THURSDAY, DECEMBER 17, 1896.

SIR GEORGE AIRY.

Autobiography of Sir George Biddell Airy, Honorary Fellow of Trinity College, Cambridge, Astronomer Royal from 1836–1881. Edited by Wilfrid Airy, B.A., M.Inst.C.E. (Cambridge: University Press, 1896.)

DE MORGAN, in a letter to Dr. Hamilton, has humorously described one of the most salient features of Airy's character. "Airy," he wrote, "is the prince of methodists. My theory is that when he tries his pen on blotting-paper, he makes a duplicate by the pressing machine, files, and indexes it." This is scarcely an exaggeration, and suggests that every line that Airy wrote, however trivial, found an assigned place in the Greenwich archives. Scarcely any one could have left fuller materials from which a biography could have been constructed; while the genius of order and arrangement that pervaded Airy's life, must have made the task of compilation comparatively simple. The editor tells us that this love of order outlived capacity itself, and that at the close of his life he occasionally exhibited more anxiety to have a letter placed in its proper pigeon-hole, than even to master its contents. In addition to this mass of information which Airy had stored up, he had also written a series of skeleton annals of the Observatory, which, he remarks, unavoidably partook in some measure of the form of biography. It is from these skeleton notes, existing in manuscript, that his eldest surviving son has prepared the present biography. The editor, in the use he has made of this information, has had evidently but one wish—that of placing before the world the public life of a celebrated man, to whom this country is much indebted for hard and conscientious work, and along lines which sometimes lay utterly outside his official duties. Mr. Wilfrid Airy is content to be merely a commentator, to keep in the background, and to let Sir George tell his own tale. The result of this devotion to the memory of his father, is to exhibit everywhere in the clearest possible manner what Airy did, and to what extent he can command our gratitude; but it prevents the introduction of any great amount of new or interesting information, which the less public portion of his papers might have disclosed, and to a knowledge of which the public might be permitted.

The plan of the book is arranged to give a strictly chronological account of Airy's life, and indeed, after Airy came prominently before the public, each year is separately treated. Seeing that the history of the National Observatory for forty-five years is the history of Airy's life, the main contents of these yearly accounts are supplied either by copious extracts from, or abridgements of, the Annual Reports of the Astronomer Royal to the Board of Visitors. These extracts are supplemented by references to other work in which Airy was interested, but of which no mention to the Board of Visitors was necessary. At the end of each yearly summary, a few remarks on private history are added; but these generally contain little more than the dates for which he had leave of absence, and the mention of the places visited on those occasions. Sometimes a letter to or from private friends is added, and every one will regret that more examples of his correspondence could not be given. But in justice to the editor, it must be borne in mind that, if the book is to be kept within ordinary bounds, it is not possible to allow more than five or six pages to each year so treated, a space tha does not permit many extracts from private letters. No doubt the editor regrets that he has been compelled to suppress so much that would have added to the interest of the book.

In the first chapter is given a personal sketch of the subject of the memoir, dealing with his habits and amusements, and necessarily offering some estimate of his character. In one or two particulars this is, perhaps, written rather too modestly. For instance, there is very little allusion to Airy's classical attainments, on which, on more than one occasion, the writer of this notice has had reason to remark that Airy prided himself. Moreover, that Airy laid great stress on the importance of a classical education is shown by his references, in the earlier part of the autobiography, to the authors that he read, and his strict adherence to the practice of writing some Latin prose every day. In 1824, he conceived the idea of competing for the Middle Bachelor's Prize, and began a Latin essay with that view. This he abandoned with regret, not from the hopelessness of the competition, but from want of leisure.

In the second chapter, and generally throughout the book, Airy speaks for himself in the first person. Here he gives an interesting description of the life of a Sizar at Cambridge some eighty years ago. It is curious and instructive to follow Airy's life at this time, ridiculed for his strict adherence to the prescribed costume of drab knee-breeches, dining off the fragments of the Fellows dinner, brought to him on pewter plates, declaiming in chapel, and the undergraduates attempting to cough him down because he was long in preaching. The contentment with which Airy went through this portion of his life, the pleasure with which he looks back to his quiet rooms in Neville's Court, almost the worst in the college, his continual success in his many examinations, all offer pictures which we cannot afford to lose, and will be read with a certain charm by those who knew him in his later days. Airy retained for his University a profound affection throughout his life, an affection which, among other ways, evidenced itself in the continual struggle which he waged in after years with the examiners, in his attempts to place the examinations on a footing that he held to be best suited for undergraduate education. The correspondence which Airy had with Prof. Cayley and others on this subject is specially interesting as offering a conspicuous example of Airy's power of controversy, a power which many must have had reason to remember. We have no intention of criticising the position which Airy supported, a position which was perhaps inevitable, considering his own University career and early training, both of which he found admirably adapted to his after-official life. This life possibly prevented him from fully appreciating the educational value of a mathematical training, marvellously widened and extended as it had been since he left the University. It will generally be felt that it was fortunate for Cambridge life and mathematical advancement that the views that he urged were not generally admitted by those responsible for the scheme of instruction and education.

It is unnecessary to recall here the principal events of Airy's scientific career. So many accounts were written shortly after his death by those well qualified to speak, that his indefatigable work and the honours that he earned are comparatively fresh in our memories. But there have been moments of unusual interest in his busy life, when his conduct has been somewhat rudely assailed, and his judgment questioned by his contemporaries. One would like to know what Airy thought of these attacks, and whether he attempted to justify himself to his own mind. So far as this autobiography goes, there is no evidence that he was ever elated by well-merited success, or depressed by captious criticism. He never makes any attempt to defend himself or to blame others. The path of duty, as he conceived it, is manfully pursued with firmness and decision. His confident reliance on his own judgment seems never for a moment to desert him. As an illustration, one may quote his reference to the discovery of Neptune. In the whole history of astronomy, there is no subject about which a keener interest is felt, by amateurs especially, than in the Adams and Le Verrier controversy, and the part played by the more conspicuous actors in that history. Few, possibly, have read the whole correspondence, and fewer still, probably, are qualified to give a right judgment on all the facts; but this does not prevent warm partisanship and a determined effort to find a scapegoat, on whom they can vent their spleen and ill-temper. And if this is still the case after fifty years, one can imagine what were the excitement and the disappointment at the time of discovery. Here is the last place in which Airy can say how he was affected by the uproar, and also to add anything to the history of the epoch. Practically he says nothing. He contents himself by referring to his official communications to the Royal Astronomical Society, and adding, "I was abused most savagely both by English and French," but there is not one word to hint that he ever thought he could have acted differently, or that the course he pursued was not the only one practicable. His equanimity is apparently quite undisturbed. Similarly, in 1847, when Airy endeavoured to persuade the Royal Astronomical Society to so alter the bye-laws as to permit a medal to be given to both Adams and Le Verrier, and his proposal was defeated after two days' stormy discussion, there is no evidence to show that he blames those who prevented this act of tardy justice, or that he considered their judgment was warped by unworthy motives. The attacks made across the Council table on that occasion were certainly bitter, and in some cases unwarrantable; but on Airy they seem to have left no permanent impression, or at least so slight that he does not care to chronicle it.

But that Airy could feel acutely and rebuke severely is quite sufficiently testified by his conduct towards Sir James South and General Sabine. These two names have been frequently quoted as illustrative of the bitterness of Airy's animosity. But it must be remembered that both these opponents called in question his conduct as Director of the Observatory, and it is possible that he felt more keenly attacks directed against the institution than against himself personally. From the former it will be admitted that Airy had ample provocation. South had attacked him in the House of Commons through Sir Robert Inglis, questioning almost everything that Airy had done in the Observatory, and later had lodged a formal complaint at the Admiralty that Airy did not personally observe with the instruments in his charge. Sir James was worsted on both occasions; but in his reference to them, Airy does not exhibit any rancour, or think it necessary to add anything to the defence made at the time of the accusation. For him the incident is closed, and he refers to it as impersonally as to any other piece of history. General Sabine had implied mistrust of the magnetical observations, and after an acrimonious correspondence, Airy distinctly intimated that he could no longer act in confidence with Sabine as a member of the Board of Visitors. There the ncident closed, and the dispute probably went no further than concerned the special matter in question; for Airy subsequently makes a not unkindly reference to Sabine's general powers as a mathematician and investigator.

It has been said of Airy that he was a man who never made a friend, and this has been adduced as a proof of the moroseness or the self-sufficiency of his character. The editor seems to have had some such remark in his mind, and at the conclusion of what may be called the first part of Airy's life—namely, the exchange of Cambridge for Greenwich—he inserts some remarks on the friends with whom Airy was intimate, and with whom he maintained constant intercourse till their death. As these friends were all older than Airy, they all predeceased him, and one can understand that there is no similar reference to friends that he made at Greenwich, when he left the Observatory for the White House. A man who had enjoyed the intimacy of Whewell and of Sedgwick, of Sheepshanks and of Peacock, may have found it difficult to fill their places, and with him memory may have satisfied the want that social intercourse meets in other men. Moreover, he was singularly happy in his family relations. Other writers have told us what Airy did in scientific work; this book tells us something of his private life, and exhibits him as a most affectionate husband and devoted father. His wife, to whom he proposed marriage two days after his introduction, a mark of precipitancy that one would have scarcely anticipated in the late Astronomer Royal, "was by natural ability and education well qualified to enter into the pursuits of her husband, and in many cases to assist him." In one place, Sir George Airy tells us that the best diagrams with which he illustrated his lectures were painted by his wife. His solicitude to make her participate in the pleasures he derived from his short journeys, by writing to her daily while he was absent, speaks much for his affectionate disposition. Those who have known Airy only in his official relations, will find much in this book to make them review the estimate they may have formed of his character.

W. E. P.

A NEW WORK ON CYTOLOGY.

Die Morphologie u. Physiologie des Pflanzlichen Zellkernes. Eine kritische Litteraturstudie. Von Prof. Dr. A. Zimmermann. Pp. 188. (Jena: Gustav Fischer, 1896.)

IF it be true that the growth of a science is to be estimated by the degree of division of labour which it exhibits, botanists have every reason to regard the work of the last fifteen years with no small degree of satisfaction. For the incessant investigations in every department of plant-life have been so vigorously prosecuted, that it has become utterly impossible for any simple mind to grasp the details of the various ramifications of the subject as it exists at the present day. At the same time, it is essential for any one who desires to avoid the evil results of exclusive devotion to one branch of the science, that he shall be in a position to appreciate the general nature of the results which are being arrived at in other fields of inquiry.

Now it can hardly be denied that at present the why and the wherefore of the phenomena exhibited by living bodies is the theme which is attracting, perhaps, the widest share of interest on the part of the botanist and zoologist alike; and the generalisations accruing from investigations of matters germane to these problems, possess a significance hardly less weighty for others who, though not strictly speaking biologists, are yet seeking to penetrate the mysteries embodied in the terms life and organisation.

And although we are accustomed to hear hypotheses confidently advanced and views dogmatically urged in connection with these and kindred matters, it is surprising to discover how small a substratum of solid fact we have as yet secured wherewith to lay the foundations for our many and elaborate theories. Thus the philosopher speculates on the origin and nature of consciousness, too often without possessing the faintest conception of the anatomy and physiology of the brain; writers on heredity are too prone to generalise from a scanty range of empirical facts, the mutual relations of which are still at best but obscure. And yet it is only by carefully collecting and collating the facts, that they can be made to tell their own story; and seeing that the aims both of biology and of philosophy are at bottom the same, namely to explain as far as may be the phenomena of life, it is surely not too much to expect that the living substance, the protoplasm, should form a prime object of earnest research. We are fairly well acquainted with the rough and ready ways in which organisms adapt themselves to their surroundings; we possess some knowledge as to the chemical processes which are inseparably associated with the exercise of vital activity; but of the mechanism itself, of the essential machinery, we know next to nothing at all, and the isolated facts which have as yet been gleaned respecting it often appear so conflicting that we might almost despair of ever getting really at close quarters with the object of our quest at all.

It is in the hope that this point of attack may prove to be not altogether impregnable, that such considerable efforts are being now concentrated on the details of cell structure. And we have made certain advances in this direction. We know that the essential feature of the sexual process lies in the fusion of two cells; we know that these cells have passed through antecedent changes very dissimilar from those which characterised the ordinary cells constituting the body or *soma* of the organism. What as yet we do *not* know is how to arrange our newly acquired facts in proper perspective; that knowledge can only be attained when our range of available fact is far greater than is at present the case. But the obstacles which beset the investigator in this difficult path are so many, that it may even take years to unravel the sequence of events in a single nuclear division. Nevertheless it is certain that the time so spent is not wasted, for it is only when we shall have arrived at such a position as will enable us to compare a large number of carefully and accurately ascertained facts that we can reasonably expect to apply our knowledge to the effective storming of some, at least, of the outworks of the citadel in which nature's secrets are so jealously guarded.

Dr. Zimmermann has rendered no small service to those who desire to do something in the field of cytological inquiry. He has carefully and impartially (perhaps too impartially) summarised the results of nearly all the recent advances in this branch of botany, and thus his book forms a handy work of reference to the extensive literature which is so rapidly growing up on these matters.

But the reader must not expect to meet with a critical and synthetic discussion of the results which have been obtained. He is left, for the most part, to form his own conclusions as best he can; and perhaps we may be pardoned for wishing that Prof. Zimmermann had seen his way to give a little more definite expression to his own views, especially as he is himself well known as an investigator in these matters. For example, on page 59 there is figured a dividing nucleus of *Lilium Martagon*, after Guignard, in which prominent centrospheres are represented as occupying the poles of the spindle. But in all the figures of the *same plant* taken from the author's own works, the centrospheres are omitted; and yet in one passage only (so far as we have seen) is any doubt tentatively cast on the accuracy of the statements alleging the existence of centrospheres in the lily. We think definite plain statements in a case like this would have been more useful than a cautious expression of doubts which have been growing up for a long time respecting the instance just cited. At any rate, such a course would have raised the question. It must be faced sooner or later, and the sooner it is raised—and finally answered—the better.

The book is divided into three main parts, the first dealing with technique, and with the chemistry and physiology of the nucleus in general. The second part of the work is devoted to a consideration of the structure and behaviour of this body in the different groups of the vegetable kingdom, and a good deal of useful information respecting fertilisation and embryology is here brought together. The third part consists of a copious and most useful bibliography, which will be welcome to every one who wishes to obtain a more thorough knowledge of the subject.

Dr. Zimmermann naturally could not profitably discuss the questions suggested by a study of the literature here abstracted without due reference to the work accomplished by the zoologists in the same field. But, in his preface, he has expressly signified his intention of confining himself in the main to the phenomena exhibited by plants; and so, however much we may regret the results of this self-denial, we cannot but admit that the author has acted wisely in refraining from drawing general conclusions which must have been one-sided, and proportionally futile. As it is, although we cannot exactly say his book is very readable, it is at any rate a useful one, and should be certain of receiving a favourable reception at the hands of those whose business or pleasure impels them to keep abreast with current investigations in this department of science.

J. B. F.

COLLIERY MANAGEMENT.

Colliery Working and Management. By H. F. Bulman and R. A. S. Redmayne. Pp. xvi + 330. (London: Crosby Lockwood and Son, 1896.)

THREE hundred and forty years ago the learned German writer Agricola, enumerated, in the first book of his treatise, *De re metallica*, the various branches of knowledge that ought to be acquired by a mine manager. First he should be familiar with chemistry, geology, mineralogy and other branches of philosophy; secondly with medicine, that he may cope with the diseases and accidents to which miners are liable; thirdly with astronomy, that he may carry out scientific surveys; fourthly with geometry, that he may prepare underground plans and sections; next with arithmetic, that he may keep account of the mining costs; then with engineering, that he may construct machinery and buildings; also with drawing and colouring, that he may execute designs; and lastly with mining law, that he may avoid difficulties with others, and prevent his neighbours from taking advantage of him. Much more difficult are the problems with which the colliery managers of to-day have to deal. They have to extract coal from great depths, and to labour under stringent legislative enactments. In short, in the words of Mr. T. Forster Brown, the ideal colliery manager ought to be a scientific philosopher with a thoroughly practical knowledge of mining, of men, and of applied mechanics. The successful execution of the duties of a colliery manager implies the getting of the largest possible proportion of the workable coal in the best condition at the lowest possible cost, and with the greatest degree of safety to the miners. It is remarkable, therefore, that the methods of working the coal, and the arrangement and supervision of the labour employed, have received but slight consideration in the literature of coal-mining. This is due to the fact that Mr. H. W. Hughes' recently published text-book of coal-mining and the older treatises on the subject deal rather with mine engineering than with colliery working; and owing to the vast amount of matter to be dealt with, subjects relating to labour, wages, cost of working and systems of getting the coal, have to be crowded into one or two chapters. Mr. Bulman and Mr. Redmayne, who are both experienced colliery managers of great literary ability, are therefore to be congratulated on having supplied an authoritative work dealing with a side of the subject which has hitherto received but scant treatment.

The authors break up their book into fourteen chapters In the first three chapters they deal historically with the progress achieved during the last few centuries in the methods of working coal, in working costs, and in conditions of labour. In the succeeding five chapters they describe the duties and qualifications of a colliery manager and of the various grades of subordinate officials, the superintendence of labour, the arrangement of labour and the system of wages, wages bills and cost-sheets, and the tools and appliances used by the workmen. In the concluding six chapters they discuss in practical detail the different systems of working coal, namely the bord and pillar, the longwall, and the double and single stall methods, and the modifications requisite for working two seams near together. Lastly in an appendix covering seventy-five pages, they give the text of various documents illustrating the past history or the present condition of coal-mining, including a statement of the comparative cost of working bord and pillar and longwall, the official abstract of the Coal Mines Regulation Act 1887, the special rules established under that Act, pitmen's yearly bonds in 1767, 1779 and 1859, forms of hiring agreements, forms of rules regarding the drawing of lots to determine working places, joint-committee rules, and the text of the Coal Mines Regulation Act 1896, and of the Truck Act 1896. The volume concludes with a glossary of mining terms and an excellent index.

From this summary of the contents, it will be seen that the arrangement of the matter has been well thought out, and that the volume is an addition of permanent value to mining literature. The book is, however, open to one grave objection. It is too local in character; almost all the examples being selected from Northumberland and Durham, the district with which the authors are most famillar. Even when they describe the longwall method of working, they choose their instances from the North of England coalfield. The longwall system of that coalfield, however, differs considerably from that of the Midlands, where the method originated, and where it is carried out to perfection. This difference is due to the fact that the conditions of labour are not the same in the two coalfields. In the North, each man works for himself; whilst in the Midlands sets of men work together, the result being that in the former district longwall consists of short faces or stalls, whilst in the latter the stalls are from thirty to fifty yards long, and continuous instead of being a series of broken steps. In fact, longwall in the North can rarely be regarded as longwall proper, but would be better described as a longwall modification of the bord and pillar method.

The local character of the work is also apparent in the technical terms employed. The pages are freely sprinkled with such words as *cavils*, *cracket*, *dillies*, *jenkin*, *keeker*, *kist*, *ramble*, *stook*, *wailing*, &c. Outside the North of England coalfield these terms are not understood, and constant reference to the glossary is absolutely necessary. This indiscriminate use of local slang is greatly to be regretted as tending to limit the book's field of usefulness. It might easily have been avoided, for Prof. Le Neve Foster has shown in his mining works that it is quite possible to replace provincialisms by words that are generally understood among English-speaking nations.

The authors elucidate their text by 119 woodcuts and 28 plates, most of which are admirable reproductions of photographs taken underground with the aid of the magnesium flash-light. These illustrations are excellent. The only exception that can possibly be taken to them is that several of them are unnecessary. This is most noticeable in Plate iv, representing miners' children at school. As a photograph this is a perfect piece of work; but for any indication to the contrary the girls represented might have been pork-butchers' children, and the illustration could, if needed, pass as such. Plate xxi and others, which have little connection with the text, appear to have been introduced merely because they are underground photographs, of which their authors are pardonably proud. BENNETT H. BROUGH.

OUR BOOK SHELF.

The General Principles of Zoology. By Richard Hertwig. Translated by George W. Field. Pp. xii + 226. (New York: Holt, 1896.)

THE English version of the general part of Prof. Richard Hertwig's "Lehrbuch der Zoologie" will be welcome to all teachers of biology in this country.

The value of a text-book of zoology can nearly always be tested by the character of the introductory chapters on the general principles of the subject. To write clearly, accurately and, withal, briefly on such topics as the structure of protoplasm, the character of cells, the fertilisation of the ovum, and the general principles of embryology, requires the knowledge and experience of one who has both investigated and taught for many years.

Prof. Hertwig is a master of his subject, and his "General Principles" is written in a masterly manner.

Among the many excellent chapters in this volume, we may call attention to those on the development of morphology and on comparative histology, which should be carefully read and considered by all those who are engaged in teaching the elementary principles of zoology.

The illustrations are numerous, well chosen, and admirably executed.

Whilst expressing admiration for the book as a whole, it must be noted, with some regret, that Prof. Hertwig writes so confidently of the truth of the hypothesis that the chromatin only is the bearer and transmitter of the hereditary characters. This is a speculation which was never founded on facts, which is not supported by recent investigations, and one which it is to be hoped will soon be lost and forgotten.

The chapter on the geographical distribution of animals is by no means of the same standard of excellence as the others. The statement, on page 216, that the deep-sea fauna is "distinguished from the coast fauna by its archaic character" is not accurate. It is true that a few archaic families have survived in deep-sea water, but by far the greater number of the members of the abysmal fauna are extremely specialised representatives of shallow-water groups.

The translation is good, and we may congratulate Mr. Field on his courage in rejecting the common American translation of the word "anlage" in favour of the more reasonable and intelligible word "rudiment."

S. J. H.

British Patent Law, and Patentees' Wrongs and Rights. By Hubert Haes. Pp. xiii + 102. (London: W. B. Whittingham and Co., Ltd., 1896.)

THERE is a feeling among most men engaged in industries that a patent is a bad security for an invention, and that the best way to reap the fruits of an improved chemical process, or of any novel industrial method, is to keep the knowledge secret. This indicates a weakness in the British patent system; and though the matter is a very difficult one to deal with satisfactorily, some change is desirable which will better protect the general public and deal with patentees more justly. Under the system at present in vogue, no examination as to novelty is made before granting the patent. Mr. Haes suggests, among other reforms, that the Government should undertake the most thorough search, in the case of every application for a patent, to ascertain whether the specified invention has previously been patented within this realm. At present this task is left to the patent agents, the Government taking fees but no responsibility. It is stated, "to show in what estimation British patents are held in Great Britain, it is necessary only to mention that, to obtain for an invention a British patent which shall have the likelihood of being valid, it is becoming the custom to apply for the German patent for it. It is found cheaper and quicker to do this than to search the English records, because the German government does that before granting its patent." As the commercial prosperity of our country depends upon inventions, Mr. Haes' statement of patentees' wrongs, and proposed remedies deserves attention.

Diagrams of Terrestrial and Astronomical Objects and Phenomena. By R. A. Gregory, F.R.A.S. (London: Chapman and Hall, Ltd., 1896.)

IN a set of twelve diagrams issued under the above title, the author has supplied a convenience which has been wanted for some time past in the class-teaching of elementary science, thus removing a considerable part of the difficulty experienced in obtaining, in diagram form, results of recent work in any subject. Teachers of physiography will be directly benefited, but most of the diagrams will be found useful in the illustration of geographical and elementary teaching. Many of the figures are almost of necessity similar to previous ones; but even in these cases the treatment is original, the descriptive text being specially clear and devoid of superfluous detail. Evidence of the degree to which recent discoveries are brought up to date is specially well shown in the diagram of "the sun's family of planets," in which the planets Jupiter and Saturn are reproductions from the drawings of these bodies by Profs. Keeler and Barnard respectively, observed by them at the Lick Observatory quite recently. A diagram illustrating the various forms of aqueous circulation is also specially clear and self-explanatory. C. P. B.

The Romance of the Sea. By Fred Whymper. Pp. xii + 468. (London: Society for Promoting Christian Knowledge, 1896.)

"FICTIONS, facts and folk-lore" of the sea make up the pages of this book, but the first and last of these are much more prominent than the facts. Interesting stories, compiled mostly from the writings of others, have been roughly grouped by the author, and the tissue of words here and there makes a slight connection between them. Phenomena of the sea and skies are given some attention, but from the purely descriptive point of view; and the same remark applies to the accounts of sea-monsters, coral, and volcanic islands. Boys with a love of the sea and adventure will be charmed with Mr. Whymper's collected narratives, and they will probably rejoice at the small attempt made to retail scientific facts at the same time.

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.*]

The Use of Kites for Meteorological Observations in the Upper Air.

ATTEMPTS to use kites for meteorological observations in the upper air began more than a century ago. The lack of light instruments which record automatically and continuously, prevented the success of the early experimenters. Such records are now obtained for the first time by means of kites at the Blue Hill Meteorological Observatory, near Boston. A history of kite-flying for meteorological observations, with a general account of the work at the Blue Hill Observatory, was given by the Director, Mr. Rotch, in a paper read before the Physical Section of the British Association at the Liverpool meeting (1896). Notes in NATURE of October 22 and 29, vol. liv. pp. 598 and 629, mention briefly the altitudes to which a meteorograph has been lifted at Blue Hill during the past summer. A few of the details of the recent highest ascent may be of interest to the readers of NATURE, especially as it shows that clear and definite meteorological records can be obtained at a great height by means of kites, at a comparatively small expense. The meteorograph weighs three pounds, and records temperature, humidity, and atmospheric pressure. The record of October 8, from the earth's surface to an altitude of 9375 feet above sea level, was as clear and sharp as the records of similar instruments in thermometer screens at the observatory. The temperature-scale on the chart is centigrade, and the humidity pen records 10 per cent. too low, so that 90 per cent. represents saturation. The barograph-pen is made to record altitudes in metre; but it went entirely off the scale, which is too small for the altitude reached. The record was, however, completed on the part of the chart above the scale. A determination of the altitude was made by placing the barograph under an air-pump, and finding the fall of pressure necessary to raise the barograph-pen to the highest point recorded when on the kite. From the amount of fall and the temperature recorded by the thermographs on the kite and at the observatory, the altitude was computed. The altitude was also computed from the angular elevation of the kites and the length of line recorded by a reel, 3 per cent. being allowed for the sag of the steel wire holding the kites. The amount of the sag was determined by previous theodolite measurement, from a long base line, of the altitude of the kites. The altitudes by the two methods agreed within 1 per cent. of the height, and the mean of the two is given. In this ascent nine kites with a total area of about 170 square feet and 18,000 feet of steel wire, weighing about 46 lbs., were used. All the work of the ascent was managed with an ordinary wooden windlass by the three members of the staff—Mr. Fergusson, Mr. Sweetland and myself. The sea-coast is about six miles from Blue Hill, and the general level of the surrounding land is about 100 feet above sea-level. The top of Blue Hill, from which the kites were flown, is 635 feet above sea-level. Cumulus clouds had begun to form when the ascent began, and the meteorograph was soon elevated to the cloud-level, as shown by the humidity record, and was then lowered to remove a defective kite. In the second ascent the clouds were entered at an altitude of 4500 feet. The successive kites added to lift the line as they rose to the cloud-level, and again, when they were drawn below it, gave the data for numerous successive determinations of the altitude of the bases of the cumulus clouds, and furnish an example of the accuracy and frequency with which clouds can be measured in this manner, as shown by the following results:—

	a.m.	p.m.								
Time ...	11.18	1.58	2.05	2.39	3.01	3.34	3.36	4.34	4.57	5.23
Altitude	2974 ft.	4500	4641	5035	5405	5254	5097	5044	5000	5130

These measurements show that the level of the bases of the cumulus clouds rose steadily from 11 a.m. to 3 p.m., then diminished slowly. Theodolite measurements at Blue Hill show this to be the normal daily course of the cumulus. The kite-meteorograph passed above the tops of the cumulus at 3.08 p.m. and the humidity fell in a short time 46 per cent., showing a very dry air above the clouds; a condition which the meteorograph has shown in every case when it was lifted above the clouds, the fall of humidity usually being very rapid after the top of the cloud is passed.

The temperature on October 8 fell below the freezing point at 1.35 p.m. at an altitude of 4540 feet, and continued below freezing until an altitude of 3850 feet was reached at 8.24 p.m. in the descent. At the highest point the recorded temperature was 10° below the freezing point. At the Blue Hill Valley Station at this time the temperature shown by a thermograph was 49° F., making a fall of 29° F. in 9300 feet, or 1° in 320 feet. This fall is slower than the average we have found, which is about 4° in 1000 feet during the day-time, or 1° in 250 feet. During, and immediately preceding, decidedly colder weather the rate of fall increases to about 6° in 1000 feet. The rate of fall is least preceding warmer weather, since a warm wave, as a rule, sets in first aloft.

The ease with which a meteorograph can be lifted to the height of a mile is shown by the fact that this was accomplished three times in four days during August in normal weather conditions. The highest point reached by no means represents the highest point attainable with kites, since at the time of the highest ascent the pull of the kites on the line was 100 lbs., while the breaking strain of the line is over 300 lbs., so that had there been more wire on the reel a much greater altitude might have been reached. Three, or possibly four or five, miles does not seem unattainable in this manner. The importance of such observations for the further developement of meteorology is shown by the fact that the weather conditions at the height of a mile above any station differ more from the weather at that station than does the weather at any place within 500 or 1000 miles at the level of the station on the earth's surface. At the height of a mile in the free air the temperature is usually from 15° to 25° F. colder than at the earth's surface, and there is virtually no daily change in temperature, the nights being as warm as the days. The only changes are due to the passage of warm and cold waves. During fair weather at this height the days are very damp, and the nights extremely dry. Low clouds frequently cover the earth, and even rain may fall from these while the sun shines bright at the height of a mile. The average velocity of the wind at this height is four times greater than at the ground, and hurricanes of 100 miles an hour are not uncommon. At least, the meteorograph records obtained by kites, and measurements of the heights and movements of clouds with theodolites, indicate that these are the conditions which exist above Blue Hill.

H. HELM CLAYTON.
Blue Hill Meteorological Observatory, Milton, Mass., U.S.A., November 20.

The Theory of Dissociation into Ions.

PROF. ARMSTRONG (page 78) says that the chief concern of chemists has been to establish facts; and perhaps this is true; but to an outsider it has seemed recently as if some few facts were unwelcome to the school of chemists represented by himself. For instance, they seemed annoyed at one time with the inertness and the specific-heat-ratio of argon; now he expresses himself as if vexed with the slowness of ionic velocities, and "declines to accept it."

If the ions travelled quicker, a liquid would conduct better than it does, and perhaps that is what Prof. Armstrong desires; but it is difficult to see any ground for his objection to the present state of things. In a rare medium, like a gas, the ions migrate quickly; in a dense medium, like a liquid, they migrate slowly; and their numerical speeds, as measured, exactly for liquids, approximately for air, are not inappropriate to the relative crowdedness. What more can be desired? The facts do not even demand much difference between the gaseous and liquid states; though even if they did they would still have to be accepted, just as the facts of viscosity and its contrary affection by temperature in the two states have been accepted.

I know very well, and have long known, that Prof. Armstrong objects to the idea of perfectly free ions; but surely he is aware that many physicists object to it too, with whatever glimmering of chemical instinct they possess, and they have endeavoured to show that the facts can be expressed without such an hypothesis. Physicists have also objected to the idea of a dissolved salt existing as a free gas in a solvent, notwithstanding the remarkable analogies with gaseous laws, discovered in an admirable manner by physical chemists, that such a substance presents;

and now Prof. Poynting (*Phil. Mag.*, October) shows in detail how the analogies may be accounted for without postulating any dynamical similarity.

There remains the so-called dissociation needed to explain electrolysis. It has been long known, however, that a kind of instability, or ease of interchange, is all that is necessary, not actual permanent dissociation into constituent atoms. What is certain is (1) that the atoms of an electrolyte migrate in opposite directions, and (2) that they require no appreciable electric force to tear them asunder. These are facts, and the instability of composition thus evidenced is such as almost to compel the provisional use of the term "virtual dissociation"; although that condition may very likely be brought about by the loose affinities of outlying members of complex molecular aggregates—a conception which Prof. Armstrong himself promulgated as an hypothesis, but has not yet, I believe, made definite.

The problem presented by the fact of molecular combination is, I suppose, universally recognised by physicists as a difficult but important one, and attempts have been made—by Helmholtz among others—to attack it.

Occasionally it happens that the perennial attempt to reduce one province of chemistry after another, to simple dynamics ultimately, to thermodynamics or electro-dynamics provisionally, meets with some partial success; but it seldom meets with appreciation, perhaps not always with apprehension, from professed chemists. Thus, for instance, Prof. Armstrong seems to speak with some bitterness of "those who are now arrogating to themselves the position of superior persons to whom has been granted the mission and plenary powers to reform an ancient society long steeped in superstition—to wit, the chemists."

Does he intend by such phrases to surround the domain of chemistry with an adiabatic boundary or barbed wire fence for the exclusion of trespassers? I have reason to believe strongly that it is not so, and that it is only his wide knowledge and reading which tends to make him hypercritical.

OLIVER J. LODGE.

As Prof. Armstrong has, in the issue of NATURE dated November 26, continued the discussion on the theory of solution, may I be allowed to point out that there are two entirely distinct questions involved?

The first is to investigate the state of a dissolved substance and the cause of osmotic pressure, and the second to ask what is the physical reason why some solutions possess that property, absent from others, by virtue of which they become electrolytes, have abnormally great osmotic pressure, and high chemical activity.

The answer to the first and more fundamental question remains uncertain. Van 't Hoff's work showed that there was a very close analogy between solution and evaporation, and this led to the idea that there might also be a dynamical similarity between the condition of a gas and that of a substance dissolved in a liquid. Such an hypothesis, although it at once explains the application of the gaseous laws to dilute solutions, neglects the undoubted similarity between the process of solution and certain kinds of chemical action. Prof. Poynting has done a good work in showing that, on certain fairly probable assumptions, the phenomena of dilute solutions can be fully explained by the opposite idea of aggregation. We have, therefore, two hypotheses, each based on an analogy, and each capable of accounting for the facts to be explained. It is probable that neither of them represents the exact mechanical truth, and I imagine that their authors would make no such claim on their behalf. While using both views as guides to future work, we need commit ourselves to neither. Although, personally, I am, at present, inclined to think that some form of chemical theory will ultimately be found to be capable of representing the facts, I have no wish to express my faith in any definite hypothesis. As Prof. Armstrong says, "there is no need to be in so great a hurry—it is no disgrace to admit that we cannot yet explain all the mysteries of the universe."

It will be seen that this first question does not at all involve the second, which refers to the nature of the fundamental property distinguishing an electrolyte from a non-electrolyte. Yet Prof. Armstrong uses Prof. Fitzgerald's warning against prejudging the first question, and Lord Rayleigh's repetition of that warning, as reasons for refusing to accept the evidence for a particular answer to the second.

I may repeat what I said in the letter which appeared in your issue of October 15, that, although there is strong evidence to show that the opposite ions are free from *each other*, there is nothing in the facts of electrolysis inconsistent with the view that they are united with solvent molecules, and that solution is essentially a chemical process, and the cause of osmotic pressure a combination between the solvent and the dissolved matter.

Lord Rayleigh's words, as quoted by Prof. Armstrong, are: "It is to be hoped that chemists will take into grave consideration the emphatic warning that Prof. Fitzgerald has given, particularly as to the danger of supposing that there is any dynamical similarity between the condition of a gas and that of a dissolved substance in a liquid. . . . There is possibly a risk of pushing analogies too far, and of supposing that there is a real dynamical similarity, whereas, perhaps, there is only a similarity in mathematical law."

This statement is clearly meant to apply to the question of the fundamental nature of solution—the question whether or not the dissolved matter is to be considered to exist in a condition dynamically similar to the gaseous state. It does not refer to the second problem, which is concerned with the nature of the property characteristic of an electrolyte. Yet Prof. Armstrong adds: "I, for one, require no better support than this, and shall continue to be, as I have been from the outset, a determined opponent of what, I think, may fairly be termed the nonsensical hypothesis of ionic dissociation."

If the evidence in support of the idea of dissociation is not strong enough to carry conviction to Prof. Armstrong's mind, the supporters of the theory can only mutely regret that they have no chance of making so distinguished a convert; but, when he quotes the words I have copied as an argument against the theory, it seems desirable to call attention to the fact that those remarks were really aimed at something else.

Prof. Armstrong attacks the whole idea of charged ions, and quotes Maxwell to show that it is only a provisional hypothesis. Of course the convection theory of an electrolytic current is merely a convenient way of stating observed facts, such as those grouped together under Faraday's law. It seems clear that the path of the energy used by the current lies in the neighbouring dielectric, just as is the case with a metallic circuit, and it is probable that the real part played by the mobility of the ions is to allow the slipping to go on, by means of which can alone occur that transformation into heat of the energy of the polarised dielectric which we call an electric current. But, whatever the true nature of the process, it is certain that the passage of a definite quantity of electricity through a solution is always associated with the decomposition of a definite quantity of the electrolyte, and, therefore, with the passage in opposite directions of a definite quantity of the opposite products of decomposition—call them ions or what you will. To this extent, then, we are free from hypotheses, and this is ground enough on which to found the whole theory of ionic migration and its consequence, the dissociation of the ions from each other.

Prof. Armstrong complains of the ease with which the dissociation theory can be reconciled with new views as they are developed, and can be made to explain new phenomena as they are discovered. It seems to me that this adaptability goes to show that the fundamental idea of the theory is in accordance with the facts of the case.

I have no desire to defend the moral character of the ions when they have freed themselves from the bonds of that union which Prof. Armstrong seems to think should possess the sanctity of the marriage tie. I fear it is very likely that they *do* form those connections which he has condemned in such very plain language. Indeed, things may be even worse than he suggests. The ions may actually pass from one molecule of the solvent to another, carrying their charges with them, till contact with an electrode ends their career of infamy. Considerable mental agility is needed to follow *all* the metaphors which Prof. Armstrong crowds into a single sentence, but, at any rate, it is plain that this freedom of life clears the ions from the accusations of bearing "water molecules on their backs," and of being "chained to them like galley-slaves."

With regard to the velocities of the ions, I cannot quite see the reason for Prof. Armstrong's belief that they are really higher than is generally supposed. Even on the purely gaseous theory of solution, which Prof. Armstrong here uses to support his argument, the dissolved ions must have very short free paths, and, although the velocity with which they vibrate backwards and forwards from one solvent molecule to another may be great, when it comes to jostling their way for an appreciable distance in a definite direction through the surrounding crowd of solvent molecules, they will only be able to move very slowly. The migration of the ions is really a process of diffusion under the influence of electric forces, and will, of necessity, be very slow. I can assure Prof. Armstrong that no dissociation apologist will argue "that the charges act as brakes." It is by reason of their charges that the ions are urged forward by the electric forces. Without them, the velocities would not reach even those present figures which appear so despicable, but would merely take the much smaller values given by ordinary liquid diffusion. By placing in contact a coloured and a colourless solution, containing one ion in common, and passing an electric current across the junction, Prof. Armstrong can actually watch the ions migrating, and check the accuracy of the "conventional time-table." W. C. D. WHETHAM.

Trinity College, Cambridge, November 27.

I FEEL sure that many readers, like myself, must have welcomed the sentiments expressed by Prof. Armstrong, in his article on this subject which appeared in your issue of November 26. It seems to me a duty of teachers to protest against the growing tendency there seems to be of putting forward the crude hypotheses of the ionist school, as though they had the same claim to acceptance as well established scientific laws, about which no reasonable doubt exists. So far from this being the case, the arguments commonly advanced in support of this theory seem to consist mainly of the misapplication of physical laws to a few carefully selected cases, aided by plausible but misleading assertions.

The objections that have from time to time been urged against both the views and the methods of argument have never received proper attention at the hands of the advocates of ionic dissociation. (Prof. G. F. Fitzgerald's Helmholtz Lecture; a paper by Prof. S. U. Pickering, *Journ. Phys. Soc.*, vol. xi., &c., remain unanswered.) It is, therefore, with the object of drawing attention to certain further difficulties and, as I conceive, errors in the above theory, rather than of evoking a discussion, that I now write.

In answer to the question—how is it that substances that are supposed to dissociate have "abnormally" large values for osmotic pressure, lowering of freezing-point, and reduction of vapour pressure?—we are told that the dissolved substance exerts the same pressure as if it were a gas and occupied the volume of the solvent, and that when dissociated it exerts a greater pressure on the solvent. Now, surely the term "osmotic pressure" in such a sense is misleading; not only is there no evidence of the substance exerting *pressure* on the solvent, but rather that by an attractive force it can allow water to pass into it, and hold it, up to a certain particular pressure, which, if exceeded, will cause water to pass out again through the semi-permeable wall. There is in this nothing at all comparable to gaseous *pressure*, which certainly never is the cause of another fluid entering it in a closed vessel; for I suppose it will hardly be imagined that in a gas diffusion-cell it is the pressure of the gas inside that causes another gas to pass by endosmosis into it. Similarly with regard to vapour pressure, an attraction between solvent and dissolved substance can account for a reduction of the vapour tension, but a pressure exerted on the solvent by the so-called gasified dissolved body cannot.

In regard to the lowering of freezing-point, we are actually sometimes told that this is a direct effect of the pressure of the salt on the solvent, with a beautiful reference to the lowering of the freezing-point of water by pressure, but with a calm oblivion of the fact that an increase of pressure would raise the freezing-point of other solvents in common use, such as benzene, acetic acid, &c. The alleged fact that the vapour pressures of a solution and of the solid solvent are the same at the temperature of the lowered freezing-point, may be true, but it affords no explanation of the way in which such depression of the freezing-point is brought about.

Ostwald, in his "Outlines of General Chemistry," p. 139, suggests a cyclic change of frozen solvent cooled to $T - \Delta$, melted by addition of the active substance, and raised to T again, but his data are fallacious in not taking into account the considerable difference in specific heat of the solid and liquid solvent, and the consequent variation of latent heat with temperature; so that the heat evolved on freezing and absorbed on melting are not the same as he assumes them to be.

In that same Bible of the ionists a very curious representation of the action of a current on an electrolyte is given (p. 273), where Ostwald states that there is no place for any energy of the current being expended in doing the work of dissociation, and "that it has to perform no work in the matter at all." So much for the researches of Favre, Joule, &c., let alone the most elementary fact that the adverse E.M.F. of polarisation is roughly proportionate to the heat of combination of the electrolyte, and that EQ. units of work must be expended in the transference of Q. units of electricity through the electrolytic cell, quite apart from work done against ohmic resistance. Apparently this idea owes its origin to the observation of Helmholtz, that feeble E.M.F.s can send exceedingly small currents through an electrolyte; but he points out in one of his papers, that if only one cubic centimetre of detonating gas were dissolved in the liquid, "its constituents need only migrate once in thirty-six days from the anode to the kathode in order to produce the observed current." He also showed that under so small a pressure as 10 m.m. an E.M.F. of 1·64 volt is necessary to separate visible gas, while the value calculated from the heat of combination of H_2 and O is 1·49 volt.

In the same chapter (p. 275), Ostwald asks us to "*imagine*" two insulated vessels A and B, connected by a syphon and filled with solution of potassium chloride. Let a negatively charged body be brought near A, remove the syphon and charged body, then A is left with a positive charge. Now, he says, in A there must be an excess of free potassium ions, and if the electricity be conducted away, the potassium assumes its ordinary form, and, acting on the water, develops hydrogen "*which can be collected in a suitable apparatus and tested.*" Now I have calculated the electric capacity of such an arrangement, and supposing a very large beaker and an inductor placed close to it, to be used, the capacity of the condenser so formed could hardly be so large as ·0001 microfarad. We can be generous and suppose that the vessel A is charged to a potential of 50,000 volts above the earth; with this potential the quantity would be 5×10^{-6} coulomb, which would yield approximately ·00000005 milligramme of hydrogen! Did Ostwald repeat the charging by induction, removal of the syphon, and discharging 20 million times, and so obtain a milligramme of hydrogen which he "collected" and "tested." Even if this be "imagined," it would evidently do just as well to leave out the potassium chloride altogether, as water, as pure as Kohlrausch ever obtained it, would, with 50,000 volts, answer the purpose equally well.

When from this experiment (?) he draws the conclusion that—"The assumption that electrolytes contain free ions is not only possible but necessary," one may form some opinion of the kind of evidence that ionists consider conclusive.

In conclusion, I would like to ask ionists the following questions:—

Why do not ions, if free to move under the influence of small external electric forces, attract each other with immense force if they be charged with such enormous quantities of + and − electricity?

Where did they get these charges from?

Does dissociation absorb or evolve heat?

Why does not an E.M.F., however small, liberate gas from dilute sulphuric acid?

Why does solid Ag_2S conduct electrolytically? Is it "dissociated into ions"?

There are many other questions, but I should really like to know the answers to these first. I believe many of the points I have here raised have been brought forward by others before, so I lay claim to no originality in their suggestion, but hope that their consideration may give pause to those who are at present only partly "dissociated," until, at least, some reasonably satisfactory explanations are forthcoming. E. F. HERROUN.

Queen's College, Harley-street, W., December 2.

Responsibility in Science.

MY first letter (NATURE, October 15, p. 572) on this subject maintained that Prof. Poulton had no right to hold physicists as a body *responsible* for views presented by two or three of their number, however eminent. Prof. Poulton (NATURE, December 3, p. 100) seeks to justify his action on the ground that "in a matter of such great importance . . . it is probably fair to conclude that, with the great majority of physicists, 'silence gave consent.'" This doctrine of silence is surely untenable. If an authority on acoustics pronounces views even on the fundamentals of sound, is an electrician to be held consenting when he forms no opinion or reserves it to himself? In the present case it should be added that whilst questions in geo-physics or astro-physics are often most interesting to the public, they hardly as yet touch the fundamentals of physics, but constitute merely theoretical applications. If we put at 5 per cent. the proportion of physicists who have studied for themselves any given problem in geo-physics, and who have the necessary qualifications to justify the expression of an opinion, we should probably indulge in an over-estimate. It is in fact only a very small minority of whom anything but silence could possibly have been expected.

In the next place, even if the doctrine of silence were accepted, the occasion for applying it does not exist. A considerable number of persons—some in my opinion imperfectly equipped for the task—have criticised the theories of Lord Kelvin and Prof. Tait. In his letter Prof. Poulton represents all such critics as geologists or zoologists, but in his B.A. address (NATURE, September 24, p. 502) he admitted the existence of mathematical critics. Most of these critics had, I think, in reality as much claim to the title physicist as to that of mathematician. I myself five years ago, in two papers whose physical character was indicated by the title "Some Applications of Physics and Mathematics to Geology," while pointing out that in my opinion the critics were mistaken in supposing they had demonstrated the essential erroneousness of Lord Kelvin's work, advocated strongly the maintenance of an agnostic attitude towards the question of the solidity of the earth's interior. These papers appeared in the *Philosophical Magazine*, were reprinted in the "Annual Report of the Smithsonian Institution," and have been referred to since in several standard works. So far as I know, no attempt to controvert their arguments has been published, so that on the doctrine of silence they would seem to represent the views of the "majority of physicists." It is obvious to any mathematical physicist, and I should have hoped to others, that so long as the solidity of the earth's interior is an open question, no theoretical application of the mathematical equations for solids—whether to temperature or any other internal property—can be regarded as final.

My reason for advising Prof. Poulton to allow for possible errors in speculations other than Lord Kelvin's, and for commenting on the absence of any reference on his part to Lord Kelvin's recent experiments on rock conductivity, was as follows:—

The key-stone in Prof. Perry's valuable contribution to the subject, on which Prof. Poulton so largely relies, is the *demonstration* that, even on the assumption of a solid earth, the hypothesis of thermal homogeneousness does not necessarily supply an absolute maximum to the habitable age of the earth, inasmuch as higher estimates can be obtained on the simple hypothesis that the internal strata conduct better than the surface strata. This disposes of the *necessary* character of Lord Kelvin's conclusions on this subject—even if solidity be granted—but still may leave his estimate a not improbable one, so far as physical grounds are concerned, unless a presumption can be raised that the conditions of Prof. Perry's problem exist in nature. A study of Prof. Poulton's address led me to think that in his anxiety to increase the *à priori* probability of the conditions postulated in Prof. Perry's solution, he was attaching undue weight to theoretical speculations which seemed to tell in its favour, while omitting all mention of recent direct experiments by Lord Kelvin which told against it. In my letter I quoted Prof. Poulton's own words, so far as space allowed, and certainly did not represent him as holding the theoretical evidence to be "conclusive."

The second half of my first letter was intended to show Prof. Poulton, by reference to his own address, another aspect of the case, viz. the serious inroads which would be made on a physicist's time if he criticised everything he thought erroneous. It seems that Prof. Poulton agrees mainly with my criticisms, only he maintains that the views criticised are products solely of my imagination. Flattering as it would be to my *amour propre* to believe my imagination so gifted, I must acknowledge the suspicion that most physicists who read Prof. Poulton's address, as published in NATURE, will find a simpler explanation. Take for instance Prof. Poulton's remark, "the earth, even when solid, will alter its form when exposed for a long time to the action of great forces," and my criticism, "here and in the rest of the passage is a strong flavour of the erroneous view that a solid is *rigid* in the mathematical sense, except when viscous under great and prolonged stress." Elasticians, I suspect, will fail to recognise this as the criticism solely of an exuberant imagination.

One word more: Prof. Poulton speaks as if the opinion of "the majority of physicists" were binding on their fellows. Now in the first place the voice of the majority is not yet recognised as dominant in science, and in the second place no provision exists for collecting suffrages. In the society of zoologists and geologists the individual physicist may possibly become a very fountain of universal knowledge, but amongst his peers he is chary about expressing too definite an opinion on questions he has not specially studied. CHARLES CHREE.

December 7.

The Satellite of Procyon.

THE announcement in the Astronomical Column of NATURE for November 19 (p. 62), of the discovery of a close companion to Procyon by Prof. Schaeberle, with the 36-inch telescope of the Lick Observatory, will be extremely interesting to those who know anything of the history of the investigations which have been made as to the cause of the irregularity in the proper motion of Procyon observed by Bessel in 1844, and Mädler in 1851. Following up their observations, Dr. Auwers in 1861 computed an orbit on the assumption of a circular motion in a plane perpendicular to the line of sight, round a point about 1″·2 distant, having a period of about 40 years, the position angle being about 90° for 1873, and this, with an assumed motion of about 9° per annum, would make the present angle about 300° for the hypothetical companion.

Otto Struve measured a supposed new companion in 1873, March 28, with the 15-inch refractor at Pulkowa, and found, as a mean of several measures, the P. angle 90°·24, and distance 12″·49; and also in 1874, April 10, when he measured the P. angle 99°·6, and distance 11″·67; but, singular to relate, though looked for with the 26-inch telescope at Washington on several occasions from November 1873 until January 1876, and also by the three Clarks (father and two sons) with the McCormick 26¼-inch telescope, Otto Struve's companion was missed by both instruments.

The Washington observers, however, gave estimated places for three new companions within 10″ distance; but when Mr. S. W. Burnham, at the Lick Observatory, examined Procyon on the early morning of November 18, 1888, with a view to confirm all these observations or otherwise, he gave the following record:—"*Procyon.*—Carefully examined with all powers up to 3300 on the 36-inch under favourable conditions. Large star single, and no near companion."

Should the existence of the new companion, now said to be discovered by Prof. Schaeberle, be confirmed by other large instruments elsewhere, the orbit will likely prove to be an excentric one, and that the companion has just emerged from the dazzling rays of the bright primary sufficient to allow it to be measured with the 36-inch; but after the previous experiences in the supposed discovery of other companions, astronomers will be the more inclined to await further observations, especially as the new Yerkes 41⅝-inch object-glass is now ready for mounting at the newly-erected Observatory, and will be in the hands of such keen-eyed and experienced double-star observers as Messrs. Burnham and Barnard.

In NATURE for March 28, 1889 (p. 510), Mr. J. M. Barr, of St. Catharine's, Ontario, suggested that photography might be employed to obtain the image of a satellite on the sensitive plate by intercepting the image of the brilliant primary by a suitable screen, and in NATURE for April 11 following (p. 558), in addition to other particulars, I referred to the instrumental difficulties connected with getting the impress of a probably faint companion, at the extremely close distance of two to three seconds of arc. ISAAC W. WARD.

Belfast, November 30.

The Leonid Meteor Shower.

IF the recent observations proved that comparatively few meteors of this system were visible, they were interesting as showing the maximum to have occurred on the morning of the 15th, instead of on the morning of the 14th as expected. In 1879 I found the greatest density of the shower occurred some hours before its probable time, while in 1888 the best display came six hours later than I had been led to expect. Minor returns are, however, more difficult to determine as regards the exact period of maximum, and are likely to teach us little in this respect. The state of the sky, the altitude of the radiant, and the presence or absence of the moon have each an important effect on the visible aspect of a meteor shower, and render fair comparisons from year to year scarcely possible, the circumstances being rarely the same in two cases.

The Leonids in 1896 were certainly more numerous, judging from the majority of the reports, than in an ordinary year, and no doubt a further increase in their strength will be apparent in 1897, but the moon will then rather seriously interfere with observation. Judging from the times of maxima observed in 1799, November 12 a.m., 1833 November 13 a.m., and 1866 November 14 a.m., the maximum will occur before midnight in 1899; but we have a good prospect of observing the return of 1900 at about 3 a.m. November 15. As regards the next return in 1933, it will probably be well seen from the eastern parts of Europe, while that of 1934 seems likely to be witnessed from England on the morning of November 16. Too much confidence should not, however, be placed in these indications, as the shower has exhibited some irregularities in the past. Thus in 1867 it returned about two hours later than its computed time, while in 1868 it most unexpectedly proved quite a brilliant display about fifteen hours after its time.

W. F. DENNING.

Bristol, December 10.

Oyster Culture in Relation to Disease.

IN Dr. T. E. Thorpe's paper in the issue of NATURE for December 3, there are several erroneous statements which are not calculated to do good. He says that the "Belgian and Dutch oysters chiefly come to Grimsby and Brightlingsea." This is quite wrong, as the greatest quantity of Dutch oysters come to London, some go to Manchester, Liverpool, and other large towns: Belgian oysters are nearly unknown in England.

Again, Dr. Thorpe says that the greatest number of oysters are eaten in September. This again is wrong. The greatest quantity of oysters are sold in the months of November, December, and January.

Again, Dr. Thorpe says "the value steadily increases up to December, and gradually diminishes month by month until it reaches the minimum in June and July." This is not correct, as the better class of oysters do not come to market so late, and the price of good oysters is always maintained.

Dr. Thorpe says, further, "the layings in the bed of the Colne, which presumably furnish the supply for the time-honoured 'Colchester Feast,' are subjected to the comparatively concentrated effluent of Colchester sewage at low water, and to the additional pollution to which the river is subjected at Wyvenhoe and Rowhedge." The oysters sent by the Colne Fishery Board to London and the continent, also those eaten at the "feast," are not fattened in the bed of the Colne, but in a creek lower down the river called the "Pyfleet." On page 28 of Dr. Cartwright Wood's report, reprinted from *The British Medical Journal*, he calls the Pyfleet oyster the standard oyster for purity. Dr. Cartwright Wood, on page 25, also says "these experiments accordingly, as far as they go, tend strongly to confirm the view that in a state of nature the oyster might very rapidly get rid of the effects of contamination."

The Park, Hutton, Essex, December 7. G. H. BAXTER.

BEFORE your correspondent peremptorily asserts that certain statements are "quite wrong," it might be worth his while to ascertain that he was quite right in so doing. To begin with, he has evidently not read the Report to the Local Government Board "On Oyster Culture in Relation to Disease," or he would have discovered that the statements to which he takes exception are made not on my authority, but on that of the Inspector of the Local Oyster Industries. On p. 24 of Dr. Bulstrode's report, under the heading "Oysters imported direct from abroad and consumed without being relaid in our waters," it is stated that "large quantities are also imported from Holland, Belgium, and other countries. . . . I am informed by Mr. Mussun, of Liverpool, with whom I conferred at Cleethorpes, that the chief ports for the introduction of American oysters into this country are Liverpool and Southampton, and for North Sea oysters Grimsby and Brightlingsea."

It is not to be supposed that all the oysters imported into Grimsby are eaten there: no doubt they find their way "to Manchester, Liverpool, and other large towns."

I stated, on the authority of Dr. Bulstrode, that in 1894 27,747,000 oysters, of the value of 84,271*l.*, were landed on the English and Welsh coasts by English dredges. Dr. Bulstrode also gives the following table (p. 4), showing how this number was distributed over the several coasts, together with the corresponding value of the oysters.

Month.	Oysters.	Value.
January	2,289,000	£8437
February	2,217,000	7846
March	2,231,000	6838
April	1,768,000	6050
May	2,096,000	5497
June	1,768,000	3948
July	1,694,000	3967
August	2,670,000	6909
September	3,124,000	8054
October	2,947,000	8585
November	2,426,000	7493
December	2,517,000	10,647
	27,747,000	£84,271

This table shows that the greatest number of oysters are landed, and therefore presumably eaten in September, and that their value increases up to December, and then gradually diminishes month after month until it reaches a minimum in June or July.

My remarks on the Colne oyster layings were based on the statements of Dr. Thorne Thorne (p. xii) and Dr. Bulstrode (p. 40). The latter gentleman, after mentioning the fattening grounds in the Pyfleet, which, of course, are distinct from the layings in the Colne, says: "Provided, therefore, that all oysters, prior to consumption, are laid down for a sufficient period on the fattening grounds of the Pyfleet, there is probably no reason to suspect the wholesomeness of Colne Fishery oysters, but it seems to me very undesirable that oysters should be despatched from market direct from the bed of the River Colne."

I have no desire to asperse unduly the character of the Colne oyster, of which, if I were an Essex man, and interested in its culture, I should be as jealous as Mr. Baxter apparently is. I can only hope, therefore, with Dr. Cartwright Wood, that when the Colne oyster finds itself at the sea-side, and "in a state of nature," it not only "might" but will "get rid of the effects of contamination," and rapidly show itself "the standard oyster for purity." Still, on the whole, it is to be preferred that the oyster, like the woman, should be without "a past."

T. E. THORPE.

Radiography.

YOUR columns are eagerly searched every week for information regarding the latest developments of radiography, and for the best methods of working. I think it may be said that we are still in a state of empiricism as to the technique of the subject. We can get fair representations of most of the bones in the human body, though we have much to learn even in this elementary detail. But the definition of the soft parts with sufficient accuracy for diagnostic purposes is still, so far as I am aware, beyond us.

Judging, however, from occasional results, I fancy this desirable point will be reached ere long; for on examining a recent radiograph of a rabbit, I find the masseter muscles well defined, together with accurate outlines of the internal organs. In the case of a partridge, radiographed to discover the cause of "towering," the tendons of the thigh muscles are sharply defined, and in a hedgehog many minute details are perfectly clear. In each of these I gave an exposure of seventy-five minutes, at a distance of 14 inches with a low tension (under 3 inches). I am now using a Rhumkorff coil capable of giving a 10-inch spark, a Watson "penetrator" tube, and Cadett "professional" plates. I should be glad of information as to the best method of working direct on to sensitised paper, to save the time and expense involved in taking glass negatives. G. M. LOWE.

Lincoln, December 7.

"Chelidonium majus" as a Cure for Cancer.

WITH reference to the probable value of *Chelidonium majus* in the treatment of cancer, I beg to enclose the two following extracts from ancient writers for the purpose of showing that its value, for internal use, was not unknown.

In the "Ortus Sanitatis," of J. A. Cuba, published at Mayence in the year 1491, he makes the following remark, *inter alia*, upon the property of this plant.

"Et ad cancrum oris pulvis radicis cum pulvere rosarum conficitur, et cum aceto decoquitur."

Again, Bodæus à Stapel, of Amsterdam, in his edition of the "Historia Plantarum" of Theophrastus (1644, p. 894), after describing the method of preparing a decoction of the plant, says:—

"Primi liquoris seu elementi aquei usus existimatur, quod *intra corpus* sumptus, omnes humores corruptos et perniciosos corrigit et educat."

Barton and Castle, in their "Flora Medica" (1838), remark that "Linnæus, Murray, Gilibert, and others express their astonishment at the oblivion into which a plant so energetic as the Celandine has fallen, while the ancients knew how to appreciate its qualities." C. LEESON PRINCE.

The Observatory, Crowborough Hill, Sussex, November 26.

Measurements of Crabs.

THE crabs measured by Prof. Weldon, which were 12·5 centimetres long, had the ratio of frontal breadth to carapace length equal to 778·39 thousandths with a quartile deviation of 10·79; the adult crabs had the above-mentioned ratio 604·94 with a quartile deviation of 9·96. He concluded that since 9·96 is less than 10·79 the adults were less variable than the young, and that this diminution of variability might be accounted for by the selective destruction of those young crabs in which the ratio of frontal breadth to carapace length was much greater or less than the average. That Prof. Weldon was mistaken in making this inference may be shown thus:—

If he, in his investigations, instead of considering the ratio of frontal breadth to carapace length had considered its reciprocal, the ratio of carapace length to frontal breadth, he would have arrived at the result that those 12·5 centimetres long had a ratio of carapace length to frontal breadth amounting to 1284·7 thousandths with a quartile deviation of 17·9, while the adults had a ratio of carapace length to frontal breadth of 1653·1 with a quartile deviation of 26. This would have shown that the ratio of carapace length to frontal breadth was more variable (in Prof. Weldon's sense of the word) with adults than with the young. This, he would probably have argued, may be due to the selective *survival* of crabs in which the ratio of carapace length to frontal breadth deviates excessively from the average. But those crabs in which the ratio of carapace length to frontal breadth deviates excessively from the average are precisely the same as those in which the ratio of frontal breadth to carapace length deviates excessively from the average, which latter he concluded were selectively destroyed. Thus the same reasoning applied to the same data leads to two totally irreconcilable explanations. Such reasoning must be false.

Prof. Weldon's erroneous conclusion seems to have arisen from making the mistake he accuses me of making, *i.e.* confusing variability (the quantity measured by quartile deviation) with importance of variability. Having proved that variability in the above sense of the word was less in the case of adult than of young crabs in regard to the ratio of frontal breadth to carapace length, he argues about the diminished variability as if it were the same as diminished importance of variability, which is in the general case measured by ratio of deviation to average amount of the quantity measured. J. A. COBB.

Minneapolis, November 25.

Diselectrification by Phosphorus.

IN No. 1410, vol. lv. of NATURE, Mr. Shelford Bidwell refers to the discharge of electricity by phosphorus when it is oxidised. In a paper published by Prof. Naccari (*Atti della Science di Torino*, vol. xxv., February 22, 1890) as well as in one of our own (*Wiedemann's Annalen*, xxxix. p. 321, 1890), you will find a record of this observation. ELSTER AND GEITEL.

MANY thanks for sending me the above. I much regret that I did not know of the experiments referred to. I made a considerable search before sending you my letter; but it is so difficult to ascertain what has been done before, that one hesitates to publish anything. SHELFORD BIDWELL.

Riverstone Lodge, Southfields, S.W., December 2.

Cultivation of Woad.

LATELY at Leighton Buzzard, I saw an old book, "E. Bowen's Complete System of Geography, 1743," in which some account is given of the growth and preparation of woad in Bedfordshire. There is a Woad Farm at Lathbury Bridge, near the confluence of the river Lovat, or Ouzel, with the Ouse, at Newport Pagnell, Bucks, and commented upon in the *Bucks Standard*, November 8. The author [name not given], after referring to the more ancient growth of woad, gives it as his opinion that, "this once largely used herb was grown on this farm at a later period, and hence its name."

The lands of the Woad Farm are alluvial clay and river gravel, and there is an osier-bed in the locality.

December, 1896. A. C. G. CAMERON.

Dormant Seeds.

THE remarkable experiments of Prof. C. de Candolle reported on p. 21, and those formerly described of Prof. Giglioli, seem certainly to show that life in a seed may be prolonged indefinitely under suitable conditions; or rather, that so long as no destructive change occurs, the power of living, not necessarily life itself, persists in the protoplasm. It has occurred to me as *barely possible* that some seeds from amber might be made to grow. It sounds a very wild suggestion, but the conditions of perfect preservation, with protection from air and moisture, are peculiar, and should offer as good a chance as some of those arranged by Prof. Giglioli, or cited by Prof. de Candolle. T. D. A. COCKERELL.

Mesilla, New Mexico, U.S.A., November 19.

The Arrangement of Branches of Trees.

MAY not the want of symmetry or the "anyhowness" of the arrangement of the branches of trees serve some highly useful purpose? May it not help to prevent the trees being overturned in the highest winds by the want of synchronism in the motions of the branches? I have never seen or heard of such an idea, and it may be open to serious objections; but some time ago I watched the branches of a large plane tree, still partially in leaf, during a high gale, and it seemed incredible the tree could stand, but for the fact that whilst one large limb was swaying one way, another would be swaying the opposite way, and so on, all plunging and bending anyhow, with no two in harmony. Some of the larger limbs would swoop down as others bounded up in a sudden gust, and some swaying laterally with the wind would be balanced by others at another part of the tree swaying against the wind.

The oak, the beech, the ash, and so on, have all this "anyhowness" of branch arrangement, they at the same time being our largest trees and most in want of it.

Do the early stages of tree evolution point to a more methodical mode of branching? THOS. SWAN.

Maryfield House, Leslie, Fife, December 11.

Curious Purple Patches.

REFERRING to "Purple Patches," in NATURE of November 12, I have frequently seen patches like those mentioned, but not quite so large, on the decks of ships immediately after they had been scrubbed with *salt water*. I have also seen them in bad weather at sea when salt water was coming over the side. I never remember noticing them after rain, or at any other time than when salt water has been on the decks.

The idea I have always had, and heard others at sea speak of, is that they were small salt-water organisms squashed out by the foot.

I have noticed them most frequently on the Scottish coast, but I have also seen them in China. Out here I have not observed them. E.

Mediterranean Station.

FASCINE TRAINING AND PROTECTION WORKS.

IN the *Engineering Magazine* (New York) for June is an interesting illustrated article on "Bank Revetment on the Mississippi," with illustrations showing the condition of the banks of the river after "caving" and the method of making and fixing the fascine mattress work used for their protection.

The lower part of the Mississippi runs through a vast alluvial plain, the surface of which is below the level of the water in the river in times of flood. This land is protected by banks locally known as "dykes" or "levées," which prevent the flood water from inundating the district. The first of these banks was built at New Orleans in the early part of last century. They are constructed of the earth taken from surface of the ground close by, and are constantly liable to damage by floods. Some of them are of considerable dimensions, and of sufficient width at the top to form a roadway for carts and other vehicles. From time to time these banks have been extended until there has been developed the great levée system which extends nearly from Cairo to the Gulf of Mexico, protecting an area of about 30,000 square miles of rich land and numerous towns and villages, and guiding the floods in a permanent high-water channel to the sea.

These banks are a constant source of care and anxiety to those who have charge of them, being subject to "caving" caused by abrasion; the action of soakage water; and the undermining of the foot of the slope by the current. To prevent this caving, and for the repair of the bank, where it has taken place, brush and stone revetments are used. The material for this purpose is principally live willow or cotton wood poles from 25 to 30 feet long, and fascines fastened together in the form of mattresses by iron wire. No revetment work in the world approaches the magnitude of that undertaken on the Mississippi. Here mattresses, having a superficial area of seven or eight acres, are sunk in the bottom of the river in depths of from 80 to 100 feet, and in currents flowing at the rate of from 4 to 5 miles an hour. Dykes 430 feet long by 60 feet high, containing 80,000 feet of lumber, 2000 tons of rock, and nearly 20,000 lbs. of iron wire and rods, are placed in the water in a depth of 150 feet.

The mattresses are constructed by first building on floating ways a rigid head of poles, to which weaving poles are fastened at right angles. On these, woven willow brush is laid; a grillage of poles is then fastened to the top, and after being secured to the bank and mooring-barge, the mat, 400 feet long by 150 feet wide, is sunk by means of large stones thrown from the barges. After sinking the mat the upper portion of the bank is levelled to a regular slope by what is termed an "hydraulic grader." This machine consists of a pump having a discharging capacity of 2000 gallons a minute, fixed on a barge. The hose from this pump terminates in a 1¼-inch nozzle, from which the water is directed on the bank at a pressure of 160 lbs. on the inch, reducing it to the required slope. By this method the excavation of one cubic yard of earth takes a fraction less than one cubic yard of water, and uses 3 lbs. of coal. The height of the bank thus graded often averages 30 feet, and the material removed along a length of 100 feet, about 3500 cubic yards, costing about 4 cents (2*d.*) per yard for removal. When the bank is levelled and dressed to the required slope, a revetment of two layers of brush, with pole grillage above and below, fastened with wire and spikes, is placed thereon and then covered with stone. Another method of protection is by fascine mats made of bundles of poles 3 feet in diameter, laid normal to the bank; to these is fastened at intervals of 8 feet a 5/16-inch wire cable and ¼-inch wire strand. Fascines 11 inches in diameter, made of bundles of willows, are then placed parallel to and against the head, and held in place by a turn of the wire, and the operation repeated until the desired size is attained. These woven mats often have dimensions of 300 by 1000 feet. To build and sink a fascine mattress 300 feet wide, requires from 250 to 300 men, and the average progress per day is about 150 lineal feet. Of the finished cost about 45 per cent. represents labour, and 55 per cent. material.

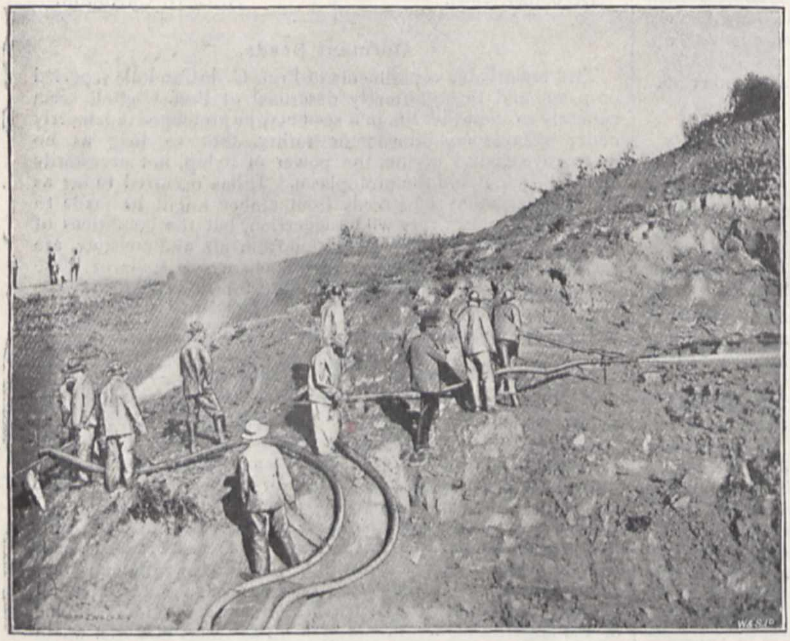

FIG. 1.—Details of Hydraulic Grading.

The article in the *Engineering Magazine* only deals with fascine work as applied to the maintenance and repairs of the banks of the river. The jetties at the mouth of the Mississippi, constructed for the deepening of one of the outfalls of the river into the Gulf of Mexico, for the purposes of navigation, were constructed entirely of fascine mattresses. In order to improve the depth from the gulf into this magnificent river, which has a navigable water-way extending over 16,000 miles, Captain Ends advised the training of one of the principal outlets, and so by confining the water within defined limits, and increasing its velocity and scouring power, to obtain greater depth. He undertook to carry out the necessary works to effect this purpose without receiving payment unless he succeeded in obtaining a channel 200 feet wide with an average depth of 26 feet, and a central depth of 30 feet. This he successfully accomplished. The east jetty is rather over two miles in length, the other being a little shorter; the effective width between them is 700 feet. The mattresses used in the construction of the jetties were made principally of willows brought from the swamps over distances varying from 20 to 300 miles;

these were weighted with stone brought down the Ohio River from a distance of 1320 miles, the quantity used amounting to 100,000 cubic yards. The mattresses used were about 100 feet long, and from 40 to 50 feet wide. They were built on inclined ways at the head of the Pass, and when completed launched like a boat and towed floating to their place along the line of the jetty, and then loaded with stone and sunk. The same method of training the outfall of the river has been adopted on other parts of the coasts of the Gulf of Mexico and of the United States.

The jetties at the mouth of the river Maas, in Holland, were also constructed of fascine mattresses in a somewhat similar way. These piers are about one and a half miles in length, and terminate in a depth of twenty-two feet at low water. Experience shows that their elasticity saves them from any damage from the shocks caused by the impact of the waves. They were economical in construction, and have been found after twenty years' experience to stand the wear and tear of the waves of the North Sea. The great dam across the Zuyder Zee at Schellingwoude, in connection with the North Sea Canal, was also constructed with fascine mattresses on the exterior, the centre part being filled in with earth.

Owing to the scarcity of material for making the fascines, this system of mattresses has not been employed in this country. But more than half a century ago fascine training walls were largely adopted for the improvement of the four large Fen rivers emptying into the Wash, and this system is still in use. They have answered their purpose admirably. The fascines are made of thorn faggots about three feet in girth, tied together by tarred rope. These faggots are brought to the spot where the training wall is being constructed in barges, and placed in layers, the number of faggots in width depending on the height the wall is to be carried. Each layer is covered with clay or marsh sods, and the side next the river finished to a slope of about six inches horizontal to one foot vertical, the brush ends being placed outwards and trimmed up. Sometimes the faggots are staked down, but this, as a rule, is not found to be necessary. This method of training has by experience been found to be economical, durable, and efficient; and has this great advantage over stone training walls, that vessels which by accident run on to the walls are not damaged in the way they are when they come in contact with the stone.

A full description of this work, and also of the mattresses used in Holland and America, with illustrations, will be found in the chapter on "Training," in the work on "Tidal Rivers," added a short time ago to Longmans' Engineering Series.

SIR WILLIAM MACGREGOR'S RECENT JOURNEY ACROSS NEW GUINEA, AND RE-ASCENT OF MOUNT VICTORIA.[1]

BY the courtesy of the Prime Minister of Queensland, Sir Hugh M. Nelson, I have been favoured with the following copy of a telegram from His Excellency the Administrator of British New Guinea to His Excellency the Governor of Queensland :—

"Without loss of life or limb have crossed New Guinea from mouth of Mambare to mouth of Vanapa. Followed Mambare to foot of Mount Scratchley where river divides to embrace the mountain. Ascended Mount Scratchley, on top of which observed with small theodolite. Found easy road west of Stanley Range, without descending re-ascended Mount Victoria to observe, but weather unfavourable. Descended Mount Knutsford, and found a not difficult road to coast. The miners have been at work at foot of Scratchley, probably the whole of which is auriferous. Wharton Chain connects Mount Scratchley with the great Mount Albert Edward, which is also well inside British territory. All these great mountains seem composed of slate and quartz. No natives between Government Station and Mount Scratchley. On the latter is very friendly tribe. Excellent relations with natives from Mount Knutsford to the coast. Had scarcely a single completely dry day. I strongly dissuade any travelling towards the interior before April or May. Native carriers will not be permitted to proceed inland with Government sanction before then, when all possible facilities will be given to prospectors during the dry season. (Signed) "WM. MACGREGOR."

FIG. 2.—Constructing Fascine Mat on Mattress Ways

It is well known that in 1889 Sir Wm. MacGregor, who at that time had but very limited resources at his command, successfully accomplished the ascent of the Owen Stanley Range to its highest summit, which he named Mount Victoria.

In the course of my official duties, the work of compiling the map illustrating the explorer's route on that occasion devolved upon myself, and I am consequently morally responsible for the correct delineation of all the features upon it, although this does not appear on the face of the map itself. At the same time I had the privilege of being the first to deal with, examine, and make public the geographical results of that famous journey, in a paper read, in Sir Wm. MacGregor's presence, at a meeting of the Royal Geographical Society of Australasia, Brisbane, on September 2, 1889. I mention this to show that I have an intimate knowledge of every detail connected with the work and results

[1] Read at a special meeting of the Royal Geographical Society of Australasia, Brisbane, October 30, 1896.

of the expedition in question, and am fully prepared to enter into all the particulars of it, even more fully than I have done on a previous occasion, or in my work on "British New Guinea."

For many years before the arrival of Sir Wm. MacGregor in New Guinea, several attempts had been made to explore the Alpine region of the Owen Stanley Range. For various reasons, no one had been able to accomplish it. These attempts, by Captain Armit, Messrs. Chalmers, Goldie, Morrison, Hartman, Hunter, Cuthbertson and Forbes, resulted in signal failure, neither of the explorers reaching even the foot of the great range. In a letter published in the *Proceedings* of the Royal Geographical Society, London, September 1890, Mr. H. O. Forbes stated that his "nearest approach to Mount Victoria, by my own map, is between eight and nine miles," and that it was only necessary for him to descend to and cross the Warume River below him to obtain access to several leading spurs running directly to the summit of Mount Victoria. He believed that the road traced by his eye from the hills in the Sogeri region on his first arrival in New Guinea was more eminently feasible than the one followed by Sir Wm. MacGregor in the latter's journey to the summit of Mount Victoria. Against this statement it may be pointed out that there seems no doubt whatever that Mr. Forbes did not see the highest crest of the mountain from his nearest approach to it, and it is almost certain that he could not have obtained access to the crown of Mount Victoria along the south-easterly spur of it. Concerning this accessible spur which Mr. Forbes purposed ascending, Sir Wm. MacGregor says, it is a mighty precipitous buttress exceeding 12,000 feet in height "bristling with peaks and pinnacle-like rocks, and contains hundreds of inaccessible crags and precipices."

Sir Wm. MacGregor's route lay for some distance up and along the Vanapa River, and apparently he has followed his old track very closely from the crown of the Owen Stanley Range to the South Coast in his recent journey across New Guinea. The important bearing which the successful accomplishment of this remarkable journey must necessarily have upon the development of the country will be fully apparent to all who have watched the progress of British enterprise in the possession since its establishment some ten years ago. Apart from the increase to our knowledge of the geographical conditions of the interior of the south-eastern portion of the island itself—an increase that cannot fail to be of the very greatest interest and importance—the advantage of having a practicable trade route across the British Territory is one that can scarcely be overestimated. It is almost impossible to give an accurate forecast of its bearing upon the opening up and settlement of the country and the development of its mineral resources. That valuable minerals occur in the high ranges of the interior has been clearly enough shown by the alluvial gold obtained in the upper reaches of the Mambare River, and the auriferous character of Mount Scratchley, to which special mention is made in Sir Wm. MacGregor's telegraphic message to the Governor of Queensland. There is little doubt, too, that mineral deposits will also be found on the southern slopes, or near the base of the Owen Stanley Range, and this region will soon be rendered accessible along the overland trade route passing the western spurs of the range in question.

The Mambare River (the Clyde of the Admiralty Charts) debouches into Traitors Bay on the north-east coast of the possession. The mouth of this interesting river is only about two miles inside the Anglo-German boundary, on the 8th parallel. It is navigable for an ordinary-sized steam launch for about forty miles up, and on the lower reaches are extensive areas of good alluvial land interspersed with remarkably fine fields of sago palms. The district is famous for its very lofty forest trees and fine climate. The river was explored for the first time by Sir Wm. MacGregor in 1894, and recently he again ascended it on his journey across the island. There is no doubt but that it affords easy access to the mineral areas of the interior, and especially to the bracing highland zones of the Owen Stanley Range, Mount Albert Edward, Mount Scratchley, and other neighbouring ranges, that were hitherto regarded as inaccessible. It forms an easy section of the great overland trade route now discovered, and for the first time opened up by the Lieutenant Governor, and it is almost certain that the Mambare district will ere long become one of the most important in British New Guinea.

Excellent relations have been established with the natives of the interior, and indeed all along the overland route the natives met with have been very friendly, a prevailing condition that will have an important bearing upon the future development of the country by British enterprise.

Not the least important geographical results of Sir Wm. MacGregor's recent journey is the discovery of a connecting chain between Mount Albert Edward and Mount Scratchley, and the practicability of ascending the Owen Stanley Range to its highest summit on Mount Victoria from the north-east as well as from the opposite side.

J. P. THOMSON.

JOHAN AUGUST HUGO GYLDÉN.

THE ranks of astronomers have suffered severely of late, and it is with deep regret that we are compelled to record that the Royal Observatory of Stockholm has now lost its renowned Director. Prof. Hugo Gyldén could ill be spared, especially at such an early age as fifty-five. On November 9 last he was seized with paralysis of the heart, and died during the afternoon at the Observatory. The following particulars of his life and work have been gathered from the obituary notices contributed to the *Astronomische Nachrichten* by Herr Karl Bohlin, and to the *Comptes rendus* by M. Callandreau.

Hugo Gyldén was born at Helsingfors in the year 1841 (on May 29), his father, Nils Abraham Gyldén, being a professor of Greek at the University. At the age of sixteen he went to the University of that town; after first studying chemistry, and, at a later date, mathematical astronomy, he gained in 1860 the title of "Magister der Philosophie." To make his studies more complete he went abroad, and during the years 1861–62 he was found at Gotha and Leipzig, having come in contact with Hansen, Le Verrier, and Delaunay. In December of 1862 he was elected a Teacher of Astronomy, and in the following year a Doctor of Philosophy.

Pulkowa saw him first in 1862, and after a year's work there he was made an "Adjunct Astronom," being promoted in 1865 to "Älteren Astronomen." The following year he received the title of "Hofrath."

About this time his investigations related to the constitution of the atmosphere and refraction, which form now the basis of the refraction-tables at Pulkowa. At the same time, also, he was busy with elliptic functions in their relation to the "mécanique céleste," the first results of which appeared in the *Studien auf dem Gebiete der Störungstheorie*, I., 1871.

The important service he thus rendered to astronomical science led the Royal Academy of Sciences of Stockholm to offer him the vacant place of Astronomer of the Academy and Director of the Observatory in Stockholm. This he accepted and retained until his death.

His activity, while holding this office, was displayed not only in the development of pure scientific works, but in drawing around him a number of students, among which may be mentioned O. Backlund, A. Donner, P. Harzer,

A. Shdanow, E. v. Haerdtl, M. Wolf, M. Brendel, V. Wellman, and H. Masal.

Such was his renown on the continent, that pupils came from all countries to study under him and hear his lectures. He was one of the few who knew how to communicate to his hearers the noble passion for the science which animated him. His enthusiasm raised the expectations of his pupils, while, at the same time, their spirits were benefited by the rich ideas of their master. Gyldén was a true teacher whose noble character obtained respect, while his simple and cordial nature inspired affection.

Astronomers know that to Gyldén a great advancement of the astronomy of precision is due ; his admirable series of observations with the meridian circle hold a high place of honour.

He wrote his celebrated historical representation of astronomy, which appeared later (1877) in the German language as "Die Grundlehren der Astronomie." He was also the founder and publisher of the observatory publication "Iakttagelser och undersökningar anstälda på Stockholms observatorium," which contained not only the results of the observations with the meridian circle, but theoretical investigations carried out by him and, to some extent, by his pupils.

Gyldén, is above all, known in the world of science by his works that he pursued since the death of Le Verrier, on the general theory of perturbations. In proceeding to a revision of the methods of approximation in the "mécanique celeste," he has rendered the most eminent service to this branch of science.

Having completed the main points of his investigations on the intermediate and absolute orbits of the heavenly bodies in a series of publications, "Undersökningar af theorien för himlakropparnas rörelser," I.–III., 1881–1882, he was able in 1884, by means of a grant of money from his Government, to make considerable progress in the application of his theory to the solar system. It was his intention to bring together all the results in one work entitled "Traité analytique des orbites absolues des huit planètes principales," but only the first part, containing the analytical developments of the absolute orbits, has as yet appeared. Gyldén, unlike Tisserand, did not have the satisfaction of leaving behind him a complete work.

Unfortunately he was denied the labour of completing the necessary numerical calculations. On the other hand it was a great pleasure for him to see his last great work, consisting of tables giving the coefficients, in the expressions of the perturbations, dependent on the proportion of the half-major axes, in a nearly completely printed condition. This was brought about by the generous assistance of Miss Bruce, who supplied the necessary means.

In the year 1884 he was called by the University of Göttingen to fill the post of Professor of Astronomy there ; but, following the expressed wish of the Stockholm Academy of Sciences, he remained, receiving, through the generosity of the King, means to deliver lectures at the University. Since 1888 he was an active teacher of astronomy at the High School in Stockholm.

The results of Gyldén's many and varied scientific studies on stellar parallaxes, proper motion of stars, explanation of certain variable stars, application of partial anomalies, conveyance of perturbation developments, cosmical questions, &c., have appeared in a series of large and small treatises, in the *Acta der Akademie der Wissenschaften*, and the *Acta Mathematica*.

Besides being a member of several foreign Societies, he was President of the Astronomischen Gesellschaft from 1889 to 1896.

Gyldén has left behind him a widow, two sons and two daughters, besides numerous friends, scattered in different parts of the world, who lament deeply the loss of a kind friend and sympathetic fellow-worker.

NOTES.

THE final entombment of M. Pasteur is to take place on the 26th of this month, at the Pasteur Institute. The reason why so inconvenient a day for English people has been fixed is that the 27th is the anniversary of Pasteur's birth, and as that day falls on a Sunday this year, the Saturday previous was chosen as more suitable. The ceremony is to be semi-official and *semi intime*. The members of the family and a few intimate friends will attend a short religious service at Notre Dame, where Pasteur's remains have in the meantime been deposited, and members of the Institute of the Academy, the representatives of the Government, and delegates from learned societies and foreign countries will meet the cortège on its arrival at the Pasteur Institute at 9.45 a.m. It is expected that Sir Joseph Lister will represent the Royal Society, Sir John Evans the British Association, Sir William Priestley the University of Edinburgh, and Sir Dyce Duckworth the Royal College of Physicians. The mausoleum in which the remains of the great investigator will find their last resting-place, is a fitting memorial which has taken more than a year to complete, and will be decorated with various designs indicative of Pasteur's work and of the benefits he has conferred on humanity and the several industries.

DR. BEHRING, the discoverer of the anti-diphtheritic serum, has had the Grand Cordon of the Crown of Italy conferred upon him.

THE German Emperor has conferred upon Dr. Roux, of the Pasteur Institute in Paris, the Royal Order of the Prussian Crown of the second class.

LADY PRESTWICH has given to the Geological Department of the British Museum the collection of fossils formed by her husband, the late Sir Joseph Prestwich.

IT is reported that Dr. Thorne-Thorne, chief medical officer of the Local Government Board, has arrived at Brussels, accompanied by a colleague, to study the vaccination system in Belgium and the laws and regulations bearing upon the subject.

THE death is announced of M. Alfred Nobel, whose name is well known in connection with the invention of dynamite and similar high explosives.

Globus (vol. lxix. No. 24) announces that the waters of Lake Titicaca continue to subside with astonishing rapidity. A large area of land has been exposed on the northern shore.

LIEUT. HOURST, whose explorations in the Niger region were referred to last week (p. 133), arrived in Paris on Sunday last. The *Times* correspondent says he was welcomed at the railway station by representatives of the Colonial Office, the French Africa Committee, the Egypt Committee, the Paris Geographical Society, and the Explorers' Society. He has made a splendid collection of sketches and photographs.

MR. J. E. S. MOORE, of the Royal College of Science, London, who has been investigating the African Lake Fauna, has this week notified his safe return to Zanzibar. In a letter, dated August 10, he reported himself about to start on his last dredging trip. He has made extensive zoological and geological collections ; and in the correspondence which he has sent home, he announces, among other things, the discovery of an apparent dimorphism in the Tanganyika medusa, with active budding in both forms.

IT is reported that the bubonic plague shows no abatement at Bombay. So far, eight hundred deaths have been reported ; but the actual number is believed to be much larger. The *British Medical Journal* has drawn attention to the serum prepared by Dr. Yersin at the Pasteur Institute in Saigon for the treatment of the plague; and the authorities in Bombay are urged to request Dr. Yersin to visit their city, and to afford him opportunities of practising his serum injections on the plague-stricken. The success claimed for the serum in Amoy, China, can be readily tested in Bombay.

REUTER reports that at Laurvik, on the southern coast of Norway, near the Swedish frontier, about nine o'clock on Monday morning, a wave of earthquake was perceived, taking the direction east to west. Several houses shook. At Karlstad in the province of Wermland, in Sweden, at 8.30 a.m. on Sunday, December 13, there occurred two very strong shocks of earthquake following each other in quick succession from south-east to north-west, and lasting about twenty seconds. Houses trembled, and furniture was thrown down. Seismic disturbances were also felt at other places in the province of Wermland. The shocks in this district were preceded by loud rumblings.

WE are gratified to know that the year 1896 has not been permitted to pass without the formation of a strong and representative Committee to promote a national memorial to Dr. Edward Jenner. At a meeting held at St. George's Hospital last week, Sir Joseph Lister occupying the chair, it was resolved, upon the proposition of the Bishop of Rochester: "That the present year being the centenary of the first successful vaccination is an appropriate time to inaugurate a work of national utility in honour of Edward Jenner." The resolution was seconded by Lord Reay, and supported by Sir Richard Quain and Dr. Michael Foster. Lord Glenesk moved the second resolution: "That a subscription be set on foot with the view of founding some institution of a nature to be hereafter determined in connection with the British Institute of Preventive Medicine to be distinguished by Jenner's name." Dr. Wilks, in supporting the resolution, said that every civilised country in the world had accepted this discovery. We alone had no great national monument. Prof. Burdon Sanderson, Mr. Jonathan Hutchinson, Dr. Bond and Dr. Glover also expressed their support, and the resolution was passed. Prof. Clifford Allbutt moved: "That a public meeting be called early in 1897 to consider the resolutions passed at this meeting, and to finally decide the form of the memorial." He urged that the memorial should involve means of carrying on research. The motion was seconded by Mr. Brudenell Carter, and agreed to. A Committee, containing not only the names of a number of distinguished men of science, but of other men of "light and leading," was nominated by the meeting; so we may confidently expect to see, at no very distant date, a worthy monument erected in recognition of Jenner's work and merit.

THE steamer *Wilkommen*, which arrived at New York from Dantzic a few days ago, is reported to have had a novel experience. On the morning of November 17, in lat. 48° 10′ N., long. 44° E., an immense meteor fell from south-east to north-west, and leaving a trail of light which remained visible for several minutes, entered the ocean apparently about two miles ahead of the steamer. Fifty minutes later a great wave swept over the steamer, but there is no evidence that this had any connection with the fall of the meteor.

THE preparation of a flora of Russia is being arranged, according to a *Daily News* correspondent, by the Imperial Natural History Society of St. Petersburg. An appeal is to be sent to all institutions and persons occupied with the study of botany to assist in the work. The flora of European Russia will be published first, and followed in time by those of Asiatic Russia and the Caucasus, the material being acquired from voluntary workers. It is hoped that the undertaking will meet with support and encouragement because of its great scientific importance.

PROF. G. VICENTINI and Prof. G. Pacher, writing in the *Atti e Memorie* of the Academy of Padua, describe several interesting results obtained with the current of a Tesla transformer, the most noteworthy effect being the production of shrill musical sounds with a disposition of the apparatus which the authors propose to call an "electrical syren." The phenomenon in question presents several peculiar features.

AN apparent proof of the inheritance of acquired characteristics was obtained two years ago by Mr. Leonard Hill, in experiments upon guinea-pigs, the results being briefly described by him in these columns (vol. 50, p. 617). From a note in the current number of the *British Medical Journal*, upon a recent discussion at the Zoological Society, it appears that further experiments has led Mr. Hill to a conclusion opposed to that provisionally expressed in his letter to us. According to our contemporary, Mr. Hill has been entirely unable to confirm the experiments by which Brown-Séquard determined the inheritance of acquired characteristics. By division of the cervical sympathetic nerve, a permanent droop of the upper eyelid can be obtained. This Brown-Séquard stated to be inherited by the young. Mr. Hill divided the nerve in six guinea-pigs on the left side, but none of the children inherited the permanent droop of the eyelid. He again divided the nerve in twelve of the children, and interbred them, but none of the young inherited the permanent droop. A temporary droop of either the right or left upper eyelid, frequently observed in the young, was caused by conjunctivitis arising from infection of the eye at birth, for the young were never born with the droop. With the conjunctivitis disappeared the droop, which was not due to paralysis, but to photophobia, and often disappeared on sudden excitation of the animals.

THE actual state of affairs as to the attempt to prevent free access to the Giant's Causeway was described at a recent meetting of the Belfast Naturalists' Field Club, by the President, Mr. Lavens W. Ewart, in the following words:—"A few speculators have banded themselves together to endeavour to exclude the public from free access to this truly gigantic creation, and they have invoked the Court of Chancery to establish them in this undertaking. Three gentlemen, of whom, unfortunately, I am one, have been served with writs in respect of so-called trespass, and the battle has begun. A committee had already been formed to protect the rights of the public, and they are defending the action. Owing to the fact that the Causeway Syndicate is a public company, they cannot be required to give security for costs, and as their capital consists of, I am informed, but 7*l*., whether we win or lose, we—that is to say, the Causeway Defence Committee—will have to pay our own costs. Our solicitors estimate that the costs may amount to 400*l*., and this sum at least we must raise. We ask for help in the matter of collecting subscriptions, and collecting lists will be supplied to all who will take them. Large subscriptions, as a rule, are not asked for, but small sums given by the many, for it is a matter which concerns the many. Evidence is also wanted from those who have known of the Causeway as a public resort for forty or fifty years or more."

THE Anthropological Institute of Great Britain and Ireland has successfully promoted the study of the science of man ever since it was founded; and the twenty-five volumes of the *Journal*, now complete, contain abundant evidence of the extent to which the Institute has contributed to the progress of anthropology in the last quarter of a century. The Council are anxious, however, to obtain a greater measure of public support, to see a larger attendance of Fellows and their friends at the meetings, to increase the number of papers printed in the *Journal*, and to illustrate them more fully, and to aid in many other ways in the progress of anthropological research. "In most continental countries," rightly remarks the President, Mr. E. W. Brabrook, "the means of doing this would be found in a subsidy from the State, and few appropriations of public money would be more worthy or more likely to prove reproductive, in benefit to the community at large, than a payment in aid of anthropological work. In this country, however, it is the practice to leave work of this kind to those who show a voluntary interest in it by joining the Institute as Fellows." It is hoped, therefore, that the number of Fellows will be largely increased, so as to increase the usefulness of the Institute, and assist still more actively the progress of anthropological science.

WE have been glancing through a new list of the staffs of the Royal Gardens, Kew, and of botanical departments and establishments at home, and in India and the Colonies, in correspondence with Kew. If evidence of the influence of Kew upon the advancement of botanical science is ever needed it will be found in this list, published as Appendix III. to the *Bulletin of Miscellaneous Information*. Nearly seventy members of the staffs of botanic gardens in diverse regions of the world are marked as having been trained at Kew. No establishment that we know of can present a better record of work accomplished, and none could desire a worthier testimonial of efficiency than that shown by the wide distribution of Kew men. For the information of directors, superintendents, and curators in botanic gardens across the seas, we announce that a list has just been published of seeds of hardy herbaceous annual and perennial plants and of hardy trees and shrubs which, for the most part, have ripened at Kew during the year 1896. These seeds are not sold to the general public, but are available for exchange with colonial, Indian, and foreign botanic gardens, as well as with regular correspondents of Kew. No application, except from remote colonial possessions, can be entertained after the end of March. The list is published in the *Bulletin* for 1897, Appendix I., an advance copy of which has been sent us.

DURING the last fifty years much work has been done by marine naturalists all round the British coasts, with a view to determining the distribution of those animals which live on the floor of the sea. It has been fully recognised that the localities frequented by many marine species are very definite and extremely limited in extent, and that both the nature of the sea-bottom and the creatures which live there exhibit as much variety as we are accustomed to find on land. The Marine Biological Association, with the assistance of a grant made for the purpose by the Royal Society, has recently been engaged in an attempt to place our knowledge of this subject upon a sounder basis by investigating in detail some of the grounds in the neighbourhood of Plymouth, including important fishing grounds, with reference to the nature of the sea-bottom at each locality, and the whole assemblage of animals found there. Detailed charts are being prepared to exhibit the variations which take place from point to point. No attempt has previously been made to study fishing grounds with such thoroughness, having regard not only to the fishes, but to the whole collection of animal life which forms the basis of the food upon which the fishes exist. The investigation, which has involved a large amount of dredging and trawling, as well as the identification of the numerous species captured, has been carried out by Mr. E. J. Allen, the Director of the Plymouth Laboratory.

THE principles upon which long-period weather forecasts are made in India were described in a recent number of NATURE (November 26, p. 87). In connection with this subject it is interesting to note that the official forecast of the cold-weather rains in Northern and Upper India has just been published. According to the Calcutta correspondent of the *Times*, the conclusions drawn are that the winter rains in Upper India (from December to February) will very probably be at least normal, and that they may be in moderate excess. It is probable that the winter precipitation in the Gangetic plain will be about normal, and very probable that it will not be above normal. It is very probable that the rainfall of the next four months will be slightly defective in Assam and perhaps in Bengal. It is, on the whole, very probable that the rainfall in Central India and the Central Provinces will not be above the small normal of the period, and may be below it. The general inference is that the indications are to some extent conflicting, but that, on the whole, they are favourable in North-western India. The rainfall will hence be normal, or above it, in Upper India, and probably normal, or in slight to moderate deficiency, in North-eastern and Central India.

THE jubilee of the foundation of the Hakluyt Society was celebrated by a special meeting on Tuesday. During the fifty years the Society has been in existence it has issued numerous volumes containing the texts of travellers and voyagers in all parts of the world, which were previously unedited, untranslated, or unknown. By this action, remarked Sir Clements Markham, in his address to Tuesday's meeting, the Society has continued the work and strove to fulfil the aspirations of Richard Hakluyt. This great man, like the Society which bears his honoured name, is not so well known to the present generation, which owes so much to his labours, as he ought to be. Hakluyt saw the two great needs of his country. The first was caused by the ignorance of our seamen as regards the scientific branch of their profession. The second was the absence of records, and the way in which important voyages and travels were allowed to fall into obllvion. He strove, during a long life, with great ability and untiring perseverance, to remedy these evils; and the measure of success he attained justly placed his name among those of worthies who deserve well of their country. The great work of Hakluyt was the "Principal Navigations," in three folio volumes, a monument of useful labour. Shakespeare owed much to this work: Milton owed much more. Hakluyt died on November 23, 1616, in his sixty-fourth year.

THE U.S. Commission of Fish and Fisheries has just distributed a report, by Mr. B. W. Evermann, upon salmon investigations in the headwaters of the Columbia River, in the State of Idaho, in 1895, together with notes upon the fishes observed in that State in 1894 and 1895. The observations refer chiefly to the spawning habits of the redfish (*Oncorhynchus nerka*) and the Chinook salmon (*O. tschawytscha*). The proof that the large form of redfish is anadromous—that is, passes from the sea into fresh waters at certain seasons—appears to be conclusive, but the evidence that the small redfish comes up from the sea is not complete. It seems probable that both forms are anadromous; but, so far as the Idaho lakes are concerned, the small form has not been proved to be so. The redfish all die soon after spawning, while the young remain in the lakes and connecting waters for at least one year from the time when the eggs were spawned. The Chinook salmon also die soon after spawning; and the young appear to remain, for one year after the eggs are laid, near where they were hatched.

THE current number of the *Journal de Physique* contains a paper, by M. C. Duperray, on the optical properties of a glass cylinder in rapid rotation in a magnetic field. The experiments were undertaken to test the accuracy of Villari's result, that it requires quite an appreciable time (1/800 second) for a piece o flint glass to acquire the property of rotating the plane of polarised light when subjected to a magnetic field. Villari came to this conclusion, which is in direct contradiction to the results obtained by Bichat and Blondlot, and Curie by rotating a glass cylinder between the poles of a magnet, with the axis of rotation perpendicular to the lines of force. If a beam of polarised light traversed the cylinder in the direction of the lines of force, Villari found that the rotation of the plane of polarisation decreased as the velocity of rotation of the cylinder increased, so as to become zero for a velocity of about 200 turns per second. He explained this result as being due to the molecules of the glass requiring a finite time to acquire the power of rotating the plane of polarised light. The author, in order to test the accuracy of Villari's deduction, has examined the optical properties of the rotating glass cylinder, and he finds the following :—The effect of centrifugal force on the glass is to virtually constitute it a bi-refringent body, with its axis parallel to the axis of rotation. Hence, unless the plane of polarisation of the incident light is parallel or perpendicular to the axis of rotation, the emergent light is elliptically polarised. The author, making use of this discovery, then arranged the plane of polarisation either parallel or perpendicular to the axis of rotation, and found that in a magnetic field of such a strength that the rotation was about 5°, so that the plane of polarisation of the emergent light remained practically either parallel or perpendicular to the axis of rotation, no change in the rotation produced by the magnetic field was produced by rotating the cylinder even at velocities exceeding 200 turns per second. Hence he concludes that the bi-refringence induced by the rotation may have vitiated Villari's results.

In *Science* of May 1, 1896, Prof. Bigelow says :—"A scientific knowledge of the action of the currents in cyclones and anti-cyclones can be obtained only by a determined attack upon the physics of the upper levels of the atmosphere." Following out this idea, and owing to the impetus given to the systematic study of the clouds by the action of the Meteorological Conference at Munich in 1891, Mr. H. B. Boyer, the Weather Bureau observer at Key West, Florida, has published a pamphlet entitled "Atmospheric Circulation in Tropical Cyclones, as shown by the Movement of the Clouds." The observations were begun in 1891, and in the treatment of the data each storm is taken in its chronological order, while the different currents and the bearing of the centre are shown on diagrams. The conclusions as to the behaviour of the upper and lower clouds in tropical storms are, so far as they go, valuable, and agree, upon the whole, with those found to obtain in our latitudes.

Spelunca continues to publish accounts of cave exploration in various parts of the world. No. 7-8 of vol. ii. contains some good views of cliffs and caves in the Liparis, along with other interesting matter.

Two publications of the Geological Survey of Alabama have come to hand. One is a very detailed description of the iron industry of that State; the other (*Bulletin* No. 5) is a preliminary report on the mineral resources of the Upper Gold Belt, with petrographical descriptions of the crystalline rocks.

Physical investigators and instrument makers will be interested to know that Prof. C. V. Boys contributes to the *Electrician* of December 11, the first part of a detailed description of the method of making and manipulating the fine quartz fibres for which his name is famous.

The Belfast Naturalists' Field Club has issued, as an appendix to its *Proceedings*, a "Bibliography of Irish Glacial and Post-Glacial Geology," by R. Ll. Praeger. This contains a list of over 700 books and papers, varying in importance from a geological survey memoir to an anonymous letter to a local newspaper. A subject-index and a geographical index are added. It should prove of great value both to Irish and to "glacial" geologists; while in the thoroughness with which it has been compiled, and the method of cataloguing, it may serve as a model to all local bibliographers.

A detailed discussion of the meteorological conditions at Frankfurt a. M., from observations extending over thirty-six years (1857–92), has been completed by Dr. Julius Ziegler and Prof. Dr. Walter König, and is now published under the title "Das Klima von Frankfurt am Main" (C. Naumann). The observations, which were made under the auspices of the Physikalische Verein, have been subjected to a very careful analysis, and the results are expressed diagrammatically upon ten full-page plates and several figures in the text.

Three local scientific societies have lately sent us reports comprising papers read at their meetings. In the *Transactions* of the Edinburgh Field Naturalists' and Microscropical Society (1894–96), we notice papers on Daubenton's Bat (*Vespertilio Daubentoni*), as observed and captured in Glen Dochart, Perthshire, the geology of Arran, trout and their influence in purifying water, the little Auk, poisonous plants, the habits of Gulls, popular delusions in natural history, and researches on snake poison, with special reference to the work of Dr. Cunningham, of Calcutta.—The *Transactions* of the Ealing Natural Science and Microscopical Society (1895–96) contain a descriptive list of the birds of the Lower Brent Valley, and abstracts of lectures on parasitic and saprophytic plants, the last stages of the Great Ice Age in the neighbourhood of Ealing, and the relation of man thereto, recent astronomical photography, the life-history of *Atypus piceus*, wild bees, the structure of flames, and others.—The portrait of Prof. Ramsay forms the frontispiece of the *Proceedings* of the Bristol Naturalists' Society, and is accompanied by a short biographical notice. Among the papers is one on the British Jurassic Brachiopoda, and another on some ancient British remains at Long Aston, Somerset.

Limits of space prevent us from doing more than refer to a few of the papers in the *Journal* and *Proceedings* of the Royal Society of New South Wales (vol. xxix.), received a few days ago. In an important paper Mr. Lawrence Hargrave describes his aeronautical experiments with cellular kites. Mr. G. H. Knibbs contributes a long account of the history, theory, and determination of the viscosity of water by the efflux method; and Dr. C. J. Martin gives the results of a detailed investigation of the physiological action of the venom of the Australian Black Snake (*Pseudechis porphyriacus*). The surviving refugees, in austral lands, of ancient antarctic life are considered by Mr. C. Hedley. The paper by Mr. H. C. Russell, on icebergs in the Southern Ocean, and that of Mr. Henry A. Hunt, on types of Australian weather, have already been noted in these columns. In a paper on the amount of gold in sea-water, Prof. Liversidge concludes that gold is present in the sea-water off the coast of New South Wales in the proportion of about ·5 to 1 grain per ton, or, in round numbers, from 130 to 260 tons of gold per cubic mile. The results, in a second paper on the removal of silver and gold from sea-water by Muntz metal sheathing, indicate that by keeping the metal in the sea for several years the proportion of gold increases, while that of silver decreases. Ethnologists will be interested in Dr. John Fraser's presentation of three myths about the Senga parroquet, showing how intimately Fiji and Samoa were connected in the minds of the early myth-makers. The subjects of other contributions to the volume are Australian vegetable exudations; notes on Antarctic rocks, collected by Mr. C. E. Borchgrevink; the great meteor of May 7, 1895; and fascine work in New South Wales.

The additions to the Zoological Society's Gardens during the past week include a Grey Ichneumon (*Herpestes griseus*) from India, presented by Colonel Smythe; a Changeable Tree Frog (*Hyla versicolor*) from North America, two White's Tree Frogs (*Hyla cærulea*) from Australia, presented by Mr. F. E. Blaauw; two Maned Geese (*Chenonetta jubata*) from Australia, purchased.

OUR ASTRONOMICAL COLUMN.

"BUREAU DES LONGITUDES."—The *Annual* for the year 1897 is still as complete as ever, and is a necessary *vade mecum* to the astronomer, physicist, and chemist. Our readers are so familiar with the usual contents of this compact little volume, that we limit ourselves to summing up the chief alterations and additions. The table of minor planets has been completed up to September 7, 1896, the number of these bodies now amounting to 431. Cometary notices have been brought up to the year 1895, while several new values for double-star elements have been inserted. Among the articles, which are always of great interest, are three from the pen of M. F. Tisserand. The first is a masterly summary of our knowledge of the proper movement of the solar system; the second, on the fourth meeting of the International Committee for the completion of the photographic map of the heavens; and the third, on the labours of the International Commission on fundamental stars. M. H. Poincaré writes on the kathode and Röntgen rays. M. J. Janssen discusses some epochs in the astronomical history of planets, and the work done at the Mont Blanc Observatory during the present year. Several discourses are also included, namely, that delivered by M. A. Cornu at the funeral of M. Fizeau, and those delivered by M.M. Janssen, Lœwy, and Poincaré at the funeral of the late Director of the Paris Observatory.

"THE SYSTEM OF THE WORLD."—In a small pamphlet entitled "Unser Weltsystem" (Gustav Fock, Leipzig), Herrn A. F. Barth presents us with an essay on the movements of the bodies contained therein. Without going at all into mathematical reasonings, complicated by numbers, he limits himself to discuss in words the questions that arise. In this way a clear idea of the movements of the earth round the sun, and also those further movements due to perturbations, can be obtained. Not only are the earth's motions discussed, but those of the moon are also taken in hand. One may here, among other things, learn what are the causes which give us different lengths of days, months and years, and how these may be converted into one another. These and several other points are touched upon, and the author concludes with a few general remarks on the extent of space.

Another pamphlet (Gauthier-Villars et Fils, Paris) contains an exposition of the mechanical formation of a "Système du Monde," after a new theory by Lieut.-Colonel du Ligondès. M. L'Abbé Th. Moreux is the writer of the essay, and he introduces this new idea to us after a short summary of previous hypotheses, such as those of Laplace and Faye. Assuming that motions in space can take place in all directions, then if there exist spots around which these movements are to a certain extent symmetrical, and if such a region be more or less homogeneous, then disturbances will be equally symmetrical in every direction, and a nearly round mass will be formed. The next stage in the development of this mass is its change of shape from circular to lenticular. This is brought about by the particles circulating towards the interior of the mass, and therefore coming into collision with one another. With condensation the mass becomes less homogeneous, and the law of gravity becomes modified. A general deformation of all the orbits of the particles commences, and finally a lens-shaped mass is the result. A ring now begins to be formed, having its point of greatest density some distance from its centre. The values of gravity vary along a radius, being small at the centre, reaching a maximum some distance away, and finally vanishing. The point of maximum velocity coincides with the maximum value of gravity. The ring becomes now the centre of attraction of bodies lying near it. Stresses are set up and a rupture takes place, this ring being split into three parts. At a later epoch the conditions are such that another ring of small dimensions is formed; this forms a second maximum point of density on the flat disc, which eventually is ruptured. These rings finally condense and form the several planets. The theory accounts for the different densities, sizes, rotations, and velocities of the planets, and also for the cases of the satellites. Space forbids us, however, from going into this theory more in detail, but there are several good points about it which make it interesting.

"COMPANION TO THE OBSERVATORY."—This annual for the year 1897 contains the usual amount of useful information, and the arrangement remains as formerly. Mr. Denning gives the list of principal meteor showers for the year, but we are surprised to see that no additional information is given of those swarms which will be of special interest during the next year or two. Data for the total solar eclipse which will occur on January 21, 1898, in addition to the two annular eclipses in 1897, are given. An ephemeris for Jupiter's fifth satellite up to the middle of May also receives a place, but its accuracy is doubted, for, as Mr. Marth says, no recent measures have been made, so that the adopted daily rate of motion is based on measures made in 1892 and 1893. The variable star information is very full and complete; but, if we may venture to make a suggestion, the table giving the mean places for the year 1897 would be made more useful if the approximate periods were to be placed against each star.

BACTERIAL WATER PURIFICATION.

THE twenty-seventh annual report of the State Board of Health of Massachusetts for 1895 has just been issued. This is the eighth year that the valuable experimental work of the now famous Lawrence Experiment Station has been continued. Although no very remarkable novel features have been recorded in the practice of bacterial water purification, it is highly satisfactory to find that the previous important work of the station is fully confirmed by the investigations conducted during the past year. An interesting point to which attention is called is the tendency exhibited by sand-filters to increase in bacterial efficiency in proportion to their period of service. In support of this the working of the oldest experimental filter at the station, and one of those with the greatest effective size of sand grain, is cited. This filter in 1893, filtering at an average rate of 2,000,000 gallons per acre daily, had a bacterial efficiency equal to 96·75 per cent.; during 1894 its rate of filtration was 4,500,000 gallons per acre daily, and its bacterial efficiency reached 98·97 per cent., whilst in 1895, although working at approximately the same rate as in the previous year, its bacterial efficiency rose to 99·57 per cent. This increased bacterial efficiency, caused by greater length of service period, was considerably more marked in the case of filters constructed of medium coarse or coarse sands than with those in which medium fine sand was employed. It would be out of place in these columns to discuss the various technical questions dealt with in the report, but there is one point which is very clearly brought out, and which is of particular interest in connection with the controversy which has recently arisen over the bacterial examinations of the London water-supply. An attempt has been made more than once to discount the value attaching to early bacterial examinations of the London waters, which first exhibited the efficiency of the purification processes employed, on the ground that the samples for investigation were not collected direct from the filters but from the delivery pipes. It has been contended that the numerical results obtained from samples drawn from the mains do not represent the bacterial efficiency of the purification processes in operation at the works, and this contention is based upon the hypothesis that the bacteria present in the effluent multiply in the pipes before delivery. The examinations made at the Lawrence Experiment Station show that there is no foundation whatever for this supposition. Thus in the monthly averages of daily bacterial examinations made of the Lawrence water conducted over six months, we find the raw river water contained 7533 bacteria per cubic centimetre, the effluent taken direct from the filter 134, the reservoir outlet 119, and the samples taken from the City Hall tap 86 bacteria per cubic centimetre. These results are sufficiently striking and instructive, and require no further comment. Another point to which considerable interest attaches is the effect upon the total number of bacteria which appear upon a gelatine plate, produced by the time during which the latter is kept and the colonies counted. Thus a water-plate poured from raw river-water exhibited 913 colonies per cubic centimetre on the first day, after two days the number rose to 8613, after three days to 12,317, whilst after four days they numbered 15,017 per cubic centimetre. Similarly in a sample of the same water filtered, whilst only three colonies could be counted on the first day, 48 made their appearance after two days, 72 after three days, and 87 per cubic centimetre after four days. The bacteriological examination of water, it cannot be too frequently insisted upon, is surrounded with subtle pitfalls into which the unwary may very easily be decoyed, and if the method is to take its position as a scientific process, too much attention to the details upon which its accuracy depends cannot be expended. In conclusion, in the section devoted to bacteriological technique, we note the introduction of a new word. Hitherto we have spoken of plate-cultivating a given water, but this expression we find cut down to "plating" a water; as, however, the general practice is now to substitute dishes for plates, we shall probably be reduced to the ugly phraseology of "dishing" a water.

G. C. FRANKLAND.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—At the Junior Scientific Club, on December 9, Mr. E. S. Goodrich read a paper on the "Evolution of the Ungulata," and Mr. E. C. Atkinson gave an account of some further experiments on rowing, exhibiting and describing also the improved form of his rowing indicator.

CAMBRIDGE.—All the graces which were non-placeted on December 10, were carried by considerable majorities. The professorship of Surgery has accordingly been suspended for one year, the professorship of Logic and Mental Philosophy is established, and the Sedgwick Memorial Museum of Geology will be built on the ground lately belonging to Downing College. At the same Congregation it was agreed to present to the Lord President of the Privy Council a memorial urging the necessity of legislation bearing upon secondary education.

Mr. Ernest Clarke, Hon. M.A., of St. John's College, Secretary of the Royal Agricultural Society, has been appointed the first Gilbey Lecturer in the History and Economics of Agriculture.

Mr. J. J. H. Teall, of St. John's, has been appointed an elector to the Professorship of Geology; and Dr. A. S. Lea an elector to the Professorship of Physiology.

THE Hamilton Court Building Company, consisting of friends of Columbia University, have purchased land in New York City, at a cost of two hundred thousand dollars, and will erect upon it, at a cost of one million dollars, a dormitory to accommodate 900 students of the University.

THE following are among recent announcements:—Dr. W. Valentiner, associate professor of astronomy at Heidelberg, to be full professor, and Dr. Knövenagel to be associate professor; Dr. P. Freiherr von Lichtenfels to be professor of mathematics in the Technical High School at Graz; Dr. W. Rothert to be associate professor of botany in the University of Kasan; Dr. Seitaro Goto to be professor of botany in the First High School at Tōkyō, Japan; Dr. Kepinsky to be associate professor of mathematics at the University of Krakau.

THE William Gossage Laboratories, just added to the Chemical Section of Liverpool University College, were formally opened on Saturday by Lord Derby, President of the College, in the presence of a large and representative gathering. The laboratories have been built and equipped at a cost of 7000*l.* by Mr. F. H. Gossage and his partner Mr. T. Sutton Timmis, as a memorial of the father of the former, the late Mr. Wm. Gossage, distinguished as a chemical investigator and inventor of chemical processes. An address was delivered by Prof. Ramsay on chemical education and the equipment of laboratories. A full report of the address and other speeches made upon the same occasion is given in the *Liverpool Courier* of Monday, December 14.

SIR P. MAGNUS, in the course of some remarks at the Norwood Technical Institute, on Wednesday of last week, reviewed the history of the polytechnic institutes in London and the provinces. He estimated the amount spent on evening teaching, exclusive of interest on capital outlay for buildings, at over 175,000*l.* a year. It was pointed out that the London institutes give facilities not only for technical but also for literary and general education, which are not obtainable on the same scale and on similar lines in any other capital in the world. The reason why in some other countries, especially in Germany and Switzerland, lads are better able to profit by the technical instruction of evening classes than they are in this country, is because the lads leave school at a later age and more generally attend continuation classes.

IT is very satisfactory to note that our political leaders have lately devoted themselves to expounding the connection of science with industry. Mr. A. J. Mundella, M.P., speaking at the Birmingham Municipal Technical School, on Friday last, on the subject of German competition, said he quite admitted that we had suffered loss from our past neglect, particularly in regard to the development of the new sciences and new discoveries, which Germany had adopted and developed in a marvellous manner. He instanced the growth of the colour trade in Germany. That industry was an English discovery, founded by a Birmingham man, and worked in Manchester. Yet English manufacturers, not for the want of money or want of enterprise, but from the want of knowledge, had allowed it to be exploited by Germany, and the trade, amounting to many millions a year, had almost entirely left this country.

IN the course of an address at the Battersea Polytechnic, on Wednesday in last week, the occasion being the distribution of prizes and certificates to evening students, Mr. John Morley, M.P., referred to a few points of importance to science and education. He remarked that those who had studied the education question seriously were aware that a London polytechnic was not the same thing as a German polytechnic. In German polytechnic institutions the students learned the highest, most important, and profoundest principles in connection with the scientific subject which they there studied. The main object in the London polytechnic institutes was a different one; it was that the craftsman, the man who made things and did things with the labour and skill of his hand, should have opportunities brought within his reach of training not merely in the mechanical details but in the principles and the basis of his work. It was difficult, however, it was impossible, to put scientific methods and spirit into the habits of people who had not already undergone a preliminary training. There was a direct connection between technical education and an improvement in their national system of secondary education which did not yet exist. He hoped that the Government before many weeks were over would lay before the House of Commons a scheme for the improvement of secondary education. Every one saw that a higher appreciation of science, of the technical arts, of the improvement of scientific research and investigation on the part of the great English manufacturers was of the very utmost importance. One very often heard of the workmen being complained of; but it was now being seen that the leaders and captains of industry, especially the employers and the heads of great manufacturing enterprises, must open their minds to the improving of scientific investigation and research and training, both for the heads of the enterprises as well as for those who had the actual conduct and the carrying of them out. When the sources of the successful competition against this country in certain branches of industry were investigated, he believed that competent men in trade who had examined the matter would say that one great source of the success of foreign competition, and especially of German competition, had been the existence in Germany for some years of an organised and systematic plan for technical education, technical education connected with the other branches of education; and he hoped that this country would speedily amend and reform its system. . . . A scheme was being framed for a Teaching University for London—a most important scheme. It was most desirable that this body, when it was established, should not be so constituted as to discourage the evening teaching and evening learning of such places as the Battersea Polytechnic. They should allow students from such institutions as this to be admitted by their examinations.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, December 11.—Prof. Ayrton, Vice-President, in the chair.—A paper on the applications of physics and mathematics to seismology was read by Dr. C. Chree. Prof. J. Milne has attempted to account for certain changes in the indications of spirit-levels and delicately suspended pendulums by the supposition that they are due to meteorological agencies, such as rainfall or evaporation. Thus he considers that a relative excess of moisture—say, on the west of an observatory—is equivalent to a surface load on that side tending to make the ground, on which the observatory rests, slope downwards from east to west. The author, by making the assumptions as to the physical state of the substance of the earth that it is a homogeneous, isotropic, elastic solid, has examined in as general a manner as possible the amounts of flexure which would be produced by different systems of loading. He points out that the alteration in the reading of such an instrument as a spirit-level depends not only on the bending of the surface of the earth, but also on the attraction exerted by the load, which slightly alters the direction of "gravity." He shows that if ψ_1 is the alteration in level produced by the bending, and ψ_2 the alteration in the direction of gravity, then the ratio ψ_1/ψ_2 depends only on the elastic constants of the earth, and is quite independent of the shape and size of the loaded area. In the case of a material having the elasticity of steel $\psi_1/\psi_2 = 2$, for brass $\psi_1/\psi_2 = 5$, and for an incompressible material $\psi_1/\psi_2 = 11$. The author considers that this last value most truly represents what occurs in practice, and hence that the pressure effect is considerably larger than the gravitational effect. The pressure effect is worked out for the cases where the loaded area is a square, and a long narrow rectangle, and it is found that for a square of 100 metres side the effect, at a point one metre from one side, of loading the square with a layer of water one centimetre thick, is to alter the level by 0·0012 second of arc. For the case of a tidal river 100 yards wide, and for a rise of 5 metres, the effect on an observatory at 100 yards from the bank would be to alter the level by 0·1 second of arc. Hence the effect of an estuary or tidal river is likely to be much more marked than differential evaporation or rainfall. The author also considers the effects of the attraction of the sun and moon, producing as they must "tides" in the solid crust of the earth, on the reading of a level and the measured altitude of a star as obtained with an artificial horizon. Finally the author considers the light the measurements on the velocity of propagation of earthquake disturbances throw on the credibility of the hypotheses he has made us to the elastic constants of the earth. He shows that the two observed velocities of 2·5 and 12·5 kilometres per second would lead to values for Young's modulus, and the rigidity below those found in the case of iron; the bulk modulus, however, obtained is very high, and this he considers quite probable on account of the enormous pressure to which the earth's deep-seated material is subjected. Prof. Perry said he had thought of taking up the subject from an experimental point of view, and trying the effect of loading a large block of indiarubber. He had not had time to refer to the author's paper, in which the reasons were given for taking the earth as incompressible. He (Prof. Perry), however, thought that this assumption led to results in contradiction to actual observed facts. Prof. Milne had obtained results which, for want of any other explanation, he had been compelled to attribute to meteorological causes. The reason Dr. Chree had obtained so small a value for the effect of loading by surface water might be because he had assumed erroneous values for the elastic constants. If he took a value for Poisson's ratio such as we meet with in practice, the effects would be much larger. Prof. Darwin had also investigated the folding of the surface of the earth due to loading. The results obtained by the author with reference to the velocity of waves did not seem quite satisfactory. The small waves which were found, both at Berlin and the Isle of Wight, to precede the main waves coming from an earthquake in Japan were not accounted for. The wave velocity in an infinite mass of steel (a very elastic material) was about 6 kilometres per second, which was very different from 12·5 kilometres per second. The author had assumed such values for the elasticity as would give the correct velocity. The author in reply said that in applying the equations of elasticity to the earth's interior, unless the material were supposed nearly incompressible, one obtained values for the strains too large to be consistent with the fundamental mathematical hypothesis, that the square of strains are negligible. In the case of surface loading no such restriction was necessary, so far as the surface layers, at least, are concerned. The differences between the several numerical estimates for the ratio of the gravitational and pressure effects of a surface load were principally due to the differences in the hypothetical values ascribed to the rigidity. It was his wish to make it clear that the pressure and gravitational agencies treated in detail in the paper were not the only ones likely to affect the level; he had specially called attention to solar heating and possible direct influence of moisture on the foundations of buildings, &c. The reason why for the one wave velocity so much higher a value was obtained than that Prof. Perry calculated for steel, was solely the high value, 24 : 1, found for the ratio of Thomson and Tait's elastic constants *m* and *n*. He knew Prof. Darwin had treated of the phenomena met with in loose earth in some cases, but could not say whether this was what Prof. Perry referred to. He had himself once thought of attempting an application of what Prof. Karl Pearson termed the "equations of pulverulence," as treated in detail by Prof. Boussinesq, but had not done so, partly from a feeling of uncertainty as to their physical value. Supposing these equations satisfactory, they ought to give better results than the equations of elasticity when surface load was applied to a deep alluvial soil.—A paper on musical tubes, by Mr. R. T. Rudd, was, in the absence of the author, read by the Secretary. The author has examined a set of tubes ranging in length from 95 inches to 12 inches, made out of "1-inch" gas-tube. Having tuned these to a diatonic scale, he found that there was a very marked difference in the character of the sound of the long, the middle, and the short tubes. Commencing with the long tubes, the first two octaves have a full rich tone very similar to that of a church bell. They range from D of 145 vibrations per sec. to D of 580 vibrations. At about this point the tone changes from that of a church bell to one peculiar to tubes, the note also falls back in the scale more than a fifth, viz. to F♯ (360), the same tube giving two notes, to either of which the attention can be directed. In order to distinguish these different classes of sound produced by tubes, the author calls the tone corresponding to that of a church bell the "low grade," the next one the "middle grade," and that produced by short tubes (27 in. and under) the "high grade." At the junction between the high and middle grade there is a fall in the note of about an octave and a half. The following formula may be used for calculating the pitch of the note given by a tube: $V = DC/L^2$, where V = frequency, D = external diameter, L = length, and C is a constant which for iron tubes has the value 100×10^4, 62×10^4, or 22×10^4, according as the note belongs to the low, the middle, or the high grade. The author explains the effects by a consideration of the partial tones present and their effect on the ear. Prof. Rücker said he thought it a great pity that in England such confusion of nomenclature existed, so that partials were often called over-tones. He considered that the author had made an extremely ingenious attempt to explain the differences of pitch observed, this explanation apparently resembling that given by Prof. Everett to account for combination tones. The author explains the presence of a note of frequency 630, as being formed in the ear by the harmonies having frequencies of 1260, 1900, and 2600. He also explains the absence of lower partials having frequencies of 780, 390, and 140 by the supposition that they are so far removed from the "focus" as not to appreciably affect the ear. Another explanation of the presence of a note of frequency about 630 would, however, be the formation of a difference tone between the partials of frequency 780 and 140. Mr. Blaikley agreed with Prof. Rücker as to the vagueness of the terms often employed, and said that it appeared that in the "high grade" the note was caused by the first proper tone, in the "middle grade" by the second, and in the "low grade" by a difference tone produced by the fourth, fifth, and sixth proper tones. The distance of the nodes from the end of the tube was ·224 of the length, and not ·25, as the author states, and in the case of a tube clamped at the node, this difference in the position of the clamp would have a marked effect on the tone. A great distance in the tone was also produced by varying the hardness of the hammer. Prof. Ayrton said he had once investigated the behaviour of some tubes by analysing the note given out by means of a Helmholtz analyser. In the case of the tubes that gave a good note, it was found that the components were few and well-marked, while in that of the tubes which gave a bad note, the components were numerous and sometimes very ill-defined. The relative length, diameter, and thickness of the tube had a great influence on the tone.

Chemical Society, December 3.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read: Constitution and colour, by A. G. Green. Colouring matters may be classified in two groups, viz.: (1) Colours whose leuco-compounds are not readily oxidised on exposure to air; (2) colours whose leuco-compounds are rapidly oxidised on exposure to air. It is shown further that the members of class 1 are all para-derivatives, whilst those of class 2 can all be represented as ortho-compounds.—Derivatives of α-hydrindone, by C. Revis and F. S. Kipping. The authors have studied α-hydrindone in order to determine whether its reactions are analogous to those of camphor, which it resembles somewhat in constitution; there is, however, a marked difference between the chemical behaviour of the two ketones.—Notes on nitration, by H. E. Armstrong.—3′-Bromo-β-naphthol, by

H. E. Armstrong and W. A. Davis. 3′-Bromo-β-naphthol is prepared by digesting 1 : 3′-dibromo-β-naphthol with hydriodic acid.—Derivatives of nitro-β-naphthols, by W. A. Davis.—Morphotropic relations of β naphthol derivatives, by W. A. Davis. The author shows that a marked crystallographic relation exists between a number of 1 : 2 and 1 : 3′ : 2 naphthalene derivatives; although the crystalline systems of the various substances examined are not the same, yet the axial ratio $c : b$ is nearly the same in all.—Researches on tertiary benzenoid amines, by Miss C. de B. Evans. A number of sulphonic acids of benzenoid amines have been prepared; it is shown that although orthosulphonic acids are readily obtained from aniline derivatives, there is usually extraordinary difficulty in preparing metasulphonic acids.—On the circumstances which affect the rate of solution of zinc in dilute acids, with especial reference to the influence of dissolved metallic salts, by J. Ball. The effects on the rate of solution of zinc in dilute acids of (1) variations of concentration of the acid; (2) previous special treatment of the acid; (3) variations of temperature; (4) variations of pressure; (5) variations of the surface condition of the zinc; (6) admixture of other metals with the zinc; (7) performance of the solution in vessels of different materials; and (8) addition of various substances to the acid solution, have been studied. It is of interest to note that the addition of foreign salts to the solution always accelerates the dissolution of the zinc.—The oxidation of ferrous sulphate by sea-water, and on the detection of gold in sea-water, by E. Sonstadt. The author shows that by prolonged agitation of half-a-gallon of sea-water with twenty grains of mercury, an appreciable quantity of gold is taken up by the mercury.

Mineralogical Society, November 17.—Annual Meeting; Dr. Hugo Müller, F.R.S., in the chair.—The balance-sheet for the year ending December 31, 1895, was presented, and showed that the state of the finances of the Society continues to be very satisfactory. The number of members is now 130. Two numbers of the journal have been issued during the past year, including an index of authors and subjects for the ten volumes of the journal which have now been published. The Council were able to congratulate the Society upon the continued steady sale of the journal. Mr. Thomas Henry Holland, superintendent of the Geological Survey of India, Calcutta, was elected a member of the Society. The following papers were then read: Notes on Zirkelite and Derbylite, by E. Hussak and G. T. Prior; some crystals of iron pyrites from Cornwall, by A. Hutchinson; crystallographic notes on Zinckenite, Wolfsbergite, Plagionite, Stephanite, Enargite, and Anglesite, by L. J. Spencer; the discovery of Prehnite in Wales, by T. J. Harrison.—It was subsequently announced that the following gentlemen had been duly elected as Officers and Council of the Society for the ensuing year: President, Prof. N. S. Maskelyne, F.R.S.; Vice-Presidents, Rev. S. Houghton, F.R.S., and Dr. Hugo Müller, F.R.S.; Treasurer, Mr. F. W. Rudler; General Secretary, Mr. L. Fletcher, F.R.S.; Foreign Secretary, Prof. J. W. Judd, F.R.S.; ordinary members of Council, Mr. W. Barlow, Prof. A. H. Church, F.R.S., Prof. H. A. Miers, F.R.S., and Mr. W. J. Pope; in addition to the following members not requiring re-election: Prof. Geikie, Messrs. Harker, Hutchinson, Kitto, Prof. Lewis, Lieut.-General McMahon, Messrs. Tutton and Watts.

Geological Society, November 18.—Dr. Henry Hicks, F.R.S., President, in the chair.—On *Cycadeoidea gigantea*, a new cycadean stem from the Isle of Portland, by A. C. Seward. The specimen described by the author was discovered a short time since in one of the Purbeck dirt-beds, and is now in the Fossil Plant gallery of the British Museum. A comparison of this fossil with recent cycads and ferns brought out many points of close agreement with the former, and as regards the structure of the ramenta, evidence was afforded of an interesting survival of the closer resemblance which formerly existed between cycadean and fern-like plants. The stem has been named *Cycadeoidea gigantea*.—The fauna of the Keisley limestone (Part ii., conclusion), by F. R. C. Reed. The author described the ostracoda, brachiopoda, mollusca, echinodermata, and actinozoa of the Keisley limestone. He gave a list of fossils from the limestone, and indicated those species which occurred in the limestone of Kildare, the *Leptæna*-limestone of Sweden, and Stage F of the East Baltic provinces. As a result of his researches he concluded that the fauna had a thoroughly ordovician facies; that it was closely comparable with that of the limestone of the Chair of Kildare, and of the *Leptæna*-limestone, and less closely with that of Stage F of the East Baltic provinces; that its palæontological features pointed to its stratigraphical position being at the base of the Upper Bala, and that it must be regarded as the locally thickened development of a bed which was elsewhere in Great Britain very thin, or entirely absent, or represented by beds having different lithological characters and a different fauna; and that the fauna had certain unique characters which marked it off from all other known assemblages of fossils in Great Britain.

Royal Microscopical Society, November 18.—Mr. A. D. Michael, President, in the chair.—The Secretary read a note, from Mr. E. M. Nelson, on the Hugh Powell Microscope in the Society's collection. A discussion ensued, in which Mr. Ingpen, Mr. Vezez, Prof. Bell, Mr. Beck, and the President took part. —Lieut.-Colonel H. G. F. Siddons exhibited and described a portable cabinet for mounting apparatus.

Linnean Society, November 19.—Mr. A. D. Michael, Vice-President, in the chair.—Dr. D. Morris, C.M.G., exhibited from the Royal Gardens, Kew, the inflorescence of *Pterisanthes polita*, a singular species of the Vine Order (Ampelideæ), received in 1894 from Mr. H. N. Ridley, of Singapore, and now in flower for the first time in Europe. *Pterisanthes* is closely allied to *Vitis*, but shows in a more interesting manner the true nature of the tendrils, and a special modification of the receptacle suggested only in *Vitis macrostachya*. Dr. Morris also exhibited dried flower-stems of the Australasian twin-leaved Sundew (*Drosera binata*, Labill.), received at Kew from the Sheffield Botanic Garden. In this instance the stems were 3 feet 6 inches high, bearing about thirty to fifty large pure white flowers, nearly 1 inch across. The plant grown in gardens in this country is seldom more than 9 inches to a foot high.—Mr. W. G. Ridewood read a paper on the structure and development of the hyobranchial skeleton and larynx in *Xenopus* and *Pipa*. The conclusions were drawn that *Pipa* and *Xenopus* are descended from tongue bearing ancestors, and that in spite of the anatomical differences between the two genera, the sub-order Aglossa is a natural one.—A paper was then read by the Rev. T. R. Stebbing, F.R.S., "On the collection of Amphipoda in the Copenhagen Museum." Some of the more striking rarities were described, together with a few of a less uncommon type. The collection being cosmopolitan, the opportunity was taken of bringing into notice certain other new or insufficiently known forms received from Prof. Haswell, of Sydney, N.S.W., and from Mr. G. M. Thompson, of Dunedin, N.Z. The range of the various specimens described extends from Cuba to Ceylon; from the North Atlantic to the South Pacific; from the western coast of Scotland to the eastern coast of Australia and New Zealand. Nine genera and ten species were discussed, six of each being new.

Zoological Society, December 1.—Sir W. H. Flower, K.C.B., F.R.S., President, in the chair.—Mr. R. E. Holding exhibited and made remarks on a three-horned fallow deer's head and a malformed head of a roebuck.—Mr. H. E. Dresser exhibited and made remarks on a specimen of Pallas's willow-warbler (*Phylloscopus proregulus*), shot at Cley-next-the-Sea, Norfolk, on October 31, 1896, being the first instance of the occurrence of this bird in Great Britain.—Dr. Forsyth Major gave an account of the general results of his zoological expedition to Madagascar in 1894–96. Amongst the more important results attained by Dr. Major was the discovery of remains of a new fossil monkey (*Nesopithecus*), forming the type of a new family of Quadrumana, and of about twenty new species of living mammals, several of these belonging to new genera. A very fine series of bones of the extinct Æpyornithes obtained by Dr. Major would enable some nearly complete skeletons of this group to be put together for the first time.—A communication was read from Mr. Stanley S. Flower, containing an annotated list of all the reptiles and batrachians known to occur in the Malay Peninsula and on the adjacent islands. A new species of gecko (*Gonatodes penangensis*) was described, and original observations relating to the distribution, variation, and habits of known species were added, especially with regard to the tadpoles of various batrachians.—Mr. G. A. Boulenger, F.R.S., read descriptions of some new fishes from the Upper Shiré River, British Central Africa, based on specimens collected by Dr. Percy Rendall, and presented to the British Museum by Sir

Harry Johnston, K.C.B. The present collection contained examples of fourteen species, of which five were now described as new to science.—A second communication from Mr. Boulenger contained remarks on the lizards of the genus *Eremias*, section *Boulengeria*.—Mr. R. Lydekker, F.R.S., gave an account of an apparently new deer from North China, living in the menagerie of the Duke of Bedford, at Woburn Abbey, to which he proposed to assign the name *Cervus bedfordianus*.—The Secretary read a communication from Mr. A. J. North, of the Australian Museum, Sydney, containing an account of a cuckoo in the Ellice Islands (*Eudynamys taitensis*), which appears to lay its eggs in the nest of a tern (*Anous stolidus*).—The Rev. T. R. R. Stebbing communicated a paper by Dr. H. J. Hansen, of the Copenhagen Museum, on the development and the species of the Crustaceans of the genus *Sergestes*.

Entomological Society, December 2.—Dr. Sharp, F.R.S., Vice-President, in the chair.—Dr. Sharp exhibited the series of Longicorn Coleoptera of the genus *Plagithmysus* from the Hawaiian Islands, of which a preliminary account had recently been given by him elsewhere. He said that these examples were the result of Mr. Perkins' work for the Sandwich Islands Committee, and afforded a fair sample of his success in the other orders, which would be found to have completely revolutionised our knowledge of the entomological fauna of these islands. He stated that Mr. Meyrick had recently informed him that the *Geometridæ* would be increased from six species to forty-four, and that the genus *Plagithmysus* showed an almost equal increase; and that the working out of the specimens was very difficult, owing to the variability of the species and to their being closely allied.—Mr. Malcolm Burr exhibited a specimen of a cockroach, *Pycnoselus indicus*, Fabr., taken in a house at Bognor, Sussex. He said this was the first record of the occurrence of the species in England. According to De Saussure, it was distributed throughout India, Ceylon, Mexico, and the United States.—Mr. P. Crowley exhibited a remarkable variety of *Abraxas grossulariata* taken in a garden at Croydon last summer.—Mr. Tutt exhibited some Micro-Lepidoptera from the Dauphiné Alps. Several specimens of *Psecadia pusiella*, Röm., showing considerable difference in the width of the black zigzag band crossing the centre of the forewings longitudinally. The species was taken at La Grave, in a gully at the back of the village. A large number of specimens were secured, chiefly resting on the trunks and branches of two or three ash and willow trees growing on the bank at the side of the gully. A few specimens, however, were obtained drying their wings on the grass on the bank, but Mr. Tutt stated that he failed to find pupa-cases. Mr. Tutt also exhibited specimens of a "plume" which had been named *Leioptilus* (*Alucita*) *scarodactyla*. He also exhibited specimens, from Le Lautaret, of *Gelechia spuriella*, *Sophronia semicostella*, *Pleurota pyropella*, *Œcophora stipella*, and *Butalis fallacella*. The latter were chiefly interesting from the fact that they were taken at an elevation of about 8000 feet.—Lord Walsingham, F.R.S., read a paper entitled, "Western Equatorial African Micro-Lepidoptera." A discussion ensued, in which Dr. Sharp, Herr Jacoby, and others, took part.

CAMBRIDGE.

Philosophical Society, November 9.—Mr. F. Darwin, President, in the chair.—"On the Nature of the Röntgen Rays," by Prof. Sir G. G. Stokes. In this communication the author explained the views he had been led to entertain as to the nature of the Röntgen rays, and to a certain extent the considerations which had led him to those conclusions. As Röntgen himself pointed out, the X-rays have their origin in the portion of the wall of the Crookes' tube on which the so-called kathodic rays fall, and it is natural that notions as to the nature of the X-rays should be intimately bound up with those entertained as to the nature of the kathodic rays. Two different views have been adopted on this question. Several eminent German physicists hold that the kathodic rays are essentially a process going on in the ether, the nature of which nobody has been able to explain; and that if any propulsion of molecules from the kathode accompanies them, it is merely a secondary phenomenon. The other view is that the kathodic rays are not proper rays at all, but that they are essentially streams of molecules. The author expressed the fullest conviction that the kathodic rays are no mere process going on in the ether, but that the propulsion of molecules is of the very essence of the phenomenon; only it is to be remembered that the molecules are not to be thought of as acting merely dynamically, by virtue of their mass and velocity; they are carriers of electricity; and it would seem to be mainly to this circumstance that some at least of their effects are due. He indicated what he believed to be the true answers to the objections of those who regard the kathodic rays as processes in the ether; and adopting the theory that they are streams of molecules explained how, in his opinion, this theory, taken in connection with the more salient features of the X-rays to which the kathodic rays give birth, leads us to a theory of the nature of the X-rays. Everything points to the X-rays as being, like rays of light, some process going on in the ether, and sufficient indications of their polarisation appear to have been obtained (at least when those indications are taken along with the undoubted polarisation of the Becquerel rays with which they have so many properties in common) to refer the Röntgen as well as the Becquerel rays to a disturbance transverse to the direction of propagation. The absence of refraction, which is so remarkable a feature of the X-rays, suggests that their progress through ponderable matter takes place by vibrations in the ether existing in the interstices between the ponderable molecules; a view which, if correct, leads incidentally to a somewhat novel view as to the mechanism of the refraction of light. The absence, or almost complete absence, of diffraction and interference of the X-rays leads to one of two alternatives—either that they are of excessively short wave-length, or that they are non-periodic or only very slightly periodic, the X-light being on the latter supposition regarded as a vast succession of independent pulses analogous to the "hedge-fire" of a regiment of soldiers. According to the author's view, each electrically charged molecule on arrival at the target gives rise to an independent pulse, and the vastness of the number of pulses depends on the vastness of the number of molecules in even a minute portion of ponderable matter.—"On the Contact Relations of certain Systems of Circles and Conics," by Mr. W. McF. Orr.—"On certain cases of discharge in vacuo, and on the zigzag path of Lightning," by Mr. J. Monckman.

PARIS.

Academy of Sciences, December 7.—M. A. Cornu in the chair.—Pleurisy in man studied by means of the Röntgen rays, by M. Ch. Bouchard. The existence of pleurisy in the human subject is very clearly indicated by the Röntgen ray shadows, but the method offers no advantages over the ordinary clinical diagnosis.—On the composition of the gases which are evolved from the mineral waters of Bagnoles de l'Orne, by MM. Ch. Bouchard and Desgrez. The gas contained traces of helium, 4·5 per cent of argon, 5·0 per cent. of carbon dioxide, the remaining 90·5 per cent. being nitrogen.—The theory of the confluence of the lymphatics and the morphology of the lymphatic system of the frog, by M. L. Ranviër.—On the quaternary elephants of Algeria, by M. A. Pomel. In the two quaternary geological horizons six species of elephant have been found, the distinguishing characteristics of which are described.—The quaternary rhinoceri of Algeria, by M. A. Pomel.—Observations on the total solar eclipse of August 9, 1896, made in Japan by M. H. Deslandres.—Optical analysis of urine, and the exact estimation of proteids, glucosides, and saccharoid non-fermentable materials, by M. Fr. Landolph.—Germination of the spores of the truffle, by M. A. G. Grimblot.—Modification of a fundamental principle relating to imaginary quantities, by M. L. Mirinny.—An air compressor with two cylinders, by M. J. Niffre.—Comparison of the observations of Vesta with the tables, by M. Leveau.—On a class of paraboloids, by M. A. Mannheim.—On the problem of Dirichlet and the fundamental harmonic functions attached to a closed surface, by M. Le Roy.—On the equations representable by three linear systems of points, by M. Maurice d'Ocagne.—The construction of standard plates for the optical measurement of small air thicknesses, by MM. A. Pérot and Ch. Fabry.—On the property of discharging electrified conductors communicated to gases by the X-rays by flames and by electric sparks, by M. Emile Villari. A reply to the claim for priority in this subject by M. E. Branly.—On lithium nitride, by M. Guntz. It is practically impossible to prepare lithium nitride in a pure state, as it exerts a solvent action upon every substance used as a containing vessel.—On the heat of formation of selenic acid and some selenates, by M. René Metzner. Measurements are given for the heat of neutralisation of selenic acid with soda, potash, baryta, lead oxide, and silver oxide; and of the heat of formation of the various hydrates.—Estimation of phosphorus in the ashes of coal and coke, by M. Louis Campredon. It is shown that the whole of the phosphorus cannot be extracted from the ash even after a very prolonged heating with hydrochloric acid. Fusion with alkaline carbonates of the residue left after extraction with acid always gives a further amount of phosphate, which is the larger the longer the ash has been ignited.—Analysis of commercial copper by the electrolytic method, by M. A. Hollard. Details are given of the method employed for the exact estimation of the copper in crude coppers.—On ozone and the phenomena of phosphorescence, by M. Maurice Otto. Most organic substances are capable of giving rise to phosphorescence when placed in contact with ozone. The luminosity produced with ordinary distilled water is shown to be due to the presence of minute quantities of organic matter.—On the new bread for military purposes, by M. Balland.—Researches on the modifications of nutrition in cancerous subjects, by MM. Simon Duplay and Savoire. The alkaloidal substance isolated by M. Griffiths, in 1894, from cancerous urines, would appear to be due to the introduction of foreign micro-organisms; when the cancerous growth is in a part of the body naturally aseptic, no such substance can in general be found in the urine. An alkaloidal substance, differing in its reactions from that described by Griffiths, was, however, present in one case of sarcoma.—On a new method of collecting the venom of serpents, by M. Paul Gibier. It has been found that after suitable arrangements have been made for holding the snake and collecting the venom, the serpent refuses to emit a single drop of the venom. This difficulty is overcome by stimulating the venom glands and neighbouring muscles with a weak alternating current, when, in a few seconds, the glands are completely emptied.—Use of the grisometer in the medico-legal examination for carbon monoxide, by M. N. Gréhant. The gas is extracted by the aid of acetic acid and the mercury pump, and the carbon monoxide determined in the gas mixture by means of the grisometer.—On the development of some annelids, by M. Auguste Michel.—Observations on the rhizoctone of the potato, by M. E. Roze.—Destruction of *Heterodera Schachtii*, by M. Willot.—The endomorphic transformations of the granitic magma of Ariège, in contact with limestones, by M. A. Lacroix.—Artificial reproduction of pirssonite, northupite, and gaylussite, by M. A. de Schulten.—The Upper Jurassic strata in the neighbourhood of Angoulême, by M. Ph. Glangeaud.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 17.

ROYAL SOCIETY, at 4.30.—On the Dielectric Constant of Liquid Oxygen and Liquid Air: Prof. Fleming, F.R.S., and Prof. Dewar, F.R.S.—On the Effect of Pressure in the Surrounding Gas on the Temperature of the Crater of an Electric Arc: Correction of Results in former Paper: W. E. Wilson, F.R.S., and Prof. FitzGerald, F.R.S.—Influence of Alterations of Temperature upon the Electrotonic Currents of Medullated Nerve: Dr. Waller, F.R.S.—Subjective Colour Phenomena attending Sudden Changes of Illumination: S. Bidwell, F.R.S.—On the Occurrence of Gallium in the Clay-Ironstone of the Cleveland District of Yorkshire: Prof. Hartley, F.R.S., and H. Ramage.—On some Recent Investigations in Connection with the Electro Deposition of Metals: J. C. Graham.

LINNEAN SOCIETY, at 8.—On the Chalcididæ of the Island of Grenada: Dr. L. O. Howard.—On the Development of the Ovule of Christisonia, a Genus of the Orobancheæ: W. C. Worsdell.

CHEMICAL SOCIETY, at 8.—On the Experimental Methods employed in the Examination of the Products of Starch-hydrolysis; on the Specific Rotation of Maltose and of Soluble Starch; on the Relation of the Specific Rotatory and Cupric-reducing Powers of Starch-hydrolysis by Diastase: Horace T. Brown, F.R.S., Dr. G. H. Morris, and W. H. Millar.

ROYAL STATISTICAL SOCIETY, at 5.30.

FRIDAY, DECEMBER 18.

EPIDEMIOLOGICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Wells, and Well-Sinking: John W. Kitchin.

SUNDAY, DECEMBER 20.

SUNDAY LECTURE SOCIETY, at 4.—Creatures of Other Days: Rev. H. N. Hutchinson.

TUESDAY, DECEMBER 22.

ROYAL INSTITUTION.—Use of Liquid Air in Scientific Research (before H.R.H. the Prince of Wales): Prof. Dewar, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Steel Skeleton Construction in Chicago: E. C. Shankland.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Alterations of Personality; A. Binet, translated by H. G. Baldwin (Chapman).—The Cell in Development and Inheritance: Dr. E. B. Wilson (Macmillan).—Second Annual General Report upon the Mineral Industry of the United Kingdom of Great Britain and Ireland for the Year 1895: Dr. C. le Neve Foster (Eyre and Spottiswoode).—Light as the Interpretation of the Law of Gravity: A. M. Cameron (Sydney, Angus and Robertson).—London University Guide and University Correspondence College Calendar, 1896–7 (Clive).—Hygiene for Beginners: Dr. E. S. Reynolds (Macmillan).—Compressed Air Illness: Dr. E. H. Snell (Lewis).—Roentgen Rays and Phenomena of the Anode and Cathode: E. P. Thompson (Spon).—Knowledge, Vol. xix (326 High Holborn).—Studies in the Morphology of Spore-producing Members: Prof. F. O. Bower. II. Ophioglossaceæ (Dulau).—Die Leitfossilien: Dr. E. Koken (Leipzig, Tauchnitz).—Elementary Non Metallic Chemistry: S. R. Trotman (Rivington).—The Fauna of British India, including Ceylon and Burma. Moths, Vol. iv.: Sir G. F. Hampson (Taylor and Francis).

PAMPHLETS.—Die Seen des Salzkammergutes und die Österreichische Traun: Dr. J. Müllner (Wien, Hölzel).—Die Abfluss-und Niederschlagsverhältnisse von Böhmen, &c.: Dr. A. Penck (Wien, Hölzel).—Atlas der Österrischischen Alpenseen, i. Liefg.: Dr. F. Simony and Dr. J. Müllner (Wien, Hölzel).—Ditto, ii. Liefg.: Dr. E. Richter (Wien, Hölzel.—The Results of the Use of Tuberculin in the Castlecraig Herd: J. Wilson (Edinburgh, Johnston).

SERIALS.—Lloyd's Natural History. Game Birds: W. R. Ogilvie-Grant, Parts 1 and 2 (Lloyd).—Himmel und Frde, November (Berlin, Paetel).—Engineering Magazine, December (Tucker).—Journal of the College of Science, Imperial University, Japan, Vol. x. Part 1 (Tōkyō).—American Journal of Science, December (New Haven).—Transactions of the Yorkshire Naturalists' Union, Part 20 (Leeds, Taylor).—Bulletin de l'Académie Royale des Sciences, &c., de Belgique, 1896, Nos. 9 and 10 (Bruxelles).—Journal of the Franklin Institute, December (Philadelphia).—Botanische Jahrbücher, &c., Zweiundzwanzigster Band, 3 Heft (Leipzig, Engelmann).

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