THURSDAY, JUNE 1, 1893.

MODERN METEOROLOGY

Modern Meteorology: an Outline of the Growth and Present Condition of Some of its Phases. By Frank Waldo, Ph.D., Member of the German and Austrian Meteorological Societies, late Junior Professor, Signal Service, U.S.A. (London: Walter Scott, 1893.)

IF it be true that the condition of the weather forms a general and engrossing topic for conversation among Englishmen, books which treat of meteorology should attract the attention of many readers in this country, and Dr. Waldo be assured of many students. But in this particular work the author has not dwelt upon the more popular side of the subject, he has not exhibited the capacity for making weather forecasts, or discussed the success which has attended such predictions, or the future that lies before work of that description. He has had in view rather that smaller class of readers, with whom meteorology means something real and hopeful, and who by accurate and patient work are earnestly striving to make it rank among the exact sciences. Considering the very substantial progress that meteorology has made, the opinion is shared by many, possibly by the author of this work, that the day has already come when this science is entitled to rank among the older and more systematised branches of scientific inquiry. This is entirely to misconceive the situation. Just as incorrect and unfair would it be, to see in the widely scattered and ardent meteorological observers, a class, whose power and knowledge are limited to the acquisition of the readings of barometers and thermometers, Meteorology may not yet have produced its Kepler. certainly not its Newton, but working hypotheses, founded on rigorous dynamical principles are everywhere being tested, amended, harmonised with observed facts, showing that the days of simple accumulation of observations are giving place to a new and more hopeful era. It is with the earnest hope of encouraging and instructing this army of observers, that Dr. Waldo in this little book endeavours to place before them the most recent results, which the pioneers of meteorology are seeking to establish with a fair prospect of success.

Dr. Waldo explains that he is mainly a student of what may be termed the German school of meteorology, a fact which may be expected to colour his work very materially. Practically it has its advantages and disadvantages. The views supported by that school are set forth at very considerable length, and since the ordinary English reader may not have had the same opportunities for making himself acquainted with the original memoirs that Dr. Waldo has enjoyed, it is a great advantage to be introduced to the special teaching of von Bezold, or of Oberbeck, or von Helmholtz, by one who has graduated in that school with no mean honours. On the other hand it is curious to the English reader, to find names which are as familiar to him as household words, authorities which he is accustomed to hold in the highest respect, passed over with the briefest mention and apparently as undeserving of consideration. This is a disadvantage both to the author and reader. The author admits the drawback and apologises for omissions to French and English authorities, while in the student it is liable to produce a sense of disproportion and exaggeration, and even of unfairness to his own countrymen. But with this exception, understood and allowed for, this book is a valuable contribution to the literature of the subject.

In an introductory chapter, which might have been extended with advantage, the author gives a rapid but admirable sketch of the various sources whence the recent history of meteorology may be gathered. These sources include not only distinct treatises and the periodical literature, but the work accomplished and recorded at the various congresses that have been held from time to time. This latter portion is treated in a very sketchy manner, and might have been much enlarged, lest the importance of such gatherings and the international benefits to be derived therefrom should be overlooked.

The second chapter, which is practically a book of nearly two hundred pages, will certainly not be considered the least satisfactory part of the volume. Here is given the history and description of the more important of the meteorological instruments, with their methods of use, and given too, at great length, because the author asserts that there is no work in English which gives an adequate description of such instruments. Without endorsing this somewhat sweeping assertion, there can be no doubt but that this chapter is eminently worthy the attention of those for whom in a great measure the book is intended—the teachers of physical geography and elementary physics. The author is as a rule fortunate both in what he inserts and in what he omits in his descriptions. His remarks on normal barometers are especially valuable and will be much appreciated. Dr. Waldo is particularly qualified to speak on questions touching the construction of these instruments, for we believe he was engaged in comparing the accuracy of the various standard barometers in use in the principal observatories in Europe.

In the section on wind-measuring apparatus, is well illustrated that feature to which attention has been called, the small regard paid to English experiments in meteorological inquiries. We place very considerable confidence, in this country at least, in the researches of Mr. Dines, and are disposed to consider him as an authority on the proper constant to be employed in the reduction of the indications of Robinson's anemometer. It is true these researches are not altogether ignored, but they are dismissed in a couple of lines, which though they may give fairly accurately one of the principal results of his work do not in any adequate degree express the value of his inquiry, and this omission, if such it can be called, contrasts very remarkably with the enormous space which is given a little further on to the description of the instruments and the record of the hourly and momentary occupation of the staff at the Pawlowsk observatory. We have no wish to disparage this, possibly, first of meteorological observatories. We believe all that experience can suggest and devotion effect to secure accuracy and well directed observation is done here. It may well be that Pawlowsk presents us with an ideal meteorological observatory, supported with magnificence and directed with equal energy and ability. But the scale of magnificence depicted is more likely to breed a spirit of discontent in those who do excellent work with smaller means, than furnish a scheme on which they can conduct their more modest establishments. We are the more disposed to quarrel with the author for the space devoted to this long and tedious description because we feel that useful matter which Dr. Waldo could so ably have contributed has been crowded out. Under the title "Apparatus and Methods" we could have hoped space would have been found for "Methods of Reduction." Dr. Waldo admits not only that the ordinary observer is at times at a loss for reliable guidance in the reduction and discussion of a particular series of observation, but that the specialist in other inquiries into which meteorology enters or may enter cannot find the observations put into a form ready for use. Possibly the author feels that the subject of reduction is sufficiently large to demand a treatise to itself, but nevertheless many a meteorologist who has carefully tabulated his readings, for years it may be, would turn to a book expressly addressed to himself in the hope of finding some hints, which would enable him to extract something useful from his observations or at least to reduce them on systematic and uniform lines.

Having dismissed the subject of instruments and observatories, the author proceeds to discuss the Thermodynamics and general motions of the atmosphere, and these two chapters, upon which has evidently been lavished an immense amount of care, sustain the interest of the book and carry us a long way into a very difficult subject. It cannot be said that these chapters are light reading. The author has attempted a difficult, it may be an impossible task, for he virtually proposes to give the results of mathematical analysis without the use of mathematical symbols. Such forms of descriptive writing are seldom a success for any class of readers and it is scarcely too much to say that any one who can follow the successive steps of the argument, put forward by the various authorities here quoted, would find his work easier if the author had not dispensed with the assistance of ordinary symbols. But any one who struggles successfully with the difficulties of these chapters will find himself put in possession of the latest views of the exponents, of what the author has called the German School of Meteorology, though at the head of it we should place Prof. Ferrel with his high American reputation.

Of the views of the various authorities here set out, we think Prof. Ferrel fares the best, as being most clearly expressed and in the completest detail, but in this instance Dr. Waldo was assisted by the fact that Prof. Ferrel has himself translated his book on "Recent Advances in Meteorology," published under the auspices of the United States Government in 1885, into a popular treatise on "The Winds." We are thus enabled to have in this section and particularly in the following one on the "Secondary Motions of the Atmosphere," copious extracts from Prof. Ferrel's book in his own words, and this is extremely fortunate, for Ferrel's views have altered not a little since he first submitted them to public consideration, and it is a little difficult to be certain that we have the last words of this distinguished meteorologist. For the remainder, it would be a great advantage to the reader if the various views quoted from the original authorities were not left so disconnected, but the points of harmony and divergence brought into stronger relief. The author is too content to stand in the background and allow the various authorities to put forward their views without sufficiently accentuating their strong points. Indeed, it would seem at times as though the several points of divergence were not fully appreciated. We may illustrate this peculiarity by an instance which also shows the indifference of the author to English authorities on the theoretical side, a peculiarity to which we have already called attention in practical work. In the historical account of Ferrel's work is mentioned (p. 275) the fact that Prof. James Thomson published a paper in the Proceedings of the British Association, 1857, "expressing somewhat of the same dissatisfaction with current theories that Ferrel had printed in 1856, and the line of reasoning as regards a new theory was much of the same nature, but not so complete as Ferrel's. This paper is now chiefly valuable historically." Then follows a defence of the late Prof. Thomson against a possible charge of plagiarism. We doubt whether this defence will be appreciated, for in 1857 the views of the Glasgow Professor differed widely from those held by Prof. Ferrel. That they have gradually approached since, is due rather to the fact that Ferrel has modified his views as originally held. The distinguishing feature, or at least one distinguishing feature, in the theory of the latter, a theory which Prof Thomson had characterised as pervaded by impossibilities and incongruities, is the assertion that there must be a heaping up of the top layers of the atmosphere to a maximum height at about the parallel of 28°, and a depression of them not only over the Equator but around the Poles and in high latitudes generally. He would thus produce six zonal vortex rings of circulation, three in the Northern and three in the Southern Hemisphere. Prof. Thomson's theory was a modification of the older theory of Hadley, recognising and emphasising the conditions to which a thin stratum of air would be submitted under the effects of friction and impingement at the earth's surface. As the final outcome of his theory, Prof. Thomson concluded that in temperate latitudes, there are three currents at different heights :—"That the uppermost moves towards the Pole and is part of a grand primary circulation between equatorial and polar regions; that the lowermost moves towards the Pole, but is only a thin stratum forming part of a secondary circulation; that the middle current moves from the Pole and constitutes the return current for both the preceding, and that all these three currents have a prevailing motion from west to east in advance of the earth."[1] Those who have followed the development of Prof. Ferrel's ideas will find and will admit, that his later theory, published in 1860 bears a far greater likeness to that published by Prof. Thomson in 1857, than it does to his own earlier efforts in 1856. If there be any plagiarism, and it is not at all necessary that there should be, since the change of view could be amply explained by the gradual growth and improvement of Ferrel's views in the interval, it can scarcely affect the reputation of the English meteorologist.

But the value of the book is not to be measured by

[1] Phil. Trans. vol. 1893 A. p. 675.

the appreciation the author may have of English work. That it would have been better written if his reading had been wider or his acquaintance with the English literature of the subject more thorough, Dr. Waldo would himself admit. The object of the book is distinctly to make known in English reading circles what has been effected on the Continent by the studies of Von Bezold, Siemens and others, and this object is well executed. The exhibition of the views of these masters in lucid terms, and with a few exceptions the author makes his meaning very clear, is more than a sufficient reason for the appearance of the book, which will be welcomed by many students, who are thus put in easy possession of much abstruse work, which possibly embodies the more or less crudely shaped views that they themselves have held, but have been unable adequately to express.

WILLIAM E. PLUMMER.

THE TRANSMISSION OF TELEPHONE CURRENTS.

Telephone Lines and their Properties. By William J. Hopkins. (London: Longmans, Green and Co.)

IN this book the author has attempted the difficult task of instructing both the student and the practical man, and the result is, on the whole, more successful than is usually the case. The first half of the book is a text-book of the modern practice of telephone lines in America, and contains a large amount of good and interesting information on overhead and underground lines, poles, insulators, wires, conduits, cables, exchanges, and switchboards. This covers too wide a field to be useful to a telephone engineer, as each subject is necessarily treated in a cursory manner, but to an English reader it is very interesting, if he knows enough of his own practice to note and appreciate the points of difference. Some of these indeed will make the general public thankful for the restrictions under which telephone men labour over here, and one of the illustrations—a street telephone pole, about 100 feet high, with eighteen heavy wooden cross-arms—is a testimonial to the patience of American people. One or two of the explanations of facts outside strictly electrical information require revision; for instance, the coating formed on copper wire exposed to damp air is the hydrated carbonate of copper, and not the chloride, as stated by the author. Also the dictum on cables for underground circuits is somewhat curious, indiarubber insulation being condemned as not impervious to moisture, and liable to soften by heating, thereby allowing the wire to sink through the insulation. Considering that in another part of the book a current of ten milliamperes is given as a maximum for telephone work, it is difficult to see how any appreciable heating is to take place, as the current density is such as would rejoice the heart of Mr. Heaphy. Again, the accusation that indiarubber will not exclude moisture for a longer time than anything else, makes one wonder what they make it of in America. But after all these may be differences of opinion, and in general the information is unusually accurate, and is very clearly expressed. The only exception to this is in the chapter on switchboards, where the frequent use of technical terms is likely to give some difficulty to a student who is ignorant of practice. The addition of inverted commas to a technical expression is small assistance, where no explanation of its meaning is volunteered.

The second half of the book rises above the text-book standard, and gives a very good account of recent work on the bearing of the capacity and inductance of a circuit on its transmitting power, and the effect of the configuration of itself and neighbouring wires, on its freedom from cross-talk and external influences. The paper of Mr. J. J. Carty, of New York, on the effects of electrostatic induction from neighbouring wires is largely quoted from and discussed, and his theory of the phenomena energetically advocated. A large number of experiments are described in a very clear manner, and the deductions seem mostly incontestable. But the law connecting length of wires that run parallel with each other with the amount of cross-talk produced seems incorrect. It is founded on only one series of experiments, and is given as $C=k\sqrt{l}$ where C is the induced current and l is the length of parallel line. It should surely be of the form $C=kl/(R+r)$ where R and r are the impedance of the receiving instruments, and of the whole length of line respectively.

The experiments very ingeniously show that by electrostatic induction the charged wire will induce a charge in the neighbouring wires, and a series of such induced charges in opposite directions make an alternating current similar to the primary current. The comparatively high potential of a telephone wire and the extremely small current render this explanation the only possible one, and the absence of electro-magnetic induction even from a much larger current is shown by simple experiments. After this the method of shielding the line by symmetrical arrangement, or by stranding or transposition of the wires is clearly explained, as the induced current causing cross-talk is reversed in direction at every turn, so that only the last section will affect the receiving instruments. After considering air lines, the author gives a careful investigation of the construction of cables, with the effects of large capacity and the methods of reducing it. Cross-talk is also considered, and designs for non-inductive cables suggested. The unequal efficiency of composite lines from the two ends is mentioned with unnecessary hesitation as to the reality of the fact, and no definite explanation is offered. It is found best to have the larger capacity at the sending end, probably because there is a considerable loss of electricity in transmission, and hence a smaller current over the larger half of the line, whereas in the reverse direction a large current has to be transmitted over a great distance, only to be, to a great extent, absorbed in the capacious cable.

The chapter on external influences is written with impartiality and completeness, and contains an account of some curious observations on the effect of tramways and electric lighting wires. Some good advice is given on the methods of avoiding disturbance, the double metallic circuit being recognized as the only completely satisfactory way out of the difficulty. An account of one instance of disturbance is sufficiently alarming, that a small arc lamp was maintained in a telephone circuit during a magnetic storm! If this source were only more regular, it might be another solution of what to do when the coal gives out. An elaborate investigation of the action of electric light circuits ends in a set of rules and restrictions for the electric light engineer so stringent and complicated that it would effectually check all disturbances by frightening off a contractor altogether, and a three-wire system would be rendered impossible. However the author recognises that the best remedy lies in the telephone engineer's own hands.

The book concludes with a reprint of a paper by Mr. J. J. Carthy on Inductive Disturbances in Telephone Circuits.

The general style of the book is good and intelligible, and the diagrams clear and new, the old familiar text-book pictures being rigidly excluded. The arrangement into chapters and headings is carefully done, though in the endeavour to make each one complete some repetition is unavoidable. The reason of the omission of an index at the end is hard to understand, as its use in a book intended to be kept is undoubted, and the insertion of the title of the book on every page instead of that of the chapter does not mend matters. As the author states, the mathematical processes have been mostly omitted, or inserted as footnotes. But the few that are found in the latter place might just as well have been left out. For instance, to quote Lord Kelvin's somewhat complicated formula for the current density at any point in a conductor is not so useful as a reference to his original paper would have been, and the formula is not used to obtain any result. Immediately after this follows a remarkable *proof* that $dN/dt = E$. The use of the term "volume" for "current" is needlessly unscientific, but in general the terminology is accurate and consistent. That comprehensive but dangerous word, "retardation" is used with careful explanation of the component parts of its cause, though in one or two places it is loosely employed for "inductance," or "capacity," with consequent inaccuracy.

To sum up, it will be found a useful and very readable book, giving information not otherwise easily obtainable, and both practical men and students will find it repay careful reading. FRANCIS G. BAILY.

MODERN PURE GEOMETRY.

An Elementary Treatise on Modern Pure Geometry. By R. Lachlan, M.A. (Macmillan, 1893.)

BY a recent regulation for the Cambridge Mathematical Tripos provision is made for the introduction of a paper on "Pure Geometry": this to include, in addition to Euclid, the simple properties of lines and circles, the elementary properties of conic sections treated geometrically, for which a place has already been found, such questions as may be treated by inversion, reciprocation, and by harmonics. It has been for some time a reproach that pure geometry has not occupied a more prominent position in the University curriculum. The University has never lacked able geometers, and amongst the present generation our author has won for himself a good name. He has put together an excellent manual complete enough to meet present wants, and doubtless in subsequent editions he will bring the present work even more up to date than it is. Some of our best text-books are overloaded with corollaries and much other matter which it is difficult for the student to retain clearly in his mind. Mr. Lachlan appears to us to have steered a most judicious course, and avoided overloading his book in this way. Mr. Pinto (in "Lothair") speaking of the limited range of the English language (which, however, he admitted to be expressive), said it consists of four words. If this be so, the word we should select to characterise Mr. Lachlan's essay is that it is "charming." It treats of the subject in sixteen chapters, in which, after devoting the first three to an introduction, measurement of geometrical magnitudes and fundamental metrical propositions, he starts from harmonic ranges and pencils, and carries the student at once to the theory of involution. He then discusses properties of the triangle (giving an account here of the recent additions to this branch of the subject, from which we infer that it has at length got a footing in the University) and of rectilinear figures. The reader then has laid before him a clear account of the theories of perspective, of similar figures (previously introduced to English readers in Casey's "Sequel"), and of reciprocation. The properties of the circle are discussed under the heads of the circle as a figure by itself, and then in relation to one or more circles. In this division of the subject our author gives account of his own discoveries and of the many interesting additions contributed by Mr A. Larmor. In two remaining chapters the theories of inversion and of cross ratio are unfolded. The treatment in the text is strictly confined to the line and circle. We believe that a further volume extending the methods herein employed to the conic sections is in course of preparation. A few slips have caught our eye, viz. p. 53, ex. 4; § 97 ex.; p. 55, ex. 7; § 116; § 262; § 268, and one or two other easily corrected mistakes. In such a mass of mathematical work there may well be others. References are given to the sources whence many of the questions are taken. We note that an oversight, which we have had occasion to point out twice before in NATURE in reviewing the late Dr. Casey's "Sequel," is perpetuated here. On pp. 68, 71, a question is cited from a "Trin. Coll., 1889" paper, whereas it was given many years previously in the *Educational Times* (Feb., 1865, and April), and was then by a correspondent carried back to Steiner (Crelle, vol. liii.). The figures illustrate the text very clearly, and there is a full index at the end.

OUR BOOK SHELF.

An Analytical Index to the Works of the late John Gould, F.R.S. By R. Bowdler Sharpe, LL.D. With a Biographical Memoir and Portrait. (London: Henry Sotheran and Co., 1893).

THE compiler of the present work mentions in the preface that the need for it was originally suggested in the course of a discussion between Lord Wharncliffe and Lord Walsingham as to some ornithological question. They decided to refer to one of Gould's plates, but could not readily find the volume in which the figure was given. It occurred to both of them that "such a difficulty would not arise if there existed a complete 'Index' to all the folio works issued by Gould," and Lord Wharncliffe asked Mr. Bowdler Sharpe whether he would undertake the preparation of the kind of volume that was wanted. As Messrs. Sotheran were willing to publish an "Index," Mr. Sharpe set about the task, hoping to be able to accomplish it within a reasonably short period. As a matter of fact, he says, the enterprise "has taken me as many years to finish as I expected it would have taken months." The "Index" does not relate to all the papers published by Gould in various journals, but it does include every work which he issued separately, whether in folio, or octavo, or quarto form; and Mr. Sharpe, with the aid of his assistant at the Natural History Museum, has been careful to check the various references, the number of which is nearly seventeen thousand. He has also put in some "extra synonyms from popular works, such, for instance, as Oates's 'Birds of British India,' which in a few years will have familiarised Indian naturalists and sportsmen with a certain set of names which do not occur in Gould's works, though the species may be duly figured therein." The work, which is very handsomely "got up," will be of great value to all who are fortunate enough to possess Gould's writings, and it will frequently be of good service to every serious student of ornithology. In the biographical memoir Mr. Sharpe not only presents the leading facts of Gould's career, but has much that is fresh and interesting to say about the results of his scientific labours and about the essential qualities of his character.

An Elementary Treatise on Pure Geometry, with numerous examples. By J. W. Russell. (Oxford: Clarendon Press, 1893.)

THE opening sentence of the Preface—"The author has attempted to bring together all the well-known theorems and examples connected with Harmonics, Anharmonics, Involution, Projection (including Homology), and Reciprocation"—indicates that the writer has given himself a "tall order." Within the limits of 323 pages we have here collected every possible property that a student can desire to have. Our only objection to the book is that it is too full for ordinary purposes, but as the matter is put together with considerable skill and ability—thus evidencing the writer's familiarity with, and mastery over, his subject—and illustrated with a choice collection of worked-out exercises, we cordially commend it. We could wish that a handbook for school use were founded upon it. There used to be a rumour abroad that the late Prof. Henry Smith intended to publish his Geometrical Lectures. That hope is now, we presume, frustrated, but as Mr. Russell's first lessons in Pure Geometry were learnt from Mr. Smith's lectures, and as many of the proofs of the present work are derived from the same source, we must possibly take it as the substitute for the "Geometrical Lectures." The get-up of the text is on the usual lines of the Clarendon Press and is all that one could desire.

Sun, Moon, and Stars: Astronomy for Beginners. By A. Gilberne. (Seeley and Co., Limited).

THIS small book comprises 300 pages of matter, and contains a most interesting account of the various members of the solar system and other celestial objects more remote. The narrative is particularly adapted to a large class of people who desire to know somewhat of the wonders and awe-inspiring phenomena connected with the science of astronomy without making a special study of them; yet sufficient interest is aroused to induce a beginner to search for more information. The work, however, does not claim to be a text book, although to a beginner it will serve as a capital starting-point. It is printed in open and pleasing type, and contains instructive illustrations. A few passages might be somewhat improved upon, as for example, p. 143—

"It is said that a cannon-ball, reposing on the sun, if lifted one inch and allowed to fall, would dash against the ground with a speed three times greater than that of our fastest express-trains."

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.*]

Mr. H. O. Forbes's Discoveries in the Chatham Islands.

UNWILLING as I am to interpose in the discussion between Mr. Wallace and Mr. Forbes (*supra* pp. 27, 74), yet each of those gentlemen having referred to opinions formerly expressed by my brother and myself, it seems fitting that I should offer a few words on the present occasion, if it were only to avoid misapprehension; but I would premise that I have not seen Mr. Forbes's paper read before the Geographical Society or his article in the *Fortnightly Review*. To this I would add that I am no more ashamed of opinions in the utterance of which before the Royal Society in 1868 I took a share, than I am of having then been a quarter of a century younger than I am now. Whether they are to be considered modified by what I published some halfdozen years later, when I next touched upon the subject, I do not greatly care, and leave to the judgment of those (if any there be) who may take the trouble of comparing the passage in the *Philosophical Transactions* (1869, pp. 357, 358) with that in the "Encyclopædia Britannica" (ed. 9, iii. p. 760); and what I now think, or at least thought some eighteen months ago, when the last thing I wrote on the question was passed for press, will I hope be before the public in October.

However I would point out that one thing seems needed to make this discussion real, and that is proof of the assertion, made in NATURE—at first tentatively (xlv. p. 416), then positively (*tom. sit.*, p. 580), and again with fuller details (xlvi. p. 252), that *Aphanapteryx* ever inhabited the Chatham Islands. Mr. Forbes has been so kind as to show me on two occasions the bones which he ascribed to a species of that genus, and I was fortunately able to let him compare them with those of the real *Aphanapteryx* in the Museum of this University, being all that have as yet been recovered from Mauritius. I pointed out to him differences between the remains of the two forms which appeared to me of generic value, and I thought I had satisfied him on this score, since he did me the honour of asking me to suggest a new name for the form which he had discovered. In that view I was confirmed by finding that, shortly after his last visit to Cambridge, he described the Chatham-Islands bird as *Diaphorapteryx* at a meeting of the British Ornithologists' Club on 21 December, 1892, as I learn from its printed *Bulletin* (No. IV. p. xxi.). All this would matter little to any but specialists did it not seem that what Mr. Wallace rightly terms a "tremendous hypothesis" is based on the asserted existence of *Aphanapteryx* in the Chatham Islands, and I understand that, on the strength of the assertion, further daring speculations have been indulged in, to support which Purple Waterhens, extinct or expiring Starlings, and what beside I know not, have been dragged in. Whether the additional evidence is worth anything remains to be seen; but though I fully recognise the importance of Mr. Forbes's discoveries, rightly interpreted, we are as yet without proof that *Aphanapteryx* inhabited any part of the New Zealand Region; and if it did not, then as regards the speculations based upon it *cadit quæstio*.

ALFRED NEWTON.

Magdalene College, Cambridge, 27 May.

The Fundamental Axioms of Dynamics.

REFERRING to my previous article in NATURE on the above subject (May 18, vol. xlviii. p. 62), there are a few explanatory remarks which may be usefully made,—most of them suggested by the recent discussion at the Physical Society, especially as summarised by the President (Prof. Rücker).

There seems to be some feeling against the advisability of ascending successive steps in a ladder of reasoning unless there be already some perception as to what is to be met with on the top. If the ladder shows signs of ending in a medium of unknown and in some respects paradoxical properties, that fact appears to be felt as an inducement to mistrust the steps which lead thither.

But it must surely be admitted that if each rung is in itself firm and strong, and if successive rungs follow one another with a reasonable amount of sequence, then we ought fearlessly to mount and abandon ourselves whithersoever they lead, quite irrespective of dim suspicions about unacceptable consequences.

Some doubt seems also felt concerning the wisdom of attempting to pack important laws into small compass; but to this I plead that the axioms already stated by me are most of them purely Newtonian, and that for the attempt thus to summarise science in as few and simple statements as possible we have the high encouragement of his example. It is true that Newton issued his axioms in a form as perfect as it was reasonable or possible then to make them, and did not bring them out as matter for discussion. But to this two pleadings may be put in:—

(1) That their perfect form did not by any means *prevent* discussion, nor would it have been desirable if it had; it only made the inevitable discussion painful to him instead of pleasant.

(2) That in his day he was minting fresh coins, complete in design and workmanship, for the use of a race which possessed nothing of the kind; whereas now one is partly trying to rub off a little tarnish and furbish up old currency in more modern style, and partly trying to put into circulation a few fresh coins at a time when everybody feels that they have quite as much money as they want.

The step in advance which I believe has now to be made is the explicit introduction of the Ether into the scheme of physics. Newton knew well enough that a connecting medium was a philosophic necessity, but he did not see his way to asserting its physical existence and discovering its properties. Consequently his philosophy was all stated in terms of action at a distance.

But science has progressed since then, and the ether has become accessible in many then undreamed-of ways. It appears to me, therefore, that the time has come for enlarging the Newtonian axioms, on the basis of the labours of Faraday and Maxwell and of other men now living, and for fearlessly following up any consequences to which the new axioms may lead us.

My philosophic creed runs somewhat thus:—First that by our senses we become aware of *motion*; I don't much care by what sense it is, it seems to me by the muscular sense—partly eye muscles perhaps, mainly arm or leg muscles—but it may be by a succession of tactile sense-perceptions as some modern physiologists and psychologists believe. But none of these questions belong to pure physics: somehow or other we *are* aware of Motion and Time and Space. We had already erected the structure of Geometry without invoking motion and time, we now erect Kinematics. And by motion, which is a usefully vague term, I mean nothing less than the whole of kinematics.

Next in order of complexity we become aware of *force* plainly through our muscular or our tactile sense, and thus, indirectly, we gain the tremendously important idea of "matter." The *ratio* of force to motion is *inertia*; one of the most constant and fundamental qualities in the apparent universe. The *product* of force and motion is *activity*, whence arise the complex but brilliantly useful ideas associated with the term *energy*. In elaborating these we erect the whole science of Dynamics.

Thus far the scheme is essentially Newtonian, and the Newtonian axioms may be held to summarise its essentials in the briefest and clearest way. If I presume to restate them it is because the modern terms "acceleration" and "stress," which were not available for Newton's use, assist the expression, so that by their aid some minor difficulties, such as those caused by the phrase "uniform velocity and direction" disappear; this phrase need not have been introduced had a vector acceleration been a thing of easy apprehension or of common knowledge in Newton's time.

Prof. Minchin urges the explicit retention of the first law, not as a measure of time only, but as a qualitative statement introductory to the quantitative assertion of the second; and I fully agree. I should like to take the opportunity of thanking both Prof. Minchin and Prof. Henrici for their careful criticism of my Physical Society paper.

Premising that the necessary definition of terms must be understood or supplied, I now repeat from my former article the essence of the Newtonian laws.

Axiom 1. Without force there can be no acceleration of matter.

Axiom 2. The inertia of matter is unconditionally constant. [*Or*, Acceleration of matter is proportional to unbalanced or resultant force.]

Axiom 3. Every force is one component of a stress, and a stress in a body or system does not accelerate it.

Before proceeding, let me here intercalate a remark about the kind of *scholium* with which, on page 62 (NATURE, vol. xlviii., May 18) I prelude the definitions and axioms. I do not intend the "experimental results" there quoted to be used for teaching purposes; in fact, my present aim is in no respects pedagogic, but more ambitious; I quote them as affording some sort of experimental basis for the Newtonian axioms. An experimental basis is a necessity—in other words, an axiom must be based on some sort of experience; and the experience on which the Newtonian laws are based can hardly be considered as of a very commonplace type.

It is easy to *illustrate* the second law with bits of elastic and trucks on wheels, but it is not so easy to prove it with accuracy—the sort of accuracy attempted, for instance, in the case of the law of Ohm. It is customary to say that Astronomy proves it, but as a logical procedure that would be a terribly circular one; and besides, the nature of gravitation is so singularly unknown that it can hardly with satisfaction be used as a foundation stone.

Anyhow, the proof which by those experiments I *suggest* is, first to establish Hooke's law for a spring, statically, by weights, *i.e.*, to prove that force is proportional to displacement; next to show that vibrations of the spring are isochronous, *i.e.*, that acceleration is proportional to displacement; and thus to deduce that force and acceleration are proportional (in this case at any rate) to a high degree of accuracy. The difficulties, such as they are, of this proof are of a merely mathematical order, and are hence entirely unimportant.

The third "experimental result" quoted is only to suggest the impact experiments which Newton himself considered desirable as a basis for his third law.

One other point before proceeding. With regard to the claim for obviousness, or *prima-facie* certainty, sometimes set up in connexion with a long-known law of nature, on any such ground as that it is a mere assertion that Cause equals Effect:—may I say once for all, and quite impersonally, that such a claim appears to me to be metaphysical nonsense of the worst kind—the kind which has tended to bring real Metaphysics into unmerited disrepute. Is it not plain that everything depends on what is cause and what is effect, and that the interpretation of nature essentially consists in the discovery and accurate specification of what in any given case the true cause and the true effect are?

Now comes the new departure, or extension of the Newtonian axioms, so as definitely to include the medium which it has been one of the chief works of the present century to discover.

The chief axioms I intend to propose and trace the consequences of are:—

Axiom 4. A stress cannot exist in or across empty space.

Axiom 5. Material particles (atoms of matter) never come into contact.

Axiom 6. A stress must extend from one material particle to another: it cannot end in ether.

This last is hardly axiomatic, but it is based on special experimental evidence (Phil. Trans., 1893).

From these laws and from the law that stress is essential to activity (which last does not need a separate statement, being deducible from the Newtonian axioms), a series of what appear to me fundamentally important deductions may be made.

Some of these deductions relate to already known and admitted facts, while others introduce some as yet unknown or unadmitted: the former set are mostly referred to in my paper to the Physical Society, the others must be dealt with hereafter.

OLIVER LODGE.

MAY I make through your columns some criticisms on Prof. Lodge's views of dynamics, which I am afraid I failed to render intelligible to him during the discussion on his paper before the Physical Society?

It would be useless to say anything about his theory of "Contact Action," for he has rendered the whole discussion upon that point nugatory by saying in his reply to the criticisms that he does not admit that any two bodies can ever come into contact at all, *i.e.*, that the contact action he contemplates is something that takes place only between "the bodies" and an "ether" which exists between them. It follows that his own arguments and illustrations, as well as the criticism upon them, are all beside the point, for they all dealt with contacts between "bodies," not between a body and an "ether" in which it was moving. We must therefore begin *de novo*, and we must start this time with some definition or explanation of what he means respectively by "the bodies" and "the ether" which surrounds them.

But the point I particularly wished to discuss was his view of the "identity" of energy. I do not think any such identity can be recognised, at any rate if we grant Prof. Lodge's own hypothesis that energy on being transferred from one body to another is always transformed from Kinetic to Potential energy, or *vice versâ*, for I maintain that potential energy, as such, belongs to a system of bodies not to any particular one of them, and so has no local habitation even though it has a name.

The law of the conservation of energy is usually expressed by the formula—

$$\text{Kinetic} + \text{Potential Energy} = \text{Constant.}$$

But if this is to be a physical law, and not a mere truism, its terms must be defined in such a way that it is not a mere formal consequence of their definitions. As to Kinetic energy, everybody is practically agreed in defining it as $\Sigma\frac{1}{2}mv^2$, or, which is the same thing, as $\Sigma\int mvdv$. But if we define potential energy, as Prof. Lodge would apparently have us do, as $\Sigma\int -Fds$, the formula does not assert a physical fact—at least no new one—but is merely an identity. The equation of energy in this form would, indeed, be quite useless, for we should have to know the previous path of each particle in order to evaluate $\int Fds$. And so we find that in the equation of energy, as used by mathematicians, the "Potential Energy" has nothing to do with any paths the particles may have described, but is a mere function of their present co-ordinates.

The truth is that the physical fact implied in the law of conservation is not that the *energy in general* is conserved throughout all changes in the system, but merely that the *kinetic* energy is always the same whenever the system returns to the same configuration; that term being held, if necessary, to include, not only geometical form, but such conditions as temperature, chemical or electrical state, &c.

The law of energy is then better stated thus: "In any independent system of bodies—

Kinetic energy + A function of the configuration of the system = Constant."

And we may, if we like, call this function "Potential energy," since it diminishes as the kinetic energy increases; but we have no right to assume *à priori* that it is the same sort of thing as kinetic energy. It is true that in some cases what used to be called potential energy is now regarded as in great part kinetic, but this can only be done if at the same time we change our conception of the "configuration" of the system. If we regard the energy stored in a reservoir of compressed air as kinetic instead of potential, we must include the average positions of its particles in our statement of the configuration of the system.

But the important conclusion to be drawn from this is that potential energy (*quâ* potential) does not belong to a single particle but to the system as a whole, or at least it can only be allocated to such portions of the system as may by themselves be regarded as independent systems. If ever all energy were explained to be kinetic energy, and if we could then explain how it comes to be transferred from one body to another, we might be able to trace the biography of a piece of energy as we might that of an atom of matter. But even if "potential energy" may thus be regarded as only a name used to veil our present ignorance of what has happened to the kinetic energy, it is still illogical to talk of the "identity" of energy till this veil has been removed. And I cannot see that anything Prof. Lodge has said helps us in the smallest degree to remove it.

EDWARD T. DIXON.

Trinity College, Cambridge, May 27.

On the Velocity of Propagation of Gravitation Effects.

IF, according to the accepted kinetic theory of gases, the velocities of molecules "vary between zero and infinity" (Maxwell): it must certainly result that frequently enormous velocities are accidentally attained by even gross molecules, and this produces no perceptible disturbance measured by us. It would be admittedly almost puerile to ask how high a velocity might normally be possessed by a large number of particles of matter (as an *à priori* question, that is), provided the particles be perfectly elastic, so that there is no jar at their encounters, but the movement goes on with perfect smoothness, so that its existence may escape detection by the senses. Moreover there is no resistance in space to free motion of material particles.

In regard to the effects of gravity then, the practical question for us (in regard to their elucidation) becomes, What is the velocity demanded for the transmission of gravity? This velocity, whatever it be (if very great, but finite), may then reasonably be considered to exist in matter in some form, or to be possessed by it. To assert *à priori* that the existence (say among particles of matter) of a velocity even many times that of light, is unlikely, or to view this with incredulity as an abstract fact apart from its possible utility—would seem to partake somewhat of the nature of a prejudice, due possibly to absence of adequate reflection.

A high normal velocity has the undoubted mechanical advantage of being able to produce a given dynamical effect by means of very small particles, *i.e.*, without demanding for such effect any large collective mass or the employment of a great quantity of material. Smallness in size moreover allows the particles to possess a very long mean path: and they have the advantage of occupying, *in toto*, very little room (although they may be relatively numerous).

Without going into the question of the *modus operandi* of such effects as explosions of gases, dynamite, &c., it at least appears manifest that by the rejection of "action at a distance," a store of motion of a very high intensity in the matter of space would be consistent with, or would be demanded in order to give some rational account of sudden developments or transferences of motion. It may appear questionable whether a normal velocity of matter in space only equal to that of light, would be sufficient to account for the explosive violence of somt transferences of motion. The rate of travel of light when viewed in relation to the intervening distances of the chief bodies of the universe—may appear even slow. More than three years, for instance, are occupied in the transmission of a wave from the *nearest* star to our system.

It may be reasonable then to assume that the possibilities for the existence of a higher rate of intercommunication than this (that of luminous effects) may exist in nature, and that the bodily mass movements of the units of the universe may influence each other more quickly than their molecular movements; since gravitational disturbances or their measures appear to demand this. It is so far certain that in addition to the luminiferous ether there may be plenty of room for finer and therefore more mobile material: or no one, as far as I am aware, has urged a difficulty on this head, provided its presence were subservient to some great mechanical purpose.

Hamburg, May 16. S. TOLVER PRESTON.

Singular Swarms of Flies.

IT may interest some of your readers if I describe a sight which I saw this forenoon, which was quite new to me and apparently to all who witnessed it. After a brisk N.N.E. breeze in the morning, at about 11 a.m. it fell flat calm, the sky becoming inky black, with every sign of a heavy thunderstorm impending. Soon after, looking out of my office window at a belt of trees some hundred yards away, my eye was caught by a most singular and to me (at first) uncanny sight.

Above the trees, apparently one on each principal prominence of their outline, there appeared a number of slim clouds, like straight wreaths of thin smoke, slanting upwards into the sky. Though they maintained their positions, they seemed alive and moving, in a manner partly suggestive of the twisting motion of a water-spout. A field-glass showed the clouds to be swarms of small flies; and looking around, similar swarms were seen above all the trees everywhere. They were perfectly visible to the naked eye a quarter of a mile off, and the glass showed them on the furthest trees in sight, these being nearly a mile away. All seemed to have much the same peculiar slant, pointing more or less towards the (then invisible) sun. Some of the swarms looked to be fifteen or twenty feet long.

Over a few of the low bushes on a bank of rough ground close by, similar swarms were to be seen. Even these, however, were inaccessible; but I caught some of an apparently similar swarm drifting over the ground between the bushes, and inclose some of the specimens herewith. To me they look just like the insects which ordinarily strew one's table under the lamp at night (I notice, by the way, that to-night there are none, though the window is open as usual), and therefore I am led to suppose that the special character of the swarms noticed to-day appertains to some condition of the atmosphere, and not to the species of insect; but perhaps some of your contributors can throw light on this point. It would also be very interesting to know whether similar swarms were noticed elsewhere to-day, and whether they showed the same slant as was noticed here.

R. E. FROUDE.

Admiralty Expt. Works, Haslar, Gosport, May 27.

P.S.—The swarms of flies disappeared about 1 p.m., as the thunder clouds cleared away.

Popular Botany.

WE do not expect accurate scientific information from journalists; but so much confusion and error are seldom compressed into a small space as are to be found in a paragraph of which I send you extracts, cut from a London daily:—"A sad case of accidental poisoning by wild hemlock is reported from Tyne Dock. A little band of school children playing on some waste ground had gathered a quantity of a common variety of this dangerous plant, known to country folk as 'fool's parsley.' According to the evidence of one of the party, a little girl aged eight named Pringle, her sister 'said it was cabbage, and she should eat some.' Another boy and girl, named Shafter, who were still younger, followed her example. All three were soon afterwards taken ill. One 'complained of her legs as if they were tired'—a common symptom of hemlock poisoning—and 'her head afterwards got bad.' Pringle ultimately recovered under treatment, but the two Shafters on reaching home gradually became unconscious, and died the same afternoon within twenty minutes of each other. This species of hemlock, known to science as the *Conium maculatum*, is said to be much more poisonous in May than in any other month." It would be interesting to know what the plant really was. It can hardly have been the true hemlock, *Conium maculatum*, and instances of fatal poisoning by fool's parsley, *Aethusa cynapium*, are so rare that an authentic record would be valuable. It is difficult to imagine either of these plants being mistaken for cabbage. Can it have been *Cicuta virosa* or *Oenanthe crocata?* It would be interesting if any reader of NATURE could throw light on the subject.

The following delightful paragraph is cut from the same paper a few days later:—

"Can plants see? Darwin gave it as his opinion that some of them can [one would like to know where], and an Indian botanist relates some curious incidents which tend to verify the belief. Observing one morning that the tendrils of a convolvulus on his verandah had decidedly leaned over towards his leg as he lay in an attitude of repose, he tried a series of experiments with a long pole, placing it in such a position that the leaves would have to turn away from the light in order to reach it. In every case he found that the tendrils set themselves visibly towards the pole, and in a few hours had twined themselves closely round it."

ALFRED W. BENNETT.

Gaseous Diffusion.

IN your Notes of last week there is a description of an experiment for showing gaseous diffusion, devised by Prof. v. Dvorák, which, however, does not seem so striking as one that was shown at the Royal Institution more than twenty years ago by, I think, Dr. Odling.

A cylindrical porous battery cell was closed by a cork through which passed a vertical glass tube of about half an inch in diameter. The lower end of the tube was bent upwards into the form of a delivery tube, and was placed in a pneumatic trough, with a cylinder filled with water inverted over the end of the tube. On placing an inverted bell-jar of hydrogen over the porous cell, gas was rapidly collected in the cylinder, and this contained sufficient hydrogen to explode on the application of a flame. On removing the bell-jar, the hydrogen diffused outwards, and water was drawn up the wide tube.

Cooper's Hill, May 29. HERBERT MCLEOD.

NOTES UPON THE HABITS OF SOME LIVING SCORPIONS.

THE literature which treats of the habits of living scorpions is not voluminous, but it labours under the disadvantages of being based largely upon undetermined species, and of being often of questionable trustworthiness with regard to the statements that are made. Even accounts that have been given of late years of the same species of scorpion differ widely as to facts of no small importance. Mons. L. Becker, for instance, asserts that the senses of hearing and seeing are highly developed in *Prionurus australis*, the thick-tailed yellow scorpion of Algeria and Egypt; Prof. Lankester, on the contrary, declares exactly the opposite to be the case. Discrepancies such as these and the deficiencies above mentioned show the need for fresh observations upon the subject, and no further excuse need be offered for publishing the following notes upon the habits of some specimens of two species of scorpions, *Parabuthus capensis* and *Euscorpius carpathicus*, which I was fortunate enough to keep for some months in captivity.

For the specimens of Parabuthus I gladly take this opportunity of expressing my thanks to my friend Mr. H. A. Spencer, of Cape Town, who kindly collected them for me at Port Elizabeth, while acting as medical officer on board the Union Steam Ship Company's s.s. *Mexican;* while for the Euscorpius I am indebted to the kindness of Dr. Gestro, of the Natural History Museum at Genoa. This last genus of scorpion Prof. Lankester has also written about; many of my observations, therefore, merely confirm those of this author. No description, however, has to my knowledge ever been published upon the habits of any species of Parabuthus. This genus, however, belongs to the same family as Prionurus, and the behaviour of the two in captivity seems to be very similar.

There is an abundance of evidence that scorpions are nocturnal, and mine were no exception to the rule. They would spend the daytime huddled together in corners of their box or under pieces of wood; at night they would wander about, presumably in search of food. It was easy, however, at any time during the day to rouse them from their sluggishness by applying a little artificial warmth to the box. One end of the box containing the Parabuthus was closed with a plate of perforated zinc. If this box was placed in the fender at a distance of about a couple of feet from a moderate fire, with the zinc end turned towards the grate, the scorpions would climb upon the metal plate and bask in the warmth. But immediately the box was brought near the bars of the grate they would all clamber or tumble from their position with ludicrous haste. It must not be supposed, however, that the amount of heat required to make them retreat was at all great. As a matter of fact warmth that I could without inconvenience bear for several minutes upon my hand would throw these animals at once into a state of the greatest consternation.

When walking both Parabuthus and Euscorpius carry the large pincers or chelæ well in advance of the head; these appendages thus fulfil the office of antennæ or feelers. In Parabuthus the body, however distended and heavy with food, is raised high upon the legs exactly as Prof. Lankester has described in Prionurus, and the tail is usually carried, curled in a vertical plane, over the hinder part of the back. In Euscorpius, on the contrary, as has also been pointed out by Prof. Lankester, the ventral surface of the body is scarcely raised from the ground during progression, and the tail, which is very slender and relatively much lighter than in Prionurus or Parabuthus, is dragged along, extended, and with a slight curl only at its hinder end. This difference in the carriage of the tail depends possibly upon the difference in its size and weight. For it seems reasonable to suppose that the heavy, robust tail of a Parabuthus or Prionurus is carried with less muscular effort when curled over the back than when stretched out behind as in Euscorpius.

When attempting to climb up the smooth sides of their box the Parabuthus would raise themselves upon the extremity of the fifth segment of the tail, and by keeping this organ perfectly rigid and in the same straight line as the body they could maintain themselves in a nearly vertical position, thus reaching considerably higher than if supported upon the hind legs alone.

The method of digging shallow pits or holes in sand, which Mons. Becker and Prof. Lankester have described in the case of Prionurus, is also practised by Parabuthus. Standing upon the first and fourth pairs of legs, and using the tips of the chelæ and the end of the tail as additional props, with the disengaged legs a scorpion rapidly kicks the sand backwards between the legs of the last pair, very much as a rabbit or rat does when burrowing. Then with the apparent intention of removing what would prove an obstacle to its vision when crouching in the hole, it sweeps aside with its tail the heap of sand that has been thrown up, until the area surrounding its lurking place is tolerably level.

I never saw a Euscorpius digging in the sand. They were usually to be found during the daytime under pieces of wood, to which they were nearly always clinging belly uppermost. It is difficult to explain why this attitude should be assumed. Many terricolous arthropods, however, have the same habit, and I see no reason for thinking that in the case of Euscorpius it has any connection with the copulation of these animals as Prof. Lankester suggests.

All scorpions appear to be carnivorous, and there seems to be little doubt that they live principally upon insects or other articulated animals. My specimens of Euscorpius would eat blue-bottles and small flies, small cockroaches (*E. germanicus*), wood-lice, small spiders, and centipedes (*Lithobius* and *Geophilus*). The Parabuthus were fed principally upon the common house-cockroach and upon blue-bottles. It is interesting to note in connection with this last fact that Prof. Lankester's examples of Prionurus would not eat this common cockroach, nor did they seem to care for blue-bottle flies. This difference of instinct in the choice of food is remarkable, seeing how similar these two scorpions are in other particulars, both of habit and structure.

No one acquainted with the agility of a cockroach and the usual sluggishness of a scorpion would think that the latter would often succeed in capturing the former. Yet in truth, when placed in the same box, the insect seldom has a long lease of life. Its ultimate fate is always due to its ignorance of the scorpion's nature, and to the latter's adroitness in seizing anything that comes within reach. Wandering round the box, and exploring every inch of its new quarters with its antennæ, the cockroach soon discovers the presence of the scorpion by touching it with the tips of these organs. The scorpion's sense of touch, however, is as delicate as the insect's, and the latter's antennæ, or any part of it that happens to be near, is quickly seized by the pincers of the scorpion. Should the latter be disinclined for food and take no notice of the cockroach's first approach, the insect, continuing its wanderings, will fearlessly creep over the scorpion, just as a rabbit will over a python. Obviously this fearlessness must prove its destruction in the end, if not immediately. By means of its agility and strength, a cockroach sometimes eludes the scorpion's first clutch, and sometimes, but not often, breaks away from the latter's hold. But it does not readily learn from its narrow escape the advisability of giving its enemy a wide berth the next time they meet.

Although usually trusting to their heels for escape, cockroaches occasionally resort to a method of self-defence which is sufficiently curious to be described. Advancing upon an adversary rear end foremost, and at the same time wagging from side to side this region of the body, they deliver vigorous backward kicks with their spiny hind-legs. This novel and humiliating mode of fighting, although not likely to prevail long against jaws and stings, is sufficient, nevertheless, to gain sometimes for the insects a temporary reprieve. I have indeed seen a fine female Madeira tarantula spider retreat in discomfiture before a big cockroach of the same sex, which assaulted her in the way described.

As soon as a cockroach is seized the use of the scorpion's tail is seen; for this organ is brought rapidly over the latter's back, and the point of the sting is thrust into the insect. The poison instilled into the wound thus made, although not causing immediate death, has a paralysing effect upon the muscles, and quickly deprives the insect of struggling powers, and consequently of all chance of escape. If the insect, however, is a small one, one in fact that can be easily held in the pincers and eaten without trouble while alive, a scorpion does not always waste poison upon it. Thus I have seen a Parabuthus seize a blue-bottle fly, transfer it straight to its mandibles, and pick it to pieces with them when still kicking. Prof. Lankester only rarely saw his scorpions feed. I was more fortunate and repeatedly watched the operation, which is always performed exactly as this author has described. An insect is literally picked to pieces by the small chelate mandibles, these two jaws being thrust out and retracted alternately, first one and then the other being used. The soft juices and tissues thus exposed are drawn into the minute mouth by the sucking action of the stomach. It would seem, however, that some hard chitinous pieces are also introduced into the alimentary canal, for the entire exoskeleton of a cockroach is rarely, if ever, left after the meal is finished.

Feeding is a slow process; a good-sized cockroach will last a Parabuthus for upwards of two hours or more. But although voracious eaters when the chance presents itself, they are able to endure with impunity starvation of several weeks' duration. Unlike spiders, which are notoriously thirsty creatures, scorpions never seem to need anything to drink. At least none of mine were ever seen to touch water, although a supply of it was at first always kept in their box.

With regard to the higher senses, the only one that seems to be highly developed is that of touch. Mons. L. Becker declares that sight and hearing are excessively developed; but I cannot substantiate this statement in either particular. With regard to hearing, my observations agree entirely with those of Prof. Lankester, who could not detect the existence of any sense of this nature. None of my scorpions ever gave the slightest response to any kind of sound, although they were tried with tuning forks of varying tone and with shouts of both high and low pitch. These animals, in fact, resemble the hunting spiders in being apparently devoid of auditory organs. They further resemble them in the development of their visual powers, being able to see a moving body, like a living cockroach, at a distance of only about three or four inches. Even at a distance less than this they do not seem able to distinguish form. Thus a specimen of Parabuthus excited by the presence of cockroaches in the box, was seen to rush at one of its fellows that crossed its line of vision about two inches off, evidently not recognising by sight a member of its own species, for directly the pincers came in contact with the latter the mistake was discovered, the pugnacious attitude dropped, and no further notice was taken. This last observation shows that more is learnt from the sense of touch than from that of sight, an inference which is further supported by the habit, above referred to, of carrying the pincers well in front of the head as if to feel the way. There is no doubt that the external organs of touch in scorpions are the hairs which thickly or sparingly cover various parts of the body. The tail is often very thickly studded with setæ, and the poison vesicle always has some upon it. Their use upon this latter organ is very plainly seen during the act of stinging. For this act is not by any means a random thrust delivered indiscriminately at any part of a captured insect. On the contrary, a scorpion generally feels carefully for a soft spot, and then with an air of great deliberation delicately inserts its sting into it. There can be little doubt that this care is taken that there may be no risk of damaging the point of the sting against a substance too hard for it. A reckless stab against the resisting chitinous exoskeleton of a beetle, for instance, might easily chip this point and thus deprive the scorpion of its most efficient weapon of attack and defence. The same care of the sting is shown in the carriage of the tail, this organ being curled in such a way that the point cannot come into contact with any foreign bodies. Even when teased with a piece of stick or irritated by being crawled upon by a cockroach, a scorpion is not often sufficiently provoked as to use the sting. The tail is certainly used to knock aside the instrument or sweep off the insect, but the sides or lower surface of the organ are employed, the vesicle being carefully tucked down. Upon one occasion a Parabuthus was seen to kill a cockroach and retire to a corner to eat it in peace, beginning at the tail end. Presently a smaller example of the same species coming along and finding the opposite extremity of the insect disengaged, started feeding on its own account. So quietly was the process carried on by the two, that not until nothing but a few shreds remained did the larger discover the presence of its messmate. Thereupon it quickly brought its tail into use and by beating off its unwelcome guest secured for itself the remains of the meal. But although the provocation was great the defrauded one never attempted to use its sting to punish the intruder.

In connection with the organs of touch, the pectine or ventral combs must not be forgotten. Of the function of these appendages something is known, though no doubt much remains to be learnt. Their situation near the generative aperture, their larger size in the males, and the modification of their basal portion in the females of some species, *e.g.* Parabuthus, suggest that they are tactile sexual organs of some importance, and Gaubert's discovery of the nervous terminations in the teeth is a satisfactory confirmation of this supposition. But apart from sexual functions it is highly probable that they are useful organs of touch in other relations of life, enabling their possessor to learn the nature of the surface over which it is walking. In favour of this view may be adduced the fact that these animals have been seen to touch the ground with their combs. Moreover, it is a very noticeable circumstance that scorpions which, like Euscorpius, creep along with their bellies close to the ground, have very short combs; while in others which, like Parabuthus, stand high upon their legs, the combs are exceedingly long. I once noticed a Parabuthus marching over a piece of a dead cockroach. When she had half crossed it, instead of going straight ahead as was expected, she halted abruptly, backed a little, and, stooping down, started to devour the fragment. From the height at which the body was being carried, I am persuaded that no portion of its lower surface, except the combs, could have come into contact with the piece of food; so there can be little doubt that its presence was detected by means of the organs in question.

Creatures which, like snakes, are both carnivorous and venomous, and present at the same time an appearance which is by no means reassuring, are always held in bad repute by mankind in general, and suffer in accordance with the principle laid down in the adage, "Give a dog a bad name and hang him." But amongst creatures of this description it is probable that scorpions qualify for first place with respect to the number and enormity of the vices with which they have been charged. Those that are most frequently alleged against them are general ferocity, murder, cannibalism, infanticide, and suicide. And yet in spite of this serious charge-sheet, there is no doubt that they are much-maligned animals. For in defence of the accusation of ferocity I can say that I never saw a scorpion use its destructive weapons except with the legitimate object of killing prey for purposes of nutrition, or as a reasonable means of defence when molested. Naturally enough they will not tolerate handling, but when allowed to crawl upon the hand they make no attempt to sting it, and merely evince a desire to escape to surroundings more natural and congenial than human skin. From the charges of cannibalism and murder, however, these animals cannot be so easily cleared. For there is an abundance of evidence that they do sometimes, when in captivity, both kill and eat each other. Nevertheless, so far as my experience goes, members of the same species do for the most part live together in perfect harmony. Once only did I see a large Euscorpius eating a small one. But since the latter showed no signs of violence, there are no reasons for supposing that it had died other than a natural death. Like many other animals, scorpions may be made to fight by artificial means, and when roused to a high pitch of excitement by too much heat, they will clutch and grab at each other with the appearance of the greatest ferocity. But I never saw any evil result from these tussles. The combatants always seemed to prefer to part company without bloodshed.

As for the accusation of infanticide, it appears to be quite groundless. For it is well known that a mother-scorpion protects her young by carrying them about on her back until they are able to shift for themselves.

The question as to whether scorpions do or do not commit suicide by stinging themselves to death, when placed in a circle of fire, or otherwise tortured by that element, is one which has excited a considerable amount of discussion. The belief that they do do so, with the object of escaping from the pains of burning, is of long standing, and probably has many adherents at the present time. But the experiments of Mr. Bourne upon some Madras species have shown (firstly) that the poison has no effect upon the scorpion that possesses it, nor yet upon a member of the same or of a closely allied species, and (secondly) that these animals are easily and quickly killed by a moderately warm temperature (50° C.). Moreover, when distressed by a too warm atmosphere, or, according to Lankester, by chloroform vapour, these animals have a habit of waving their tails in the air and of thrusting the sting forwards over the head, as if to punish some unseen enemy. And if the sun's rays be focussed with a lens upon the back of a scorpion, the animal immediately brings its tail over, and attempts to remove with it the cause of irritation. So that the true account of at least some of the so-called cases of suicide by scorpions seems to be this: the animals in reality have died from the heat to which they were exposed, and the observers have erroneously inferred that the thrusts of the tail were intended to put an end to the animal's sufferings. My own experiments are all in favour of this conclusion. I held a specimen of Euscorpius in a corked test-tube over a low fire. As soon as the air in the tube began to grow warm the animal, apparently in great distress, struggled about the confined space for a few seconds, brandishing its tail the while, then lapsed into insensibility. The glass of the tube at this period was only slightly warm to my hand. Taken out of the tube and placed near an open window, the animal quickly revived; but it died the third time the experiment was tried. On no occasion, however, did it attempt to sting itself. I also experimented upon Euscorpius and Parabuthus by focussing the sun's rays upon them, and by placing mustard upon the membrane between the plates of the back. Both the species attempted to remove the cause of irritation by scraping at the burning spot with the sting of the tail; but they seemed particularly careful not to sting themselves.

There seems, however, to be sufficient evidence to prove that some scorpions have been seen to sting themselves during the course of experiments of a nature similar to those described above. One observer indeed mentions, in the case of an Indian scorpion, that blood issued from the wound made by the sting—a piece of corroborative detail which enhances the probability of the accuracy of the observation. But it is *à priori* improbable that the scorpion has any intention of killing itself. It seems, however, not improbable that a random blow meant for an unseen enemy might accidentally strike and pierce the deliverer; or that when the irritation is localised, as in the cases of burning with a lens, acid, whisky,[1] or mustard, the scorpion, failing to remove the substance by the ordinary means of scraping with the tail, might thrust its sting into the spot affected, with the intention, not of killing itself, but of destroying the agent that is causing the pain. Or, indeed, it is conceivable that the mental faculties are so deranged by torture and the approach of death, that the scorpion does not recognise its own body by its sense of touch, and stings it as it would sting any other object within reach of its tail. If a blow inflicted in either of these ways were to pierce the brain, or were to seriously lacerate the great dorsal blood-vessel, it might, one can suppose, cause death of itself, independently of the burning.

So that if it be admitted that scorpions have sometimes killed themselves, our verdict, it would seem, must be—accidental suicide, or suicide while of unsound mind.

R. I. POCOCK.

NOTES.

WE greatly regret to have to record the death of Dr. Charles Pritchard, F.R.S., Savilian Professor of Astronomy at Oxford. He died at Oxford on Sunday morning last in his eighty-fourth year. We hope to give on a future occasion some account of his career as a man of science.

THE gold medal ot the Linnean Society has this year been awarded to Prof. Daniel Oliver, of Kew, to whom it was presented at the anniversary meeting of the Society held at Burlington House on the 24th inst.

A TABLET erected in Truro Cathedral to the memory of the late Prof. John Couch Adams was unveiled by the Bishop of Truro on Saturday last. Canon Mason, a companion of Prof. Adams at Cambridge, delivered an address, in which he spoke of the illustrious astronomer as "one of the greatest of Cornishmen." The tablet—the cost of which has been defrayed by public subscription—was designed by Mr. Pearson, R.A., and executed by Mr. Juleff, sculptor, of Cornwall. The Latin inscription, a translation of which will be placed near the tablet, is by the Archbishop of Canterbury.

THE new engineering and electrical laboratories at University College, Gower Street, were opened on Monday last by the Duke of Connaught. Many invited guests were present at the ceremony. Mr. J. E. Erichsen, the president of the college, in beginning the proceedings, said it was confidently anticipated that when the two laboratories which were about to be opened were fully equipped with mechanical appliances and electrical apparatus the college would possess every requirement for advanced research and thorough teaching. The cost would not fall far short of £20,000, and the council hoped that a liberal response would be made to the appeal for funds which had been issued, and especially that the great City Companies, which had done so much for education and were so deeply interested in the success of such an enterprise, would give their assistance. Engineering was all-important, not only from a scientific, but from a national point of view, and it was needless to dwell on the importance of increasing the opportunities of the youth of this country for the study of the wonderful science of electricity, which half a century ago was little more than a toy for the learned, but now, through the telegraph and the telephones, entered into the daily life of us all, and before which gas was, it would seem, destined to "pale its ineffectual fires" as an illuminant. It was to be hoped that such laboratories as these would lead to fresh scientific triumphs and further practical developments. The Duke of Connaught, before formally declaring the laboratories open, delivered a short address, in the course of which he said it had been his good fortune to see some of the greatest engineering works in different parts of the Empire, and he was certain that those who, like himself, had seen them would recognize the vast importance of a thorough study of the sciences on which they reposed. Foreign nations were competing with us on all sides, and if we were to maintain the proud position which we had hitherto held we should have to use every endeavour to increase the opportunities of study and of practical work. He trusted that the ceremony of to-day would mark a new era in the history of the college, and would tend to the prosperity and the increased power of engineering in this country.

THE death of Prof. Ernst Eduard Kummer is announced. He died at Berlin on May 14. Dr. Kummer was a Foreign Member of the Royal Society, and at the time of his death was in his eighty-fourth year.

A MEMOIR of the late F. A. Genth was read at a recent meeting of the Chemical Section of the Franklin Institute, and will be published in the June number of the Institute's Journal. It was prepared by a committee specially appointed for the purpose. Mr. Genth is described in the paper as one of the ablest mineralogists, and certainly the foremost mineral analyst, hitherto known in the United States. The writers also speak in high terms of his personal character, and of his remarkable power as a teacher.

MISS AGNES CRANE writes to us from Brighton with regard to an intimation she has just received from the "chief commissioner (Geology) of the Women's Auxiliary Branch of the World's Congress." It is to the effect that the last week in August has been set apart, for a short session during the day, for the presentation of specially-prepared geological papers by women. Such papers are not to exceed half an hour in reading. The co-operation of English workers in this science is invited, and an address to "geological women" will shortly be issued. The chief commissioner in geology is Mrs. Louisa F. Lowery, of 11, Gainsborough-street, Boston, Mass.

A GEOLOGICAL excursion to Dorking will be made by members of the Geologists' Association on Saturday, June 3, under the direction of Prof. Boulger and Mr. T. Leighton, the object being to examine the district described by the directors in a paper read before the Association on December 2, 1892. Arrangements for excursions on the remaining Saturdays of June have also been made.

THE following prize subjects have been recently announced by the Belgian Academy for 1894:—A. Mathematics and Physics. (1) Exposition and discussion of the various theories of diffusion of one liquid into another, with new facts bearing on this; (2) Estimate of theories explaining the constitution of solutions; new experiments throwing light on the subject, and especially on the existence of hydrates in aqueous solutions; (3) The investigations of modern geometers on the theory of the triple orthogonal system to be summarised and

[1] It is stated that in some parts of N. America scorpions sting themselves to death if a drop or two of whisky be placed upon their backs; and that from this manifestation of their dislike of alcohol, these animals are known to the natives as teetotallers.

extended in some important respect. B. Descriptive Sciences. (1) New researches on the intervention of phagocytosis in the development of invertebrates; (2) Description of the phosphate, sulphate, and carbonate minerals of the Belgian region, with indication of beds and localities; (3) New researches on the peripheral nerve-system of Amphioxus, and especially on the constitution and genesis of the sensitive roots; (4) New researches on the mechanism of cicatrisation in plants. The prize in each case is a gold medal worth 600 francs. Further, the Jean Servais Stas prize of 1,000 francs is offered for new researches determining the (at present uncertain) atomic weight of one or several elements. Memoirs may be written in French or Flemish, and must be sent in, with motto, &c., before August 1, 1894. Only manuscripts are allowed.

At the time of our last issue an anticyclone from off the Atlantic was spreading over the south-west of this country, and caused a renewal of the drought in many places in the south and east of England, but in Scotland and the north of Ireland the conditions were less settled, and a moderate gale was experienced in the north of Scotland. The maximum day temperature ranged during the first part of the period from about 55° in some parts of the north to 74° in the extreme south, while the night minima were generally high for the season. During the early part of the present week the barometer continued high, but several small depressions formed over the south and east of England; cold northerly winds spread over the whole kingdom, accompanied by rain in many districts, and a decrease of several degrees in the temperature, the shade thermometer falling to the freezing point in the north of Scotland during the night of May 29. The *Weekly Weather Report* of May 27 showed that the temperature for that period was again above the mean, the average excess being from 3° to 5°. Rainfall was rather more than the mean in the north of Scotland, but less in all other districts. Bright sunshine was more prevalent over England and parts of Scotland than in the previous week; in most parts of England the percentage of possible duration was from 41 to 46, while in Ireland it was 19 to 20, and in the north of Scotland only 17 per cent.

Dr. J. Hann has published in the *Sitzungsberichte* of the Vienna Academy of Sciences some of the results of the anemometrical observations made at the Meteorological Institute at that place from 1873 to 1892. The discussion, which occupies eighty octavo pages, is divided into three sections: (1) the daily period of absolute wind velocity (without regard to direction), (2) the yearly period of the velocity, and (3) the yearly period of the direction. In the two first sections a comparison of similar results for other stations, partly specially calculated for this purpose, has been made. The following are a very few of the results of Dr. Hann's valuable and elaborate work. The wind velocity shows a principal single daily period, with a minimum at 6h. a.m., and a maximum at 1h. p.m. Another secondary minimum is exhibited at 7h. 30m. p.m., and is followed by a secondary maximum at 10h. p.m. The cause of these secondary extremes is found to lie in the daily range of stormy winds; on calm days the secondary extremes disappear. The absolute mean maximum velocity occurs in March, about 14 miles per hour, and the minimum in October, about 10 miles per hour. There also appears to be a secondary maximum in November, and a secondary minimum in January, while from spring to summer there is again a slight increase in the velocity. With regard to direction, the northerly component has its maximum in March and its minimum in October, the easterly component has its maximum in April and minimum in July, the southerly component has also its maximum in April and its minimum in June and, lastly, the westerly component reaches a maximum in July and a minimum in February.

The Royal Observatory of Turin has recently published a work on the climate of that place, prepared by Dr. G. B. Rizzo, which is based on one of the longest series of observations extant. The monthly means and extremes of temperature and summaries of weather are given for 138 years (1753–1890), and the monthly means and extremes of atmospheric pressure for 104 years. The climate of Turin is of the Continental type, but is not very severe, as the mean difference between the hottest and coldest months is only 40°. The mean for January is 33°, and for July 73°; the mean of the annual minima is 13°, and the maxima 93°. The average number of days with rain and snow is 106, and the amount 33 inches. As this long series offers facilities for the investigation of secular variations, Dr. Rizzo has endeavoured to determine the periods of recurrence of hot and cold years. He finds that the observations do not support the period of thirty-five years quoted by Brückner, but that the hot and cold years succeed each other at intervals of about nineteen years. The causes which produce these variations are unknown, but they appear to depend upon local, rather than upon any extra-terrestrial conditions. The years of most rainfall are the coldest, but the series shows no sign of the climate changing, as some persons have imagined.

It is well known that the population of France is made up of many different elements, including, among others, Aquitanians, Ligurians, Gallic and Belgic peoples, Franks, Burgundians, and Norsemen. The Paris Society of Anthropology is strongly of opinion that much might be done to distinguish these various elements from one another, and has accordingly issued a circular in which it indicates to local observers the points about which information is wanted. These relate both to living persons and to human skeletons, or parts of skeletons, found in ancient monuments and elsewhere. Such remains, if there are no local buildings in which they can be placed, will be received by the Society and preserved in its museum.

M. A. de Mortillet contributes to the *Bulletins de la Société d'Anthropologie de Paris* (No. 1, 1893) an interesting note on Manx cats. He points out that the Isle of Man is not the only part of the world in which tailless cats are found. They are very common on the coasts of Japan, and have been cleverly represented by Japanese artists. M. de Mortillet suggests that Manx cats may be descended from specimens brought to the Isle of Man from Japan by sailors.

During a recent stay at Buitenzorg, in Java, Herr Haberlandt made some experiments in the Botanical Gardens there, on the transpiration of tropical plants. In general this was found considerably less than that of plants in Central Europe. Thus of seventeen tropical species, some with coarse, leather-like, others with tender, leaves, nine species transpired per day and per square decimeter surface less than 1 gramme; in six the amount was between 1 and 2 gr.; and in two only it reached 2·6 and 3·25 gr. Now, with European vegetables and woody plants it varies commonly between 2 and 5 gr., and sometimes reaches 6 or 7 gr. or more. This result the author considers a strong argument against the view that the transpiration current is of first importance in nutrition of land plants. These tropical plants, with their small transpiration, show extremely luxuriant vegetation, and are able, through osmotic forces, doubtless, to convey nutritive salts to their highest parts. It is curious that, spite of the great humidity of the air and the large amount of water in the ground, these plants often possess guards against too great transpiration, such as thick, cuticularised epidermis, deeply sunk stomata, and especially tissues adapted for storage of water. And the reason cannot lie, as sometimes at the coast, in the presence of salt in the ground. Herr Haberlandt finds an explanation in the fact that while he total transpiration is comparatively small, the hot sunny forenoons may occasion large evaporation. The transpiration in a forenoon hour was, in general, four to twelve times that in an afternoon hour; sometimes as much as twenty or thirty times. The forenoon hours are by far the most favourable to assimilation, and it is most important to the plant that its turgescence be not then too much depressed, an end accomplished through those water reservoirs.

THE last issue of the memoirs of the Novorossian (Odessa) Society of Naturalists (vol. xvii. 3) consists of a very elaborate work in French, "Monographie des Turbellariés de la Mer Noire," by Dr. Sophie Pereyaslawzewa, ex-director of the Sebastapol Biological Station. The title of the work does not, however, exactly render its contents, as the author has not only given a monograph of forty-five species of Turbellariæ from the Black Sea, of which twenty-nine species and the genus, Darwinia, are new; she deals also with the anatomy and embryogeny of the Turbellariæ, and presents them in a new light. The striking likeness between a young Accela and an Infusorian—she says—must probably be considered as the cause of the many errors committed as regards the Turbellariæ altogether. Various authors have differed immensely in their description of the Accela; some have found in it no digestive cavity, others have denied the histological differentiation of the teguments; others, again, have denied the existence of a nervous system. It might have seemed that such instances would soon have been dissipated when carefully-prepared sections were resorted to; but the sections, made by different explorers, seemed to support the same views, as known from the works of Graeff and Goethe. Mrs. Pereyaslawzewa now maintains, and supports her affirmations by carefully-prepared sections, that the Accela has a nervous system, almost simultaneously discovered by Metchnikoff, herself, and Delage, and demonstrates that it possesses also a pharynx and a digestive cavity; that its teguments are histologically differentiated, and that the name Acæla is not applicable to adult individuals, so that she has felt bound to change this name into *Pseudo-acoela*. This very elaborate monograph being published in French, it is accessible to all men of science. It is illustrated with sixteen well-printed plates, lithographed in Warsaw, from the author's own drawings.

IT is known that certain plant-stuffs (alkaloids, tannin, oxalic acid, &c.) protect plants from attack by animals. This function, in the case of oxalic acid, has been recently studied by Herr Giessler (*Jenaische Zeits.*), taking species of rumex, oxalis, and begonia. The acid mostly occurs in the epidermis and peripheral tissues of the vegetative organs; parts underground have little or none. The leaves show most, but the acid may be found in the stem, and the leaf and flower stalks. Curiously, it does not, like other protective matters, appear in young organs. The older and more sappy the tissues, the more oxalic acid do they contain. Snails, which avoided those plants in the natural state, ate them when the oxalic acid had been precipitated. The substitution of various means of protection for one another was elucidated by Stahl; plants not protected mechanically have chemical protection, and *vice versâ*. In the plants studied by Herr Giessler mechanical protection is deficient. Further, in organs that have little or no oxalic acid, is found tannin. These two "vicariate" with each other also in different species of a genus. In many tissues both occur together. The protective function of a secretion, lastly, does not exclude other functions. Thus, regarding the epidermis as a water-reservoir, the osmotically very active organic acids doubtless play an important part in the filling of the cells with water. The occurrence of begonia and oxalis species in very dry places, as also the deficiency in means of protection against transpiration, more pronounced the higher the quantity of acid, put this function of oxalic acid in a still clearer light.

PROF. SOLLAS, F.R.S., communicated a paper on the granophyre of the Carlingford and Morne mountains to a recent meeting of the Royal Irish Academy. The granophyre is everywhere intrusive into the gabbro, and owing to the contrasted character of the two rocks it is possible to trace out their relation in the fullest manner. The behaviour of the granophyre is of great interest; from wide dykes, comparatively few in number, it passes into innumerable thin lamellar injections, which seam the gabbro through and through. These can be further followed into cracks of microscopic minuteness, and these swell out at intervals into ganglia, which give a white spotted appearance to the otherwise almost black gabbro. The ganglia are granophyric infillings of what were once drusy cavities in the gabbro, and it is suggested that the quartz so frequently found in gabbro associated with granitic rocks, as *e.g.*, at Carrock Fell, is of a similar origin. Of equal interest is the abundance of gabbro fragments included in the granophyre, and since the mineral constituents of the gabbro present features peculiarly easy to recognise, there is no difficulty in following the changes which they have suffered in consequence of their immersion in the originally molten granophyre. Thus the Bytownite, which frequently occurs as phenocrysts in the granophyre, has frequently become surrounded by a marginal zone of orthoclase, and the diallage can be traced into amphibole and biotite and colourless granules of pyroxene, which either remain in clusters about their place of birth or are dispersed throughout the rock. It would, indeed, appear that the ferro-magnesian constituents of the granophyre which have led observers to designate it as syenite and augite granophyre are entirely derived from the grabbro, and it hence becomes an interesting question to consider whether in numerous other instances rocks intermediate in composition to the extremely acid and basic rocks with which they are associated may not also have arisen from the admixture of two already differentiated magmas, and not by the progressive modification of a single original magma.

AT a recent exhibition by the French Société de Physique, MM. Macé de Lépinay and Perot showed a lecture-experiment illustrating well the phenomenon of mirage. A long vessel with plane sides contains a saline solution, on which is poured some distilled water. By diffusion, the liquids gradually mix and form a layer in which the density varies in a continuous way. If now a ray be sent, by means of a reflector, slightly upwards in the axis of the vessel, it describes a curve, passing through a maximum and descending. Its trace on a vertical plate of ground glass traversing the tube throughout its length, shows exactly the path taken, and gives a very pretty effect. On the same occasion, M. Pellin exhibited photographs of the fine gratings produced by Prof. Rowland, of Baltimore, whereby fine lecture experiments in diffraction can be produced at but small cost.

AN elegant method of optically studying the process of diffusion in liquids is described by Herr O. Wiener in *Wiedemann's Annalen*. It is somewhat similar to MM. de Lépinay and Perot's beautiful imitation of the mirage, and consists in sending a beam of parallel rays through a vessel containing two liquids of different density and refractive power. A trace of fluorescein makes the path of the rays visible, and shows that they are bent away from the less highly refracting liquid in the region where diffusion is taking place. By carefully pouring a layer of carbon bisulphide on to one of chloroform, and a layer of alcohol on the top of both, it is possible to make the beam describe a wavy path, due to alternate refractions by the alcohol and the chloroform, both of which are less highly refractive than carbon bisulphide. For the purpose of minutely investigating the process another arrangement is adopted. Parallel rays of monochromatic light are sent through a slit at 45 degrees to the horizon, and pass through the diffusion vessel on to a screen. The dividing surface is indicated by a decided upward or downward bend of the line on the screen, which becomes gradually less pronounced and more evenly distributed as diffusion equalises the refractive indices. The amount of vertical displacement at each point of the curve measures the difference of concentration in the region traversed by the ray. The constant of diffusion can be calculated from the rate of change of the diffusion curve, and the displacement of the point of maximum bending indicates the lesser diffusivity of the liquid towards which it takes place. Herr Wiener has also successfully applied the method to the determination of the thermal conductivity of water by photographing the diffusion curve in various stages.

THE question as to whether there is a true hysteresis in the case of dielectrics has received considerable attention lately, and Arno, Hess, and Janet have published the results of extensive researches on this subject. A note by M. Charles Borel in the current number of the *Comptes Rendus* has some bearing on this point. He suspends a disc of paraffined paper by its centre in front of a plate which is charged, by means of a rotating commutator, alternately positively and negatively. The duration of the charge was 0·006 second, and between charges of opposite sign it was put to earth for an equal intervals When a glass rod is placed on one side of the disc, so that the plane of the disc and the axis of the rod are parallel to the lines of force of the field, and the end of the rod nearest the charged plate is slightly inclined towards the disc, the latter is rotated. This rotation can be explained by the mutual action of the residual charges in the disc and glass rod when the charged plate is earthed. Different specimens of glass produced very different results on the suspended disc, some having no effect whatever. The replacement of the disc of paraffined paper by one of mica had little effect, while discs of pure paraffin or ebonite showed only a feeble effect. It was found that rods formed of conductors or of good insulators, such as ebonite and shellac, produced a feeble rotation in the opposite direction to that produced by most dielectrics. If the rotation is really due to the residual electrification of the disc or rod this rotation in the inverse direction may be expected whenever the rod has no residual electrification. The effects of crystals held in different directions was tried, and it was found that, in general, the deflection varied with the direction of the crystal, which was normal to the charging plate.

Wiedemann's Annalen for May contains a paper by Herr J. von Geitler on the reflexion of electrical waves in wires. The waves were generated by means of the arrangement used by Blondlot, the secondary circuit being connected to two parallel wires 280 metres long. The variation of potential along these wires was measured by means of a differential electrometer, consisting of a double aluminium needle suspended by a quartz fibre before four metallic plates. These plates were connected, two and two, to the parts of the wire whose difference of potential had to be measured, in such a way that the attraction between the pairs of plates tended to turn the needle in opposite directions. The experiments show that if a series of electrical waves travel along two equal and uniform parallel wires there is a regular loss of phase and partial refexion wherever the parallelism of the wires is destroyed, or wherever there is a change in the diameter of the wire. The same effect is produced by joining the plates of a condenser to the two wires at any point. The curves showing the connection between the electrometer throw and the length of a branch circuit attached to the main wires are of a very curious form, and owing to the loss of half a wave length at the reflexion at the end of the branch circuit in one case, the curve obtained when the ends were separate was the exact inverse of that obtained when the ends were joined together.

MR. W. ROE contributes to the *Agricultural Journal*, of Cape Colony (April 6) an interesting paper on some of the disadvantages that may result from irrigation. Most water used for irrigation contains variable quantities of soluble salts, more especially soda salts, chlorides, and sulphates, not taken up largely by plants. Every application of water, therefore, adds to the saline ingredients of the soil—a very different effect from that of excess of rain water, which so far as there is open subsoil for it to drain away would be likely to take out rather than add to the soluble salines in the soil. This mischief, accumulation of salts in the soil, is aggravated in a dry-air land where evaporation is great. The air, acting like a sponge on a surface, takes up the water, leaving the accumulated salts in the surface soil. But this surface soil is as the sponge to the layer beneath. Constantly after each water-leading the water is drawn to the surface, and evaporated, and its measure of salts left behind. Obviously the harm done by this accumulated salt will depend on the nature and quantity of the salines in the water used, as also upon the quantity of water applied. A good quality of river water may vary in having five to twelve grains to the gallon of soluble salts ; more than this becomes risky, unless the sub-soil is very porous.

THE Rugby School Natural History Society has issued its report for the year 1892. The report, as the editor explains, differs from those of previous years in that the papers included in it deal solely with the natural history of the neighbourhood. They are all, with one exception, reprinted from the Rev. W. O. Wait's "Rugby, Past and Present," and as in the main they are written by old members of the Society, they may be regarded as presenting a kind of summary of the Society's work from its foundation to the present day.

A PAPER on the Siyin Chins, by Major F. M. Rundall, is included in the third volume of the "Supplementary Papers" of the Royal Geographical Society, and has also been printed separately. The author knows the Chin Hills well, and gives a very interesting account both of them and of the tribes by which they are inhabited. The paper is accompanied by a map.

THE new instalment of the proceedings of the Geologists' Association includes the presidential address of Prof. J. F. Blake, delivered on February 3. It deals with the basis of the classification of Ammonites.

AN essay on the laws of heredity, read originally by S. S. Buckman before the Cotteswold Field Club, has been translated into German, and issued as one of the series of "Darwinistische Schriften," published by Ernst Günther, of Leipzig. The German title of Mr. Buckman's work is "Vererbungsgesetze und ihre Anwendung auf den Menschen."

MESSRS. CROSBY, LOCKWOOD AND SON will issue in a few days an English edition of the "Handbook of the Steam Engine," by Herm. Haeder. The editor and translator of the English edition is Mr. H. H. P. Powles.

"A CONTRIBUTION to the Chemistry and Physiology of Foliage Leaves," by H. T. Brown, F.R.S., and Dr. G. H. Morris, has been reprinted, by Messrs. Harrison and Sons, from the "Journal of the Chemical Society," May, 1893.

THE Entomological Society of London has issued a catalogue of its library. The work has been edited by G. C. Champion, hon. librarian, assisted by R. McLachlan, F.R.S., and D. Sharp, F.R.S. Great additions to the collection have been made since the last printed catalogue was published in 1861 ; but there are still certain deficiencies, and Mr. Champion expresses a hope that some of these may be speedily supplied by Fellows, and that the publication of a separate Appendix may thus at no distant date be rendered necessary.

A COMPREHENSIVE study of the nature of the dissociation of hydriodic acid gas by heat, the conditions of equilibrium of the dissociated constituents, and the circumstances under which recombination occurs, has been made by Prof. Victor Meyer and Herr Bodenstein, and their results are contributed to the current number of the *Berichte*. The investigation was conducted upon similar lines to Prof. Meyer's recent experiments upon gaseous mixtures of hydrogen and oxygen, a series of a large number of equal-sized bulbs connected by capillary tubes being simultaneously filled with the pure gas and subsequently sealed and separated by fusion of the capillaries. In commencing the experiments Prof. Meyer was surprised to observe the comparative readiness with which gaseous iodine and hydrogen unite without the aid of platinum sponge or other condensing agents. If a glass tube containing a little iodine is filled with hydrogen, sealed, heated in a bath of the vapour of boiling sulphur, and after cooling opened under water, a considerable escape of pent-up hydriodic acid gas occurs, and the water immediately afterwards ascends in the tube owing to the absorption of the remainder. The hydriodic acid for the purpose of the experiments was all prepared by the direct union of the pure elements, inasmuch as the gas prepared by the usual method from iodide of phosphorus was always found to contain admixed volatile phosphorus compounds. The preparation was conducted by leading the mixture of iodine vapour and hydrogen over heated platinised asbestos, when it was found that 86 per cent. of the iodine entered into combination. The product, after passing through a suitable vessel in which the uncombined iodine was condensed, was received in cooled water, the gas regenerated by warming the fuming aqueous solution, and finally freed from moisture by leading it over phosphoric anhydride and from the last traces of free iodine by passing it over red phosphorus free from yellow phosphorus and lower oxides of phosphorus. The hydriodic acid gas thus obtained proved to contain no perceptible trace of impurity. Before proceeding to fill the bulbs the air was expelled from them by means of a current of pure hydrogen, which was allowed to pass through them for 24 hours, with occasional heating to near the softening point of the glass in order to remove the film of condensed air adhering to the surface of the glass. The hydrogen was finally displaced by pure hydriodic acid and the bulbs sealed. These extreme precautions, which were adopted in order to secure a number of specimens of pure hydriodic acid, afford a striking example of the infinite pains which are required to effect the final settlement of many of the apparently simple problems of elementary chemistry.

PROF. MEYER has definitely decided the question of the action of light upon pure hydriodic acid gas. Bulbs exposed upon the roof of the Heidelberg laboratory during the summer months became filled in a few days with large brilliant crystals of iodine. After ten days' exposure 58 per cent. of the gas had been dissociated, and at the end of the summer 99 per cent., or practically all. The fact that the waves of light are so active in effecting dissociation rendered it imperative that the thermal experiments should be conducted in the dark. The whole of the above experiments in connection with the preparation of the gas and the filling of the bulbs were therefore conducted in a dark room. The thermal results may be very briefly summarised. The statement in text-books that hydriodic acid commences to dissociate at 180° is incorrect. It is only in presence of admixed air that this occurs. At 310° the decomposition of the pure gas is so slight that it would take 2,000 hours to attain the point of maximum dissociation at which equilibrium is established. This point was determined indirectly to be attained when 0·1669 of the original quantity of gas was dissociated. At the temperature of the vapour of boiling mercury (350°) equilibrium was found directly to be established when 0·1731 was decomposed. At 394° (boiling retene) 0·1957 was dissociated, and at the temperature (448°) of boiling sulphur 0·2150. It is of particular interest to learn that Prof. Meyer has further proved by direct experiment that the formation of hydriodic acid from gaseous hydrogen and iodine proceeds at any temperature until exactly the same condition of equilibrium is attained as in the corresponding dissociation experiment. Thus when the synthesis of hydriodic acid was conducted at the temperature of sulphur vapour the reaction proceeded until only 0·21 of the elementary gases remained uncombined, the same amount as was dissociated when starting with the compound gas. Perhaps the most interesting result of the investigation is that concerning the rapidity of the dissociation. It has been found that whenever two bulbs of equal size are heated for equal lengths of time precisely the same amount of decomposition or of formation occurs. The reaction is thus found to proceed with strict regularity, the amount of dissociation or of synthesis at any fixed temperature being a direct function of the time, and capable of expression by a simple mathematical formula which is given in the memoir and which is amply verified by a large number of experiments.

NOTES from the Marine Biological Station, Plymouth.—Last week's captures include the Mollusca *Eulima distorta* and *Rostanga coccinea*, the Isopoda *Anthura gracilis* and *Munna Kröyeri*, and the Brachyura *Eurynome aspera* and *Portunus marmoreus*. The gelatinous alga, which has been so abundant in the townettings since the beginning of April, has at length almost completely disappeared. Swarms of the Leptomedusæ *Irene pellucida* (half-grown) and *Obelia lucifera* (full-grown and mature) have repeatedly been taken; but for some weeks past an occasional specimen of *Corymorpha nutans* has been the only representative of the Anthomedusæ. A single large *Bipinnaria* larva has been observed. On the shore young individuals of this year's growth of the Nemertines *Amphiporus lactifloreus* and *Lineus obscurus* (= *gesserensis*), and of the Crustacean *Carcinus mænas* are now plentiful. The following animals are now breeding:—Several *Terebellidæ*, the Opisthobranch *Philine aperta*; the Crustacea *Virbius varians*, *Portunus marmoreus*, *Stenorhynchus phalangium* and *tenuirostris*.

THE additions to the Zoological Society's Gardens during the past week include a Common Hedgehog (*Erinaceus europæus*, white var.) from Berkshire, presented by Mr. R. T. Hermon-Hodge: a Ruddy Ichneumon (*Herpestes smithi*) from India, presented by Mr. Maurice Welsh; a Guillemot (*Lomvia troile*) British, presented by Mr. H. B. Hewetson, F.Z.S.; two Ringhals Snakes (*Sepedon hæmachetes*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; an Aurora Snake (*Lamprophis aurora*) from South Africa, presented by Mr. T. E. Goodall; a Levaillant's Amazon (*Chrysotis levaillanti*) from Mexico, a Grey Parrot (*Psittacus erithacus*) from West Africa, a Cardinal Grosbeak (*Cardinalis virginianus*), a Rose-breasted Grosbeak (*Hedymeles ludovicianus*) from North America, deposited; a Jaguar (*Felis onca*, ♀) from South America, two Striped Hyænas (*Hyæna striata*, ♂ ♀) from North Africa, a Black-necked Swan (*Cygnus nigricollis*, ♂) from Antarctic America, twelve Green Lizards (*Lacerta viridis*) South European, purchased.

OUR ASTRONOMICAL COLUMN.

THE ECLIPSE OF APRIL, 1893.—M. Bigourdan communicates to *Comptes Rendus* for May 23 (No. 21) a brief preliminary account of his observations made during this total eclipse of the sun. The station he occupied was Joal (approximately Longitude 1h. 16m. 38s. E. of Paris, and Latitude 14° 9′ 25″ N.)

and the observations were made from the Observatory erected by the Expedition of the Bureau des Longitudes. With an eye-piece magnifying 190 times he observed several occultations of solar spots by the moon, and in about fifteen cases he noticed the phenomenon that is equivalent to that seen in observations of the Transit of Venus and known as the black drop. It was produced, he says, not only at the contact of large spots, but at the point of contact of small ones, and even of the simple filaments forming the penumbræ of spots. M. Bigourdan also made a special look for the phenomena known as Baily's beads, sometimes seen when the sun has been reduced to a very fine crescent by the advance of the lunar disc, but from all accounts he seems to have been unable to see any trace of them. A search round the sun for an intra-Mercurial planet, with a telescope giving a field of 25′, was also made, but with no satisfactory result, since he says that his instrument was not suited for that purpose: the negative result thus obtained affords no argument against the existence of such a body. The duration of totality lasted exactly 4m. 1s.

FINLAY'S COMET (1886, VII.).—The following is the current ephemeris of this periodic comet, as given in *Astronomische Nachrichten*, No. 3164:—

12h. M.T. Paris.

1893.	R A. (app.) h. m. s.	Decl. (app.) ° ′
June 1	0 40 53	+1 15·6
2	45 24	1 44·6
3	49 55	2 13·9
4	54 29	2 43·2
5	0 59 4	3 12·5
6	1 3 41	3 41·9
7	8 18	4 11·3
8	1 12 56	4 40·6

AURORA OBSERVATIONS.—In the event of Lieut. Peary's expedition to a high station in North Greenland (about Lat. 77° 30′ N. and Long. 70° 15′ W.), where regular observations of the aurora will be undertaken, it is hoped that everyone, wherever he may be, will help to supplement these observations by noting himself the times of absence and presence of this phenomenon. With so many workers in so many lands, it is needless to say that a systematic method of recording what is seen should be followed. With the intention of supplying this demand, Mr. M. A. Veeder has issued a set of blanks similar to those that will be used in the expedition, so that when properly filled up comparisons can be made in detail. In addition to the investigation of the local distribution of the aurora, it is hoped that the electro-magnetic conditions of solar origin may be more inquired into, and it is on this account that these circulars have been sent to both solar and magnetical observatories as well as to individual observers. As for the Arctic records, they will be continuous whenever observation is possible, relays of observers connected with the expedition relieving each other. In making such observations it is emphasised here that minute descriptions of the formation of arches, streamers, prismatic colours, and the like, accompanying such variations in the extent of displays, are of interest, but are far less important than that the times should be noted as accurately as possible. Any one desiring these blanks can be supplied directly by applying to M. A. Veeder, New York.

THE CONSTANT OF ABERRATION.—Prof. Chandler, in the *Astronomical Journal* (No. 296), gives the third of his most important papers relating to the constant of aberration, treating in this article specially of Struve's Prime-Vertical Observations, 1840–55, from the new point of view with respect to the variation of latitude. In this discussion, in addition to a direct solution for all the unknowns, he has made an indeterminate one, employing the constants pertaining to the 427-day term, and expressing the unknowns in terms of y and z. As regards the former solution, employing the observations of the seven stars from the years 1840–42, the value of the observations obtained is 20″·533, Struve's value from the same material being 20″·445, and for the whole data from 1840–55 the aberration is 20″·514. This last-mentioned value would be the "definite value from Struve's Prime-Vertical Observations, if we accept the direct solution as the best," but he says the *indeterminate* solution throws doubt upon this point. The definite value, as given by this solution, gives $20''\cdot481 + 0\cdot111y + 0\cdot230z$; and, since as yet the most probable values of these constants are not known, those of the 427-day period applied to the special case of Polaris, which were independent of the aberration, give, on this assumption, 20″·474, a value, as will be noticed, smaller than that by the direct solution. The value 20″·500 for the aberration constant is, according to Prof. Chandler, too great, as inferred from the discussion here given. As a "matter of interest" he gives the values of the aberrations deduced from the observations of the several stars made in 1840–42.

THE ASTRONOMICAL DAY.—"Is it desirable, all interests considered, that on and after January 1, 1901, the astronomical day should everywhere begin at mean midnight?" This is the question that has been put forward by a joint committee of the Canadian Institute and the Astronomical and Physical Society of Toronto, and printed in a circular-letter addressed to astronomers of all nations. Many of our readers may remember that as far back as 1884 the Washington International Conference carried unanimously the following resolution, there being representatives of twenty-five nations, "counting among them several astronomers of world-wide fame," that "the conference expresses the hope that as soon as may be practicable, the astronomical and nautical days will be arranged everywhere to begin at mean midnight." That the astronomical and civil day should start together at the same moment seems without doubt the right method of procedure, for what is gained really by reckoning the astronomical time from noon and the civil from the preceding midnight? It is true that changes will have to be made in the *Nautical Almanac*, and all such-like year-books, both astronomical and nautical; but on the assumption that the change is made simultaneously by all nations, and taking into account that such a change cannot come into vogue for five or six years on account of the fact that these books are printed a few years in advance, there seems really no difficulty ahead. The suggestion that the change, if made, should take place with the change of the century seems to be an excellent epoch for such a transition, for besides giving time for a thorough discussion of so important a question, it will, as Otto Struve says, "stamp itself on the memory of all who hereafter would be busied in the investigations in which exact chronology plays a part."

ROYAL OBSERVATORY, GREENWICH.—The Annual Visitation of the Royal Observatory at Greenwich by the Board of Visitors takes place on Saturday, June 3 next. The Observatory will be open for inspection at 3 p.m.

GEOGRAPHICAL NOTES.

DR. NANSEN writes confirming the statement made in this column as to the baselessness of the assertions regarding the failure of his expedition. He is making rapid progress with his preparations, and expects to sail in the *Fram* on his great venture on June 20.

THE most recent change of name in Africa is the adoption of the official title Niger Coast Protectorate for what was previously known as the Oil Rivers Protectorate, comprising the coastward part of the Niger delta.

NATAL, which has been a British colony for fifty years, has entered upon the final stage of colonial independence by the adoption of responsible government. It is expected that this step will lead to a rapid development of the resources of the country, and a considerable extension of its railways.

THE Antarctic whaler *Balæna* put into Portland Roads for coal on May 25, and reached Dundee on May 30, being the first to return. Mr. W. S. Bruce, who was on board as surgeon and in charge of scientific observations, reports that the homeward trip was favoured by very fine weather. He confirms our fear that opportunities for scientific work had often to be lost on account of the purely commercial character of the trip, and the rigid interpretation of his instructions by the captain. An account of the voyage and its results will probably be given to the meeting of the British Association at Nottingham. On the return journey a series of floats was thrown overboard from the Antarctic ice-margin to the equator, in order to endeavour to get light on the direction and speed of the currents. The lowest air temperature experienced amongst the ice was 21° F.

THE new number of the *Geographical Journal* publishes an old minute of a committee of the Royal Geographical Society held in 1845 to consider the nomenclature of the oceans. At this meeting Sir John Franklin took part, and as he sailed on his last voyage shortly afterwards it is possible that his absence prevented the matter from being further discussed. The provisional resolution come to by the committee was to give the following names and limits to the oceans :—Arctic Ocean and Antarctic Ocean, to the waters lying within the Arctic and Antarctic Circles respectively. The Atlantic and Pacific Oceans stretched from the Arctic to the Antarctic Circles, and were separated from each other by the meridian of Cape Horn. The Indian Ocean extended from India to the Antarctic Circle, divided from the Atlantic by the meridian of Cape Agulhas and from the Pacific by that of the south point of Tasmania. Mr. Arrowsmith, the eminent cartographer, was present at the meeting, and it is customary in Continental works to refer this systematic definition of the oceans to him. As a matter of fact his maps had a great deal to do with the nomenclature acquiring popularity. The committee proposed a triple sub-division of the Atlantic and Pacific into a northern, southern, and inter-tropical part. This has not come into general use. It is time that the question of oceanic nomenclature should be seriously considered again, and that the morphology and physiology of these great features be taken into account as well as their superficial outlines in determining a scientific classification.

THE IRON AND STEEL INSTITUTE.

A MEETING of the Iron and Steel Institute was held on Wednesday and Thursday of last week, May 24 and 25. There was a somewhat short programme, only five papers being on the agenda, and one of these was not read. There were, however, two additional papers afterwards brought in, but they were only read by title, and as they were not discussed, had very little influence on the proceedings. The papers read were as follows :—On the elimination of sulphur from iron and steel, by J. E. Stead, of Middlesbrough ; on the Saniter process of desulphurisation, by E. H. Saniter, Wigan ; notes on puddling iron, by John Head ; on the recording pyrometer, by Prof. W. H. Roberts Austen. On the members assembling on Wednesday morning, the president, Sir Frederick Abel, occupied the chair, and the usual formal business of reading the minutes was first undertaken, after which the report of the council was read by the secretary, from which it appears that the advance of the institute in respect to membership has not been altogether satisfactory of late. The resignation of the secretary, Mr. Jeans, was also mentioned. The opportunity has been taken by the council, of Mr. Jeans's retirement, to introduce some modifications in the secretarial and editorial arrangements. Mr. Bennett H. Brough, an Associate of the Royal School of Mines, who has for some time past been an assistant professor at the Royal College of Science, has been appointed to the office of secretary and editor to the institute.

Sir Frederick Abel next evacuated the presidential chair, which was then occupied by Mr. E. Windsor Richards, the new president. Mr. Richards is an excellent representative of the practical steel manufacturer, having been engaged in the iron and steel trades all his life. He was for some time manager at the important steel works at Eston in Middlesborough. Some time ago he vacated his position there to take the management of the Lowmoor Iron Works, an establishment almost classical in its antiquity, in an industry which has been so entirely reformed within the last few years. Lowmoor, however, keeps to its old traditions and still produces best Yorkshire iron in the manner practised from a period extending back into the early days of iron manufacture, and this in spite of the improvements and advances made in the manufacture of mild steel. Mr. Richards having been conducted to the chair, at once proceeded to deliver his inaugural address. One of the most important parts was his reference to the remarkable extent to which English steel is made from foreign ore. It is, of course, unnecessary to state at any length the reason for this, as the fact must be well known to nearly all our readers. The iron ores of Britain, upon which our engineering supremacy was so long supposed to rest, is, with some not very important exceptions, unfitted for the production of ingot iron, more generally known as Bessemer, or mild steel. The chief reason for this is the considerable percentage of phosphorus it contains. We have, however, in Lancashire and Cumberland, hæmatite ores which are of a suitable description, but these are not so largely worked as at first might be thought they would be, and the bulk of hæmatite ore required for steel making in England is brought from Bilbao, in North Spain. It has been generally thought of late that these deposits are being rapidly exhausted, and though the use of calcium will perhaps somewhat extend the life of the supply, the end may be sufficiently near to the present time to make it worthy of the serious consideration of steel makers. In the basic process, there is, however, a means by which our native phosphoric ores can be rendered suitable, to a large extent, for steel making purposes, and the successful working of the basic system is therefore a matter of national concern. In England, the process has received serious opposition. Perhaps we have been over-conservative in this matter ; or perhaps, on the other hand, we have displayed no more than salutary caution. However this may be, the Germans have gone far ahead of us in the production of basic steel. Germany, like England, has large deposits of phosphoric ore and, unlike England, has not that free sea communication with Spain, which has rendered the importation of hæmatite ores a matter of little difficulty and small expense. It was natural, therefore, that Germany should take hold of the new system with less caution and more vigour than the English steel makers, but the result has been somewhat antagonistic to English interests. Mr. Windsor Richards, in his presidential address, told us that the west coast of England has raised $2\frac{3}{4}$ million tons of ore, free from phosphorus, and could probably increase that quantity to produce $1\frac{1}{2}$ million tons of pig iron, should the demand arise. During the twelve months ending December 1892, the quantity of basic steel made in England was 406,839 tons. In Germany and Luxemburg 2,013,484 tons of steel were made from phosphoric ores.

Mr. Windsor Richards is now, as we have said, an "ironman," which seems a curious thing in the present day, after he has held, perhaps the most important position of his time in the steel trade ; however, there is yet a large demand for Lowmoor iron, and the old-fashioned methods of production are still in vogue. Of this he gave some very interesting particulars. The address dealt at some length with the question of over-production, and it seems pretty evident that our facilities for making steel are far ahead of the demand for the material. In spite of this money is still being expended in steel-making plant, although so large a part of that already existing is at present lying idle, and appears likely to do so. The year 1892 was in many respects one of the very worst the iron and steel industry has ever known.

The two papers by Mr. Stead and Mr. Saniter on the elimination of sulphur from iron, were contributions of great value. The subject is one of very considerable importance, and fortunately has been occupying the attention of metallurgists for some time past. It would be impossible for us, in a brief notice of this kind, to give an abstract of these two papers ; indeed they are only complementary to papers already read by the authors at former meetings. Calcium chloride is the purifying material in admixture with lime, and the process is adapted, either for purifying fluid iron or pig iron direct from the blast furnace. The process is effected by running the fluid metal into a ladle having a layer of the purifying materials on the bottom, and afterwards running the metal into pigs or plate metal for subsequent use in the puddling process ; or the crude sulphury pig may be treated in the basic Siemens furnace or Bessemer converter, with the desulphurising mixture. About $\frac{1}{2}$ cwt. of crude calcium chloride is used per ton of steel, n conjunction with an excess of lime above that which is usually employed ; the cost of the calcium chloride is about 35*s*. per ton. About 70 per cent of sulphur can be removed from the charge of metal in an open hearth furnace by this process. It may be added that the process is in practical working at Wigan. What we have already said with regard to dephosphorisation of ore in its bearing on the use of our native ores also applies, to a great extent, to desulphurisation, and although Mr. Saniter does not stand alone in the introduction of a desulphurising process, there is no doubt that he has rendered this country considerable service by his efforts in this direction. The reading of these two papers, together with the introductory business and the presidential address, occupied the whole of the Wednesday sitting, and the discussion on both papers was taken jointly on Thursday morning. The chief point raised was whether the process was one requiring such delicacy in manipulation that ordinary workmen could not be trusted to carry it out so as to produce uniform results. Whether this objection will be fatal time will show, but the general opinion appeared to be that by employing fairly skilled workmen the difficulties of manipulation were not such as could not be got over, and that fairly uniform results would follow reasonable care in working.

The next business was the reading of Prof. Roberts-Austen's paper on the recording pyrometer. It will be remembered that at the annual meeting of two years ago, Prof. Roberts Austen gave a description of the Le Chatelier pyrometer, and the application of it, which he had introduced, by which it was adapted for recording work in blast furnace practice. The object of the present paper was to give some particulars of the most recent form of this recording pyrometer, which Prof. Roberts-Austen has devised. At the request of Mr. E. P. Martin, Managing Director of the Dowlais Iron Works, Cardiff, an instrument was made and put into operation as a means of recording temperature of the blast in an iron smelting furnace. The spot of light from the mirror of a galvonometer is thrown on sensitised paper, the paper itself being traversed at a uniform speed. In this way the record of temperature at all times is obtained. The author gave an instance of the value of the instrument. The blast to the furnace in question was supplied by a number of hot blast stoves on the ordinary regenerative principle. When the chequer work in a stove has been heated up sufficiently and the blast is first turned on for supply of the furnace, the temperature of the blast is naturally at its maximum. As the blast cools the chequer work, by abstracting heat from it, the temperature gradually falls, and it continues to decrease until it is considered desirable to re-heat the stove, and then a new stove is switched on. It will be seen therefore, that the temperature of the blast in the main, common to two or more stoves, will vary regularly, so that a curve on the diagram indicating temperature, will consist of a number of more or less steep inclinations; in fact, very much representing the teeth of a saw. That would be the normal inclination; occasionally, however, the gas valves leak, and then the stove may be receiving hot gases when it ought only to be passing air. The average temperature when this leaky stove is in use will naturally be higher than that due to another stove; in fact, it will be heated at the expense of the remaining number of the group. The result is antagonistic to regular working which is so much desired in blast furnace practice, and though the evil effect may be neutralised by the heat absorbing property of the large mass of material in the blast furnace—acting, as it were, as a fly-wheel for heat—the state of irregularity, if carried to excess, might be very harmful. It is also, of course, desirable that the blast furnace operator should know at the earliest time when his valves are going wrong; in fact, the whole system upon which the Cowper stove is based bears on the proper reversal of the blast. Prof. Robert Austen's apparatus fulfils the required conditions in supplying the knowledge required, and the invention cannot fail to be one of the greatest service to the metallurgist.

A paper by Mr. John Head on puddling iron was next read and was followed by a short discussion, after which the meeting concluded with the usual votes of thanks.

ROYAL GEOGRAPHICAL SOCIETY ANNIVERSARY MEETING.

THE anniversary meeting of the Royal Geographical Society held on Monday afternoon was, as we anticipated, exceptionally large and representative. The report of the council stated that the membership of the Society on the 1st of May was 3691 (including 22 ladies), a net increase of 166 fellows since May 1st, 1892, being the largest net addition to the membership of the Society since 1875. The total net income for the year was £93,000, and the expenditure £9012. In addition to the services performed to the fellows and the public by means of evening meetings, the use of the Map Room and Library and the publication of the *Geographical Journal*, twenty four intending travellers have received instruction in practical astronomy and route-surveying from Mr. Coles, and instruments have been lent to eleven travellers for use in all parts of the world.

In order to express disapproval of the words we italicise in the first paragraph of the report, which ran as follows:—

Membership.—The question of electing Ladies as Ordinary Fellows was considered by a Special General Meeting on April 24th, when it was decided in the negative by a considerable majority. The Council regard this vote (unless hereafter rescinded by a General Meeting) as conclusive against any further election of Ladies as Ordinary Fellows, *without prejudice to the* status *of those already elected.* They consider that, under the circumstances, all the legal expenses incurred in connection with this important question may equitably be defrayed by the Society, and they have accordingly provided for their being so defrayed.

Mr. Dibden, seconded by Colonel Montague, moved the rejection of the report, but on a division being taken the report was accepted by a large majority. The medals and other awards for the year were then presented as follows:—

The Founder's Medal, to Frederick Courtney Selous, in recognition of his extensive explorations and surveys in British South Africa. The Patron's Medal, to W. Woodville Rockhill, for his travels and explorations in Western China, Kokonor, Tsaidam and N.E. Tibet. The Murchison Grant for 1893, to Mr. R. W. Senior, who, for several years in succession, has carried out a most laborious duty in the higher ranges of Kulu and Lahaul, Punjab Himalayas, and the results achieved in point of accuracy, expedition, and amount of work done, have been exceptional in the face of great hardships and great physical difficulties. The Gill Memorial, to Mr. Henry O. Forbes, for his explorations and natural history observations in New Guinea, the Malay Archipelago, and the Chatham Islands. The Cuthbert Peek Grant, to Mr. Charles Hose, for explorations and natural history observations and collections in Saráwak, North Borneo. Six prizes of £5 each, and eight of books, given by the Royal Geographical Society to Students in Training Colleges for 1893, were presented to the successful candidates who were introduced by Mr. Mackinder.

A ballot was then taken for the election of officers and council for the ensuing year, and the list proposed by the council was, as usual, adopted. The new president is Mr. Clements R. Markham, F.R.S., and the vice-presidents are the Hon. G. C. Brodrick, Sir Joseph Hooker, F.R.S., Sir John Kirk, F.R.S., Dr. W. T. Blanford, F.R.S., General R. Strachey, F.R.S., and Captain W. J. L. Wharton, F.R.S.

Sir M. E. Grant Duff, the retiring president, then read the anniversary address on the progress of geography, in which he summarised the various activities of the Society. In the course of this he said that during the four years in which he had the honour to be president, he had seen the number of Fellows increase by three hundred and fifty-eight, and they were now close upon three thousand seven hundred. Before long the Society would have to take into the most serious consideration the acquisition of a new domicile. "Our constantly increasing collections would of themselves, as I have pointed out before, ere long drive us from our present quarters, and we have, in addition, reason to believe that even if we could extend our borders where we now are, on anything like reasonable terms, which we cannot, certain changes in the streets in this part of the town would ere long improve us off the face of creation. Then, although the University of London has been most kind to us in lending us their theatre, and although the character of our papers and of our publications, as well as our position as the leading geographical society of the world make us, I think, not unworthy recipients of the kindness of a university, whose operations extend over the whole of the British Empire, we cannot look forward to the present state of things continuing for an indefinite period. A vote of the Senate might at any time put an end to it."

An epitome of the year's exploration—which has been sufficiently recorded in our "Geographical Notes" from week to week—concluded the address, which was received with great applause. On the motion of Lord Northbrook, seconded by Sir John Lubbock, an enthusiastic vote of thanks was passed to the retiring president, who briefly replied.

At this stage a controversy regarding the question of the admission of women to the Society was started, and after some spirited speaking, the leading opponents of the recent action of the council stated that they were perfectly prepared to concur with the wishes of a majority of the Society as ascertained by means of a *plébiscite*, or a special general meeting to be convened at an early date.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The number of entries for the Honour School of Natural Science this year is 41, which compares favourably with past years, the highest number of candidates who obtained a place in the class list in any previous year being 31 in 1891 and 1886. There are also 51 candidates for the preliminary examinations in Science. Comparing these numbers with those of the candidates in other subjects, we find Literæ Humaniores 136 candidates, History 108, Law 70, Theology 65, and Mathematics 14. Of the 41 candidates who seek Honours in Natural Science 5 offer Physics, 21 Chemistry, 13 Animal Physiology, 1 Botany, and 1 Geology. It is remarkable that there is no candidate offering Animal Morphology.

It is understood, although it is not yet officially announced, that Merton College will give a biological Fellowship in October next, the examination for which will be held at the end of September or early in October.

A meeting of the demonstrators and assistants at the Museum was held on Saturday last to discuss their position as regards the rest of the University, and it was decided to memorialise the Visitatorial Board on the subject.

CAMBRIDGE.—Prof. Foster will deliver the Rede Lecture in the Senate House on June 14 at noon. The subject of the lecture is "Weariness."

Mr. F. Darwin, Deputy Professor of Botany, announces two courses of lectures, to begin during the ensuing Long Vacation, an elementary one by Mr. Willis, of Caius College, and a more advanced course by Mr. Wager, of the Yorkshire College, Leeds.

The Special Board for Medicine have issued new schedules in Physics and Elementary Biology for the First M.B. Examination. In regard to the former a practical examination in Experimental Physics is for the first time explicitly included in the scheme.

By means of the bequest of £300 to the University by the late Mr. Henry Tyson, of Kendal, a gold medal in Mathematics and Astronomy has been founded. The award will be made on the results of the examination for Part II. of the Mathematical Tripos.

The Engineering Laboratory Syndicate have approved Mr. W. C. Marshall's plans for an engineering laboratory, and submitted them to the Senate for adoption. They propose that the most urgent needs of the Department of Mechanism shall be met by proceeding with such portions of the work as it may be possible to execute with the funds at their disposal. About £3500, in addition to the amouut already subscribed, will be required to complete the building, and a further expenditure of not less than £1000 on necessary apparatus should follow. The Syndicate trust that the development of the school may not be long delayed for want of these sums.

The Tripos Examinations Syndicate have put forward a scheme by which nearly all the Triposes will begin after the last Sunday in May, and the Honours lists will be published by the end of June. This will involve the postponement of the general admission to the B.A. degree until the first week of July, which falls in the Long Vacation. The proposal is only tentative, and it will inevitably give rise to animated discussion.

Mr. E. W. MacBride, Scholar, of St. John's College, has been nominated to occupy the University's table at the Plymouth Marine Biological Laboratory in June.

Honorary degrees are to be conferred on the Maharajah of Bhaonagar, Lord Herschell (as Chairman of the Governors of the Imperial Institute), and Lord Roberts of Kandahar and Waterford; Prof. Zupitza, the eminent philologist, and Mr. Standish Hayes O'Grady, the Celtic scholar, are to be similarly honoured.

SCIENTIFIC SERIALS.

The Quarterly Journal of Microscopical Science for April, 1893, contains:—Description of a new species of Moniligaster from India, by W. Blaxland Benham (Pl. xxxii. and iii.). The species is from the Nilgiris and is named *M. indicus*.—Note on a new species of the genus Nais, by W. Blaxland Benham (Pl. xxxiii.). The worm was found in a ditch in the neighbourhood of Oxford; it is of a dull brownish colour, about a quarter of an inch in length, and is called *N. heterochæta*, from the fact that of the normally two chætæ in the dorsal bundles one is of a "crochet" shape, the other is capilliform.—On a new organ in the Lycoridea, and on the nephridium in *Nereis diversicolor*, O. F. Muell., by E. S. Goodrich (Pl. xxxiv. and xxxv.). The new organ consists of a pair of large, highly-differentiated, ciliated patches of cœlomic epithelium, which are found in every segment, except the first and the last few. These "dorsal ciliated organs" seem to occur throughout the Lycoridea, having been found in all the genera of that family examined by the author. Some notes on the minute structure of the nephridia of the Nereids are added.—On the nephridia and body-cavity of some Decapod Crustacea, by Edgar J. Allen, (Pl. xxxvi. vii. viii.). 1. The green gland of Palæmonetes (and Palæmon) at the time of the hatching of the larva has not developed a lumen. When the larva leaves the egg the lumen commences to open and the gland consists of an end-sac and a U-shaped tube, of which the distal portion gives rise to the bladder. The bladder then enlarges greatly, growing at first inwards towards the middle ventral line, then upwards, within the œsophageal nerve-ring and anterior to the œsophagus, to the middle dorsal line, where it meets its fellow of the opposite side. The two bladders grow backwards over the stomach and beneath the dorsal sac, subsequently fusing together in the middle line to form the unpaired nephro-peritoneal sac. 2. The shell-glands are the functional excretory organs at the time of the hatching and during the latter part of the embryonal period. They open at the bases of the second maxillæ, and each consists of an end-sac and a Y-shaped renal tube, which have the typical structure of a crustacean nephridium. 3. A dorsal sac, which is completely enclosed by an epithelial lining, persists in adults of Palæmon, Palæmonetes, and Crangon. 4. At its anterior end the dorsal sac is surrounded by a mass of tissue which appears to have the power of producing blood corpuscles. 5. The dorsal sac is formed as a hollowing-out in masses of mesoderm cells, which lie on either side of the cephalic aorta. 6. The body-cavity of these Crustaceans varies in different regions: (*a*) In the anterior part of the thorax it consists of a true cœlom (the dorsal sac and nephridia) and a hæmocœle; (*b*) in the posterior part of the thorax and in the abdomen, the body cavity is entirely a hæmocœle.—Note on the cœlom and vascular system of the Mollusca and Arthropoda, by Prof. E. Ray Lankester. A reprint of an abstract of an important paper read at the 1887 meeting of the British Association, and published in these pages (vol. xxxvii. p. 498). The author adds a request for specimens of Lernanthropus to enable him to complete his researches. Five species of this genus are recorded from the Mediterranean in Carus' "Prodomus Faunae Mediterraneæ."—Contributions to a knowledge of British marine Turbellaria, by F. W. Gamble (Pl. xxxix.-xli.), records 71 species, of which 28 are now added to the British fauna. Plate xxxix. contains coloured figures of ten species.—Peculiarities in the segmentation of certain Polychætes, by Florence Buchanan (Pl. xlii.).—Review of Bolsius' researches on the nephridia of Lee ches by A. G. Bourne.

In the notice of the January number of the *Q.J.M.S.* the too brief account of Mr. Arthur Willy's paper on the Protochordata is we regret deemed calculated to produce a mistaken impression; it should read "that the author in consequence of new observations on the Ascidians, found it necessary to repudiate the theory of van Beneden and Julin, as to the prechordal vesicle of Ascidians and Amphioxus, which he had previously, without having made personal observations on the Ascidians, provisionally adopted."

THE number of the *Nuovo Giornale Botanico Italiano* for April contains three papers:—Sig. S. Sommier gives the results of a botanical tour in the region of the Lower Obi, in Siberia, including lists of the flowering plants, Vascular Cryptogams, Muscineæ, Lichens, Fungi, and Algæ obtained. A new species of fungus is described, *Helotium Sommierianum*, parasitic on *Lycopodium clavatum*. Dr. N. C. Kindberg contributes a list of mosses gathered in Southern Switzerland and Italy. Dr. E. Baroni gives measurements of the pollen-grains of various species of *Papaver*, *Chelidonium*, and *Eschscholtzia*.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 4.—"On the Thickness and Electrical Resistance of Thin Liquid Films." By A. W. Reinold, M.A., F.R.S., Professor of Physics in the Royal Naval College, Greenwich, and A. W. Rücker, M.A., F.R.S., Professor of Physics in the Royal College of Science, London.

The paper gives an account of experiments made for the purpose of determining the thickness of black soap films formed of solutions of varying composition. Two methods of experiment were employed: (1) an optical method, in which the mean thickness of about 50 plane black films contained in a tube was deduced from observations of interference phenomena; and (2) an electrical method, in which the thickness of a cylindrical black film was derived from a measurement of its electrical resistance. The optical method involves the assumption that the refractive index of a thin film of liquid is the same as that of a large quantity of the same liquid.

Reasons are given for the belief that the refractive indices in question, if not identical, differ only slightly, and hence that the thickness of a film as determined by the optical method is the true thickness.

In the electrical method the assumption is made that the specific conductivity of a liquid does not alter when the liquid is drawn out into a thin film.

If the results obtained by the two methods agree, the conclusion is that the specific resistance of a film is not affected by its tenuity; if they differ widely from each other, a change in the specific conductivity of the liquid must have taken place.

The authors showed, in 1883, that for a solution of hard soap containing 3 per cent. of KNO_3, with or without the admixture of glycerine, the mean thicknesses of black films, as measured by each of the two methods, were in close agreement. For such solutions, then, the specific conductivity is the same whether the liquid be examined in considerable bulk or in the form of a film $12\mu\mu$ in thickness. The accuracy of this result has been confirmed by a large number of observations made during the last three years.

If the proportion of KNO_3 added to the solution be diminished, the thickness of a black film, whether measured optically or electrically, is found to undergo a change.

The results obtained by the optical method show that

(1) For a given solution of hard soap the thickness of a black film increases as the percentage of KNO_3 is diminished, being $12{\cdot}4\mu\mu$ for a 3 per cent. solution, and 22·1 for a solution containing no salt. This is confirmed by experiments on soft soap.

(2) When no metallic salt is dissolved in the solution the thickness of a black film increases as the strength of the soap solution diminishes. The thicknesses are 21·6, 22·1, 27·7, and $29{\cdot}3\mu\mu$ when the proportions of soap to water are respectively 1/30, 1/40, 1/60, 1/80.

(3) If the solution contain 3 per cent. of KNO_3, variation in the proportion of soap dissolved produces very little change in the thickness of a black film.

Electrical Method.—It has been stated that for a soap solution containing 3 per cent. of KNO_3 the thickness of a black film as measured electrically is practically the same as that measured optically. If, however, the proportion of KNO_3 be diminished, the thickness (measured electrically) increased in a far larger ratio than would be inferred from the optical method. If the proportion of salt be diminished to zero, the thicknesses thus calculated are much greater than the greatest thickness at which a film can appear black. In such cases, therefore, the electrical method does not give the true thickness of the black, and the hypothesis that the specific conductivity of the film and of the liquid in mass are identical is untenable.

The following table shows the change in apparent thickness due to diminution in the quantity of dissolved salt:—

Hard Soap.

Percentage of KNO_3.	3	2	1	0·5	0
Mean apparent thickness of black film (measured electrically)	10·6 ...	12·7 ...	24·4 ...	26·5 ...	154

The large value obtained for the apparent thickness in the case of the unsalted hard soap solution is confirmed by experiments on a solution of unsalted soft soap, which gave a mean apparent thickness of $162\mu\mu$.

In different films the measured thicknesses of the black differ widely from each other, the limits being roughly $80\mu\mu$ and $230\mu\mu$. This large variation is due in some cases, at all events, to a real variation in the thickness. Two different shades of black are (in cases where the solution contains little or no salt) frequently seen in a film. They are separated from each other by a line of discontinuity which is irregular in shape. Comparative measurements on the two shades of black have been made, and the results indicate that the electrical thicknesses of the two kinds of black are approximately as 2 : 1.

The results of numerous experiments carried out with the object of determining the *cause of the great increase in electrical conductivity in black films made from unsalted soap solutions* have shown that the increase of specific conductivity in question—

(1) Is independent of moderate changes of temperature.

(2) Is not due to the absorption or evaporation of water by the film.

(3) Is not due to change in the composition of the liquid by electrolytic decomposition produced by the current used to measure the electrical resistance of the film.

(4) Is not affected by a very large change in the quantity of CO_2 in the air around the film.

(5) Is practically unaltered if the films are formed in an atmosphere of oxygen.

The next question to be answered was whether the large changes in specific conductivity affect black films only, or whether similar phenomena can be detected in the case of thicker films.

The conclusions arrived at were (1) that the specific conductivity of a film increases as the thickness decreases, and (2) that this increase is less in the case of a film to which a salt has been added and is *nil* when the proportion of salt is as much as 3 per cent.

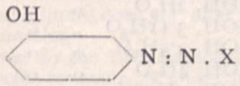
The paper concludes with a discussion as to the cause of the increase of electrical conductivity in thin films. The authors point out that it may be attributed either to a modification of the chemical constitution of the film brought about by its tenuity, or to the formation of a pellicle on the surface or to both causes combined.

Physical Society, May 12.—Prof. A. W. Rücker, F.R.S., President, in the chair.—A paper on the drawing of curves by their curvature, by C. V. Boys, F.R.S., was read, and demonstrations of the method employed given. Whilst giving a course of lectures on capillarity, in 1891, the author wished to explain the principles upon which the form of a water drop depended, and finding Lord Kelvin's rule (*Proc. R. Inst.*, Jan. 29, 1886) cumbersome, devised the modification now described. The construction depends on the fact that the total curvature is proportional to the hydrostatic pressure, *i.e.*, proportional to the depth below the plane surface of the liquid. To avoid the trouble of finding reciprocals, a rule was divided so that the distance from what would be the zero of the scale are the reciprocals of the numbers attached to them, and the curvature of an arc, being the reciprocal of its radius, can be read off immediately by the rule. To meet cases where the curvatures of surfaces are, in opposite directions, the zero, or ∞, is put at the middle of the rule and divided both ways. The chief gain depends on the abolition of cumulative errors due to compass settings, which is effected as follows: The rule is made of a thin slip of transparent celluloid with a small hole at the centre or ∞. A small brass tripod with needle feet is placed so that two feet just penetrate the paper and the third rests on the longitudinal straight line of the strip, which passes through the centre hole, thus forming a temporary but rigid centre about which the rule can rotate. A pen or pencil through the hole at ∞ traces out an arc whose curvature is equal to the reading of the scale where the needle point presses. When the rule crosses the axis of rotation of a generating curve, the numbers representing both curvatures are visible, and the position of the needle-point corresponding to a given total curvature can readily be found. A small arc is then drawn. Holding the strip firmly on the paper, the tripod is moved a little so that the sum of the two readings at the needle point and where the rule crosses the axis has the value corresponding to the position of the tracing point, and another arc drawn. Repeating the process, a very perfect and accurate curve results. Details for drawing nodoids, unduloids, catenoids, and other curves are given in the paper, and many beautiful examples, which had been executed by Miss Stevenson, were exhibited at the meeting. The author also pointed out that the locus of points about which the strip successively turns is the evolute of the curve drawn by the tracing point. Prof. Perry considered the method a new departure of great value. When he (Prof. Perry) drew the capillary surfaces of revolution in 1875, he found that cumulative errors produced considerable discrepancies. Prof. Greenhill said one would now be able to secure better diagrams of transcendental and other curves than heretofore, and he thought Mr. Boys' method would supplant the laborious processes now used to determine the paths of projectiles. Where the resistance varied as the square of the velocity the elevation for maximum range depended on the initial velocity, and for a cube law both elevation and range tend to finite limits as the initial velocity increases. Prof. Minchin inquired whether the catenary could be best drawn by using a scale of equal parts instead of one divided reciprocally. The President greatly appreciated the saving of labour effected by Mr. Boys' method, and thought the apparatus should be shown at the forthcoming exhibition of mathematical instruments in Germany.—Prof. O. J. Lodge, F.R.S., read a paper on the foundation of dynamics, in which he examines the objections raised by Dr. MacGregor (*Phil. Mag.*, Feb. 1893) against the views of Newton's Laws of Motion and the Conservation of Energy, expressed by the author in 1885. The first part of the paper treats of the nature of axioms. An axiom or fundamental law is regarded as a simple statement suggested by familiar or easily ascertained facts, probable in itself, readily grasped, and not disproved or apparently liable to disproof, throughout a long course of experience. On such bases the conservation of energy and of matter rests. Neither can be proved generally, but like other fundamental laws they fit into a coherent and self-consistent scheme, and are therefore worthy of acceptance until they are shown to be wrong. The second part relates to the first and third laws of motion. Dr. MacGregor objects to the first law on the ground that uniform motion is unintelligible unless its direction and velocity are specified with reference to a set of axes, and directly axes are introduced, difficulties occur as to their motion, because there is no satisfactory criterion of rest. Such notions the author deems artificial and unnecessary, except where it is required to define the absolute magnitude and direction of the motion. Reasoning from his own experiments, he believed the ether was at rest, for he had not found it possible to move it by matter. The first law, he said, had been considered unnecessary, as being only a particular case of the second. While admitting the latter fact, he maintained that its separate statement was desirable, on account of its simplicity, and its affording a practical definition of the mode of measuring time. As regards the third law being deducible from the first, he pointed out that if it could be axiomatically asserted that the centre of mass of a rigid system moves uniformly unless an external force acts on the system, then the third law follows. Newton apparently considered it best to state the third law as an axiom, but to many persons it is not obviously axiomatic (some engineers do not accept it), hence its deduction from the other two laws is useful. Part III. of the paper deals with the deduction of the law of conservation of energy from Newton's third law, and universal contact-action. Dr. MacGregor objects to the author's definition of energy as the name given to "work done," and contends that this definition assumes conservation. On this point Dr. Lodge invited criticism, meanwhile pointing out that his definition was analogous to the customary definition of the potential function, and a name for the line integral of a force considered as a quantity that can be stored. On the basis taken, two bodies can only act on one another whilst in contact, hence, if they move, they must move over equal distances; but their action consists of a pair of equal and opposite forces, therefore their activities are equal, and whatever energy one loses the other gains, *i.e.*, energy is transferred from one body to another without change in quantity. In Part IV. the dissipation of energy, the nature of potential energy, and the second law of thermodynamics, are considered. In discussing transference and transformation, "potential energy" is used to indicate the energy of a body under stress, and "kinetic energy," that due to sustained motion. Each corresponds to one of the factors of the product Fv, "activity." So long as one factor is absent no activity can manifest itself, but directly the missing factor is supplied, transference and transformation begin. This was shown to hold in an example of an air-gun with its muzzle plugged, chosen by Prof. MacGregor as an instance of transference of potential energy without transformation. The law of dissipation of energy is stated thus:—"If a body has any portion of energy in such a condition that it is able automatically to leave the body, that portion usually does so sooner or later." Instead of the ordinary form of the second law of thermodynamics the following statement is proposed:—"The portion of energy which a body can automatically part with is alone available for doing work." In discussing this subject the author points out that the common notion that heat engines are much less efficient than water or electric engines is a mistake, arising from the fact that in the one case the efficiency is calculated on the total energy, whilst in the latter cases only the available energy is considered. Two appendices accompany the paper, one the objectivity of energy and the question of gravitation, and the other on more detailed discussion of the transmission of energy in difficult cases.

Chemical Society, May 4.—Dr. Armstrong, President, in the chair.—The following papers were read:—The hydrates of sodium, potassium and lithium hydroxides, by S. U. Pickering. By cooling solutions of sodium hydroxide, the author has succeeded in isolating a number of crystalline hydrates; their formulæ and freezing-points are given in the following table:—

$NaOH, H_2O$	freezes at	64·3°
$NaOH, 2H_2O$	,, ,,	12·5
$NaOH, 3{\cdot}11H_2O$	,, ,,	2·73
$NaOH, 3{\cdot}5H_2O$	,, ,,	15·55
$\alpha NaOH, 4H_2O$	,, ,,	7·57
$\beta NaOH, 4H_2O$	,, ,,	− 1·70
$NaOH, 5H_2O$	,, ,,	−12·22
$NaOH, 7H_2O$	,, ,,	−23·51

The hydrate containing 3½ molecules of water is the only one of the eight which has been previously described. In the case of potassium hydroxide two new hydrates have been isolated; these have the formulæ KOH,H_2O and $KOH,4H_2O$, and freeze at 143° and −32·7° respectively. The previously known dihydrate freezes at 35·5°. Lithium hydroxide monohydrate, which was already known, was the only hydrate of this hydroxide isolated.—Detection of arsenic in alkaline solution, by J. Clark. Arsenic acid is not reduced to hydrogen arsenide by zinc dust and caustic potash, or even by sodium amalgam in alkaline solution. No trace of arsenic volatilises on heating sodium arsenate with a large excess of aluminium and caustic soda. The statement of H. Fresenius, that Gatehouse's modification of Fleitmann's test indicates arsenic acid, is hence erroneous; Fresenius's results are probably due to the use of impure aluminium or of arsenic acid containing arsenious acid. The author concludes that none of the methods hitherto proposed for the generation of hydrogen arsenide from alkaline solutions, are available for the detection of arsenic acid.—Improvements in Reinsch's process, by J. Clark. Although Reinsch's process is sensitive to minute quantities of arsenic, and removes all traces of that element from organic mixtures, there are two objections to its use in medico-legal cases. With small quantities of arsenic, the stain obtained is sometimes not easily identified, as the coated copper when heated is apt to give a sublimate of cupric chloride and organic matter instead of arsenious oxide; the method is also not suitable for quantitative estimations, as the whole of the arsenic cannot be volatilised from the copper by means of heat. The author's improvement on Reinsch's process consists in digesting the coated copper with cold caustic potash and hydrogen peroxide, and distilling with ferrous chloride and hydrochloric acid. The arsenic is precipitated in the distillate and weighed as sulphide, whilst any antimony present may be detected in the residual liquor.—The action of light in preventing putrefactive decomposition and in inducing the formation of hydrogen peroxide in organic liquids, by A. Richardson. Several observers have noted that the development of putrefactive organisms is checked by the combined action of sunlight and oxygen; this sterilising influence of light in presence of oxygen has apparently always been regarded as the outcome of an action exerted by the organism. The author has made a number of experiments with urine, in order to ascertain whether, when sterilisation has been effected by light, any oxidising agent, such as hydrogen peroxide, is formed, and whether such substance may not be the sterilising agent. No hydrogen peroxide is produced by the action of oxygen on sterilised urine in the dark, but an appreciable amount of the peroxide is formed on exposing such urine to light; the production of the peroxide is hence independent of the presence of organisms. Substances, such as manganese dioxide, which destroy hydrogen peroxide, greatly facilitate organic growth; the addition of hydrogen peroxide to fresh urine renders the liquid much less liable to change under the influence of organisms, whilst if added to urine in which fermentation has already set in, the peroxide is rapidly decomposed.—The supposed saponification of linseed oil by Dutch white lead, by J. B. Hannay and A. E. Leighton. The author shows that the statement made by several technical writers to the effect that white lead acts on the oil with which it is ground, is erroneous.—Notes on capillary separation of substances in solution, by L. Reed. The author has made experiments on the separation of salts in solution by selective absorption in bibulous paper, using a method differing somewhat from those employed by previous workers. If a drop of a fairly dilute aqueous salt solution is allowed to spread on bibulous paper, a pure water margin is obtained surrounding a sharply defined interior space containing stronger salt solution. The width of the exterior zone is apparently dependent on the nature and concentration of the solution employed; some solutions, such as those of chrome and ammonia alums, give no pure water zone.—Note on a meta-azo-compound, by R. Meldola and F. B. Burls. A comparison of meta-azo-compounds of the formula



where X is an *unsubstituted* hydrocarbon radicle, with the corresponding ortho- and para- series, would be of interest as throwing light on the question of the constitution of organic colouring matters, the "quinonoid" bonds not being present in the meta-compounds according to the present method of formulation. The authors have hence prepared metaphenolazo-α-naphthylamine with the intention of converting it into naphthaleneazo-metaphenol; they have not yet isolated the latter substance and are therefore extending the investigation to other compounds of the same series.—The influence of moisture in promoting chemical action. Preliminary note, by H. B. Baker. The author has continued his investigations on the influence of moisture on chemical action. Ammonia was dried as completely as possible by freshly ignited lime; on then subjecting it to the action of phosphoric anhydride very little of the gas was absorbed. Hydrogen chloride was dried first by sulphuric acid and finally by a week's contact with phosphoric anhydride. On mixing ammonia and hydrogen chloride, dried in this way, *no ammonium chloride fumes were produced* and no contraction was indicated by the mercury gauge attached to the apparatus: it may therefore be concluded that ammonia and hydrogen chloride do not combine when dry. Union at once occurs, however, on introducing a small quantity of moist air. In like manner sulphur trioxide was found not to unite either with lime, barium monoxide, or copper oxide. Furthermore, no brown fumes were produced on mixing dry nitric oxide with dry oxygen.—The genesis of new derivatives of camphor containing halogens by the action of heat on sulphonic chlorides, by F. S. Kipping and W. J. Pope. When the sulphonic chlorides derived from camphor recently described by the authors, are heated at temperatures not very far above their melting points, decomposition occurs and sulphur dioxide is evolved whilst haloid derivatives of camphor remain. In the case of camphorsulphonic chloride, a chlorocamphor melting at 137–138°, is thus obtained. From chlorocamphorsulphonic chloride, a well-crystalline dichlorocamphor melting at 118–119° is formed, whilst bromocamphorsulphonic chloride yields a compound which crystallises in long prisms and melts at 142–143°. These three derivatives of camphor appear to be different from any known compounds and their further study will, it is hoped, throw light on the complex question of isomerism in the camphor series.

May 5, Extra Meeting.—Dr. Armstrong, President, in the chair.—This being the anniversary of the death of Prof. A. W. von Hofmann, the President, after opening the proceedings with a short speech, called upon Lord Playfair, Sir F. Abel and Dr. Perkin to deliver addresses commemorative of Hofmann and his work.

Anthropological Institute, May 9.—Prof. A. Macalister, President, in the chair.—Mr. C. Dudley Cooper exhibited and described the skull of an aboriginal Australian.—A paper by Mr. Charles Hose on Borneo was read. The Baram District, with which the author was most intimately acquainted, is situated in the Northern portion of Sarawak, and the races inhabiting it may divided into four sections:—(1) The low country people and the inhabitants of the coast; (2) the Kayans and Kenniahs, inhabiting the head waters of the Baram River and its tributaries; (3) the Kalabits, living inland; and (4) the Punans, no nomadic tribes, found at the head waters of all the great rivers in Central Borneo. Each of these four divisions comprises a number of sub-divisions speaking different dialects, which can, however, be traced to the same origin. All the various races, except the Punans, employ dogs in hunting. The houses usually stand about twenty feet above the ground supported by huge posts of hard wood; they are some four hundred yards in length, and often hold more than a hundred families. In times gone by the first post put into the ground was passed through the living body of a slave—usually a young girl—but wild animals are now used instead of human beings for this purpose. Mr. Hose exhibited and described a large collection of native implements, weapons, and other objects, and the paper was further illustrated by a number of photographic views shown by the limelight.—Prof. Macalister exhibited a skull from North Borneo.—Mr. F. W. Rudler exhibited a wooden fire syringe from the Malay Peninsula, with a bean tinder box.—Mr. R. G. Leefe contributed a paper on the nivates of Tonga.

Geological Society, May 10.—W. H. Hudleston, F.R.S., President, in the chair.—The following communications were read:—The felsites and conglomerates between Bethesda and Llanllyfni, N. Wales, by Prof. J. F. Blake. The author brought forward fresh evidence in support of the views he had previously expressed as to the Cambrian age of these felsites, and as to the unconformity of the conglomerates on the purple slates. A new tunnel-section at Penrhyn Quarry was described, in which felsite was followed by St. Ann's Grit with a conglomerate-band, and there lying in the midst of the Cambrian series. After a word or two on the conglomerate on Moel Rhiw-wen, the sections on either side of Llyn Padarn were discussed in detail, and it was shown that the distribution of the rocks on the surface of the country could only be explained by the unconformable position of the conglomerates and grits, which, moreover, lie nearly horizontal. After a discussion of the conglomerates of Bettws-Garmon, a detailed section of the adit at Moel Tryfaen was given, in which it was shown that there was only a 3 ft. 6 in. band of conglomerate next the purple slates, followed by 1350 feet of banded slates and laminated grits with four distinct intercalated bands of felsite; and it was argued that the conglomerate on the summit, 55 yards across, could scarcely be represented by this thin band. Finally, the distribution of rocks on Mynydd-y-Celgwyn was shown to be satisfactorily explained by unconformity. Incidentally it was mentioned that a band of rock in the felsite at Llyn Padarn, which had been considered to be a deposited slate, was in reality an intrusive igneous rock. The conglomerates described were considered to be an overlap of the Bronllwyd Grit. The reading of this paper was followed by a discussion, in which the President, Prof. Hughes, Mr. Rutley, Mr. Marr, and the author took part.—The Llandovery and associated rocks of the neighbourhood of Corwen, by Philip Lake and Theo. T. Groom. The area described forms a part of the northern slope of the Berwyn Hills, and stretches along the southern bank of the Dee from Corwen to Pen-y-glog. The beds of the Berwyns are here thrown into a series of folds which run nearly E.-W.; and the northerly limbs of these folds are long and low, while the southerly limbs are short and steep. The folds are cut through by a number of faults which run nearly E.-W., generally along the crests of the anticlinals, and these invariably throw down towards the north. The southern bank of the Dee Valley is here formed by these faults. A second series of faults running about 20° W. of N. to 20° E. of S. is of later date. One of these, near Corwen, presents some peculiar features, since its downthrow in some places is on the east and in others on the west. The lowest beds present are bluish slates, with numerous Bala fossils. These are succeeded immediately by the Corwen Grit of Prof. Hughes. No fossils have been found in this at Corwen; but in a grit occupying a similar position at Glyn Ceiriog numerous fossils have been discovered. The Corwen Grit is succeeded by grey slates with grit-bands; and in Nant Cawrddu, near Corwen, and Nant Llechog, near Pen-y-glog, these slates are followed by banded black shales containing numerous graptolites of the *Monograptus gregarius*-zone. Above these are pale bluish slates; and nothing further is exposed till we reach the Tarannons. The Corwen Grit clearly forms the base of the Llandovery in this area, as suggested by Prof. Hughes. Some remarks were made on this paper by the President, Prof. Hughes, Mr. Groom, and Prof. Lapworth. Mr. Lake briefly replied.

Zoological Society, May 16.—Osbert Salvin, F.R.S., Vice-President, in the Chair.—Extracts were read from a letter addressed to Prof. Newton, F.R.S., by Prof. E. C. Stirling, of Adelaide, respecting the recent discovery of a large series of remains of *Diprotodon*, *Phascolomys*, and other Mammals at Lake Mulligan, in South Australia, about 600 miles north of Adelaide. It was anticipated that when these remains were received and examined very important additions to our knowledge of the extinct Mammal-fauna of Australia would follow.—Mr. Beddard, F.R.S., read a paper upon the structures termed "atrium" and "prostate" in the Oligochætous worms, in which reasons were given for believing that all these structures were reducible to one common plan.—Mr. G. B. Sowerby read the descriptions of fifteen new species of shells of the family Pleurotomidæ from different localites.—A communication was read from Mr. A. H. Everett, containing a revised list of the Mammals inhabiting the Bornean group of Islands, that is, Borneo, and Palawan, which, as Mr. Everett had shown in a previous paper, belongs zoologically to Borneo.—Mr. O. Thomas read a paper containing an account of a second collection of Mammals sent by Mr. H. H. Johnston, from Nyasaland. The present series (collected, like the former, by Mr. Alexander Whyte), consisted of about 75 specimens, referable to 30 species, of which a large proportion were additional to the fauna of Nyasaland.—Dr. P. Sonsino, of Pisa, read some notes on specimens of parasitic worms of the genus *Distomum*, of which he had lately examined specimens.

Royal Meteorological Society, May 17.—Dr. C. Theodore Williams, President, in the chair.—The following papers were read:—Mean daily maximum and minimum temperature at the Royal Observatory, Greenwich, on the average of the fifty years from 1841 to 1890, by Mr. W. Ellis. The author gives tables of the mean maximum and mean mimimum temperature of the air on each day of the year, and also tables showing the daily range of temperature and the mean of the daily maximum and minimum values.—Suggestions, from a practical point of view, for a new classification of cloud forms, by Mr. F. Gaster. The forms assumed by clouds at different levels and under various conditions have recently received considerable attention from meteorologists. The author, however, does not approve of the nomenclatures and classifications which have been proposed, as, in his opinion, they appear to be little, if any, better than the older ones they were intended to replace. He now proposes a somewhat different classification, arranging the clouds according to altitude under the following headings:—(1) Surface clouds, or those which appear commonly between the earth's surface and a level of about 2000 feet; (2) Lower medium clouds, including all varieties which usually float at an elevation ranging from 2000 to about 10,000 feet; (3) Higher medium clouds, or those commonly found at altitudes varying from 10,000 to about 22,000 feet; (4) Highest (or cirriform) level clouds, or those at elevations exceeding 22,000 feet. The author gives the names of each variety of cloud included in the classification, together with an account of the principal characteristics of each as far as appearance goes.—Notes on winter, by Mr. A. B. MacDowall. In this paper the author discusses the question of periodicity in winter at Greenwich and Paris, and the relation of summers to winters.

PARIS.

Academy of Sciences, May 23.—M. Lœwy in the chair.—The Permanent Secretary announced the death, at Berlin, of Herr Kummer, Foreign Associate, and M. Hermite gave a review of the work of the celebrated geometrician. Herr G. Wiedemann was elected correspondent for the section of physics, in the place of Herr W. Weber, deceased.—On the kinetic theory of gases, by M. H. Poincaré. A correction of Maxwell's proof of the law of adiabatic expansion.—Note by M. Berthelot, accompanying the presentation of his work, "On the Chemistry of the Middle Ages."—On some rare or new natural phosphates; brushite, minervite, by M. Armand Gautier. A new lime and alumina phosphate was found among the concretionary phosphates of the *Grotte de Minerve*. Microcrystalline like most of these substances, soluble in dilute mineral acids, in weak potash lie, and in alkaline ammonium citrate, except a slight clayey residue, it has a different composition from the other natural aluminium phosphates, and has been called Minervite to recall its place of discovery.—Determination of the water contained in soil carrying various crops after a period of great drought, by M. Reiset.—Observation of the total solar eclipse of April 16, 1893, made at Joal (Senegal), at the observatory of the expedition of the Bureau des Longitudes, by M. G. Bigourdan.—On the investigation of the solar corona apart from total eclipses, by M. H. Deslandres.—On a highly sensitive manometric apparatus, by M. Villard.—The heat spectrum of fluorspar, by M. E. Carvallo.—Dynamical phenomena due to the residual electrification of dielectrics, by M. Charles Borel.—On chloroborate of iron and on a method of preparing chloroborates isomorphous with boracites, by MM. G. Rousseau and H. Allaire. The method consists in letting a volatilised metallic chloride act at a red heat upon natural calcium borate or upon borosodiocalcite. In the case of iron, the product obtained corresponds sensibly to that of a boracite in which the magnesium has been replaced by iron, according to the formula $6FeO.8B_2O_3.FeCl_2$. The chloroborate of iron crystallises in transparent cubes of a greyish colour, which act upon polarised light. This optical property shows that these crystals, like those of natural boracite, present a pseudo-cubic symmetry. They dissolve slowly in nitric acid and are rapidly disintegrated by fused alkaline carbonates.—On the heat developed in the combination of bromine with some unsaturated substances of the fatty series, by MM. W. Louguinine and Irv. Kablukov. Calorimetric determinations carried out in the cases of trimethylethylene, hexylene, diallyl, allyl alcohol, and allyl bromide led to the following conclusions: The heat developed by their combination with bromine increases as one proceeds upwards in the homologous series. The presence of an atom of Br replacing H in the unsaturated hydrocarbons mentioned, considerably reduces the rapidity of the addition reaction of the bromine. In presence of the OH group the addition reaction ceases to be sharply defined and is accompanied by a substitution reaction.—On licarhodol derived from licareol, by M. Ch. Barbier.—Action of sodium sulphite upon the amidophenol salts; new method of obtaining amidophenols from their salts, by MM. Aug. Lumière and A. Seyewetz.—Ptomaïn extracted from urines in eczema, by M. A. B. Griffiths.—On δ-achroglobine, a respiratory globuline contained in the blood of certain Mollusca, by M. A. B. Griffiths. In addition to the α-achroglobine extracted from the blood of Patella, the β variety from the Chitons, and the γ variety from the Tunicata, a fourth variety, δ-achroglobine, has been discovered in the blood of certain species of Doris. 100 grammes of this substance absorb 125 cc. of oxygen at 0° and 760 mm. Its empirical formula is $C_{659}H_{792}N_{165}SO_{153}$.—On the Plankton of the northern lagoon of Jan Mayen, by M. G. Pouchet. The island of Jan Mayen possesses two lagoons formed by fresh water due to the melting of the glaciers, and separated from the sea by narrow dykes of sand and shingle. The southern lagoon is of recent date. At the time of discovery it was an open bay. The northern lagoon was explored by the steamer *La Manche* in July 1892. By means of a fine net the central portion was tested for any surface life (Plankton) that might have escaped the Austrian expedition, which had failed to discover any. As the result of prolonged work a few species were found, including a Conferva, Infusoria allied to Paramecium and Actinophrys, a Tardigrade, a Copepod, and numerous Rotifers.—Dimorphism in the development of hemosporidia, by M. Alphonse Labbé.—On the scented mists observed on the coasts of the Channel, by M. S. Jourdain. These mists occur in spring under a northeast wind, and usually in the morning. The appearance is that of a bluish-grey vapour, and the smell that of lime-kilns. The air is very dry while they last. The author thinks that they are cosmic, not local phenomena.

BERLIN.

Physiological Society, May 5.—Prof. du Bois Reymond, President, in the chair.—Dr. Schmidt spoke on the colour-reactions of the excreta, whereby the mucin exhibits certain very characteristic and distinctive differences, as compared with proteids.—Prof. Fritsch exhibited a number of lantern-slides of the electric organs of Torpedo, Malapterurus, and Gymnotus, by which he had determined the structure of the giant ganglia, the axis cylinders which arise from these and are distributed to the electric organ and the protoplasmic prolongations, which either form a means of connection between neighbouring ganglia, or else resolve themselves into an anastomosing network.—Dr. Benda also exhibited projections of micro-photographs, in linear magnification of 2000 to 3000 diameters, of the testis of Salamanders in illustration of the formation and fate of the karyokinetic nuclear rods.

Meteorological Society, May 9.—Dr. Vettin, President, in the chair.—Prof. Hellmann presented the two first numbers of reprints of important papers on meteorology and terrestrial magnetism, which he is publishing with the support of the German Meteorological Society and the branch society in Berlin. No. 1 is a *fac-simile* of the earliest German work on meteorology: Weather-book by Rynmann, dated 1510. No. 2 is also a *fac-simile* of Bl. Pascal's celebrated research by which the existence of atmospheric pressure was first determined.—Prof. Börnstein spoke on the most recent theories as to thunderstorms, of which none supply a definite solution of the problems involved, and explained a simple form of apparatus by Elster and Geitel, in Wolfenbüttel, by means of which anybody can make observations on atmospheric electricity, and invited the co-operation of the members.—Dr. Kremser gave some notes on the dryness of last April. Whereas the average fall in Prussia for April is 30 to 50 mm., the fall for last month was only 10 mm. in the extreme east, falling to 1 mm. in the central region, and to 0 mm. in the west and south-west. In Berlin a measurable amount of rain fell on only one day, the 17th, amounting to 0·5 mm., so that this month was the driest recorded since observations were first made in Berlin. Up to the present time the driest month had been October, 1865, with a fall of 1 mm. The period of drought began as early as March 21 or 22, and in many parts of Prussia had lasted for forty days, being accompanied by absence of clouds and marked temperature amplitudes of 10° to 18°.—Dr. Less gave an account of the barometric conditions over Europe during the drought. They may be divided into three periods. In the first, at the end of March and beginning of April, the highest pressure lay over France and Germany, the lowest over Russia as far as the Ural Mountains. In the second period, the middle of April, the area of high pressure had moved over towards England, while the lowest pressure had extended to the centre of Germany. In the third period a flat area of lowest pressure situated over the Atlantic had driven the area of highest pressure once more towards central Europe.—Prof. Börnstein exhibited samples of the material used in the construction of the recently-destroyed balloon "Humboldt." This balloon had become ignited, accompanied by a violent explosion, while being emptied, without any definitely ascertainable cause. The speaker demonstrated how readily the outer surface of the material could be electrified by friction, and suggested that electricity had thus been generated, and had, as a spark-discharge, ignited the gas as it escaped. This source of danger could probably be removed by placing a few long metallic wires round the valve.

DIARY OF SOCIETIES.

London.

THURSDAY, June 1.

Royal Society, at 4.30.—On the Colour of Sky-light, Sun-light, Cloud-light, and Candle-light: Captain Abney, F.R.S.—Flame Spectra at High Temperatures; Part I., Oxyhydrogen Blowpipe Spectra: Prof. Hartley, F.R.S.—Note on the Flow in Electric Circuits of Measurable Inductance and Capacity; and in the Dissipation of Energy in such Circuits: A. W. Porter.—On the Metallurgy of Lead: J. B. Hannay.—On the Motion under Gravity of Fluid Bubbles through Vertical Columns of Liquid of a Different Density: F. T. Trouton.

Linnean Society, at 8.—On Polynesian Plants collected by J. J. Lister: W. B. Hemsley, F.R.S.—On the Anatomy of a New Plant—Melastomaceæ or Gentianaceæ, Genus Novum: Miss A. Lorrain Smith.—Observations on the Temperature of Trees made in Boulder, Colorado: Dr. Baur.

Chemical Society, at 8.—Azo-Compounds of the Ortho Series: Prof. Meldola, F.R.S., E. M. Hawkins, and F. B. Burls.—The Fluoresceïne of Camphoric Anhydride: Dr. Collie.—The Action of Phosphoric Chloride on Camphene: J. E. Marsh and J. A. Gardner.—The Composition of Jute produced in England: A. Pears, jun.

Royal Institution, at 3.—The Geographical Distribution of Birds: Dr. R. Bowdler Sharpe.

FRIDAY, June 2.

Geologists' Association, at 8.—Consideration of the Principal Phenomena connected with Volcanoes: Dr. J. W. L. Thudichum.

Royal Institution, at 9.—Study of Fluid Motion by Means of Coloured Bands: Prof. Osborne Reynolds, F.R.S.

SATURDAY, June 3.

Royal Institution, at 3.—Falstaff—a Lyric Comedy by Boito and Verdi (with Musical Illustrations): Dr. A. C. Mackenzie.

Institute of Actuaries, at 3.—Annual Meeting.—Report of the Council for the Past Year and Election of Officers and Members of Council.

MONDAY, June 5.

Society of Chemical Industry, at 8.—The Movement of Air as applied to Chemical Industries: H. G. Watel.—New Cellulose Derivatives and their Industrial Applications: C. F. Cross and E. J. Bevan.

Royal Institution, at 5.—General Monthly Meeting.

TUESDAY, June 6.

Zoological Society, at 8.30.—Notes on the Anatomy and Classification of the Parrots: F. E. Beddard, and F. G. Parsons.—On Two Horns of an African Rhinoceros: Mr. Sclater.—On some Bird-Bones from Miocene Deposits in the Department of Isère, France: R. Lydekker.—On the Osteology of the Mesozoic Ganoid Fish, Lepidotus: A. Smith Woodward.

Royal Institution, at 3.—The Waterloo Campaign: E. L. S. Horsburgh.

WEDNESDAY, June 7.

Geological Society, at 8.—The Bajocian of the Sherborne District; its Relations to Subjacent and Superjacent Strata: S. S. Buckman.—On Raised Beaches and Rolled Stones at High Levels in Jersey: Dr. Andrew Dunlop.

THURSDAY, June 8.

Royal Society, at 4.30.

Mathematical Society, at 8.—Complex Integers derived from $\theta^3-2=0$: Prof. G. B. Mathews.—Pseudo-Elliptic Integrals: Prof. Greenhill, F.R.S.

Royal Institution, at 3.—The Geographical Distribution of Birds: Dr. R. Bowdler Sharpe.

FRIDAY, June 9.

Physical Society, at 5.—A New Photometer: A. P. Trotter.—Notes on Photometry: Prof. S. P. Thompson, F.R.S.—The Magnetic Field near a Wire: Prof. G. M. Minchin.

Royal Astronomical Society, at 8.

Royal Institution, at 9.—The Recent Solar Eclipse: Prof. T. E. Thorpe, F.R.S.

SATURDAY, June 10.

Royal Botanic Society, at 3.45.

Royal Institution, at 3.—Falstaff, a Lyric Comedy by Boito and Verdi (with Musical Illustrations): Dr. A. C. Mackenzie.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—Year-Book of the Scientific and Learned Societies of Great Britain and Ireland (Griffin).—Graphic Arithmetic and Statics: J. J. Prince (Murby).—Erdbebenkunde: Dr. P. Hoernes (Leipzig, Veit).—Introduction a L'Electricité Industrielle—Potential, Flux de Force Grandeurs Electriques; Ditto, Circuit Magnétique: Induction Machines: P. Minel (Paris, Gauthier-Villars).—The Theory of Telescopic Vision: E. M. Nelson (Dulau).

Pamphlets.—Wetterbüchlein von Wahrer Erkenntniss des Wetters: L. Reynman (Berlin, Asher).—Récit de la Grande Expérience de l'Equilibre des Liqueurs: B. Pascal (Berlin, Asher).—The New Priesthood: Ouida (E. W. Allen).

Serials.—Bulletin of the New York Mathematical Society, vol. 2, No. 8 (New York, Macmillan).—Internationales Archiv für Ethnographie, Band 6, Heft 2 (K. Paul).—Bulletins de la Société d'Anthropologie de Paris, tome troisième, iv. série, 4e Fasc.; Ditto, Nos. 2, 3, 4 (Paris, Masson).

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