a special resemblance to the foliage on which they feed.

The late Andrew Murray published an account of the Edinburgh specimen in the *Edinburgh New Philosophical Journal* for 1856, and then said that he "should not be at all surprised if, in the course of a few years, the Leaf-insect should be as common an inmate of our conservatories as the canary-bird now is of our dwellings." This hope has, however, not been realized, and for our opportunities of seeing it in the living state we are obliged still to rely on the kindness of naturalists who may be stationed in the tropical regions where these creatures exist, and who will take the trouble of bringing or sending them or their eggs over to us. The difference between a living and a dead insect is not so extreme as that between a live dog and a dead dog, but still it is very great, and one of our older entomologists used to say that he never really knew the species of an insect till he had seen it alive.

The Insect House in the Zoological Gardens affords, as we have said, the only opportunity that the English public have of seeing alive some of the wonderful forms of tropical insects. But, as we have already remarked, the difficulty of perpetuating the life of these examples of exotic Nature's variety and luxury beyond a short period is excessive, and reaches its maximum in London. There is, perhaps, nothing more remarkable in Nature than the pertinacity and rapidity with which the generations of many of the lower forms of insect life are produced. *Phylloxera*, *Aphis*, scale-insects almost defy the efforts of mankind to control them, and the resources of even scientific civilization contend with them as yet almost in vain. But in many of the more evoluted forms of insects we find a very different condition prevalent. Even mating can, in a large number of cases, be induced only when the creatures are placed in exactly appropriate circumstances, and afterwards the insects will only deposit their eggs in such places and under such conditions as insure at least a probability of congenial existence for their progeny. In the case of many species the females prefer to die with their eggs undeposited, rather than place them in conditions that are at all inappropriate. Thus the difficulty of keeping up a varied supply of curious forms for the Insect House is very great.

The different kinds of silk-producing moths have attracted much attention for a considerable number of years past, and in the case of several species fertile eggs are readily procured. These insects, being in many cases very large and attractive creatures, excite a good deal of interest in the visitors to the Insect House. Just at present these moths are about commencing their individual life-cycles afresh; eggs of several species have been procured, and will shortly be hatched. The caterpillars are even more interesting than the moths themselves, and their remarkable shapes and forms, and their wonderful spines and thorns, are of much interest to naturalists. Just now, too, there may be seen in the Insect House a delightful example of the early stages of insect-life in the form of the caterpillar and chrysalis of *Limenitis disippus*. This is a North American butterfly, the egg of which is hatched towards the end of summer or in autumn. Its young larva constructs for itself a delicate habitation by joining together the edges of the leaves of the willow on which it feeds, so as to form a cylindrical tube, which it lines with silk and closes at one end. The fragile creature is thus able to outlive the storms of wintry wind and weather, and to evade the ravagers of the animal world in search of food. In the protection of this dwelling it can be transmitted from North America to this country without injury to its vitality. As seen in the Insect House, the caterpillar is a curiously mottled, pale-brown, greenish and grey creature, with head bent down, but bearing on the prominent part just behind it two rather long, erect, slender horns of a deep black colour, each of them numerously spined. The chrysalis is even more remarkable, and hanging down from a twig displays itself in a very prominent manner. On the middle of its body there is an abrupt, elongate, black hump, about as conspicuous a deformity as could be devised, while at the base of this, on each side, there is a band of delicate and beautiful metallic colour. This band is in some way dependent for its tint on the living creature within, for no trace of it can be seen in the pupa-shell after the insect has escaped. This species of butterfly belongs to the family *Nymphalidæ*. The extraordinary spines of the caterpillars of this group have recently been studied, and many of them delineated, in an elaborate and interesting memoir by W. Müller, which will be found in the first volume of the *Zoologische Jahrbücher*.

The Diurnal Lepidoptera are not so well represented in the Insect House as they usually are at this time of year, there having been a great scarcity of pupæ last summer. But, besides the *Limenitis* above referred to, examples of one of the Swallow-tails (*Papilio machaon*), and of one of the large North American Skippers (*Gonioloba tityrus*), are now daily emerging from their pupa stage, and fresh additions are shortly expected.

NOTES.

We are glad to learn, from the list of birthday honours, that the Companionship of the Bath has been conferred on Dr. James Bell, F.R.S., and the Companionship of St. Michael and St. George on Mr. Ellery. A baronetcy has been granted to Prof. Stokes; but, seeing that Prof. Stokes has been for many years President of the Royal Society, and that the Government never thought of offering him any special honour until he entered the House of Commons, we may conclude that he receives his baronetcy not as an illustrious investigator, but as a politician.

On Saturday, Sir Frederick Bramwell, as President of the British Association, entertained the President-Elect, Prof. W. H. Flower, C.B., F.R.S., a large number of members of the Association, representatives of science, and other guests being invited to meet him. The dinner was given in the hall of the Goldsmiths' Company, the use of which was granted to him for the purpose by the Wardens of the Company. The list of guests included Lord Bramwell, F.R.S., Mr. Justice Denman and Mr. Justice Manisty, Mr. C. Lucas, Prime Warden of the Goldsmiths' Company, the Mayors of Newcastle and Gateshead, Sir F. A. Abel, C.B., F.R.S., Captain Abney, R.E., C.B., F.R.S., Prof. Roberts-Austen, F.R.S., Prof. Ayrton, F.R.S., the Ven. the Archdeacon of Bath, Sir I. Lowthian Bell, F.R.S., the Rev. Prof. Bonney, F.R.S., Sir J. Crichton Browne, F.R.S., Mr. Brudenell Carter, Mr. C. Cochrane (President of the Institution of Mechanical Engineers), Sir John Coode, K.C.M.G., Mr. W. Crookes, F.R.S., Prof. Boyd Dawkins, F.R.S., Prof. Dewar, F.R.S., Sir James Douglass, F.R.S., Mr. W. T. Thiselton-Dyer, C.M.G., F.R.S., Dr. John Evans, F.R.S., Mr. Francis Galton, F.R.S., Dr. Gamgee, F.R.S., Dr. Geikie, F.R.S., Mr. R. Giffen, Mr. Alfred Giles, M.P., Dr. Gladstone, F.R.S., Mr. G. B. Gregory, Mr. Thomas Hawksley, F.R.S., Prof. Henrici, F.R.S., Mr. Victor Horsley, F.R.S., Major-General Hutchinson, R.E., Prof. Judd, F.R.S., Colonel Laurie, C.B., M.P., Prof. Liveing, F.R.S., Mr. J. Norman Lockyer, F.R.S., Prof. McLeod, F.R.S., Major Marindin, R.E., Mr. Ludwig Mond (President of the Society of Chemical Industry), Mr. J. Fletcher Moulton, Q.C., F.R.S., Admiral Nicholson, C.B., Admiral Sir E. Ommanney, C.B., F.R.S., Sir P. Cunliffe-Owen, K.C.B., K.C.M.G., Dr. William Pole, F.R.S., Mr. W. H. Preece, F.R.S., Colonel Rich, R.E., Prof. Romanes, F.R.S., Sir H. E. Roscoe, M.P., F.R.S., Prof. Rücker, F.R.S., Dr. Russell, F.R.S. (President of the Chemical Society), Prof. J. S. Burdon Sanderson, F.R.S., Prof. Schäfer, F.R.S., Dr. P. L. Sclater, F.R.S., Sir William Thomson, F.R.S., Sir William Turner, F.R.S., Major Tulloch, R.E., Sir C. W. Wilson, R.E., K.C.B., K.C.M.G., Sir Francis de Winton, K.C.M.G., Mr. E. R. Wodehouse, M.P., and many others. In England, which in this respect differs widely from the other leading countries of Europe, men of science, including even those in State employ, are not invited to take part in such State functions on the birthday dinner. It was a happy thought on Sir Frederick Bramwell's part, therefore, to select the Queen's birthday as the day on which his dinner was to be given. Many of the most eminent men of science in the country had thus an opportunity of associating themselves with the expression of the general feeling of the community on an interesting public occasion. By this time it should surely be manifest to everyone that, on all such occasions, science should be prominently represented. The State has nothing to lose, but, on the contrary, has much to gain, by the full recognition of science as one of the most vital elements of national progress.

The gold medal of the Linnean Society has been awarded this year to Prof. de Candolle, the eminent botanist, in recognition of his distinguished services to botanical science.

In his Presidential address, delivered at the anniversary meeting of the Linnean Society on the 24th inst., Mr. Carruthers gave an interesting and detailed account of the existing portraits of Linnæus, many of which are in the Society's possession. The result of his inquiries showed that there are seven original and authentic portraits of Linnæus in existence; that the engravings most widely known are from the originals by Inlander and Roslin; and that these give the most faithful representation of the features of the great naturalist.

A new departure, likely to be productive of far-reaching results, has recently been taken in connection with the scientific work of the Scotch Fishery Board. Since 1809 the Scotch fisheries have been under special supervision, and at one time the Scotch fishery statistics were in advance of those of any other country. Previous to 1882 occasional scientific inquiries were made by Sir Lyon Playfair and Prof. Allman, and since 1882 investigations have been systematically carried on under the direction of Prof. Ewart and Sir James Maitland. Year by year the scientific work has been extended, and for some time a scientific department has existed in everything but in name.

This department, which seems to enjoy the confidence of the Scotch Office, and all the assistance the importance of the fisheries demands, has now been fully recognized and strengthened by the formation of a Committee of advice and reference, which includes representatives from all the Scotch Universities, and, in addition, an eminent statistician and the distinguished Director of the Edinburgh Science and Art Museum. The Committee, which is expected to advise as to technical and statistical as well as biological and physical questions, consists of Profs. Bayley Balfour, Crum Brown, Dittmar, D'Arcy Thompson, McIntosh, McKendrick, McWilliam, Traill, and Young; Sir R. Murdoch Smith, and Mr. G. A. Jameson. Those responsible for the formation of this Committee are to be congratulated, not only for the bold and enlightened policy displayed, but also for enlisting the active interest of so many distinguished men in the Scottish fisheries. The willingness of the members of this Committee to co-operate with the present directors of the scientific work is the best guarantee that their past labours have been appreciated, the best reward for surmounting the many difficulties that have necessarily been met with in initiating and carrying on fishery investigations.

MR. RICHARD BULLEN NEWTON, of the Geological Department, British Museum, has been presented to an Assistantship of the first class.

MR. MELLUISH succeeds the late Mr. Johnston as Electrician to the Government of India.

MR. HALY, Curator of the Colombo Museum, has published a "first report" on the collection of moths in the Museum. It is compiled from Messrs. Coles and Swinhoe's catalogue of the moths of India and Ceylon, and Mr. Haly has added all that is at present known concerning their local distribution and the times of the year at which the species appear.

THE Johns Hopkins Hospital, Baltimore, was opened on May 7. An address was delivered on the occasion by Dr. Daniel C. Gilman, who spoke eloquently of the close relationship between the advancement of knowledge and the progress of charity.

MESSRS. TRÜBNER have issued the first number of what ought to be a useful monthly periodical—*The Periodical Press Index*. The aim of the editor is to present a record of the more important subjects dealt with in periodical literature at home and abroad. As it would become irksome in course of time to consult a monthly index, arrangements are being made for the publication of an additional yearly volume on a plan which will render it unnecessary for students to refer to each part month by month.

PROF. H. G. SEELEY, F.R.S., will conduct the London Geological Field Class to sections on the North Downs, showing Gault and Lower Greensand, on Saturdays in June and on Whit Monday. Communications should be addressed to the Hon. Sec., Mr. R. H. Bentley, 31 Adolphus Road, Brownswood Park, South Hornsey.

A NEW substance, singular alike in its chemical nature and in its properties, has been discovered by M. Péchard. It is a mixed acid derived from oxalic and molybdic acids, and is therefore termed oxalomolybdic acid. It is a solid, crystallizing in large monoclinic prisms, and forms a well-defined series of salts. Berzelius long ago found that molybdenum trioxide readily dissolved in a hot solution of oxalic acid, but appears never to have investigated the nature of the reaction. When the molybdic acid has been added almost to saturation the liquid becomes syrupy, and on evaporation yields crystals of the new oxalomolybdic acid, which on analysis give numbers corresponding to the formula $C_2H_2O_4 . MoO_3 . H_2O$. The finest crystals are obtained by dissolving the viscous mass, formed on evaporating the saturated solution of the acid, in dilute nitric acid, and allowing it to evaporate in a desiccator. Oxalomolybdic acid is almost totally insoluble in strong nitric acid, and if an excess of nitric acid be added to a saturated solution of the new acid, small crystals at once separate; but if dilute nitric acid be employed, the crystals form more slowly, and are consequently much larger and more perfect. The crystals dissolve in cold water, more rapidly on warming, yielding a colourless and strongly acid liquid. That it is a true mixed acid is shown by the fact that it forms crystalline salts with metals. If a solution of silver nitrate is added to a warm solution of the acid in water, a yellow crystalline precipitate of the silver salt, $C_2Ag_2O_4 . MoO_3$, is thrown down. This salt is insoluble in water, but, like many other silver salts, is readily dissolved by ammonia. Barium chloride or baryta water precipitate in a similar manner the barium salt $C_2BaO_4 . MoO_3$, in the form of small colourless crystals. The sodium salt, $C_2Na_2O_4 . MoO_3 . 5H_2O$, is readily obtained in good crystals by neutralizing the acid with soda. The crystals of oxalomolybdic acid, when dry, may be preserved unchanged either in sunshine or in the dark. But, if moist, they quickly become coloured blue when exposed to the sun's rays. If characters be written on paper with the solution, they remain invisible in a weak light; but, when exposed to sunshine, they rapidly become visible, turning to a deep indigo colour. It is curious that this effect only happens when the solution is spread over paper or other surfaces, for the solution itself may be kept unaltered in the bottle for any length of time, except for a trace of blue at the edge of the meniscus, where, by surface action, a little is spread against the interior glass walls. If a sheet of paper be immersed in a saturated solution of the acid, dried in the dark, and then exposed behind an ordinary photographic negative, a very sharp print in blue may be obtained by exposure to sunlight for about ten minutes. The colour instantly disappears in contact with water, so that if a piece of this sensitized paper be wholly exposed to sunlight, one may write in white upon the blue ground by using a pen dipped in water. If, however, the paper with its blue markings be exposed to a gentle heat for a few minutes, the blue changes tc black, and the characters are then no longer destroyed by water.

THE Pilot Chart of the North Atlantic Ocean for the month of May shows that the month of April commenced with generally high barometer and moderate weather over the greater part of the trans-Atlantic routes, followed by easterly gales on the 3rd, and continuing in the eastern regions until the 11th. On the 7th and 15th, areas of high barometer left the American coast, and slowly traversed the ocean, reaching Europe on the 15th and 26th respectively. Several storms visited the American coast, one off Hatteras on the 7th and 8th being of marked severity, causing the water to rise a foot higher than ever known before at Norfolk, and doing great damage both on shore and at sea. There was a great increase of fog, especially off the coast of the United States. A large iceberg was seen on the 9th, in lat. 48° N., and long. 44° 40′ W.

A LIMITED number of copies of the first part of the "Bibliography of Meteorology," which has been for many years in course of preparation by the Washington Signal Office, has been issued in a lithographic form by General Greely. It contains 382 quarto pages, and includes all the titles of books and articles bearing upon the subject of temperature from the origin of printing to the close of 1881. Similar titles covering the period from 1882 to 1887 have also been prepared, but are not included in the present volume. The classification of the titles is based upon a scheme furnished by Dr. A. Lancaster, of Brussels, and is arranged under nineteen subdivisions, the arrangement of each subdivision being chronological under the authors' names, and, at the end, a list of authors' names is given, with references to the pages on which their works are found. We think that, considering the large amount of materials to be dealt with, this is the best arrangement that could be made, although, whenever a minor classification is attempted, it invariably leads to difficulties of arrangement, and to corresponding difficulties in turning up any particular work. We should like to have seen some reference to the libraries in which the older works are to be found, as has been done for all titles given in the Brussels catalogue. The work is one of the greatest importance to all meteorologists, and we can only hope that the favourable reception it is sure to meet with in all countries will induce Congress to order its regular publication, and that of the volumes relating to all other meteorological subjects, the materials for which are already prepared. It was on this distinct understanding that Mr. G. J. Symons handed over his 20,000 titles to General Hazen, some years ago.

AT a recent meeting of the New York Academy of Sciences, General Andrews, commenting on a paper about the proposed Tehuantepec ship railway, made some interesting remarks on the general subject of ship railways. Estimates which he regards as incontrovertible show that a ship can be hauled by a locomotive over a ship-railway, or, as he prefers to designate it, a ship-tramway, with the expenditure of only one-half the amount of coal which the same ship must burn to propel herself through the water of a canal. The most frequent objection urged against the practicability of the scheme is that it would rack the ship; but General Andrews explained that the weight is so distributed among the numerous supports that no one need sustain a greater weight than a man presses upon his foot in walking. The gradients of the route will be very slight, not exceeding 2 inches in 400 feet, the entire length of a vessel. He had made observations, during a voyage aboard the steamer *Britannic*, to measure the amount of strain to which she was exposed in a sea of no very great roughness, and found by stretching cords that the steamer was bent sixteen inches by the waves, but without the slightest injury: hence he infers that the stress on a vessel in crossing the isthmus would be inappreciable and harmless.

MR. ALEXANDER DURLACHER has presented to the Royal Colonial Institute an interesting collection of native weapons and implements from Western Australia.

A RESOLUTION has been issued by the Government of India, dealing with the preservation of antiquarian treasures, with the view of making known the conditions under which the Government can claim articles of archæological interest, and to provide for their better preservation for the public by holding out the prospect of sufficient reward to finders of treasures. The resolution lays especial stress on the importance of paying proper consideration to the claims and expectations of these latter, as the end in view will be defeated if those who discover objects of antiquarian value are not induced by the hope of sufficient reward to make their discoveries known to the public authorities.

CAPTAIN A. P. MADSEN lately communicated to the Northern Antiquarian Society of Copenhagen an account of his examination of the celebrated great "kitchen-midden" at Meilgaard, in Jutland, which has only once before (in 1869) been slightly examined. It is now situated several miles inland, but the configuration of the country showed that at the time of its formation a bay existed there. The midden was at one time some 12 feet in depth, but is now only 6. Oyster-shells predominated, then came the common blue mussel and winkles. There were also shells of three kinds of other mussels, of which two are extinct, but the third species is still found in the Limfjord. There were three places with remnants of charcoal and ashes. The bones found were those of water rats, ring seals, grey seals, dogs, pigs, foxes, martens, otters, boars, roe-deer, stags, bullocks; common swans, wild ducks, the great loon, sea-gulls, ring-doves, and crows; and of fishes, those of salmon, jack, eel, cod, and flounder. Of implements from the Stone Age were flint chisels, hooks of bone, a flint wedge, arrow-heads, drills, &c. The quantity of the remains indicated that a considerable population had lived in the vicinity, who no doubt brought the spoils of the chase thither. The land was now 20 feet above sea-level, but there was every appearance of the site having once been on a promontory by the sea. Many of the middens in Jutland were now situated from five to six miles inland, but had undoubtedly once lain by the sea. In one midden, Captain Madsen had found split marrow-bones, ornamented pottery, and polished implements, together with bones of sheep and goats, but no marine shells, indicating that there were also middens from a more recent period. Commenting upon these explorations, Prof. Japetus Steenstrup maintained that Captain Madsen's account of the rising of the land was exaggerated.

THE last number of the *Rendiconti della R. Accademia dei Lincei* contains a reference to an Italian precursor of Franklin, the Venetian physician Eusebio Sguario, reputed author of a work on "Electricity, or the Electrical Forces of Bodies," published in 1746. In this work occurs the following passage:—"Still it seems impossible for the violence of a subtle effluvium to acquire such intensity, however increased we may suppose it to be, unless by this means we should succeed in discovering the tremendous velocity of that subtle igneous matter which constitutes lightning. And who will ever venture boldly to deny that lightning is nothing else than a subtle electrical substance impelled to the last degree of its violence? It would certainly be a fatal surprise for that experimenter, who, finding in this way a means of producing artificial lightning, might fall a victim to his curiosity." This was written two years before the appearance of the work on physics by Nollet (Paris, 1748), who has hitherto been supposed to be the first writer who has expressed in clear language the close relation existing between the phenomena of electricity and lightning.

THE British Secretary of Legation in Rio de Janeiro, in a recent report states that for many years, though with varied intensity, a destructive disease has existed in the best zone of territory for coffee in the province of Rio de Janeiro. It has never been so bad as the coffee-leaf disease in Ceylon and Java, but still has done much harm. A scientific Government *emp'oyé*, Dr. E. Gölde, in correspondence with Dr. Soltmedel, of Java, has now almost proved that the Brazilian root-disease and the Ceylon leaf-disease have the same origin—namely, a small worm in the root, belonging to the group of Nematoids, similar to the worm in beetroots in Europe.

THE Hydrographical Department of Russia has devoted, since 1837, a good deal of attention to the secular rising of the coasts of the Baltic Sea, and a number of marks have been made on the rocky coasts of the Gulfs of Bothnia and Finland in order to obtain trustworthy data as to the rate of the upheaval of the coasts. Since 1869, observations have been carried on in a systematic way for measuring the changes in the level of the Baltic at several of the above-mentioned marks, and the results of the observations are now summed up by Colonel Mikhailoff in the *Izvestia* of the Russian Geographical Society (vol. xxiv. 3). Taking only those stations at which the secular change could be determined for a number of years varying from thirty-one to thirty-nine years (1839–78), the rise of the coast in a century would appear to be as follows: Aspö, 20·3 inches; Lehtö, 11·5 inches; Island of Kotkö, 26·7; Sveaborg, 22·8 and 25·1; Hangöudd, 33·7; Island of Skotland, 12·5; Island of Jussari, 31·6; Tverminö, 36·2; Island of Gloskär at Redhamn, 12·2. It thus appears that the figure of about three feet in a century, which was deduced from former observations, cannot be very far from the truth. As to local anomalies, they remain still unexplained.

THE additions to the Zoological Society's Gardens during the past week include two Yellow-fronted Tanagers (*Euphonia flavifrons*) from Dominica, presented by Mrs. Herbert; two Manx Shearwaters (*Puffinus anglorum*) from the Scilly Islands, presented by Mr. F. Hensman; an Ocelot (*Felis pardalis*) from South America, deposited; four Black-tailed Godwits (*Limosa ægocephala*), European, purchased; two Indian Muntjacs (*Cervulus muntjac* ♂ ♀) from India, received in exchange; a Persian Gazelle (*Gazella subgutterosa* ♀), two Bennett's Wallabys (*Halmaturus bennetti* ♀ ♀), a Hog Deer (*Cervus porcinus* ♂), a Collared Fruit Bat (*Cynonycteris collaris*), two Grey Wagtails (*Motacilla melanope*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET 1888 *e* (BARNARD, SEPTEMBER 2).—The following ephemeris for Berlin midnight for this object is in continuation of that given in NATURE, vol. xxxix. p. 616:—

1889.	R.A. h. m. s.	Decl. ° ′	Log *r*.	Log Δ.	Brightness.
June 1	22 54 22	2 39·9 N.	0·3730	0·3441	2·1
5	22 47 38	2 40·5	0·3786	0·3317	2·1
9	22 40 4	2 38·1	0·3842	0·3193	2·2
13	22 31 38	2 32·5	0·3898	0·3070	2·3
17	22 22 16	2 23·6	0·3954	0·2952	2·4
21	22 11 57	2 10·7 N.	0·4010	0·2839	2·4

The brightness at discovery is taken as unity.

THE MOTION OF STARS IN THE LINE OF SIGHT.—Prof. H. C. Vogel, noting the difficulty which has been experienced at the Greenwich and Rugby Observatories in making eye-observations of the displacement of the lines in stellar spectra due to the approach or recession of the stars, has endeavoured to solve the problem by means of photography, and has met with very considerable success. The atmospheric tremors, which are so baffling and often misleading to direct eye-observation, counteract each other and produce little or no effect on the photograph; and the feebleness of the light of a star when spread out into a long spectrum is overcome by a lengthened exposure. Prof. Vogel gives the following results (in German miles per second) for five stars, of which four have been observed at Greenwich:—

Star.	Vogel.	Greenwich.
Capella	+3·5	+4·8
Aldebaran	+6·5	+6·8
Polaris	−3·5	not observed
α Persei	−1·5	−4·8
Procyon	−1·5	−0·8

The Greenwich observations for 1888, nearly contemporaneous therefore with the Potsdam observations, give the motion of Procyon as −0·8. The agreement of the individual photographs is very gratifying, and is much closer than that of the eye-measures made on different nights.

THE LATITUDE OF DETROIT.—A determination of the latitude of the Detroit Observatory has recently been made by Dr. Ludovic Estes.[1] The zenith telescope was employed, and the results were discussed by the method of least squares. The value arrived at after all corrections is 42° 16′ 48″·66 ± 0″·051. An interesting point in connection with the observations is that smaller values were obtained from low stars, which seems "to indicate that northern stars are refracted less than southern, for the same zenith distance; and that, therefore, the layers of the atmosphere, instead of being parallel to the surface of the earth, are depressed more rapidly toward the north" (p. 54).

THE MINOR PLANET VICTORIA.—A programme has been prepared by Dr. Gill, of the Royal Observatory, Cape of Good Hope, for observations of the minor planet Victoria at its opposition in 1889; the opposition in right ascension occurring on July 16, and the primary object of these observations being to determine the parallax of the sun from heliometric measures. A list of comparison stars is given, and is so arranged that when the planet is situated at the greatest zenith distance where good observations may be made, one comparison star may be below and another above it, the measurement by the heliometer of the difference of two nearly equal and opposite distances giving the most accurate result obtainable.

Victoria has a zenith distance of 62° at an hour-angle of 4h. for the Cape, 2h. for European Observatories, and 3h. for Newhaven. A list is given of the limits of hour-angle during which observations of the planet may be made from June 10 to August 29.

The corrected ephemeris of the planet has been computed, and it is hoped that co-operating meridian Observatories will determine the places of the thirty-seven comparison stars with the meridian circle, and at the same time procure as many meridian observations of the planet as possible. Provided that means exist for determining the distortion of the photographic film, and the optical distortion of the field, photographs taken in both hemispheres showing the planet lengthened out so as to form a straight line, whilst neighbouring stars are well defined, are available for the determination of parallax. Dates are also given when photographic observations of Victoria may be advantageously combined with heliometer observations.

MERIDIAN OBSERVATIONS OF IRIS.—A similar programme to the above was issued by Dr. Gill, in September 1888, for observations of the minor planet Iris; and Mr. Arthur A. Rambaut, assistant astronomer at Dunsink Observatory, has made observations, with the meridian circle, of the places of the planet and the twenty-eight comparison stars given. The measures will be found in *Monthly Notices R.A.S.*, March 1889, and extend from September 7, 1888, to January 10, 1889. Between these dates twenty-six observations of Iris were made, and its apparent right ascension and declination found. During the progress of the work two comparison stars were added to Dr. Gill's list.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1889 JUNE 2–8.

(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 June 2

Sun rises, 3h. 50m.; souths, 11h. 57m. 45·8s.; daily increase of southing, 9·6s.; sets, 20h. 6m.: right asc. on meridian, 4h. 42·3m.; decl. 22° 15′ N. Sidereal Time at Sunset, 12h. 52m.

Moon (at First Quarter on June 6, 20h.) rises, 6h. 42m.; souths, 15h. 2m.; sets, 23h. 17m.: right asc. on meridian, 7h. 46·8m.; decl. 22° 19′ N.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. on meridian. h. m.	Declination on meridian. ° ′
Mercury	5 4	13 25	21 46	6 9·7	23 56 N.
Venus	2 25	9 28	16 31	2 12·5	11 33 N.
Mars	4 1	12 16	20 31	5 0·6	23 19 N.
Jupiter	21 49*	1 44	5 39	18 26·6	23 6 S.
Saturn	8 52	16 28	0 4*	9 13·2	17 17 N.
Uranus	14 52	20 22	1 52*	13 7·7	6 31 S.
Neptune	3 31	11 18	19 5	4 2·6	19 5 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

June.	h.	
4	8	Saturn in conjunction with and 1° 47′ south of the Moon.
6	—	Venus at period of greatest morning brilliancy.
6	20	Mercury stationary.

Saturn, June 2.—Outer major axis of outer ring = 39″·1: outer minor axis of outer ring = 10″·6: southern surface visible.

Meteor-Showers.

	R.A. °	Decl. °	
Near β Coronæ	228	30 N.	June 2.
,, β Ophiuchi	262	5 N.	Rather slow.
,, α Cephei	317	61 N.	Swift; streaks.

[1] Ann Arbor, Mich.: The Register Printing and Publishing Company, 1888.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·5 ...	81 17 N. ...	June 4,	23 49	*m*
S Cancri	8 37·6 ...	19 26 N. ...	,, 5,	3 18	*m*
R Virginis	12 32·9 ...	7 36 N. ...	,, 7,		*M*
δ Libræ	14 55·1 ...	8 5 S. ...	,, 3,	22 7	*m*
R Ursæ Minoris ...	16 31·5 ...	72 30 N. ...	,, 3,		*M*
U Ophiuchi... ...	17 10·9 ...	1 20 N. ...	,, 6,	3 14	*m*
			,, 6,	23 22	*m*
X Sagittarii... ...	17 40·6 ..	27 47 S. ...	,, 7,	0 0	*m*
U Sagittarii... ...	18 25·6 ...	19 12 S. ...	,, 2,	2 0	*m*
			,, 5,	1 0	*M*
R Lyræ	18 52·0 ...	43 48 N. ...	,, 5,		*M*
R Sagittæ	20 9·0 ...	16 23 N. ...	,, 7,		*m*
U Capricorni ...	20 42·0 ...	15 12 S. ...	,, 7,		*M*
W Cygni	21 31·9 ...	44 53 N. ...	,, 8,		*M*

M signifies maximum; *m* minimum.

GEOGRAPHICAL NOTES.

AT the anniversary meeting of the Royal Geographical Society on Monday, the medals and other honours already announced in NATURE were awarded. Dr. Radde, of Tiflis, appeared in person to receive his medal, which he acknowledged briefly and appreciatively. The address of the President, General Strachey, was of more than usual interest. After referring to the geographical events of the year, he took up the subject of Central Africa, its future exploration, and its subjection to the commercial and civilizing influence of Europe. General Strachey reviewed the results of European contact with the various other parts of the world, savage and semi-civilized. "There is no room to doubt," he said, "that the occupation of the earth by man in the many various modes presented to us has been determined mainly by the physical conditions of the surface, the distribution of land and sea, and the nature of the climate, operating in conjunction with the particular inherited capacities of the several branches of the human race, which have themselves been largely determined by these same physical conditions. The diffusion of races, and their more or less permanent occupation of various parts of the earth, have necessarily been regulated by their relative powers of adapting themselves to, and taking advantage of, the facilities for existence offered by the regions they occupied, and of resisting adverse pressure of all sorts brought to bear upon them from without. Among the best safeguards against that form of pressure which consists of the intrusion of other races, have ever been isolation by the ocean, or by high mountains, great land distances, forests and deserts; and hence it has been that the interiors of the great continents have for the most part been last explored, and their inhabitants least disturbed. As the first of these defences was weakened by the development of the art of navigation, the progressive races of Europe began to seek for fresh scope for their activities in many distant regions, thus for the first time rendered accessible to them. From very small beginnings within the Mediterranean, which for several centuries gained strength only by slow degrees, at length burst forth some 400 years ago the stream of conquest and commercial adventure which has in our time been carried across every part of the ocean; and has beaten on all its shores, throwing open an infinitude of lines of attack for the inroads of European progress upon regions previously resting in various conditions of relatively primitive stagnation." General Strachey then, in a highly suggestive manner, reviewed the methods and results of European conquest or European civilization in North, Central, and South America, Australasia, India, China, North Africa and South Africa, and, coming finally to Central Africa, he pointed out that the conditions there were peculiar and required peculiar treatment. "The vast area of tropical Africa," he said, "its climate, often so hostile to Europeans, and the numbers and character of the population, combined with the peculiar difficulties attending all transport in the interior, have retarded the progress of geographical discovery, and obstructed that intercommunication between neighbouring districts which supplies the natural machinery by which the progress of the less advanced races is carried forward. It is impossible to suppose that the impression to be made on these countries by the mere handful of men of northern race who are now scattered along its coasts or at a few points in its interior, can be anything but extremely slow, and it is hardly less certain that under the wholly different conditions that Central Africa presents from those of any other country hitherto brought within the operation of the process of civilization, the form which that process will take, and its results, will be very different from anything that past experience can suggest. The possibility of any colonization by direct immigration on such a scale as to produce effects in any way analogous to those obtained in North America or Australia is obviously excluded; the condition of the people over the greater part of the continent renders it equally impossible to look forward to a time when systems of administration at all approaching that of India could be established; and amalgamation between European settlers and the indigenous races appears no less out of the question. The operation of bringing a population such as that of Central Africa under the restraints of civilization will necessarily be a long and no doubt in some respects a painful one, for assuredly the conflict with slavery, cannibalism, and massacre cannot be carried to a successful issue by gentle means alone. The dangers that attend precipitation, with consequent reaction, have been already exemplified too plainly, and by the sacrifice of too many noble lives; and in circumstances such as those that here have to be dealt with, toleration of unavoidable evil at the outset may well afford the best and most certain means of introducing permanent improvement. Nor can I see any reason to question the conclusion that the best method of entering on this gigantic task is that which the general sense of Europe has practically resolved to adopt—namely, to form commercial associations intrusted with the exercise of reasonable administrative authority within the several areas assigned to them, hoping that thus the African population may by degrees be taught that the path to social and material comfort and well-being lies through well ordered industry and peaceful occupations; in imparting which lessons the earnest co-operation of the many purely philanthropic missions already established among these people may be most confidently counted on."

BEACON LIGHTS AND FOG SIGNALS.[1]

II.

IN 1876, Mr. Julius Pintsch, of Berlin, patented in this country his system of illuminating buoys or other floating bodies by compressed oil gas, and in 1878 one of these buoys was experimentally tried at sea with success by the Trinity House. The system is similar to that previously adopted by Mr. Pintsch with great success in the lighting of railway carriages, but with the addition for buoys of a specially constructed lantern, containing a small cylindrical lens for fixed light. Through the kindness of the Pintsch's Lighting Company, we have here one of these apparatus, producing an intensity in the beam of about twenty candle units. With the charge of gas contained in the buoy, the light is shown continuously, night and day, from two to four months, according to the dimensions of the buoy, without refilling or requiring any other attention except occasional cleaning of the lens and the glazing of the lantern. In 1883, Mr. William B. Rickman patented a very ingenious addition to this apparatus for producing occulting or flashing light. The apparatus is automatically worked by the issuing compressed gas on its way from the buoy to the burner. After passing the regulator where the pressure of the gas is reduced for burning, it enters a cylindrical chamber covered with a diaphragm of very flexible specially prepared leather, this diaphragm, on being slightly raised by the in-flowing gas, communicates motion to a lever, which, assisted by a spiral spring, closes the inlet pipe, and opens at the same time the passage to the burner. As the gas passes on and is consumed at the burner, the diaphragm by its own weight, assisted by the spring, sinks, and touching the lever, closes the outlet aperture to the burner, and at the same moment opens the inlet of the gas from the buoy for another charge. Thus the light is extinguished while the gas is entering the chamber, and until the latter is refilled, when the passage from the buoy is again closed by the rising of the diaphragm. A small pilot jet is constantly burning to insure the re-ignition of the gas when re-admitted to the burner. It is evident that several characteristic distinctions of light may be obtained by modifications of this ingenious apparatus. About 150 buoys lighted on the Pintsch system are already rendering valuable

[1] Friday evening discourse delivered at the Royal Institution by Sir James N. Douglass, F.R.S., on March 15. Continued from p. 91.

service to mariners in various parts of the world. For the more important stations at sea where light-vessels are now employed the system is considered to be yet wanting in that trustworthiness which should be the leading characteristic of all coast lighting. Very important experiments have lately been made by the Lighthouse Board of the United States, at their General Depot at Tompkinsville, New York, with buoys lighted electrically by glow lamps, operated through submarine conductors from the shore. These experiments have proved so successful that an installation for marking the Gedney's Channel entrance of Lower Bay, New York Harbour, with six buoys and 100-candle glow lamps, was lighted on November 7 last. Gas buoys were considered inapplicable for this special case, owing to their form and size rendering them liable to break adrift, particularly when struck by floating ice or passing vessels. The buoy adopted for the service consists of a spar 46 feet long, having its lower end shackled direct to a heavy iron sinker, resting on the bottom. At the upper end the buoy is fitted with an iron cage inclosing a heavy glass jar, in which is placed the glow lamp of 100 candle units intensity. The cable is secured by wire staples in a deep groove cut in the buoy and covered by a strip of wood. For a distance of several feet at the lower end of the buoy the cable is closely served with iron wire, over which is wound spun yarn to prevent injury from chafing on the shackle and sinker. The central station on shore, with steam-engines and dynamos in duplicate, is on Sandy Hook, at a distance from the extreme buoys of about 3 nautical miles. The installation is reported to be working continuously and successfully. For auxiliary or port lights on shore where no collisions can occur, the Pintsch gas system is found to be very perfect. At Broadness, on the Thames, near Gravesend, the Trinity House erected in 1885, an automatic lighthouse illuminated on Pintsch's system, as shown by the diagram. This small lighthouse shows a single flashing light at periods of ten seconds, the flashes having an intensity of 500 candle units. The flashes and eclipses are produced with perfect regularity by special clockwork, which also turns on the gas supply to the burner at sunset and off again at sunrise. It is also arranged for periodic adjustment for the lengthening and shortening of the nights throughout the year. This automatic light is in the charge of a boatman, who visits it once a week, when he cleans and adjusts the apparatus, and cleans the glazing of the lantern. An automatic lighthouse similar to that at Broadness has been lately installed at Sunderland by the River Wear Commissioners, on a pier which is inaccessible during stormy weather. In 1881–82 several beacons automatically lighted by petroleum spirit, on the system of Herr Lindberg and Herr Lyth, of Stockholm, were established by the Swedish lighthouse authorities, and are reported to be working efficiently. In 1885 a beacon or automatic lighthouse on this system was installed by the Trinity House on the Thames, near Gravesend, and has been found to work efficiently. The light is occulting at periods of about two seconds; the occultations are produced by an opaque screen, rotated around the light by the ascending currents of heated air from the lamp acting on a horizontal fan. As there is no governor to the apparatus, the periods of the occultations are subject to slight errors compared with those of the gas light controlled by clockwork. In 1844 an iron beacon lighted by a glow lamp and the current from a secondary battery was erected on a tidal rock near Cadiz. Contact is made and broken by a small clock, which runs for twenty-eight days, and causes the light to flash for five seconds at periods of half a minute. The clock is also arranged for eclipsing the light between sunrise and sunset. The apparatus is the invention of Don Isaas Lavaden, of Cadiz, to whom I am indebted for kindly showing me the light in action when on a visit to Cadiz in 1885. There is every probability that automatic beacons lighted either by electricity, gas, or petroleum spirit, will in consequence of their economy in maintenance be extensively adopted in the future.

Coal and wood fires, the flames produced by the combustion of tallow, nearly all the animal, vegetable, and mineral oils, coal and oil gas, and the lime-light, have been employed from time to time in lighthouse illumination, and last but not least, the electric light. None of these illuminants have received such universal application in all positions both ashore and afloat as mineral oil at the present moment, and justly so, when we consider its efficiency and economy for the purpose. So recently as 1822, the last beacon coal fire in this country was replaced by a catoptric oil light, at Saint Bees Lighthouse, on the coast of Cumberland. We have here diagrams of two of these coal fire beacons, one of them designed and erected by Smeaton in 1767 on his lighthouse at the Spurn Point, on the east side of the entrance to the Humber. So late as 1845, sperm oil was entirely used in the lighthouses and light-vessels of the Trinity House; but, shortly afterwards, colza was adopted with the same efficiency, and with a saving in annual cost of about 44 per cent. In 1861, experiments were made by the Trinity House for determining the relative efficiency and economy of colza and mineral oil for lighthouse illumination; but owing to the imperfect refinement of the best samples of the latter then procurable in the market, together with its high price, the result of the investigation was not so satisfactory as to justify a change from colza. In 1869, the price of mineral oil of good illuminating quality, and safe flashing-point, was found to be procurable at about half the price of colza, when the Trinity House determined to make a further series of experiments, and by these it was ascertained that, with a few simple modifications of the argand burners then in use, they were rendered very efficient for the purpose; it was also found that these burners were thus considerably improved for the combustion of colza. A change from colza to mineral oil was then commenced, and mineral oil is now generally adopted in the lighthouses and light-vessels of the Trinity House service; and with even greater economy than was at first anticipated, the price of this illuminant being now rather less than one-third that of colza. The most powerful oil burner then in use was one of four concentric wicks, the joint production of Arago and Fresnel, and adopted by the French lighthouse authorities about the year 1825, in conjunction with the then new dioptric system of optical apparatus of Fresnel. The standard intensity of the combined flames of this burner, one of which we have here, was 260 candle units. A further development was made during the experiments of the Trinity House in 1871, by increasing the number of wicks from four to six, which more than doubled the intensity of the light, while effecting a condensation of the luminary per unit of focal area, or, in other words, improved the optical efficiency 70 per cent. We have here also one of these burners.

I have since devised an argand burner for the combustion of all illuminating gases and oils, whereby still further condensation of the flames, together with greater intensity and economy of combustion, is obtained, and the glass chimney is protected from breakage. These improvements are effected by a special arrangement and distribution of the air currents through the rings of flame, and between them and the glass chimney. We are thus enabled on this system to increase the dimensions of lighthouse burners, for gas and oil, for ten or more rings of flame. With ten rings, we obtain an aggregate intensity, when burning cannel gas and good mineral oil, of considerably over 2000 candle units, while the improved efficiency of the luminary for optical cendensation of the radiant light per unit of focal area, as compared with the luminary of the Fresnel four-wick oil burner, has been in each case increased 109 per cent. With reference to the perfect combustion of these highly condensed flames, I may state that the efficiency for gas is exactly double that of the London standard argand burner, viz. when consuming gas of the London standard of sixteen candles, the light produced is at the rate of 6·4 instead of 3·2 candles per cubic foot. In addition to a single ring gas burner of this type we have two burners of the ten rings of flames, and models of their flames, one for gas and the other for mineral oil. These burners are all of the Trinity House new pattern, both gas and oil, and they are of the same general arrangement for combustion, except that the oil burner is provided with cotton wicks. Both produce flames of nearly the same form, dimensions, intensity, and colour.

The first application of coal gas to lighthouse illumination was made at the Troon Lighthouse, Ayrshire, in 1827; and in 1847 it was adopted at the Hartlepool Lighthouse, Durham, where for the first time it was employed in combination with dioptric apparatus of the first order of Fresnel. The slow progress made with coal gas in lighthouses, except for harbour lights, where the gas could be obtained in their vicinity, as at Hartlepool, was chiefly due to the great cost incurred in the manufacture of the small quantity required, and at the usual isolated positions occupied by coast lighthouses, involving extra cost both for labour, and for the extra transport of the coal. In 1865, the attention of lighthouse authorities was directed to gas, as an illuminant for lighthouses, by Mr. John R. Wigham, of Dublin, whose system was tried in that year, at the Howth Bailey Lighthouse, Dublin Bay. The gas burner of Mr. Wigham, one of which we have here, consists of seven concentric rings, of single flat-flame burners, amounting in the aggregate to 108. The burner is used without a glass chimney, and thus there is no appreciable condensation of the group of flames, for their employment at the focus of optical apparatus, and the relative aggregate intensity of the seven rings of flat flames per unit of focal area, as compared with the four concentric flames of the old four-wick oil burner of Fresnel, is only 2½ per cent. higher than the latter. The burner has five powers, for varying states of the atmosphere. For the minimum intensity, 28 jets are employed; and with the whole 108 jets there is a maximum aggregate intensity of the flames with cannel gas of about 2500 candle units. Several lighthouses on the coast of Ireland have been illuminated with gas, on the system of Mr. Wigham, and two at Haisborough, on the coast of Norfolk. In 1878, Mr. Wigham installed at the Galley Head Lighthouse, County Cork, his system of superposed gas flames, and group-flashing light, which consisted of four of his large gas burners vertically superposed. In conjunction with these were four tiers of first order annular lenses, eight in each tier. By successive lowering and raising of the gas flames at the focus of each tier of lenses, he produced his group-flashing distinction. This light shows, at periods of one minute, instead of the usual single flash from each lens, or vertical group of lenses, a group of short flashes, varying in number between six and seven. The unavoidable uncertainty with this system in the number of flashes contained in each group is unfortunate for the mariner, who, with the continued increase in the number of coast lights, requires the utmost precision in the distinctive character adopted for each.

In 1857, an experimental trial of the first magneto-electric machine of Holmes, for the practical application of the electric light, was made by the Trinity House at Blackwall, under the direction and to the great delight of their scientific adviser, Faraday; and after a series of experiments the satisfactory report of Faraday encouraged the Trinity House to order a practical trial of a pair of the Holmes machines. The trial was made at the South Foreland High Lighthouse by Faraday and Holmes on December 8, 1858, when electricity was found to be a formidable rival to oil and gas for lighthouse illumination, and this position it maintains to the present day. The trials of this arc light were made at the focus of the first order dioptric apparatus for oil light, which was very imperfect for the purpose, but they were sufficiently encouraging to lead the Trinity House, under the advice of Faraday, to proceed further with the electric light for lighthouses. Faraday thus wrote in his report to the Trinity House:—"I beg to state that, in my opinion, Prof. Holmes has practically established the fitness and sufficiency of the magneto-electric light for lighthouse purposes, so far as its nature and management are concerned. The light produced is powerful beyond any other that I have yet seen so applied, and in principle may be accumulated to any degree; its regularity in the lantern is great, its management easy, and its care, there may be confided to attentive keepers of the ordinary intellect and knowledge."

These truly prophetic words of Faraday's have been entirely realized. Electricity still stands foremost in the illumination of our coasts, and appears destined to be one of the greatest blessings ever conferred on humanity, and more especially on "those who go down to the sea in ships." On February 1, 1862, Holmes's machines and apparatus for electric light were installed at Dungeness Lighthouse; and in 1863, the French lighthouse authorities followed, by an installation of the Alliance Company's magneto-electric machines and apparatus for fixed lights at each of the two lighthouses at Cape La Hève. We have here the first dioptric apparatus designed and manufactured by Messrs. Chance Brothers and Co., of Birmingham, for the electric fixed light at Dungeness. We have also one of the Holmes lamps employed there. The lamp used at the previous experiments was devised by M. Duboscq, of Paris. This lamp of Holmes's is similar to those of Duboscq and Serrin, excepting that the upper and lower carbons and holders are balanced and regulated through pulleys and small catgut cords, instead of by rack and pinions. The carbons are ¼ inch square, and the mean intensity of the light in the arc was 670 candle units nearly. We have here samples of the carbons employed from time to time in the development of the electric light in lighthouses; we have also a Bergot lamp fitted with the fluted form of carbons I have recently devised. They are of the dimensions now in use in the optical apparatus at the St. Catharine's Lighthouse, and are giving a mean intensity in the arc of 40,000 candle units (Fig. 5). Cylindrical compressed carbons were soon manufactured for the electric light, and were found to be more homogeneous in quality, and the flickering of the light less, than with the original square carbons, which were simply sawn from the residual carbon of gas retorts; but there was still the objectionable crater at the points, whether direct or alternating currents were employed, involving flickering from the incessant shifting of position at the points. A considerable loss of radiant light was also involved, particularly when condensing it optically. The flickering was somewhat reduced by an improvement of Messrs. Siemens', in providing the carbons with a graphite core, but with the increasing powers of currents,

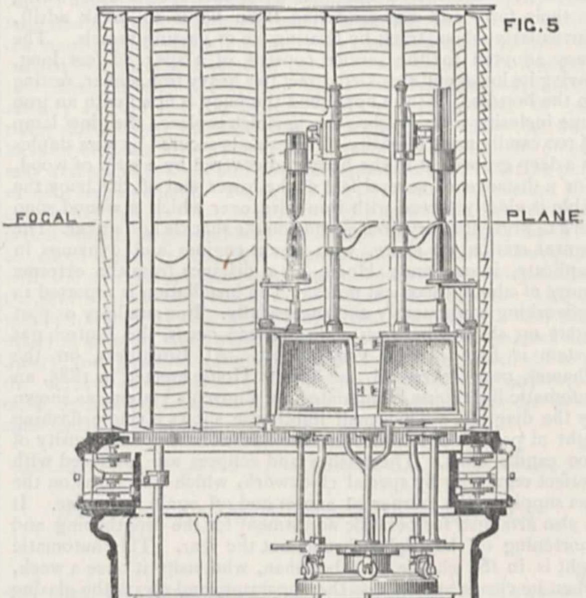


FIG. 5

and in the necessary dimensions of carbons, the results were far from satisfactory. With the fluted form of carbon shown on the diagram, the formation of the crater is prevented, and the arc is held centrally at the points of the carbons; there is thus, in addition to comparatively steady light, nearly uniform radiation in azimuth, and over a greater vertical angle for optical condensation. It now appears to me, after some practical experience with this form of carbon, that it is impossible to determine a practical limit to the dimensions of carbons that may be efficiently employed. With carbons of the actual size shown on the diagram, an intensity of about a million candle units should be produced in the arc, and about 150 millions of candle units in the condensed flashes from the optical apparatus of the dimensions now employed for oil and gas flames in lighthouses. Such an intensity is about four hundred times that possible at the focus of such apparatus with a flame luminary. Such results as these were probably in the mind of Faraday when he reported that "in principle this light may be accumulated to any degree." Flashes of the great intensity here referred to could only be employed in atmosphere impaired for the transmission of light. In clear weather they would be found to be far too dazzling to the eyes of the mariner, when an intensity of about 50,000 candle units is found to be sufficient for his guidance, and in thick fog no possible intensity can be of practical value for navigation. There are, however, various gradations of impaired atmosphere between clear weather and thick fog, in which the highest available intensity is doubtless desirable at many important landfall stations for obtaining the greatest possible range of visibility. On the other hand, at the majority of stations in narrow waters, the maximum intensity now obtained with flame light is found to be more generally efficient for navigation than higher intensities.

In 1881, the question of the relative merits of the three lighthouse illuminants—electricity, gas, and mineral oil—was receiving the attention of the lighthouse authorities of this country, which resulted in the Trinity House accepting the responsibility of carrying out an investigation at the South Foreland, of universal importance to the mariner. In the photometrical and electrical portions of this work, the Trinity House were aided by the labours of Prof. Harold Dixon, F.R.S., and Prof. W. Grylls Adams, F.R.S., which contributed very largely to the success of the investigation. The experiments were carried on during a period of over twelve months, and a vast amount of very valuable evidence was collected from numerous observers, trained and untrained, scientific and practical. The Report of the Committee was presented to both Houses of Parliament, by command of Her Majesty, in 1885. The final conclusions of the Committee are given in the following words: "That, for the ordinary necessities of lighthouse illumination, mineral oil is the most suitable and economical illuminant, and that for salient headlands, important landfalls, and places where a very powerful light is required, electricity offers the greatest advantages."

I have already referred to the necessity, with the present development of maritime commerce, that every beacon light maintain a clearly distinctive character. When the optically unaided flames of coal fires were the illuminants of our lighthouses, distinctive characters, owing to the small number of lights then employed, were of little importance, and the only distinctions then possible were the costly ones of single, double, or triple lighthouses at one station; but, with the enormous increase that has since occurred in the floating commerce of the world, and with the necessary laws now in operation, requiring all vessels to carry lights, trustworthy individuality in coast beacon lights has become a positive necessity. Until very recently, the distinctive characters consisted of the following, viz. fixed white, fixed red, revolving white, revolving red, and revolving white and red alternately. The revolving lights showed a flash at periods of ten seconds, twenty seconds, thirty seconds, one minute, two minutes, three minutes, and four minutes. There were also intermittent or occulting lights, having an eclipse at periods of half a minute, one minute, or two minutes. It is now generally considered that fixed lights are no longer trustworthy coast signals, owing to their liability to confusion with other lights, both ashore and afloat. It is also considered that, in these days of high speed vessels, the period of the character of a coast light should not, if possible, exceed half a minute. The revolving or flashing class of lights are probably the most valuable, on account of their superior intensity as compared with the fixed or occulting class, the light during the intervals of eclipse being condensed into each succeeding flash, by the revolving lenses or reflectors, and thus, with the same expenditure of the illuminant, an intensity is obtained in the flashes of five to eight times that of the fixed or occulting class. Where local dangers are required to be guarded by coloured sectors of danger light with well defined limits, this can only be accomplished with the fixed or occulting class of lights. We will illustrate this with the model before us. We will also show the clear difference of character, not generally realized, between flashing and occulting lights. A system of occulting lights for lighthouses was proposed by the late Charles Babbage, F.R.S., in 1851, but as it excluded the flashing or most powerful of the existing lights, it did not receive much favour from lighthouse authorities. In 1872, distinctive characters for coast lights was the subject of a paper by Sir William Thomson, F.R.S., at the Brighton meeting of the British Association for the Advancement of Science, when he directed attention to the extreme importance of ready identification of lights at sea, and proposed the use of quick-flashing lights, their flashes being of longer or shorter duration; the short and long flashes representing the dot and dash of the Morse alphabet as used in telegraphy. It was found, however, that the number of symbols in our alphabetical code would not be sufficient, on a thickly lighted coast, to insure individuality, and render each distinction perfectly trustworthy. Further, that very rapid repetition of each symbol is not required by the mariner, and would involve loss of accumulative power in the flashes, besides incurring unnecessary wear and tear in rotating heavy optical apparatus. Yet much is to be done in the direction of simple distinction. At the Montreal meeting of the British Association, in 1884, I submitted a paper on "Improvements in Coast Signals," in which were suggested, two alphabetical codes of flashing lights, and one of occulting, all having the same period of the symbol, viz. half a minute. In one of the codes of flashing lights, long and short flashes were proposed, as previously by Sir William Thomson; and in the other there were proposed white and red flashes. In the occulting series, long and short eclipses were proposed to be substituted for the long and short, or white and red, flashes, of the flashing codes. The system has the advantage of application to all existing lighthouse apparatus, and many lights have been altered to selected symbols of each of these series.

Little was ever accomplished in the way of warning or guidance to the mariner, during fog, until about the middle of this century. Previously, a few bells had been established at lighthouses in this country and abroad, and gongs of Chinese manufacture had been in general use on board our light-vessels, but both instruments are now acknowledged to be wanting in the efficiency now demanded in fog, to meet the requirements of navigation. The first important improvement in fog signals for the service of mariners was made by the late Mr. Daboll in 1851, who submitted to the United States Lighthouse Board, in that year, a powerful trumpet, sounded by air compressed by horse-power. The apparatus was installed at Beaver Tail Point, Rhode Island, and the favourable results obtained with it stimulated Mr. Daboll, under the encouragement of the United States lighthouse authorities, to the further development of the apparatus; and ultimately he employed Ericsson's caloric engine as the motive power, with automatic gearing for regulating the blasts. In 1854, some experiments on different means of producing sounds for coast signals were made by the engineers of the French Lighthouse Department, and in 1861–62 MM. Le Gros and Saint-Ange Allard, of the Corps des Ponts et Chaussées, conducted a series of experiments upon the sound of bells, and the various methods of striking them. In 1862, Mr. Daboll submitted his improved fog trumpet apparatus, of about three horse-power in the blasts, to the Trinity House, who, under the advice of Faraday, made experimental trials with it in London, and afterwards gave it a practical trial at the Dungeness Lighthouse, where experiments were made with it, against bells, guns, and a reed fog-horn of Prof. Holmes, whose services have been already referred to in connection with the first practical application of the electric light. This fog-horn of Holmes was sounded by steam, direct from one of the boilers employed at the station for his electric light. The results of these experiments were in favour of Daboll's trumpet; and in 1869, one of these instruments was installed on board the *Newarp* light-vessel. In the same year, Holmes having effected further improvements with his steam horn, his apparatus was fitted on board two light-vessels, and sent out to the coast of China, where they were found to give great satisfaction, as compared with gong signals. In 1863, a Committee of the British Association for the Advancement of Science memorialized the President of the Board of Trade, with the view of inducing him to institute a series of experiments upon fog signals. The memorial, after briefly setting forth a statement of the nature and importance of the subject, described what was then known respecting it, and several suggestions were made relative to the nature of the experiments recommended. The proposal does not appear to have been favourably entertained by the authorities to whom it was referred, and the experiments were not carried out. In 1864, a series of experiments was undertaken, by a commission appointed by the Lighthouse Board of the United States, to determine the relative powers of various fog signals which were submitted to the notice of the Board. In 1872, a Committee of the Trinity House, with the object of ascertaining the actual efficiency of various fog signals then in operation on the North American continent, visited the United States and Canada, where they found in service, Daboll's trumpets, steam whistles, and siren apparatus, sounded by steam and compressed air; these latter apparatus were devised by Mr. Felix Brown, of Progress Works, New York; and from the report of the Trinity House Committee, it does not appear that they were greatly impressed with this instrument, but probably they had not an opportunity of testing its real merits as compared with other signals. The late Prof. Henry, of the United States Lighthouse Board, entertained a very high opinion of the siren; and on his advice, and the urgent recommendation of Prof. Tyndall, one of these instruments was sent to England, and included in the fog signal experiments at the South Foreland in 1873-74. This investigation was carried out by the Trinity House, with the view of obtaining definite knowledge as to the relative merits of various sound-producing instruments then in use, and also of ascertaining how the propagation of sound is affected by meteorological phenomena. Prof. Tyndall, as scientific adviser of the Trinity House, conducted the investigation, aided by a Committee of the Trinity House, and their engineer. These experiments were extended over a lengthened period, in all conditions of weather, and the well-known scientific and practical results obtained, together with the ascertained relative merits of sound-producing instruments for the service of the mariner, have proved to be of the highest scientific interest and practical importance. The investigation at the South Foreland was followed up by the Trinity House with further explosive fog signal experiments, in which they were assisted by the authorities at Woolwich Arsenal with guns of various forms, weight of charges, and descriptions of gunpowder. The powders tested were (1) fine grain, (2) larger grain, (3) rifle large grain, and (4) pebble. The result placed the sound-producing powers of these powders exactly in the order above stated; the fine grain, or most rapidly burning powder, gave indisputably the loudest sound, while the report of the slowly burning pebble powder was weakest of all. Here again the greater value of increased rapidity of combustion in producing sound was demonstrated. It was found that charges of gun-cotton yielded reports louder at all ranges than equal charges of the best gunpowder; and further experiments proved that the explosion of half a pound of gun-cotton gave a sound equal in intensity to that produced by three pounds of the best gunpowder. These investigations led the Trinity House to adopt gun-cotton for fog signals at isolated stations on rocks and shoals, as already described, where, from want of space, nothing better than a ball, or gong, it had hitherto been possible to apply. Of all the sound signals now employed for the warning and guidance of mariners during fog, viz. bells, gongs, guns, whistles, reed trumpets, sirens, and sounds produced by the explosion of gun-cotton, the blasts of the siren and explosions of gun-cotton have been found to be the most efficient for coast fog signals; therefore these signals have received the greatest care and attention in their development. The siren doubtless ranks first for stations wherever it can be applied, chiefly on account of its economy in maintenance, and the facility it affords for giving prolonged blasts of any desired intensity or pitch, and thus providing any number of trustworthy distinctive characters that may be required to insure individuality in the signal. Sirens are now employed at many floating and shore stations of the Trinity House; and one, recently installed at Saint Catharine's Lighthouse, Isle of Wight, of the automatic Holmes type, of which we have here a model, absorbs during its blasts not less than 600 horse-power. The audibility of the blasts of this instrument may be considered to be trustworthy at a range of two miles under all conditions of foggy atmosphere, on the sea surface, over which it is intended to be sounded. It is very desirable that for many landfall stations a greater trustworthy range be provided for the mariner, but this can only be afforded by such increased power as would be required for a more powerful electric light installation, to serve the mariner in other gradations of thick atmosphere. A very important improvement and economy has lately been effected in the sirens of the Trinity House, by rendering them always instantaneously available for sounding at their maximum power. This is accomplished by the storage of a sufficient quantity of compressed air, at a pressure considerably above that required for sounding, to work the siren during the time required for raising steam and starting the engine. The signal is thus always in readiness for immediate action day or night, with an expenditure of fuel only incurred during fog, which fortunately on the coast of this country does not exceed an average of 440 hours per annum. The experience yet gained with the most powerful fog signals now in use, although these apparatus far exceed in efficiency for the service of the mariner in fog any light that science can provide, is not yet so satisfactory as we could desire. The best signal is, as I have already stated, occasionally not heard, under certain atmospheric conditions, beyond two miles; while under other conditions, not apparent to the mariner, the signal is distinctly audible at ten miles; therefore there is much to be desired in the development of the means of propagating sound waves, and in rendering them audible to the mariner. In conclusion I would venture to state that, with the best light and sound signals that can be provided, there are conditions of the atmosphere in which the mariner will earnestly look and listen in vain for the desired light or sound signal, and he must still, under such circumstances, exercise caution in availing himself of their guidance, and never neglect the assistance always at hand of his old trusty friend the lead.

PRELIMINARY REPORT OF THE NEWALL TELESCOPE SYNDICATE.[1]

At the end of the Lent Term the Syndicate met for the first time and drew up a Report to the Council of the Senate, recommending that a Committee of experts should go to Gateshead to view Mr. Newall's telescope and report on its condition and capabilities. A letter of acknowledgment was also sent to Mr. Newall thanking him for his generous offer.

In consequence of their recommendation, Mr. Christie, Astronomer Royal, Mr. Common, F.R.S., and Mr. Graham, First Assistant at our Observatory, went to Gateshead and made a thorough examination of the telescope and of its accessories. They reported to the Syndicate as follows:—

Report on Mr. Newall's 25-inch Refractor.

We the undersigned, being the Committee appointed by the Newall Telescope Syndicate to inquire into and report on the condition and capabilities of the above instrument, beg to submit the following report as the result of an examination made on March 28 and 29. For convenience of reference we have divided the report under three heads:—

1. On the present condition of the telescope and dome.
2. On the necessary work to be done in removing and re-erecting, to put the whole in an efficient state.
3. The capabilities of the instrument when re-erected.

I. On the evening of March 28, the sky being overcast, the quality of the object-glass was tested by artificial stars, formed by the light of a lamp shining through holes in a metal screen, placed at a distance of about 1500 yards. The result of those tests, which it is unnecessary to specify more fully, was sufficient to enable the Committee to come to the conclusion that the object-glass is a remarkably fine one, entirely free from any defect. On the conclusion of those tests about midnight, and as the Committee were about to leave, the sky cleared to a slight extent, and at intervals the telescope was turned upon some stars and upon Saturn. Owing to the state of the atmosphere, the definition was very variable, but the Committee saw enough to confirm them in the opinion they had already formed as to the excellent quality of the object-glass. During these examinations and tests the mounting showed itself to be extremely steady and quite free from vibration. On the morning of the 29th the Committee again met at Ferndene to complete the examination of the instrument and dome by daylight. The telescope is no doubt so well known that it is not necessary to state further than that it is a first-class instrument, mounted on the plan of the elder Cooke, and that it is fully provided with all the necessary appliances to make it an extremely convenient and easily managed instrument.

The condition is such that the necessary cleaning, painting, lacquering, &c., more fully described in the next section, will not be an expensive matter.

The dome and substructure were next inspected. From the brick wall, which rises to a height of about 2 feet, the whole is of iron, the various parts, including the dome, being bolted

[1] Reprinted from the *Cambridge University Reporter*, May 21.

together in such a way as to render taking down and removal a comparatively easy matter. In addition to the circular inclosure supporting the dome, the height of which is about 20 feet, the dome itself being 40 feet diameter, there are two or three rooms and an entrance porch, available as a dark room and computing room. The mechanism for moving the dome and the dome itself are in good order, but in the opinion of the Committee, it would be advisable to go to some expense in providing brackets for the wheels on which the dome runs with horizontal rollers as guides instead of the flanges on the wheels. The observing platform is a first-rate one and will need no alteration. It is suitable for general observational work, or for work where the use of a large spectroscope renders considerable space necessary in any direction.

The shutters of the dome will require some slight repair.

As regards the apparatus with this telescope there are the usual battery of eye-pieces suitable to the telescope; a series of parallel bar, ring, and other fixed micrometers, a very fine parallel wire micrometer, all complete in mahogany boxes; a fine barrel chronograph in glass case, and a good sidereal clock with compensated pendulum. These with sundry apparatus belonging to the telescope complete the outfit.

We had no opportunity of thoroughly testing the clockwork. We consider that it might be advisable to add an electric control and slow-motion gear of the modern pattern in order to render the telescope more efficient in this respect.

II. We have drawn up a specification showing more fully the work required to be done in order to put the telescope simply into an efficient state, but we would recommend that the opportunity be taken to add electric lighting to the circles and micrometer, to provide an electric control to the clock and an electric slow-motion gear. We would further recommend that 12 cast-iron brackets be added to the dome as supports for the wheels, that one or both of the flanges be turned off these wheels, and that horizontal rollers carried by the brackets be added as guides to keep the wheels on the rail. This, we think, would render the turning of the dome much more easy. We would retain the iron circular wall under the dome in preference to a brick or stone wall, as offering more favourable conditions for the telescope. We have added in the appendix our estimate of the cost of this work.

III. When erected and in working order, this telescope will be specially adapted to any work in observational astronomy for which a large aperture is required, and if it is decided to restrict the use of the telescope to micrometric measures of faint satellites, or to the scrutiny of planetary details, no outlay will be required for additional apparatus, beyond an efficient system of lighting the circles and micrometer with small electric lamps. Should it be determined, however, to undertake work in stellar physics, which we understand, from the letter published in NATURE, is the wish of the donor, and which we would strongly recommend as the most useful systematic work to take up, then the necessary spectroscopic outfit, at present wanting, would have to be provided. We estimate the cost of this at about £100. So equipped the telescope would at once be capable of commencing systematic work of first-class importance that would amply repay the cost of keeping such an instrument regularly employed, and in carrying on such systematic work no further outlay in buildings would be required, the computing and dark rooms attached to the dome being sufficient for the work to be done at the telescope. But in our view it would greatly increase the usefulness of this instrument for spectroscopic research if it were placed within easy reach of a physical laboratory where apparatus would be available for experimental investigations in connection with the telescopic observations. As regards the selection of a site we consider it a matter of great importance that the instrument should be located where it would be easy of access to members of the University engaged in making observations with it. It is essential for the effective use of an instrument in a variable climate that the observer should be as near his work as practicable.

W. H. M. CHRISTIE.
A. AINSLIE COMMON.
April 3, 1889. A. GRAHAM.

The previous experience of these gentlemen has also enabled them to give an approximate estimate of the expense of the removal and re-erection of the telescope at Cambridge. It appears unnecessary to quote the details of their estimate, but the total sum is given by them as £770.

At the time when Mr. Newall had in contemplation his offer to the University, he was already very ill, and the Syndicate heard with deep regret of his death on the 21st of April. They have reason to believe that he was gratified, before his death, with the prospect that his valuable instrument would probably contribute to the advancement of astronomical science at Cambridge.

Since his death, the executors, with the full approval of his family, have renewed the offer to the University. The Syndicate are of opinion that the University should avail itself of the opportunity of possessing this fine instrument, and they are at present occupied with schemes for its proper maintenance and use.

C. E. SEARLE, *Vice-Chancellor.*
E. J. ROUTH.
J. W. L. GLAISHER.
J. C. ADAMS.
G. D. LIVEING.
G. H. DARWIN.
May 18, 1889. J. J. THOMSON.

SOME PROPERTIES OF THE NUMBER 7.

1. MY attention was recently drawn by a pupil to the following property, which will be best illustrated by working out a particular example:

$$\begin{array}{rrl} \text{Let } N = & 342544 \mid 3 & \\ u_2 = & 34253 \mid 8 & i.e.\ u_2 = 342544 - 2 \times 3 \\ u_3 = & 3423 \mid 7 & u_3 = 34253 - 2 \times 8 \\ u_4 = & 340 \mid 9 & u_4 = 3423 - 2 \times 7 \\ & 32 \mid 2 & \quad \text{and so on:} \\ & 2 \mid 8 & \end{array}$$

if any one of the quantities u_2, u_3, u_4, &c., is divisible by 7, then N is so divisible.[1]

For, let

$$\begin{aligned} N &= 10P_1 + p_0 \\ u_2 &= 10P_2 + q_1 \\ u_3 &= 10P_3 + q_2 \\ u_4 &= 10P_4 + q_3 \\ u_{n-1} &= 10P_{n-1} + q_{n-2} \\ u_n &= 10P_n + q_{n-1} \qquad = 7Q, \text{ by hypothesis.} \end{aligned}$$

Now,

$$\begin{aligned} 10P_1 &= 10^2P_2 + 10(q_1 + 2p_0) \\ 10^2P_2 &= 10^3P_3 + 10^2(q_2 + 2q_1) \\ 10^2P_3 &= 10^4P_4 + 10^3(q_3 + 2q_2) \\ 10^{n-1}P_{n-1} &= 10^nP_n + 10^{n-1}(q_{n-1} + 2q_{n-2}); \end{aligned}$$

$$\begin{aligned} \therefore N = 10P_1 + p_0 &= 21[p_0 + 10q_1 + \ldots + 10^{n-2}q_{n-2}] \\ &\quad + 10^{n-1}(10P_n + q_{n-1}) \\ &= 21M + 10^{n-1}(7Q) = 7Q^1. \end{aligned}$$

Or we may proceed thus:—

$u_2 = P_1 - 2p_0$; $\therefore N = 10(u_2 + 2p_0) + p_0 = 10u_2 + 21p_0$; hence, if N is divisible by 7, so also is u_2, and so on.

If for 2 we substitute 1, 3, 4, 5, . . . n, then if N is divisible by 11, 31, 41, 51(3, 17), . . . $10n + 1$, so also are (the corresponding) $u_2, u_3, \ldots u_n$.

In like manner, if we strike off 2, 3, . . . n figures, then if N is divisible by (101, 201, . . . $10^2n + 1$), (1001, 2001, . . . $10^3n + 1$), . . . and so on, so are $u_2, u_3, \ldots u_n$.

2. This property was suggested by the question, "Prove that a number consisting of six like figures (111111) is divisible by 7."

Let x be the digit, and let it be repeated n times, then if N be of the form $(7p - nx)10^n + (10^{n-1} + 10^{n-2} + \ldots + 10 + 1)x$, *i.e.* such a number as 5733, in which we have $57 + 2 \times 3$ = multiple of 7, it will be divisible by 7, if $-n \cdot 10^n + (10^n - 1)/9$ is, *i.e.* if $(9n - 1)10^n + 1$ is, *i.e.* if $(2n - 1)10^n + 1$ is, *i.e.* if $(k =)\ (2n - 1)\ 3^n + 1$ is.

Omitting the case of six like digits, we write down the following table for an inferior number, the use of which is explained subsequently.

(1)		(2)		(3)		(4)		(5)	
$7p+2$...2	1	$7p+5$...5	11	$7p+6$...	111	$7p+4$...	1111	$7p+1$...	11111
$7p+4$...4	2	$7p+3$...3	22	$7p+5$...	222	$7p+1$...	2222	$7p+2$...	22222
$7p+6$...6	3	$7p+1$...1	33	$7p+4$...	333	$7p+5$...	3333	$7p+3$...	33333
$7p+1$...1	4	$7p+6$...6	44	$7p+3$...	444	$7p+2$...	4444	$7p+4$...	44444
$7p+3$...3	5	$7p+4$...4	55	$7p+2$...	555	$7p+6$...	5555	$7p+5$...	55555
$7p+5$...5	6	$7p+2$...2	65	$7p+1$...	666	$7p+3$...	6666	$7p+6$...	6666

1 In fact, 21 may be substituted for 7.

That is, third line of (3) say, 67333, 781333, &c. (note $67 = 7 \times 9 + 4$, $781 = 7 \times 111 + 4$), are multiples of 7. We may preface any one of the above series of numbers with, or affix to them, sextets of digits, like or unlike to those of the number we select. I confine my attention to sextets of like figures affixed, as in this way I am able to find what values of n make k a multiple of 7.

The series in (1) is, of course, $n = 1, 7, 13, 19$, and so on: and so for the other sets. The values of n to be taken are :—

for (1), $n = 19, 61, 103, 145, \ldots$

(*i.e.* if we write down 19 3's, we must preface these with a number of the form $7p + 6$.)

(2), $n = 2, 44, 86, 128, \ldots$
(3), $n = 15, 57, 99, 141, \ldots$
(4), $n = 10, 52, 94, 136, \ldots$
(5), $n = 41, 83, 125, 167, \ldots$

University College School. R. TUCKER.

THE BHILS AND THEIR COUNTRY.

IN the current number of the *Asiatic Quarterly Review*, Sir Lepel Griffin has a long and most interesting article on the Bhils, an aboriginal tribe of Central India living in the jungle and rough country around the Vindhya Mountains. Sir Lepel says that for eight years he presided over the province which includes the Bhil country, and he had ample opportunity in that time of studying the habits and language of this interesting people. The people themselves claim that they represent the aboriginal races of India who were forced to retire before the Aryan conquerors. Through their country flows the sacred Nerbudda River with all its Hindu shrines. The Bhils, however, seem to care very little for the Hindu deities; they have been forced by the Hindus, who treat them with profound scorn and contempt, to give a sort of half-hearted acceptance of the chief Hindu deities, but in fact they never worship the gods of their superiors. In one respect, however, they agree with the Hindus, and that is in regarding the Nerbudda with feelings of terror and veneration. From the earliest days of the Aryan conquest of India, the Bhils have been looked on as wild animals, deserving of no protection or kindness. In a few States, such as Barwani and Rajpur, they were so numerous, that their conquerors found it more profitable to tolerate them, keeping them, however, at the same time, in the most abject poverty and subjection. Since the advent of the British Government, the condition of these simple and harmless people has much improved, so that the poor Bhils are gradually becoming less and less savage. Their knowledge of woodcraft and of the habits of birds and beasts makes them invaluable to English officers. Unlike the orthodox Hindu, the Bhil has always eaten the flesh of the cow and the buffalo and other abhorred animals. In fact, he eats every wild animal except the monkey, which is universally worshipped in the form of the forest god Hanumán. The tiger is held in great respect, and the people are very unwilling to kill it, unless it is a man-eater. If a beast has thus become obnoxious, a trial is held with religious rites, and if the animal is found guilty, sentence is passed upon him, he is pursued, killed, and hung up on a tree over the main road as a warning to all evil-doers of his species. It is very curious, and shows the antiquity of this race, that at the coronation of the highest Rajput chiefs, in States where the Bhils live, the sacred mark of kingship is impressed on the forehead of the new chief by the head of the Bhil family to which this hereditary privilege belongs, and the Bhils do not regard him as their king till this ceremony is performed. The Bhils are noted for their endurance, for their capacity of living where others would starve, their indifference to the greatest changes of temperature. Not even to save his life will a Bhil tell a falsehood. Their most solemn oath is by the dog, their most valuable companion in the chase. They are gay and of a light-hearted disposition, and take every opportunity of having a feast and a drinking-bout. Their drink is made from the Mowra, a tree which abounds in Central India, the white flowers of which, when pounded and mixed with grain, form a palatable food, and when distilled by a simple process produce a highly intoxicating spirit. Their priests are not of any particular caste, but the office is an hereditary one. The deities most generally worshipped are the ordinary Vedic deities of water, fire, and the heavens, and each village has its presiding deity, who is a different personage in each village. Like Hindus they burn their dead, except unmarried children of both sexes, who are buried, as also those who die from small-pox. In case of cholera they also bury the dead, believing that the smoke from the pyre disseminates the disease. The dead are worshipped and propitiated by offerings; tree worship is unusual; witchcraft and omens are implicitly believed in; charms of various kinds are universally used.

SCIENTIFIC SERIALS.

THE *Quarterly Journal of Microscopical Science* for April 1889 contains the following:—Contributions to the knowledge of *Amphioxus lanceolatus*, Yarrell, by Prof. E. Ray Lankester, F.R.S. (plates xxxiv.–xxxvi.*b*). Referring to his notes on the anatomy of Amphioxus published in 1875, the author withdraws his confirmation of Johann Müller's statement that there is a pair of apertures on either side of the oral sphincter (velum of Huxley). In reality there are no such apertures at all. Those important structures, described as the "brown funnels," are fully described and excellently illustrated; some few numerical data of importance for the anatomical discussion of Amphioxus are given; some errors which appear to be current as to the existence or non-existence of spaces of one kind or another in the body and gill bars are corrected; and some drawings are given, which represent in a semi-diagrammatic form the structure of Amphioxus, not merely as seen in sections or dissections, with all their obvious drawbacks, but as reconstructed and corrected from the examination of numerous specimens, so that they present as nearly as might be a true conception of the living organism. This excellent paper will be welcomed by all students.—Studies in the embryology of the Echinoderms, by H. Bury (plates xxxvii.–xxxix.). In this memoir the author confines his attention;—to the primary divisions of the cœlom, starting from a stage in which at least two enterocœle pouches are already present;—the hydrocœle; its development and connections;—and to the skeleton, so far as it is developed in the dipleurula stage.—On the ancestral development of the respiratory organs in the Decapodous Crustacea, by Florence Buchanan (plate xl.).

The *Journal* for May 1889 is a special issue, and contains a memoir on the maturation of the ovum in the Cape and New Zealand species of Peripatus, by Lilian Sheldon, Bathurst Student, Newnham (plates i.–iii.). The ovarian structures are fully described in *Peripatus capensis*, *P. balfouri*, and *P. novæ-zealandiæ*. A summary of events in the maturation and fertilization of the ovum in these three species is also given; these are followed by some details of the origin of the ova from the germinal epithelium; the disappearance of the germinal vesicle; the formation of the polar bodies, and the formation of the yolk. Among the many interesting facts mentioned are those in reference to the polar bodies: in *P. novæ-zealandiæ* they appear to be completely absent, but two very prominent bodies are present in the Cape species; they are also in these species exactly similar to one another—a series of facts at variance with Weismann's theories.—With this number is given a series of very valuable indexes: an index to the *Journal* from 1853 to 1888; and one to the Transactions of the Microscopical Society from 1853 to 1868; also to the Proceedings of the Dublin Microscopical Club from 1865 to 1880. These indexes are paged separately, so that they may be bound up as an independent volume.

Engler's Jahrbücher, vol. x., includes the following articles:—The first part of the description of the plants collected by Dr. Marloth in South Africa in 1885–86 (with six plates). The descriptions are prepared by Dr. Engler, with the help of other botanists, and include the Monocotyledons, and Archichlamydeous (Choripetalous and Apetalous) Dicotyledons.—On the anatomical characters of the *Monimiaceæ*, by M. Hobein. This natural order is one as to the position of which various opinions have held; the author's observations strengthen the alliance to Laurineæ, inasmuch as in both orders secretory cells are constantly present.—A monographic review of the species of the genus Primula, by Dr. F. Pax. An attempt to trace the phylogenetic relationships of the species of this large genus.—The second part of the description of Dr. Marloth's plants from

South Africa (with four plates), including the Gamopetalous Dicotyledons, by Dr. Engler, &c.—The Piperaceæ collected by Lehmann in Guatemala, Costarica, Columbia, and Ecuador, described by Casimir de Candolle.—A new plant belonging to the Olacineæ (*Tetrastylidium Engleri*, Schwacke), by W. Schwacke. —An anatomical study of *Scirpus* and allied genera (with one plate), and a key for distinguishing them on anatomical grounds, by Dr. Ed. Palla.—On some mistaken, or little-known Rubiaceæ of South America, by Karl Schumann.—On the flora of Greenland, by Eug. Warming. Including interesting descriptions of the general appearance of the vegetation, as well as the habit of certain species, with a discussion of the origin and relations of the flora. The author concludes that Greenland is not a European province, from the point of view of botanical geography, but has nearer relations to America.—Contributions to the comparative anatomy of the *Aristolochiaceæ* (with three plates), by Dr. H. Solereder. A comprehensive investigation of the structure of both vegetative and reproductive organs.—The volume also includes the usual personal notices, and abstracts of current literature, together with a list of works recently published on geographical and descriptive botany.

Journal of the Russian Chemical and Physical Society, vol. xxi. No 1.—On hexabromtetramethylene, by A. Sabaneyeff. —On the heat of solution of lithium bromide. It is equal to 11·351, and thus occupies an intermediate position between those of LiCl (8·440) and LiI (14·886).—On the action of ethyl iodide and zinc upon paraldehyde, by W. Wedensky.—On the oxidation of erucic and ricinoleic acids by means of permanganate of potassium, by L. Urvantzoff and W. Dieff.—On the formation of cane-sugar from starch in plants, by F. Selivanoff. It was observed in tubercles of potatoes.—Notes by MM. Moltchanoffsky, Alexeyeff, and Kondakoff.—Theoretical researches into the motion of water in the subsoil, by N. Joukovsky. The author concludes from his mathematical inquiry and some experiments that the law of Darcy remains satisfactory if the secondary causes are also taken into consideration and the results are not extended to great distances from the well. As to the corrections of Darcy's law proposed by Kröber and Smreker, they do not yet correspond to all facts noticed during pumpings. —Note by W. Rosenberg on cyclonic movements.

No. 2.—Yearly reports of the Society.—Notes on primary, secondary, and tertiary nitro-compounds, by J. Bevad.—On the general law of contraction which takes place during the formation of solutions of salts, by A. Gueritch ; second paper, containing data relative to H_2SO_4 and HCN.—On the action of chlorides and hydrochloric acid upon the photochemical decomposition of chlorine-water, by E. Klimenko and G. Pecatoros. They slacken the decomposition.—On the vapour density of ethyl isocyanurate at various temperatures, by S. Krapivine and N. Zelinsky.—On the dilatation of solutions of salts, by N. Tchernay ; third paper, containing tables relative to nine different nitrates.—Note on electrical phenomena due to actinic influences, by J. Borgmann.

In the *American Meteorological Journal* for March, Mr. A. L. Rotch continues his interesting articles on the meteorological services in Europe, dealing in this number with the Paris and Montsouris Observatories. The interest of the Paris Observatory, from a meteorological point of view, is now chiefly in its long series of observations, which date from the year 1666 ; since the establishment of the Central Meteorological Office, meteorology has not been actively pursued at the Observatory. The Montsouris Observatory was founded in 1871, and deals chiefly with the collection of hygienic statistics, and the application of meteorology to agriculture. It publishes an *Annuaire*, and also a monthly summary in the *Comptes rendus* of the French Academy. Prof. H. A. Hazen contributes an article on anemometer comparisons, and discusses the results of recent experiments in America and in this country, with the view of determining the ratio between the motion of the wind and that of the centre of the cups. The results of the American experiments have been discussed by Prof. Marvin, and will shortly be published *in extenso*. The chief difficulty lies in the determination of a constant factor for all velocities, and of constants for different sizes of cups and arms. Prof. Hazen thinks it possible to construct an anemometer with arms and cups so proportioned as to give a constant factor at all velocities. Lieutenant Finley discusses the frequency of tornadoes in the State of Georgia during the last ninety-four years.

SOCIETIES AND ACADEMIES.

London.

Royal Society, May 9.—"On the Magnetic Rotation of the Plane of Polarization of Light in doubly refracting Bodies." By A. W. Ward. Communicated by Prof. J. J. Thomson, F.R.S.

In repeating Villari's experiment on the rotation of the plane of polarization of light in a spinning disk of heavy glass, placed with its axis of rotation perpendicular to the lines of force in a magnetic field, it was observed that the incident plane-polarized light became elliptically polarized. The elliptic polarization was due to the centrifugal force, which had the effect of stretching the glass along the radii of the disk and compressing it parallel to the axis of rotation. The strained glass in the magnetic field has, therefore, the double property of elliptically polarizing plane-polarized light, and at the same time rotating the plane of polarization. The strained glass therefore acted like a crystal placed in a magnetic field, and so, before Villari's experiment could be properly interpreted, it is necessary to examine how the elliptic polarization and magnetic rotation affect each other. The following investigation is an attempt to solve this question, and its conclusions show that the apparent magnetic rotation in a doubly refractive medium is a periodic function of the length of the path of light in the medium. This hitherto unsuspected result entirely accounts for the effects observed by Villari, and those observed by Lüdtge in a piece of compressed glass.

Villari's results are very similar to Lüdtge's. Villari, by spinning a disk of glass very rapidly, strained it, and on observing the magnetic rotation found it get less and less as the strain got greater and greater. There is, however, one noticeable difference between Villari's strained disk and Lüdtge's strained prism. The disk was free from strain in the middle, the prism free from strain at the ends.

I have repeated Villari's experiment at the Cavendish Laboratory, using, at Mr. Glazebrook's suggestion, an elliptic analyzer to determine the magnetic rotation. With the disk spinning about 200 times a second, the magnetic rotation was reduced from 10° to 6°. This is not so great a diminution as Villari observed, but his glass may have been softer and more easily strained.

Villari thought that the effect he observed was due to the time required to magnetize the glass. That this supposition was erroneous has been clearly established by the experiments of Bichat and Blondlot, and recently repeated by Dr. Lodge. In these experiments the oscillating discharge of a Leyden jar was found to rotate the plane of polarization in time with the oscillations. Before hearing of these results I had myself attacked the problem in a somewhat similar manner. A coil of wire was wound round a piece of heavy glass, and a current alternated 250 times a second by a tuning-fork was sent through the coil. The current was measured by a dynamometer and a tangent galvanometer. The first gave the measure of the current independently of its sign, the second showed that the integral current was zero. When the current was passing it was found impossible to extinguish the light, owing to the rapid alternations of the plane of polarization.

May 16.—"Physiological Action of the Active Principle of the Seeds of *Abrus precatorius* (Jequirity)." By Sidney Martin, M.D. London, British Medical Association Research Scholar, Assistant Physician to the Victoria Park Chest Hospital ; and R. Norris Wolfenden, M.D. Cantab. (From the Physiological Laboratory, University College, London.) Communicated by E. A. Schäfer, F.R.S.

"The Toxic Action of the Albumose from the Seeds of *Abrus precatorius*." By Sidney Martin, M.D. London, British Medical Association Research Scholar, Assistant Physician to the Victoria Park Chest Hospital. (From the Physiological Laboratory, University College.) Communicated by E. A. Schäfer, F.R.S.

From numerous experiments, the following conclusions were arrived at :—

(1) The poisonous activity of the seeds of *Abrus precatorius*, the jequirity, resides in the two proteids present in the seeds—a paraglobulin and an albumose.

(2) Both of these proteids have practically the same action. They produce severe conjunctivitis when applied to the eye ; and when subcutaneously injected, they cause local inflamma-

tion, œdema, and ecchymosis, and gastro-intestinal irritation, with extrusion of fæces and blood; the general symptoms being, first, a great fall of body temperature, and a condition of stupor, ending in death.

(3) The activity of both these proteids is destroyed by moist heat. In solution, the activity of the globulin is destroyed at between 75° and 80° C., and that of the albumose between 80° and 85° C.

(4) That abrus-poison resembles snake-venom in chemical composition, in the local lesions produced, in producing a fall of body temperature, in causing semi-fluidity or fluidity of the blood after death, and, to some extent, in the effect of moist heat on it. Abrus-poison is, however, much less active than snake-venom.

The following table shows a comparison between the activity of the venom of various snakes and of Abrus:—

Vipera berus (common adder)	Fatal dose in man, 0·0021 gramme per kilogramme of body weight (Fontana).
Hyplocephalus curtus (Australian tiger-snake)	Fatal dose in dog, 0·00485 gramme per kilogramme of body weight; ½ grain in medium size dog (15 pounds).
Cobra	Fatal dose in dog, 0·000079 gramme per kilogramme of body weight; 1/10 grain in dog weighing 18 pounds (Vincent Richards).
Abrus-poison—	
Globulin...	Fatal dose, 0·01 gramme per kilogramme of body weight.
Albumose	Fatal dose, 0·06 gramme per kilogramme of body weight.
Peptic albumoses ...	Fatal dose in dog, any dose over 0·3 gramme per kilogramme of body weight (Pollitzer).

"Appendix to paper on Descending Degenerations following Lesions in the Gyrus marginalis and Gyrus fornicatus in Monkeys." By E. P. France. Communicated by E. A. Schäfer, F.R.S.

Linnean Society, May 24.—Anniversary Meeting.—Mr. Carruthers, F.R.S., President, in the chair.—A portrait of John Jacob Dillenius (1687–1747), the first Professor of Botany at Oxford, copied from the original picture at Oxford, was presented to the Society by the President, who gave a brief outline of his career, and of his personal acquaintance with Linnæus.—The Treasurer having made his annual statement of accounts, and the Librarian's and other reports having been read, a ballot took place for the election of officers and Council for the ensuing year. The President, Treasurer, and Secretaries were re-elected, and the changes recommended in the Council were adopted.—The President then delivered his annual address, to which we refer elsewhere.—A unanimous vote of thanks to the President for his address, coupled with a request that it might be printed, having been passed, the ceremony of awarding the Society's gold medal took place. This medal, having on the obverse a fine bust of Linnæus and on the reverse the arms of the Society, below which is engraved the name of the recipient, was founded last year in commemoration of the Society's centenary anniversary, and is bestowed upon a botanist and zoologist alternately, for distinguished services to biological science. This year it was awarded to the eminent botanist Prof. Alphonse de Candolle, and in his unavoidable absence was handed to his grandson M. Austin de Candolle, who attended on his behalf to receive it. Addressing his representative, the President said:—"Monsieur de Candolle, it is a great satisfaction to me to place in your hands, for transmission to your distinguished grandfather, the Linnean gold medal, in recognition of his many important services to botanical science. These services have been so great, and are so universally acknowledged, that it is unnecessary for me to do more than to refer to them. His many systematic monographs justify his being awarded any honour that botanists can confer. His philosophical treatment of the geographical distribution of plants has greatly advanced this department of science, and his successful codification of the laws of botanical nomenclature has been of the greatest practical service to systematists. But botanists will always look with gratitude to Alphonse de Candolle for the successful carrying on of the gigantic enterprise inaugurated by his father when he undertook the publication of the 'Prodromus Systematis Naturalis Regni Vegetabilis.' By his own work, by securing the aid of accomplished *collaborateurs*, and perhaps not least by the plodding toil of reading the proof-sheets of volume after volume of dry systematic descriptions during the thirty-two years in which he took charge of the 'Prodromus,' he has laid science under a debt which cannot be estimated. The work as now completed contains descriptions of all the Dicotyledonous Phanerogams, and of Gymnosperms, which were known when the different volumes were published, amounting to nearly 60,000 species. By his numerous labours Alphonse de Candolle has added lustre to a name that had already obtained a first place amongst botanists. His son Casimir, by his scientific researches, maintains the credit of that name; and now, in handing this medal to you, Monsieur Austin de Candolle, the representative of the fourth generation, may I venture to hope that this imperfect estimate of the services rendered to science by Alphonse de Candolle may help you to realize the honour of the name you inherit, and encourage you by similar true and honest labour to transmit it with added renown to posterity."—The presentation having been suitably acknowledged by Dr. Marcet, F.R.S., a countryman and relative of the recipient, the proceedings terminated with a vote of thanks to the President and officers.

Anthropological Institute, May 14.—Prof. Flower, C.B., F.R.S., Vice-President, in the chair.—Mr. Arthur Thomson read a paper on the osteology of the Veddahs of Ceylon, and exhibited a complete skeleton and several skulls of these people. Although the skeleton was said to be that of a man of twenty-six years of age, many parts were not completely ossified. The fifth lumbar vertebra was less wedge-shaped than amongst the higher races of man, and hence there was a distinct tendency to a backward curve in this region. Attention was drawn to the fact that the left clavicle was longer than the right by no less than 10 mm., and this may probably be explained by the employment of the left arm in the use of the bow; the left arm was also slightly larger than the right. The scapulæ were small and slender, and the high index, 71·1, indicates a marked difference in shape from that of Europeans. The femora and tibiæ were remarkable for their great length, and in each case the left was the longer. On the anterior borders of the lower extremities of both tibiæ were semilunar facets articulating, in extreme dorsiflexion of the foot, with corresponding surfaces on the necks of the astragali. The extreme length of the articulated skeleton was 1578 mm., which was somewhat above that of the average Veddah, as calculated by Virchow. It appeared from examination of all the available crania that the average capacity of the Veddah male skull is 1321 cc., and that of the female skull 1229 cc. The cephalic index is 70·9. From the data given in the paper the author inferred that, if the Veddahs be not of the same stock as the so-called aborigines of Southern India, they at least present very strong points of resemblance both as regards stature, proportions of limbs, cranial capacity, and form of skull; and that, if physical features alone be taken into account, their affinities with the hill tribes of the Neilgherries, and the natives of the Coromandel Coast and the country near Cape Comorin, are fairly well established.—Some notes by Mrs. R. Braithwaite Batty, on the Yoruba country, and a paper by Mr. H. Ling Roth, on salutations, were also read.

PARIS.

Academy of Sciences, May 20.—M. Des Cloizeaux, President, in the chair.—On the telluric origin of the oxygen rays in the solar spectrum, by M. J. Janssen.—On the complete correspondence between the continuous fractions which express the two roots of a quadratic equation whose coefficients are rational numbers, by Prof. Sylvester.—On the impossibility of diamagnetic bodies, by M. P. Duhem. The author's researches lead to the general inference that the existence of diamagnetic bodies is incompatible with the principles of thermodynamics. The so-called diamagnetic bodies are simply magnetic bodies plunged in a more powerful magnetic medium, in accordance with Becquerel's hypothesis, which assumes that for these bodies there exists one distribution of equilibrium and one only, that this distribution is stable, and that a diamagnetic body is always repelled by permanent magnets.—On the artificial reproduction of the mirage, and on the interference fringes that may accompany this phenomenon, by MM. J. Macé de Lépinay and A. Perot. A process is described, by means of which conditions are realized which are analogous but inverse to those that give rise to the natural mirage.—On the expansion of quartz, by M. H. Le Chatelier. The experiments here described show that quartz undoubtedly undergoes considerable expansion between 480° and 570° C. Above the critical temperature of 570°, it ceases to expand, and on the contrary undergoes a slight contraction. The phenomenon is analogous to that observed in the dimorphic transformations of litharge, of potassium sulphate, and especially of dicalcic silicate.—On the variations of the acid function in stannic oxide, by M. Léo Vignon. The author here resumes his study of the polymerization of stannic acid, dealing more especially with stannic acid prepared by means of stannic chloride; with metastannic acid obtained by the reaction of nitric acid on tin; and with calcined stannic oxide. He finds that there must exist a complete series of stannic acids, whose first term would appear to be the soluble acid, and the last the calcined metastannic acid.—On oxalomolybdic acid and the oxalomolybdates, by M. E. Péchard.—On phosphorous acid, by M. L. Amat. In a previous note (*Comptes rendus*, cvi. p. 1400) the author showed that, under the action of heat, the acid phosphite of soda may lose water, and be transformed to a pyrophosphite of soda. His present researches make it probable that the other acid phosphites behave like the salt of soda, only the dehydratation in their case is much more difficult.—Action of the alkaline meta-, pyro-, and ortho-arseniates on the alkaline earthy oxides, by M. Lefèvre. These researches, which are confined to baryta, strontia, and lime, show that lime has a greater tendency to form chloro-arseniates than baryta, while baryta yields simple compounds more readily than lime. Strontia is intermediate between these two bases.—On the malonates of ammonia, by M. Massol. Here the author describes the method of preparation, composition, and properties of the acid and neutral malonates.—On the proportion of nitrates contained in the rains of tropical regions, by MM. A. Muntz and V. Marcano. Observations taken at Caracas (Venezuela) and at Saint-Denis (Réunion), compared with those recorded by Messrs. Lawes and Gilbert at Rothamsted and by M. Boussingault at Liebfrauenberg (Alsace), show that the quantity of nitrates contained in tropical rains is from five to thirteen times greater than in those of temperate zones. To this abundance of nitrogen under a form easily assimilated must doubtless be partly attributed the exuberance of tropical vegetation.—On the richness of wheat in gluten, by MM. E. Gatellier and L. L'Hôte. Continuing their researches on this subject, the authors arrive at the general conclusion that by careful selection and treatment wheat may be made to yield a high proportion of gluten without any reduction in the abundance of the harvest.—Papers were contributed by M. Martinand, on the alcoholic fermentation of milk; by Dom Pedro Augusto de Saxe-Cobourg-Gotha, on a specimen of crystallized iron glance from Bahia (Brazil), and on the albite of Morro Velho; and by M. P. Termier, on leverrierite (a new phyllite), and on the Bacillarites of the coal-measures.

Astronomical Society, April 3.—The following were elected officers for the ensuing year:—President, M. Faye; Vice-Presidents, M. C. Flammarion, Colonel Laussedat, General Parmentier, and M. Trouvelot; Secretary, M. Gérigny; Vice-Secretaries, MM. C. Detaille and E. Bertaux; Treasurer, M. A. Hentsch; Librarian, M. Mabire. Council: MM. Bischoffsheim, Bossert, Charton, Gunziger, Heman, Hirn, Moussette, Secretan, Oppert, Trépied, Armelin (Admiral), Cloué, Bardou, Moureaux, and Schmoll.—M. C. Flammarion summed up the progress of astronomy during the past year.—M. Faye then took the chair, and remarked that in founding this Society M. Flammarion and his collaborators had created something durable, and had rendered a great service in so doing. M. Faye proposed that the Society should hold an extraordinary meeting in September this year, on account of the Exhibition, which will bring many foreign astronomers to Paris. This proposition was adopted.—M. Guiot sent an observation of shadow cast by Venus.—M. Dumesnil, same observation; also observations of Venus, with the naked eye, on March 6, 9, 15, 23, and 28, from 3 to 4 p.m.—M. Faye made some remarks on the Samoa cyclone, and explained the parabolic path of cyclones in both hemispheres.—M. Junod sent some remarks on the attraction between rotating spheres.

BERLIN.

Physiological Society, May 3.—Prof. du Bois Reymond, President, in the chair.—Dr. Blaschko gave an account of his anatomical researches on the formation of the horny layer of the skin. According to his observations the Malpighian layer consists of polygonal cells, which are pierced by so considerable a number of fibres that the cell-substance of each consists of a network of fibres. These fibres pass through two or three cells in succession, thus uniting them one to the other; between them, and external to the cells, is found the intercellular fluid, and similarly a fluid substance in the interior of the cells. The growth of the horny layer begins in the *stratum granulosum*, with the appearance of Waldeyer's keratohyalin granules in the fibres; these granules then become larger, and the fibres disappear. In the *stratum corneum* fibres again make their appearance in the dried cells, which have now entirely lost the nucleus which they possessed when they formed part of the Malpighian layer. The speaker supported his statements by drawings and preparations which he exhibited.—Dr. Goldscheider spoke on the muscular sense, and on the experiments he had made with a view to its analysis. To assist him in his researches he made use of localized anæsthesia, produced by Faradic currents, and of the exclusion of conscious volitional impulses. Perception of motion takes place at the joints, and is unaffected by want of sensitiveness in the skin. The liminal value for the sensation of motion varies greatly for various joints, lying between 1°·30 and 0°·27. The time required for the perception of the motion is very short, and is unaffected by the position of the limb. The muscles are not concerned in perceiving the position of the limb, this being dependent on the visual centre, which is stimulated by local sensory impulses. The perception of weight is similarly dependent on the central nervous system, and the recognition of resistance experienced in raising and lowering weights is brought about by means of the varying presssure exerted by the surfaces of the joints against each other. Owing to the lateness of the hour the conclusion of this communication was postponed to the next meeting.

[*Note.*—In the report of the Physiological Society, NATURE, May 2, p. 24, line 22, *for* "ventral" *read* "dorsal."

May 17.—Prof. du Bois-Reymond, President, in the chair.—Dr. Goldscheider concluded his communication on the muscular sense. He brought forward a mass of evidence in opposition to the view, which has up to the present time been widely spread, that innervation-sensations play an important part in connection with muscular sense. Thus, for instance, the following experiment is opposed to the current view: a given muscle is stimulated electrically (the will thus being excluded), lifts a weight, and gives rise to a distinct sensation of the accompanying movement. On the other hand, a movement may be intended, the innervation-sensation being at the same time distinctly prominent, and still the sensation of movement may be subminimal and not reach its liminal value, so long as the movement when executed is very small. As regards the raising of weights, it must be borne in mind that this is performed by limbs made up of several parts connected by joints; the rigid joints give rise to the sensation of resistance. The speaker summed up the outcome of his researches as a whole in the conclusion that the muscular sense is compounded of three peripheral sensations: of a sensation of *movement* resulting from the displacement of the condyles, of a sensation of *weight* produced by the tension of the tendons, and of a sensation of *resistance* due to the pressure of the articular surfaces against each other. In addition to the above there is still another sensation—namely, of *position*, resulting from pressure, tension, and stretching of the skin and other local stimuli. Prof. Gad gave strong expression to his own view, in opposition to the conclusions of Dr. Goldscheider, that the perception of resistance is not directly a sensation but a judgment, based upon the relation of the movement to the innervation and muscular tension.—Prof. Kossel then expressed his opposition to the views of Prof. Leo Liebermann on nuclein, which he regards as a mixed precipitate of metaphosphoric acid, albumen, and bases of the xanthin series.—He next gave an account of the researches of Schindler, who had sought in the tissues for the bases of adenin, hypoxanthin, guanin, and xanthin, which are all products of the decomposition of nuclein. He found no adenin in the semen of bulls, but only the other three bases, whereas in that of the carp and in the thyroid gland not only adenin but the other three are plentifully present. Schindler had further exposed adenin and guanin to putrefactive decomposition. After prolonged exposure both these bases were entirely decomposed, hypoxanthin having taken the place of adenin, and xanthin that of guanin. In both cases the result is explained by the assumption of one molecule of water and the elimination of one molecule of ammonia.

Meteorological Society, May 7.—Dr. Vettin, President, in the chair.—Prof. von Bezold discussed the modern views on the formation of atmospheric precipitates, which, in opposition to the older views, are based upon strictly scientific principles. At one time it was thought that the precipitates are formed by the mixing of cold air with warm moist air, and since the temperature of the mixture falls to the arithmetical mean of the other two, so much moisture must be condensed as corresponds to the considerably lowered saturation-point which results from the above process. Now, however, it is known that both the rise in temperature of the cold air and the heat set free by the condensation of the moisture must be taken into account, so that in reality very little moisture is precipitated: this was clearly shown by the speaker in a series of examples, both by calculation and by graphic representation. Thus appreciable precipitations occur either very seldom or not at all when masses of air of differing temperatures are mixed together. Precipitation only occurs when a saturated mass of air is directly cooled, such cooling being brought about in nature chiefly by radiation and by the upward flow of currents of air. Hence the precipitations which take place on the lofty sides of mountains as the air rises along them, as a result of its having been warmed, and in cyclones. Since warm dry air is carried into the cyclone from the anticyclone, the clouds formed at the edge of the cyclone are subsequently absorbed; thus the clouds are most dense in the centre where the pressure is a minimum, and are progressively less dense towards the periphery. Dr. Vettin showed several experiments on the movement of smoke inside a glass case which was slowly rotating about its centre. Small vessels filled with ice were suspended in the case, causing downward currents of air, and towards these places the smoke made its way from the periphery in a whirling, screw-like formation.

VIENNA.

Imperial Academy of Sciences, March 14.—The following papers were read:—On the oxidation of β-naphthol, by E. Ehrlich.—On the encysting of protoplasm with regard to the function of the cell-nucleus, by G. Haberlandt.—Contribution to the anatomy of the aërial roots of Orchidea, by E. Palla.—Results of comparative researches on the spectra of cobalt and nickel (sealed), by A. Grünwald.—Contribution to the systematic knowledge of Muscaria (sealed), by F. Brauer.—On the intestinal mesenteries and omenta in their normal and abnormal state, by C. Toldt.—On the oxidation of paraphenylene-diamine and paramido-phenol, by E. von Bandrowski.—On some phenomena of electrical discharges and their photographic fixation, by A. von Obermayer and A. von Hübl.—On the elements of the geological structure of Rhodus, by G. von Bukowski.—Determination of the orbit of the Andromeda (175) planet, by F. Bidschof.

AMSTERDAM.

Royal Academy of Sciences, April 20.—Prof. van de Sande Bakhuigzen in the chair.—M. Martin read a paper on the so-called "old-slate formation of Borneo." This formation is known among others in the western parts of the island, where a few fossils were collected by the mining engineer, C. J. van Schelle, viz. at the Soengli Molsong, and near Boedoek and Sepang, in the "Chinese districts." It appeared, on examination, that these fossils belong to the genera Gervillia and Corbula, and as neither genus ever occurs in Palæozoic strata, the "old slate" here cannot be Palæozoic. The slates are, moreover, covered by Tertiary strata, so that the only alternative is to assume that they belong to the Mesozoic age. A further confirmation of this hypothesis he found in the fact that he had succeeded in finding, in a grey limestone of the Bojan, in the Upper Kapoes dominion, *Orbitulina centicularis*. As this fossil is Cretaceous, and the limestone in question occurs likewise in company with clay-slate, he concluded that the strata with Gervillia and Corbula are of the same age as those with Orbitulina, and that they all belong to the Cretaceous period. M. Martin feels persuaded that the Cretaceous formation is widely spread in the Indian Archipelago, and, on account of the absence of fossils, has been partly included among the "old slate," and partly among the Tertiary system.

STOCKHOLM.

Royal Academy of Sciences, May 8.—Prof. S. Lovén gave an account of a recently published memoir, by Prof. J. Steenstrup in Copenhagen, with the title, "On the Station of the Mammoth Hunters at Tredmort in Moravia."—Baron Nordenskiöld exhibited the first copy, now ready, of his great work, "Facsimile Atlas to the Oldest History of Chartography, containing copies of the best maps printed before the year 1600," a volume in folio, with fifty-one large maps, and eighty-four maps and figures inserted in the descriptive letterpress. The interesting manuscript map of Northern Europe from 1467, discovered by Baron Nordenskiöld in the library of Count Zamoiski at Warsaw, is also copied.—He also exhibited a large meteoric stone, 10½ kilogrammes in weight, which fell on April 3, this year, in the province of Scania.—Contributions to the knowledge of the absorption of the radii of heat through the various components of the atmosphere, by Dr. Ångström.—On the construction of the integrals of the linear differential equations, by Prof. Mittag-Leffler.—Note sur la série généralisée de Riemann, by Dr. A. Jonquière, of Bern.—On the action of cyanium on phenyl-sulpho-urinate, by Herr D. S. Hector.—On the action of some oxidating bodies on phenyl-sulpho-urinate, by the same.—On integration of differential equations in the problem of the n bodies, by Prof. Dillner.—The singular generatrices of the binormal and principal surfaces, by Prof. Björling.—Studies on the peat bogs of Southern Scania, by Herr G. Andersson.—Zoological notes from Northern Bohuslän, by Herr C. A. Hansson.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

The Unrivalled Atlas (W. and A. K. Johnston).—An Illustrated Manual of British Birds, Parts 11–14: H. Saunders (Gurney and Jackson).—A History of the Study of Mathematics at Cambridge: W. W. R. Ball (Cambridge University Press).—Nature's Voice: H. H. (Vickers-Wood).—The Physiology of the Domestic Animals: Dr. R. M. Smith (Davis).—A Visit to Stanley's Rear Guard: J. R. Werner (Blackwood).—Reports from the Laboratory of the Royal College of Physicians, Edinburgh, vol. i. (Pentland).—A New Theory of Parallels, 2nd edition: C. L. Dodgson (Macmillan).—Life of Sir William Rowan Hamilton, vol. iii.: R. P. Graves (Longmans).—Untersuchungen über die Theorie des Preises: R. Auspitz und R. Lieben (Leipzig, Duncker and Humblot).—Spacial and Atomic Energy, Part 1: F. Major (Eyre and Spottiswoode).—Record of Experiments in the Manufacture of Sugar from Sorghum, 1888: H. W. Wiley (Washington).—Six Species of North American Fresh-water Fishes; Six Lithographs from Drawings by A. Sonrel; Explanation of Plates by D. S. Jordan (Washington).—Transactions of the Academy of Science of St. Louis, vol. v., Nos. 1 and 2, 1886–88 (St. Louis).—Journal of Morphology, vol. ii., No. 3 (Boston, Ginn).—Journal of the Marine Biological Association, New Series, No. 1 (Plymouth).—Journal of the Anthropological Institute, May (Trübner).

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