THURSDAY, JULY 14, 1881

SYMBOLIC LOGIC

Symbolic Logic. By John Venn, M.A., Fellow and Lecturer in the Moral Sciences, Gonville and Caius College, Cambridge. Pp. xxxix. 446. (London: Macmillan, 1881.)

MANY who are interested in the progress of logical science have looked forward to the appearance of this long-expected work as one likely to give them a logical treat. They will not be disappointed. It may be impossible to accept Mr. Venn's opinions as decisive of some points which he discusses, and it would not be difficult to indicate deficiencies; but we have no book which approaches the one before us in the thoroughness with which it opens up the logical questions of the day. With equal industry and ability Mr. Venn has gone over almost the whole literature of logic so far as it contains any germs of the scientific system associated with the name of Boole. Mr. Venn writes professedly as an admirer of Boole, and his work consists to a great extent of the matter of lectures upon Boole's logic, delivered under the inter-collegiate scheme of lecturing, which has now been in operation for about twelve years at Cambridge. Thus the book is substantially an exposition of Boole's Logic, and practically the only one which we have. Boole's own great work, "The Laws of Thought," appeared more than a quarter of a century ago (1854), and has never reached a second edition. It has been much more talked about than read.

If Mr. Venn then had done nothing more than publish a comparatively easy and readable exposition of Boole's profound but difficult treatise, he would have done a good work. But he has done a good deal more, because he has worked out the relation of Boole's system to all discoverable previous attempts at a symbolic or quasi-algebraic treatment of the syllogism, as also to all who have since Boole's time endeavoured to improve upon his system. The writings of almost one hundred logicians have been investigated by Mr. Venn, and not a few of these writers are practically unknown to English readers. If I mention the names, for instance, of Bolzano, Bardili, Dalgarno, Darjes, Lipschitz, Maass, Maimon, Segner, Semler, Servois, Weise, it is unlikely that the reader, unless he has made a very special study of logic, will ever have heard of most of these names before. A great change has taken place in the standard of scholarship expected of authors nowadays. During the last century philosophers calmly wrote down whatever came uppermost in their minds, in complete indifference to their ignorant predecessors. David Hume discovered and expounded the laws of the association of ideas, unconscious that it was all in Aristotle's works. Jeremy Bentham wrote upon logic with sublime confidence, although his reading had been confined to the compendiums of Sanderson and Isaac Watts. Now a man is expected to read everything about his subject before he writes anything. The late Sir William Hamilton of Edinburgh was the ideal of the new method, towards the introduction of which he much contributed. He had all the doctrines of logicians of various schools classified in his common-place books; but when he came to work out his own system of the syllogism, fell disease arrested him before the work was half done. It must require much judgment to use the bibliographic method, as one may call it, to an adequate, and yet not to an excessive extent.

Perhaps the most interesting chapter in the whole book is the last one, containing "Historic Notes," which are however merely supplementary to a great quantity of historical information given incidentally in the preceding chapters. The table on p. 407 is one of extreme interest. It shows and classifies in the clearest way no less than twenty-five apparently different modes in which logicians from the time of Leibnitz had attempted to represent symbolically the ordinary universal negative proposition, say, no S is P. Boole and Dr. Macfarlane, for instance, express it as denying the existence of the class of things S which is P. Hamilton introduced a clumsy wedge-shaped copula with a stroke across it to express negation; Darjes entirely misused well-known mathematical signs in the expression $+S-P$. Segner's formula is hardly better, namely $S<-P$. Mr. MacColl's notation, so recently the subject of discussion in the Mathematical Society, the *Educational Times*, and NATURE, is at least convenient, namely $S : P'$, though, as I venture to hold, only a disguised form of the equation $S = SP'$. But this single page gives matter for endless study, and Mr. Venn has conferred a great benefit upon logical students in opening up the subject of logical symbolism and logical method in its full extension, thus hastening the time when some decision can be arrived at.

There is, however, much that is novel in the volume. No author, for instance, has carried the diagrammatic representation of logical relations to anything like the same extent and perfection as Mr. Venn. Starting with the well-known circular diagrams, attributed to Euler, but traced back to earlier logicians, at any rate to Lange, Mr. Venn has succeeded in representing, by interlacing oval figures, the logical relations of four or even more terms. Although opinions may differ as to the value of the method, he has unquestionably worked out a complete and consistent system of diagrammatic reasoning, which carries the Eulerian idea to perfection. He has gone even further and has converted his diagrams into a kind of logical-diagram machine, which allows the elliptic segments representing classes to be selected and rejected mechanically. Of this remarkable device Mr. Venn (p. 122) says that "it would do very completely all that can be rationally expected of any logical machine. Certainly, as regards portability, nothing has been proposed to equal it, so far as I know." The latter statement may be certainly conceded, as the machine, though constructed needlessly large, is only five or six inches square, and three inches deep. So far, however, as I can judge from the somewhat brief and unexplicit description given by Mr. Venn, I cannot see how his machine can perform logical operations automatically. The selections of classes have to be guided and judged by the selector, and all that the mechanical arrangements effect is to select a whole class of elliptic segments at one movement of the fingers. This mechanical diagram, then, is analogous, as Mr. Venn remarks, to what has been described as "The Logical Abacus," but I do not think it can be called mechanical in the same degree as the logical machine.

In connection with these complex logical diagrams arises a curious and almost amusing illustration of the impossibility of knowing all that has been written on a subject. Mr. Venn in the Historic Notes has carefully gone over all logical writings known to him, and concludes (p. 426) that "hardly any attempts have been made to represent diagrammatically the combinations of four terms and upwards. The only serious attempt that I have seen in this way is by Bolzano." This statement is qualified in the Introduction or Preface (p. xxx.) by reference to H. Scheffler's "Naturgesetze," published in 1880. But if Mr. Venn had happened to look much nearer home, into the able "Outline of Logic for the Use of Teachers and Students," by the Rev. Francis Garden, M.A., Trinity College, Cambridge (1867), he would have found at p. 39 a diagram of five interlacing circles representing the relations of five terms. The diagram is thus described at the foot, "Genus A partly overlapped by genera B, C, D, and E, giving for species AB, ABC, AC, ACD, AD, ADE, AE, ACDE." The circles are broken in their unessential parts for the purpose of saving space. Mr. Venn's ellipses are in this respect much more convenient than circles, and the method of shading segments so as to show their propositional treatment to the eye is an important improvement; but the principle on which complex logical relations may be graphically represented is clearly seized by Mr. Garden.

Mr. Venn, although an ardent admirer of Boole, as indeed all advanced logicians must be, remarks (p. xxviii.) that his actual originality (priority?) was by no means so complete as is commonly supposed and asserted. But I am a little surprised to notice that Mr. Venn, although mentioning (p. 9) Thomas Solly's "Syllabus of Logic"[1] in relation to another matter, does not draw attention to the remarkable symbolical expression for the laws of the syllogism given therein. This brief work is throughout highly acute and philosophical.

The really important question which underlies the whole discussion of symbolic logic regards a technical and apparently minor point, namely the exclusive or unexclusive character of logical alternatives. When we say, for instance, that "capital is either fixed or circulating," is it implied *in the mere form of the statement* that capital cannot be at the same time fixed and circulating? Boole held so; or, at any rate, he held that any logical equation of his own system not conforming to this condition was imperfect and uninterpretable. But since Boole's time several logicians have contended that this condition was arbitrary, and in fact an error of Boole's. It is one chief purpose of Mr. Venn's book to uphold Boole's system in its integrity, and he writes in an attitude more or less of protest against subsequent innovators. This question has been noticed by Mr. MacColl in his letter (NATURE, vol. xxiv. pp. 124-126). It is however a question which requires chapters, if not books, for its adequate treatment; it is in fact to be judged by the success of a system, rather than by any simple direct arguments.

In regard to this letter of Mr. MacColl, I may point to the fact that I have already disputed the philosophical correctness of MacColl's symbolic innovations (NATURE, vol. xxiii. p. 485), while as regards the main principles of his calculus, it is out of the question that he should claim novelty. But we may nevertheless regret that Mr. Venn has referred in a slighting tone to investigations which have been carried out with great earnestness and acuteness. Mr. Venn does not speak in the same slighting manner of Prof. Schröder's essay, though I presume it is clear that the latter was as completely forestalled by previous writers unknown to him as was Mr. MacColl. In fact the way in which independent investigators are converging and meeting in a modified Boolian system is strong evidence that the questions so clearly set forth by Mr. Venn are becoming ripe for decision.

W. STANLEY JEVONS

[1] "A Syllabus of Logic, in which the views of Kant are generally adopted and the Laws of the Syllogism symbolically expressed," by Thomas Solly, Esq., late of Caius College, Cambridge. (Cambridge, 1839.)

ASTRONOMY FOR AMATEURS

A Cycle of Celestial Objects. Observed, Reduced, and Discussed by Admiral William Henry Smyth, R.N., K.S.F., D.C.L. Revised, Condensed, and greatly Enlarged by George F. Chambers, F.R.A.S., of the Inner Temple, Barrister-at-Law. (Oxford: The Clarendon Press, 1881.)

THERE can be, we think, little doubt that the publication of Admiral Smyth's "Cycle of Celestial Objects" powerfully stimulated a taste for astronomy amongst amateurs in this country. It was popular in style, and the contents generally were such as possessed interest for the numerous class of readers who neither require nor would appreciate more technical treatises. The gossiping notes interspersed throughout the work had their special attraction for many readers.

Mr. Chambers says he would not have undertaken the task of preparing a new edition of Smyth's work for the press had he not been convinced that there was a widespread desire for it. The copyright of the work, with the Admiral's notes, unpublished drawings, &c., had come into his hands, but there remained the digesting of these materials and interweaving them with the contents of the first edition. His programme he states to have been "so to revise, prune, and amplify Admiral Smyth's *Bedford Catalogue*, as to provide a Telescopist's Manual for Refractors up to, say, 8 inches of aperture, and to embody the progress of the science up to 1880, just as the original edition might have been considered fairly complete for 5 inches of aperture up to 1845." In carrying out this programme he has deemed it essential to include objects in the southern heavens, which we do not command in these latitudes.

It is to be understood that the new edition is confined to the *Cycle* proper, or to the second volume of the original work, the *Prolegomena* being, as Mr. Chambers remarks, for the most part written up to date in the last edition of his "Handbook of Astronomy." The number of objects included by Smyth was 850, the number in the present volume is 1604. Viewing the work as one intended for the guidance of the amateur as to the objects which it may be worth his while to observe, the additions, upon the selection of which considerable pains appear to have been bestowed, nevertheless include many stars that can hardly claim to be so regarded: we allude to such objects as Nos. 252, 334, 335, 346, 371, 396, 737, 974, 1025, 1149, &c. Perhaps a less extended list with fuller

descriptions of such as possess special interest would have been equally acceptable to amateurs generally.

We are not disposed to criticise too closely a volume involving a large expenditure of time and trouble for the benefit of those who occupy their leisure evenings in telescopic observations, but as the author expresses his desire to receive corrections or suggestions for future editions of his work, we will here refer to several defects which we have remarked in a pretty careful examination of it, in the hope that his attention may be directed to the kind of revision by which another edition may be improved. Some of the more remarkable objects appear to be treated with unfortunate brevity; we may instance the fine binary star 6 p Eridani, of which a single epoch is given, without mention of the orbit having been determined by Dr. Doberck, or indeed any intimation that the star is in rapid motion: the first elements were assigned by Jacob. A still more noticeable case is that of α Centauri, one of the most interesting objects in the heavens, which is disposed of in half-a-dozen lines, without reference either to the elaborate investigations of its annual parallax since Henderson's time, to its large and well-established proper motion, or to the numerous orbits which have been computed, more especially those obtained since the passage of the peri-astron by Dr. Doberck and Dr. Elkin. Only two epochs are transcribed, one of them being the comparatively rough result of Gilliss at Santiago in 1851; in no instance would it have been better worth while to extract from the long series we possess, a sufficient number of measures to enable the reader to judge of the motion in the system. A very insufficient notice appears of Σ 518, a binary of which we may soon expect to have approximate elements, and the case of γ Coronæ Australis is quite misrepresented; from the few epochs given at p. 555, it might be inferred that there has been a direct change in the angle of position of about 30° in forty-five years, whereas there has been an actual *retrograde* motion in the angle of nearly 160°, upon which Schiaparelli calculated elements which represent the latest measures closely. Of the four cases where the author has appended orbits, in three (Castor, ζ Cancri, and ξ Ursæ Majoris) they are vitiated by typographical or other error.

Kirch's variable star in Cygnus, which Mr. Chambers calls χ^2, is the true χ Cygni of Bayer, to which letter Flamsteed's 17 Cygni has no claim; the cause of Flamsteed's misnomer was explained by Argelander many years since. The designation χ^2 is calculated to add to the doubt and confusion already existing as to this variable, of which the author unwittingly affords an illustration. The position assigned for 1890 is not that of the variable star (which is Lalande 37835), but is that of Piazzi XIX. 295, wrongly identified with Kirch's star by Piazzi, a circumstance to which, oddly enough, Mr. Chambers alludes in his notes, warning his readers against a mistake which he has himself just made. The correct place of the variable for 1890 is in R.A. 19h. 46m. 21s., Decl. 32° 38′·2.

The story of Cacciatore's supposed distant planet is left where it was by Smyth, the later calculations of Valz and Oeltzen, who showed that the motion indicated by Cacciatore could only apply to a minor planet, not being mentioned; and there are a number of other cases where the information supplied has not been brought up to date.

Mr. Chambers's volume has been handsomely printed at the Clarendon Press, and includes, for a frontispiece, the scale of colours, given by Smyth in his "Sidereal Chromatics," with the view to assist observers, in judging of the colours of the components of double stars.

OUR BOOK SHELF

Botany for Schools and Science Classes. By W. J. Browne, M.A., Lond., Inspector of National Schools. Second Edition, revised and enlarged. (Dublin: Sullivan Brothers, 1881.)

MR. BROWNE is the author of a variety of elementary mathematical books. In preparing this little manual of botany it may be presumed, therefore, that he has had to struggle with the difficulties which must always beset the amateur. The result resembles what one has often unfortunately met with in similar cases before. There is a want of simplicity in the treatment, much that is unessential and unnecessary for students of any grade, a good deal that is only of historical value, and what is worse, not a little that is downright error. This is the more unfortunate, as the questions at the end of the chapters and the examination papers which fill the last pages show that the book has a very definite aim. What, however, it may be asked, is likely to happen to examinees who reproduce such statements as the following? "*Coffee*.—The fruit consists of two halves, nearly hemispherical;" or "*Galls*—excrescences on oak, produced by an excretion thrown out round an egg deposited by an insect" (p. 98). On p. 60 the beech is given as affording an example of a capsule in its fruit; here the author has confounded the involucre with a pericarp. On the same page we find the following remark: "Around the seed . . . there is often developed a quantity of *albumen*, for the nourishment of the seed during germination"; on p. 55, "The germinal vesicle soon develops into the embryo or germ, containing the plantlet." This is on a par with the account of the process of fertilisation on p. 10, "A protoplasmic substance (*fovilla*) flows from the pollen-grain into the ovule and ripens it, so that it becomes a seed." The part of the book devoted to systematic and descriptive botany is better, though often open to criticism. If the writer had carefully studied *Penicillium* he would not have said, "The cells composing the branches (Fig. 89) are spores or *conidia*"; he has apparently been misled by his Fig. 89, which might do for one of the bog-oak ornaments sold in Dublin shops, but is a very inadequate representation of *Penicillium*. The examples of plant-descriptions are not sufficiently full, and are sometimes obscure, as for instance when the anthers of the common daisy are said to be "simple at base." The whole book still wants a thorough revision at the hands of a competent teacher to make it a safe guide for elementary students.

First Lessons in Practical Botany. By G. T. Bettany, M.A., B.Sc., F.L.S. (London: Macmillan and Co., 1881.)

THIS is an excellent little book. Its diligent study by teachers as well as pupils would give descriptive botany the real educational value which is so often claimed for it, and at bottom it no doubt possesses, if only the old type of manuals could be exterminated. What a weight would be removed from examiners' minds if examinees would really take to heart Mr. Bettany's impressive admonition (which should be hung in every examination room where plants are set for description):—"Do not *suppose* or *imagine* facts of structure which you cannot verify." It is really refreshing to come upon a manual, the object of which is to drill students in a healthy scientific method, and not merely to teach them how to impose on examiners with a show of sham and often preposterous knowledge, which has but a temporary hold on the memory and none on the understanding. The only genuine criti-

cism of a manual like this would proceed from one who had actually tested its use. Improvements will gradually suggest themselves; a few friendly suggestions might be even ventured upon offhand. On p. 63, for example, the following definition is open to objection:—"*Trichome*, a generic term for all organs developed by emergence from single cells of the epidermis." The chapter on Floral Diagrams is good. But it never seems to have been suggested that a genuine interest might be given to lessons in botany by making the pupils arrange the actual parts of the flower so as to form the diagram. All that is wanted is a flat square of cork covered with paper, on which four concentric circles are traced. It would be best to have three such squares for each pupil, with three, four, or five radiating lines drawn intersecting the circles, according as flowers with a ternary, quaternary, or quinary symmetry are to be examined. As each successive whorl of floral organs is removed, its parts should be pinned out in their proper relative positions by the pupil. The cyclical symmetry of the flower is clearly brought out in this way, even where it is apparently disguised. Some details in working the method would need a little elaboration, as, for example, the treatment of gamopetalous flowers; but this may be left to the ingenuity of teachers like Mr. Bettany.

Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz. Erster Band: 1 und 2 Lief. Pilze, von Dr. G. Winter. (Leipzig, 1881.)

FEW men have done their fellow-workers in science greater service, even if of a somewhat unobtrusive sort, than Dr. Ludwig Rabenhorst, whose recent death we announced with regret (NATURE, vol. xxiv. p. 108). His "Flora Algarum aquæ dulcis et submarinæ" is an indispensable guide to an immense labyrinth of species and genera which lie scattered up and down botanical literature. These are digested into a methodical enumeration which makes little attempt to be critical, but is content to bring the materials together just as every one who intends to study what has been done in any special group without such an aid must do for himself. Had Rabenhorst attempted more he would never have done the useful work that he did. One very convenient feature of his books is the brief synopsis of the genera of each group, accompanied by outline woodcuts of some leading types. Amongst organisms whose real affinities are often so obscure as the lower cryptogams, the utility of this plan cannot be sufficiently approved. The woodcuts often convey information at a glance which hours of study and comparison would not extract from the descriptions. The present work, of which two parts have so far appeared, is substantially a new edition of the author's "Deutschland's Kryptogamen-Flora," of which the first appeared as far back as 1844. The death of the original author may, it is to be hoped, have no effect on impeding its completion, as different groups are assigned to different hands, Dr. Winter commencing the fungi in the two parts before us. The scope of the whole work will be very much enlarged, but the same convenient features will be perpetuated. A speedy completion will be devoutly desired by all students of European Thallophytes.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Comet

FURTHER measures have been obtained at Greenwich of the position of the least refrangible edge for three of the four comet-bands with the following results:—

	Yellow band.	Green band.	Blue band.
Comet	5630·4±1·6 ...	5162·7±0·4 ...	4733·9±1·1
Bunsen Flame	5633·0 ...	5164·0 ...	4736·0
No. of Obs.	7 ...	26 ...	6

The identity of the comet-bands with those in the first spectrum of carbon appears to be clearly established, but in each case the comet-band is slightly shifted towards the blue. The displacement of the green band, if real, would indicate an approach of 47 ± 14 miles per second, whereas the comet was actually receding from the earth at the rate of about twenty miles per second. Such a displacement might, of course, be explained by an emission of cometary matter on the side towards the earth, but it would seem more probable that it is due to the circumstance that the edge of the comet-band is not quite sharp, and that a small portion on the red side is cut off. This would apply with still more force to the yellow and blue bands, which indicate somewhat larger displacements towards the blue. The displacements however, though all in the same direction, are not largely in excess of the probable errors. The comet-bands were compared with those given by vacuum-tubes containing cyanogen and marsh-gas, as well as with those of the Bunsen-burner flame, and three forms of spectroscope were used, viz. (1) the half-prism spectroscope with a dispersion of 18½° from A to H, and a magnifying power of 14; (2) the half-prism spectroscope reversed (as for prominence observations), giving a dispersion of 5° from A to H and great purity of spectrum, with a magnifying power of 28; and (3) the star spectroscope with a single prism of flint. No measures were obtained of the band in the violet, which was only seen on two occasions. It appeared to be sensibly coincident with the band in the first spectrum of carbon at 4311.

Mr. Maunder also noted several of the Fraunhofer lines in the continuous spectrum, in particular F (the position of which was determined by comparison with Hβ) and two other lines which were respectively near E and a strong double line at 5327.

W. H. M. CHRISTIE

Royal Observatory, Greenwich, July 12

I SUCCEEDED in photographing the comet in Auriga on Friday night, June 24. Since then I have taken several photographs of it. One made last night with an exposure of 2 hours 42 minutes shows the tail about 10° long. There are many stars on the plate, some shining through the tail.

HENRY DRAPER

The Physiology of Mind Reading

I HAVE received from Dr. G. M. Beard of New York (well known for his studies of Trance and related states) a letter in reference to the experiments with Mr. Bishop, of which Mr. Romanes has given an account in NATURE. Dr. Beard, writing before our experiments were carried out, mentions his own investigation, years ago, of much more remarkable performances than Mr. Bishop's, and incloses an article "On the Physiology of Mind-Reading," which he contributed to the *Popular Science Monthly* (New York) as far back as February, 1877. If this article had been shorter I would fain have asked you to reprint it, giving as it does a far more varied record of facts than came under our observation, and a series of carefully-drawn conclusions within which our conclusion falls. I will only say that if I had known of this article I should hardly have thought it worth while to spend time in the trial of Mr. Bishop's powers, or even had the curiosity to attend that first meeting amid the cloud of scientific witnesses.

G. CROOM ROBERTSON

July 9

Mind and Muscle-Reading

KINDLY allow me to correct a printer's error in my letter of last week. In describing the case of so-called thought-reading examined by myself in the clergyman's family in Derbyshire, I wrote: "The failures in *my* examination did not amount to one in ten, and were a smaller fraction when the children were not embarrassed by strangers," &c. The word "my" was printed "any," thus destroying the meaning of the sentence. I will just add that the clergyman in question is an old graduate of Trinity College, Dublin; his integrity is above suspicion, and even did not his position as a Christian minister negative the idea of trickery, the last experiment which I described disposes of this very natural explanation.

W. F. BARRETT

Special Solar Heat-Radiations and their Earth-felt Effects

THE well-filled lectures on Solar Physics by Prof. Balfour Stewart, published in NATURE, vol. xxiv. pp. 114, 150, will undoubtedly promote the study and assist the understanding of those subjects; and if a single one of the many items alluded to was not quite correctly described, that is neither surprising in itself nor likely to do much harm amidst the wealth of information which was at the same time both correctly stated and neatly conveyed. I should not therefore think myself now called on to notice one exceptional paragraph, but that it contains a most singular mistake in attributing to me conclusions from my own Edinburgh observations that are the very opposite of what I have often published between 1869 and the present time. Nor do I propose to make any positive complaint; for I rather admire the honesty of the lecturer who, after arguing for the more spotted periods of the sun's disk being its occasions of strongest heat evolutions, yet stated voluntarily and against himself that a directly opposite conclusion to his had been deduced by me from the unrivalled collection of more than thirty years of rock-thermometer observations on the Calton Hill. That is to say, that a certain eleven-year heat-wave shown by those thermometers coincided with, not the *maximum*, but the *minimum* spotted state of the sun; subject however to what the lecturer termed "a slight," but in reality a two or three year "lagging behind" the visible solar phenomenon.

Now let the sun, at any short-lived epoch, give forth an extra radiation of heat: I cannot imagine any person attempting or expecting to find its effects, after two or three *years*, as an acutely marked phenomenon in daily air and superficial earth-temperature observations. When therefore a very sharp phenomenon was marked on, or by, our thermometers, I looked for its explanation, not to what had occurred and passed away again several years before, but to something in nearly simultaneous progress on the sun. This something too, which I held forth upon even in my first paper on the subject in 1869 to the Royal Society, was ready at hand as a *vera causa;* and I ventured to describe it as "the ascending node" of the eleven-year sun-spot curve, or the time when a new cycle of sun-spots is not only well begun, but is in the act of its most rapid increase for any part of the cycle; just as a soda-water bottle effervesces most violently immediately after it is uncorked, rather than long afterwards, when some of its slowly-formed last bubbles are quietly escaping, and much more so than when it is not uncorked at all. In a letter too, printed in NATURE not two years ago, I showed how a great part of the solar action might be, and even had been immediate on our thermometers, in consequence of the very first action of a renovated sun, being a dispersion of the ordinary clouds *in situ*, whence an extra amount of direct sunshine on the earth beneath them, producing a dry hot year to the agriculturists there.

The second effects I also showed might be an increased evaporation of distant ocean-surface; the formation thereby and bringing round of greater clouds, heavy rain, and precisely the cold seasons which our Edinburgh thermometers had shown, through thirty years, did generally follow the eleven-year wave of heat. Not, evidently, that the sun was then at a minimum of heat radiation, but that a screen of wet clouds had been drawn between it and that part of the earth where observations were going on.

Now something like this whole sequence of effects has just been experienced in Madeira, all in the course of this week, subsequent to the restored energy of sun-spot manifestation and the earth-answering electric cloud of last Sunday, as I wrote to you next day.

Now that, or the first day after the specified occurrence, proved scorchingly hot, with a blue sky and the maximum shade temperature of the season, thus far.

The second day after, a thick screen of clouds was drawn between us and the sun, while the trade-wind was not only restored on the adjacent sea, but with an excess of violence more like that which is felt about Teneriffe: viz., a more southern, and therefore more sun-governed, island.

But the third day after, not only was the sun again totally invisible on account of cloud, but to the surprise of all Madeira there was a heavy, vertical downpour of rain all day long. Old residents protested that they had never, for ten years at least, known anything of the kind at midsummer season. "Precisely so," I replied; "but in the Cape de Verde Islands still further south, and more under solar dominion than even Teneriffe, you will find that every year, the sun coming to the highest northern declination is marked by heavy tropical rains. Wherefore, if Madeira is now visited in the end of June by Cape de Verde solsticial rains, be assured that the sun is at this moment shining above the clouds over Madeira with much more than his usual annual force."

But though as I write, I would seek to draw the attention of your clever lecturer to unusual solar action being often attended with earth-phenomena which lag behind a few hours only, rather than several years, I do hope he will also obtain a perusal of my paper of 1869 from the Royal Society, Burlington House, London, and take note of the forty or more year cycle, as well as other shorter ones there alluded to; for the standard eleven-year cycle, of which we have now begun a new example, will never be completely definable without knowing on each occasion how far the others are mixed up with it. Thus we had, for instance, in August last year, that eleven-year cycle's *maximum* of temperature which I had pre-announced in print ten years before; but it was very near being lost to observation by occurring not far from the middle of the long-enduring *minimum* of the forty-five years' cycle, whose prime origin is as certainly solar as that of the eleven-year, and even then much shorter cycles of twelve or fifteen days only, of which I have noted several examples since I have been here.

PIAZZI SMYTH,
Astronomer-Royal for Scotland

Jones's Hotel, Quinka do Corvalho,
Funchal, Madeira, July 2

Phenomena of Clouds

THE letter from Prof. Smyth (vol. xxiv. p. 212) recalls to my mind a phenomenon I witnessed several years ago in Arran. I was staying at Strathwhillan, on the north side of Brodick Bay, and looking northward had a full view of Goatfell and Maoldoon. The latter resembles an immense mound heaped up against the eastern side of the former. Snow had recently fallen and coated both. Then a south-easterly wind, coming up and across the firth, caused a cloud to be formed at a considerable elevation above the hills, having its under surface outlined in correct correspondence with the outlining of the subjacent mountains. This contour the cloud retained in seeming fixity for several hours. I attributed its continued existence to the effects of unequal radiation between the cold snow-covered hills and the warmer moisture-laden current above. Whether my surmise was correct, and whether the "central fixity" over Madeira can be referred to the same cause, I leave to the consideration of those more scientifically informed than I. HENRY MUIRHEAD

Cambuslang, July 8

Early English Pendulum Measures

I FIND in a volume entitled "Metrology, or Weights and Measures of Great Britain and France," by P. Kelly, "Master of the Finsbury Square Academy, London," in 1816, a list of some of the old pendulum experiments of the last century, which contains some indications quite new to me. I am in hopes that if you will allow me space enough to make them known I may perhaps hear where further information is to be found. One of the measurements which he of course mentions is that of Graham. It is rather strange that though every one of the old writers mentions Graham's experiments confidently, I have hitherto failed to find any account whatever of those experiments. The other observers mentioned by Kelly—and so far as I know by him only—are "Emerson," "Desaguillieres" [who always wrote under the name of Desaguliers], "Rotherham," and "Sir Jonas Moore." The mention is not a mere hearsay repetition of their names in this connection, as he gives the *lengths* found by each for London.

In direct connection I may remark that every one knows that the pendulum has been over and over again mentioned and treated as an ultimate appeal in case of failure of other satisfactory means of restoring national standards. In fact its *earliest* use was for this purpose *only*—except of course in horology. Is it not then a strange thing that it was *never*—during the whole of the century and a half which so regarded it—used as a medium of comparison of actual national standards? In Graham's time the relation of the French and English units of measure was so uncertain that the pendulum, with all its failings, was quite competent to establish a firmer one. Newton's table

of the variation of the seconds' pendulum with latitude was quite trustworthy enough (not to say correct enough) to furnish the geographical difference between London and Paris lengths. Yet as a fact the pendulum never was so appealed to. Yet to this day it is still not uncommonly taught that the pendulum is the proper *natural* standard of reference. In 1816 of course such was the nearly universal dogma.

I say "never," but perhaps one or other of the above observers may be adduced to confute me. J. HERSCHEL

Collingwood, July 11

Faure's Secondary Battery

IN your issue of last week you gave an account of the *soirée* held at King's College, London, on the evening of July 2, and in this account it is stated that "the great event of the evening was the exhibition for the *first* time in England of M. Faure's secondary battery."

At the *soirées* given by the Mayor of Nottingham on the evenings of June 30 and July 3 in connection with the opening of the College by H.R.H. Prince Leopold, I had the pleasure of exhibiting to large audiences one of M. Faure's new batteries. Sheets of lead were bent up into the form of shallow trays, one foot square and one inch deep; in each of these was placed a layer of red lead, then a layer of flannel, then a layer of red lead, and lastly another lead plate. These trays to the number of six were then piled one above the other, after being filled with dilute acid. The cells being connected in series, were polarised by a 10-cell battery of Grove's cells, and after twenty minutes' charging, had taken up a very large quantity of electricity. At a short lecture given during the evening the charged Faure battery was connected with a Gramme machine, and drove it round with considerable velocity for some minutes. After thus employing part of the charge the remainder was used for heating several inches of platinum wire, and for driving for a few seconds a simple form of magneto-electric engine. These experiments amply convinced those present of the practical character of M. Faure's invention. As I have not had the opportunity of examining one of the original batteries of the inventor, I was obliged to make up this experimental form. It is however a convenient form for lecture-room demonstration, as it permits the structure of the battery to be exhibited to an audience. The enormous superiority of M. Faure's cell over the old form of Planté cell is evident at once on experimenting with it. J. A. FLEMING

The University College, Nottingham, July 10

Earthquake in Van

SINCE my former letter I have had an opportunity of visiting the region most affected by the earthquake of May 30, and have obtained some further particulars about it. Its greatest severity seems to have been felt at the Armenian village of Teghourt, lying at the foot of the Nimroud Dagh, at a distance, judging by eye, of not more than four miles from the edge of the crater. This village has been almost entirely destroyed, with the loss of ninety-three lives. By the same shock about 200 houses were thrown down or more or less damaged in the aggregation of hamlets named Akhlat, some six or seven miles further distant from the Nimroud Dagh. Here however happily only two lives were lost and a few persons were injured. On June 9, in the evening, a second shock took place of less violence, which partially damaged a third village, Sipratzor, lying between the other two. As far as I was able to learn these villages were the only localities in which buildings were actually thrown down, though cracks were caused in walls, &c., in other places. The three villages are all in the direct line between the two great extinct volcanoes of the Nimroud Dagh and Sipan Dagh, which fact leads to the conjecture that there may be a line of least resistance joining the two mountains. All three villages, however, are nearer to Nimroud than to Sipan. The greater severity of the shock at Teghourt, the nearest village to Nimroud, may have been due to the latter having been the centre of the disturbance, but it may also have been caused by the fact that the village is built directly upon the solid rock of an ancient lava-bed. The only observation I was able to obtain of the direction of the earthquake wave was communicated to me at a village lying due east of the Nimroud Dagh. Here it was said that the wave came from the south, which would look as if the centre of disturbance were in the Central Kurdistan mountains, not in Nimroud; but one doubtful observation is of course not enough to establish such a point.

Whilst in the neighbourhood I took the opportunity of visiting the Nimroud Dagh. The mountain rises in a very gentle slope, so that it is possible to ride the whole way up and into the crater. The edge of the crater, where we crossed it, is 2810 feet above the Lake of Van by aneroid and about six miles distant from it; some parts of the walls however rise 500 feet or so higher, the most elevated points being to the north and south. The crater is a vast, nearly perfectly circular, hollow, between four and five miles across, the floor of which is an irregular flat dome, partly covered with herbage and partly with dwarf birch and beech and a creeping yew. Among the undulations of the dome, and especially in the depressed ring between the dome and the walls of the crater, are situated some six or seven tarns. One of these, on the margin of which we stopped to rest, is fed by hot springs, which bubble up at numerous points near its edge. I had no thermometer to ascertain the temperature of the water, but I found that one spring, which rose in a small basin almost cut off from the rest of the lake, was just about as hot as I could bear to keep my hand in. This tarn is 880 feet lower than the edge of the crater where we crossed it, this being the lowest point in the whole circuit. I saw no sign of vaporous exhalation, although local tradition has it that the mountain was active not more than four centuries ago; but time did not permit me to explore the whole of the great interior space. EMILIUS CLAYTON

Van, Turkey-in-Asia, June 20

Meteors

SEVERAL splendid meteors having lately been visible, the following observations may be worthy of note in NATURE. I may add that the most brilliant meteor was the one recorded in your columns (vol. xxiv. p. 189).

June 24, 10h. 28m., a very large bright orange coloured meteor equal to Jupiter appeared near Vega.

At 11h. 29m. a deep orange-coloured meteor, larger and brighter, than Jupiter, crossed the extremity of the comet's tail. It left a short bright streak.

June 25, 10h. 52m., a yellowish-white meteor, as bright as Vega, appeared near ζ Cygni.

At 12h. 4m. a white meteor, as bright as Jupiter, appeared just south of x Draconis, and after pursuing a wavy path, disappeared near γ Ursæ Majoris. It left a short streak.

July 3, 10h. 23m. a yellow meteor, nearly as bright as Jupiter, appeared just east of Polaris, travelled slowly in a wavy path, and disappeared north of β Cassiopei.

It will be observed that three out of these five meteors appeared in that part of the sky occupied by the comet, and also that two of them pursued wavy or zig-zag paths. B. J. HOPKINS

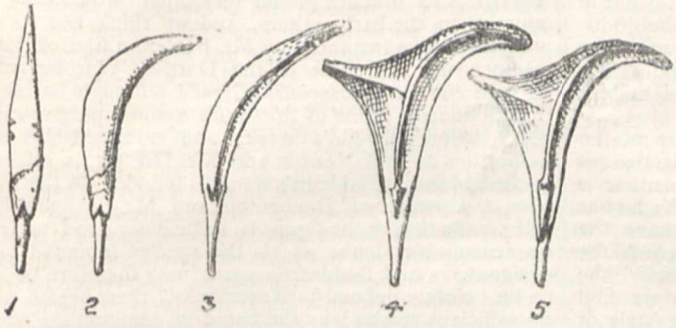
79, Marlborough Road, Dalston, E., July 5

The W-Pattern of Paddles

IN your impression of the 2nd ult. allusion is made to the origin of the W pattern which occurs upon paddles from the Solomon Isles. Without illustration it is difficult to understand the transitions which have taken place, but with the objects before you their history is easily read. I therefore inclose sketches; they are all from the same locality. In Fig. 1 it is seen that the swell of the blade of the paddle has suggested the idea of a fish's body, and accordingly the head with the mouth and eyes of a fish have been carved in their proper place. In Fig. 2 the same occurs, except that the blade is bent, probably to adapt the paddle to steering purposes, or for some other object. These two specimens represent the head of a fish in its realistic form. The progress of ornamentation is from realism to conventionalism. By comparing Fig. 3 with the foregoing it is easily seen that the W represents the mouth and sides of a fish's head reduced to straight lines, the eyes having disappeared. In all the specimens in my possession its position is always that in which the true fish's head occurs in the realistic specimens. In Fig. 4 a further change has taken place, the mouth is omitted, and the sides of the head have been brought together in a point, thus forming a simple triangle. Possibly the idea of a fish's head may have been altogether lost in this stage of the ornament, but in the next example, Fig. 5, the idea revives again, as so frequently happens in like cases, without recurring to the original model. Two eyes are seen to be inserted in the place where one occurred in the realistic specimens, the mouth still being deficient.

There can be little doubt, I think, that this interpretation

affords a true sequence of ideas that have taken place in the minds of the savages who made these things. And it is in complete analogy with the development of ornamentation in other places, of which several examples are in my museum. The interest which attaches to such specimens of savage art and ornament is purely psychological. Taken as the representatives of ideas, and arranged to show the development of ideas, they serve important purposes in the study of social evolution, explaining by analogy the law which has operated in producing many otherwise unaccountable conditions of custom, religion, or institutions, of which the successive phases of thought, having never been embodied in tangible forms or committed to writing, cannot be reproduced or arranged in their true order of succession. The sequence therefore is often lost, and wrong causes are assigned to them.



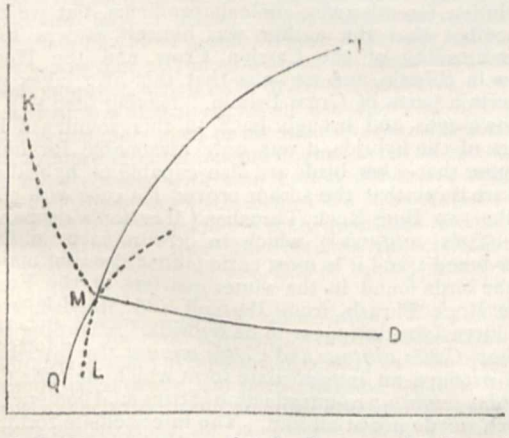
A. PITT RIVERS

Hot Ice

HAVING read a paper before the Owens College Chemical Society on January 21, in explanation of Dr. Carnelley's experiments, in which I treated the subject in a similar way to Dr. Pettersson, perhaps I may be allowed to point out one or two differences in my explanation from that given by Dr. Pettersson in NATURE, vol. xxiv. p. 176.

In the first place Dr. Pettersson speaks several times of the point *m* (the triple point) as being 0°·0078 C. below zero, whereas it must be above, because the melting-point of ice rises as the pressure is diminished.

After describing the line *m k*, which I believed then to exist, and which will probably be found really to exist if ice can be heated, Dr. Pettersson says that in the case of ordinary ice it has been proved that ice does not get hot, and that the limit of the ice-surface is along *l m*, a continuation of the water-steam line *m n*.



Now Prof. James Thomson describes *m* as the point of intersection of three different lines, *n m*, *d m*, and *q m*, the water-steam, water-ice, and ice-steam lines; *m q* being, not a continuation of *n m*, but a separate line, the difference in position being due of course to the latent heat.

I fail to see also how *m k* can be considered a continuation of *d m*, any than more of *n m*. Lastly, after denying the possibility of ordinary ice becoming hot, Dr. Pettersson describes Dr. Carnelley's ice as condensed and not frozen. In those experiments of Dr. Carnelley's which I have seen, the water was frozen round the thermometer, and not condensed on it. The matter therefore seems to stand thus:—If the ice does really become hot, the limit of the ice-surface is most probably along *m k*, whereas if Mr. Hannay and others are correct in stating that the temperatures of the ice and condenser are identical, the limit must be along *m q*, and not along *m l*, which latter is the line denoting the maximum tension of the vapour of water cooled below the freezing point without solidifying, and not of ice below the freezing point.

I would just say also that the idea of an allotropic modification of ice did not occur to me.

SYDNEY YOUNG

The Owens College, Manchester

Note on Piczorhynchus melanocephalus (Ramsay), and Ptilopus viridis (Ramsay), from the Solomon Islands

HAVING lately received several specimens of the Piczorhynchus, which I described under the above name, I find that it is the young of Mr. Tristram's *P. vidua* (see *Proc.* Linn. Soc. of New South Wales, vol. iv. p. 468) from the Solomon Islands. The white collar which commences on the nape is much broader in the young than in the adult, and the feathers of the chest are white, all margined conspicuously with black.

Specimens have been obtained on the island of "Ugi," one of the Solomon group.

I believe the fruit pigeon I determined as *Ptilopus viridis*, from the Solomon Islands, will prove to be the female of *Ptilopus argeniæ*, Gray, of which I have recently seen some fine specimens collected by the Rev. George Brown and Lieut. Richards, R.N., at "Ugi."

ED. P. RAMSAY

Anatomical Museum, Sydney, April

THE BRITISH MUSEUM CATALOGUE OF BIRDS[1]

AS has been more than once remarked in our pages, it would require more than one man's lifetime to complete the Catalogue of Birds, if the rate at which the first four volumes were produced had to be continued. Mr. Bowdler Sharpe, who has written these first four volumes, was a young man when he commenced his task, but at the same rate of progress it would have required him to live nearly a hundred years to finish the Catalogue by himself. Dr. Günther has therefore had to seek assistance from outside the walls of the Museum, and has engaged the services of Mr. Seebohm to bring out the fifth volume of the Catalogue, which contains a description of the family *Turdidæ*, containing the Thrushes and Warblers. As Mr. Seebohm has devoted several years to a study of this family, he possesses a special knowledge of his subject probably unequalled by any other ornithologist. It must be remembered that, as in the case of Dr. Günther's Catalogue of Fishes, the Catalogue of Birds is not a mere list of specimens in the national collection, but is in reality a monographic *résumé* of the birds of the world. If we look through the first four volumes of this laborious work we shall find that not only are the species in the British Museum thoroughly described, but that species not included in the collection of that institution are also treated of, and the types of rare birds in Continental museums are fully described; showing that Mr. Sharpe was not content to work solely with the collection under his charge, but that he has compared his notes with the specimens in many of the museums of Europe, and has therefore done his utmost to make the Catalogue in every way complete. But if this is true of the first volumes, it is ten times more so in the case of the fifth, which now lies before us. On turning over its pages we see that Mr. Seebohm has not only visited European museums, but has even

[1] Vol. V., Containing the Family *Turdidæ*, by Henry Seebohm.

been to America for the purpose of examining types, and the result is that up to the date of publication his work must be as complete as personal labour and an unlimited expenditure of time and money could render it. Again, the author's well-known travels in various parts of Europe and Siberia have made him acquainted with the natural history of a number of the species described in his book, and have given him a practical knowledge which must have stood him in good stead at every turn. It is not in this journal only that he will receive the meed due to his energy and perseverance, but he is sure to receive the gratitude of every ornithologist for a monograph of two such difficult families as the Thrushes and Warblers have always proved themselves to be.

Although adopting Mr. Sharpe's classification of the *Passeres*, he finds that this arrangement is artificial; but we are not sure that the arrangement of our author is altogether free from a similar charge. No one who has not studied the birds above mentioned can have the slightest idea of the extraordinary difficulty which the student would experience who tries to classify the Warblers on structural characters only, and we find no fault with Mr. Seebohm when he makes the style of coloration a generic character in these birds. But that the author himself feels a little uncertain in his key to the genera of the Warblers is shown by his introducing some of the genera three times in the *Clavis* under different sections, and it reads somewhat curiously to learn that one of the characters of the genus *Acrocephalus* is to have "the bill acrocephaline (or phylloscopine)"; the truth being that, as in the case of the species of Warblers, the genera so run one into the other that it is difficult, if not impossible, to define the exact natural limits of each. These remarks, however, almost appear hypercritical when one turns to the actual descriptive work of the author, and examines the complete way in which the synonyms are given and the descriptions elaborated, and this with the utmost conciseness consistent with completeness. One thing is evident from the list of specimens, that the British Museum series of these birds is a very full one, and we note with pleasure the constant generosity of the author himself in supplying specimens from his own collection. In the case of a bird like the common Willow Warbler, for instance, the series of specimens embraces nearly every locality whence the species is known, so that its geographical distribution is absolutely illustrated by the skins in the British Museum

In his classification of the sub-family *Turdinæ*, or True Thrushes, colour again plays an important part in classification, but we cannot complain of his arrangement, which seems to be perfectly natural, although we shall not be surprised if some ornithologists urge that some of the genera included in *Erythacus* and *Mrymecocichla* have at least as good grounds for separation on the style of colour as have some of the genera allowed by Mr. Seebohm. But not only will protests be raised on the score of nomenclature of certain species, but the novel feature of hybridisation and imperfect segregation of species introduced by the author will doubtless be subjected to severe tests. His opinions on the imperfections in the code of zoological nomenclature propounded by the British Association are well known, but the critic who attempts the task of dealing with the author on this point must clear himself of the charge (only too true we fear) that he knows of no writer who attempts to carry them out in their entirety. Mr. Seebohm observes (Introduction, p. 11): "I have accordingly adopted the law of priority with the following modifications:—that names which have been extensively misapplied must be rejected, and names otherwise unobjectionable must be retained, if a majority of ornithological writers have used them, even though they may not be the oldest. The adoption of this conformation of the law to the practice of the good old times would also have another immense advantage. It would enable us to omit the authority for the specific name, as all the names would henceforth be *plurimorum auctorum*, and thus the stigma that our names are after all trinomial would be avoided." We must demur to this reasoning, which is heterodox enough to cause the shade of Strickland to arise, and will doubtless bring forward protests from many surviving framers of the British Association code. But we ourselves feel that this practice would very often cause a manifest injustice to the early writers, and we think that this is proved in some instances by Mr. Seebohm himself, as for instance with the name of the Dartford Warbler, which he calls *Sylvia provincialis* (Gmel.), although he admits that Boddaert's name of *Motacilla undata*, published five years before Gmelin's work, and admitted by such authorities as Prof Newton and Mr. Dresser, is referable to the species. Boddaert's name is founded on the *Pittechou de Provence* of Daubenton, and Mr. Seebohm himself admits that "the figure is sufficiently good to leave no reasonable doubt as to the species intended to be designated; and Boddaert's name may therefore be held to be 'clearly defined.' Nevertheless there seems to be no sufficient reason why the name in common use should be changed." Here we consider that the long oblivion which enveloped Boddaert's nomenclature was due, not to any fault of Boddaert himself, but entirely rests with subsequent naturalists, who did not consult his work; and that therefore Boddaert has no right to suffer for the shortcomings or laziness of his successors. We are aware that the scarcity of the book makes Boddaert rather an exceptional case, but the principle applies to many of the writings of the fathers. As however the rules of nomenclature must sooner or later be re-discussed by the British Association, we may leave the defence of his principles to Mr. Seebohm himself, feeling sure that no one can read his opinions on this subject without feeling that he has a good deal to say for his view of the case.

One great feature of the present volume is the courage which the author has shown in applying the doctrine of the evolution of species to the birds as they exist at the present day. This principle was to a small extent admitted by Mr. Sharpe in his previous volumes, when he allowed the existence of sub-species, or, as Mr. Seebohm names them, con-species. The great risk that we see in Mr. Seebohm's method lies in the fact that it affords too easy a solution for otherwise difficult problems, but we must remember that the author was himself witness to the inter-breeding of the Carrion Crow and the Hooded Crow in Siberia, and we know that this also takes place in certain parts of Great Britain. Having seen this with his own eyes, and brought back to this country a large series of the hybrids, it was only reasonable for him to suppose that other birds are also capable of hybridising, and we think that the author proves his case with regard to the two Blue Rock Thrushes (*Monticola cyanus* and *Monticola solitarius*), which in certain parts of China inter-breed; and it is most curious that the vast majority of the birds found in the winter quarters of the Eastern Blue Rock Thrush, from Burmah and Malaisia to the Mollucca Islands appear to be hybrids. According to the author, *Cettia cantans* and *Cettia minuta* also inter-breed, and produce an intermediate form which he calls *Cettia cantans minuta*, a re-introduction of trinomial nomenclature which we do not at all like. The intermediate form, too, appears to be principally found in the Island of Formosa, though also met with at Chefoo, on the mainland opposite Japan, while one of the other forms is an inhabitant of Japan, with the exception of one Formosan skin in the author's collection, and the other is said to breed in South China and Hainan. Of these three forms then we should suppose that the Formosan was the oldest bird from which the other two had developed themselves, but that they had not as yet become entirely separated as distinct species. We must wait for more evidence with regard to

the South African Chats, to some of which Mr. Seebohm has applied his principle of hybridisation, as we are not yet satisfied that the changes of plumage cannot be accounted for by the more natural process due to age or the season of the year. These few remarks will not, however, detract from the sterling merit of Mr. Seebohm's volume, which bears on every page the evidences of the careful and exhaustive work which the author bestows on every subject he handles. The eighteen coloured plates are beautiful examples of Mr. Keuleman's great talents as a natural history artist, and the colouring is much more satisfactory than in the last volume of this Catalogue, issued by the British Museum.

MAGNETIC AND AURORAL OBSERVATIONS IN HIGH LATITUDES[1]

LIEUTENANT WEYPRECHT, the noted leader of the Austrian Arctic Expedition of 1872-74, whose death is a great loss to science, recently published a little text-book embodying the results of his wide experience in Arctic observation of magnetic and auroral phenomena, which will be invaluable in pointing out to future observers the precautions and requirements which only actual experience of Arctic life can suggest, and the arrangements of apparatus and stores, which, once left behind, must be done without; frequently to the loss of opportunities for observation which do not recur. It would however be wearisome to the general reader to enter into details of Arctic work, and no one to whom the matter is of practical moment will omit reading the book itself. Some however of the precautions suggested give so vivid an idea of the difficulties and even the suffering which Arctic observers have to meet in the cause of science, that we cannot forbear a passing mention of them.

In magnetic observatories, where iron is rigidly tabooed, and uniformity of temperature is of the first importance, stoves are naturally out of the question. In winter, when the huts are thickly covered with snow, the temperature should never fall below − 20° C. (− 4° F.), which, as Weyprecht says, may be borne for some hours in suitable clothing without severe suffering. Good fur garments are naturally essential. The most difficult part is the sufficient protection of the feet, that found most effectual being very wide felt boots reaching to the knee, into which the feet, clad in thick woollen stockings, are packed with dry hay or straw. The hands are covered with thick woollen gloves, and whenever they are not in actual use are further protected by fur. In absolute determinations however, which have to be carried on in a separate hut, which is also used as an astronomical observatory, and hence more open to the weather, the cold is not only much more intense, but the fingers must be left bare, or at most covered with thin cotton gloves, on account of the delicacy of the instruments. On two occasions during the *Tegetthoff* Expedition such quantities of snow were driven into the observatory through the crevices of the shutters as, by loading one side of the telescope, actually to throw it off its pillar.

For absolute magnetic observations Weyprecht gives preference to Prof. Lamont's portable theodolite, which contains in itself everything necessary for the determination of declination and horizontal and vertical intensity. If however a fixed scale could be attached to the telescope for rapid readings the instrument would be still further improved.

With regard to northern light observations, Weyprecht repeats his important classification of auroral forms given in his *Nordlichtbeobachtungen*. For observations on the altitude of auroræ, with a view to calculation of height, he recommends a simple instrument consisting of a tube with an eye-piece, movable in the magnetic meridian, and with an altitude circle reading to ½°. The tube must be attached to the end of the axis, so as to be capable of sweeping the entire meridian. The observations should be repeated at short and regular intervals, and both the upper and lower edges of the arches should be observed, thus giving at once the mean altitude and the breadth of the bands. If the "dark segment" is visible, its mean height and the azimuth of its summit must be observed, as it probably indicates the direction of the origin of the aurora. If a corona is formed the approximate position of its centre must be observed. Another method of determining the position of the corona is by measuring the direction of the rays of which the arches are formed. This is best done by measuring their inclination from the perpendicular in two azimuths 90° apart. If the tube we have mentioned be provided with an azimuth circle and cross-wires in the eye-piece with a position circle reading to ½° this is readily accomplished, the perpendicular being verified by observation of a plumb-line.

For spectral observations Weyprecht considers direct-vision instruments of good dispersion the most suitable. In low latitudes we have found a single bisulphide prism and simple slit and eye-hole without lenses to answer well, and if such an instrument were attached to the same axis as the measuring tube, which would act as a finder, we believe it would show fainter spectra than any direct vision arrangement. We do not know however how it would be affected by Arctic temperatures. Weyprecht does not mention any means of measuring the position of the lines—the simplest is Piazzi Smyth's comparison with the hydrocarbon spectrum of a spirit-lamp, and another very good scale is the band-spectrum of air yielded by a vacuum-tube fixed across the slit and made to flash as required.

Weyprecht insists on the importance of further comparisons between the movements of the aurora and magnetic disturbances, and points out the high interest that would also attach to observations of the earth-currents.

H. R. PROCTER

NOTTINGHAM UNIVERSITY COLLEGE

THE fine building, auspiciously opened the other day as a college in the heart of Nottingham, represents the last development of that all too tardy interest in higher education which, in the more recent years, has originated the Victoria University in Manchester, the Yorkshire College in Leeds, the Science College in Newcastle (a flourishing offshoot of Durham University), the Mason Science College in Birmingham, and others.

It is gratifying to find in a new provincial centre, with its varied activities and the usual temptations associated with money-getting, an intelligent, if somewhat late, appreciation of the thirst after knowledge for its own sake, as well as for that to which it may be profitably applied, and a disposition to take generous means of satisfying it.

Of the inception and growth of the Institution we need not here speak at any length. The elements of a college were already in existence. For seven or eight years past lecturers from Cambridge have visited Nottingham and drawn large audiences. The Government Science Classes were also highly appreciated. It is thus estimated that no fewer than 1400 students will be ready to take advantage of the instruction soon to be provided. Nottingham, moreover, has possessed a public library since 1868, and this, along with the Natural History Museum, greatly needed larger accommodation. From the union and consolidation of these and other educational agencies under one roof where the conditions of progress are much more favourable, excellent results may be anticipated. A distinctive feature of the Nottingham College is that it has been built by the Municipal

[1] "Praktische Anleitung zur Beobachtung der Polarlichter und der magetischen Erscheinungen in hohen Breiten," von Carl Weyprecht, Schiffseutenant. (Wien, 1881.)

Corporation of the place, is to be held as corporate property, and will be sustained mainly out of the corporate funds. With a total cost of 70,000*l.* (or, taking into account the value of the land, 100,000*l.*) the only endowments at present are the 10,000*l.* presented by an anonymous donor, and 300*l.* from Lady Ossington (for a scholarship). It is expected that the trustees of the late Mr. F. C. Cooper will, in accordance with his will, apply some part of his estate towards the endowment of classes in the College, but it is not at present known how much. Thus the expense of maintenance will, at least in the outset, mainly fall on the town itself. The experiment will doubtless be watched with interest.

The general internal arrangement of the new building may be here briefly noticed. The library-rooms are in the eastern wing, to the left of the principal front, and the natural history museum is housed in the other wing. The former include two reading-rooms on the ground and first floors. Behind the principal entrance are placed the three theatres for chemical, physical, and general lectures, the two former having laboratories, work-rooms, and professors' rooms attached. The largest theatre accommodates 600 persons, the chemical 220, and the physical 100. These rooms are well provided with modern appliances. In addition may be noted a balance-room, and an optical gallery 125 feet long for experiments in light.

It is stated in the report of the Organisation Committee that all persons will be admitted students who give evidence of their desire to improve their education and make advances in the acquisition of knowledge. More particularly the object of the founders of the institution seems to have been of a threefold character. First of all the College will absorb, as already indicated, the University Extension Lectures and Classes and the Government Science Classes, developing and systematising the courses of instruction in which these have been engaged. Next a technological school will be provided, and classes formed for teaching, in a more direct manner, the theoretical parts of certain trades. Once more, the preparation of students for residence at the older universities seems to have been contemplated; but this feature will probably, at least for some time, have little prominence.

For the purpose of systematic education the course of instruction has been arranged under four heads: (1) ancient and modern languages, literature, history, political philosophy and economy, logic, and philosophy; (2) mathematics, theoretical and applied mechanics, and physics; (3) inorganic and organic chemistry, pure and applied; (4) biological science, botany, zoology, and physiology; also geology and allied subjects. In the Government Science Classes (distinct from the College curriculum) instruction will be given in several of the subjects in which aid is given by the department at South Kensington. The Technological School will deal with the following among other subjects:—Cloth, cotton, silk, lace, and hosiery manufactures, weaving, metallurgy, gas manufacture, telegraphy, pottery and porcelain, bleaching, dyeing, and printing, tanning, mechanical engineering, oils, colours, and varnishes. It is to be distinctly understood, however, "that these classes are not so much for teaching trades as for teaching those subjects which underlie work and bear upon trade, and help to develop the intellect of the workmen."

The scheme of education provided will thus be seen to be of a comprehensive nature. All who are solicitous that England should take a good place among the nations in industrial competition will be glad to see a new technical school added to the few we already possess. The number of these schools will have to be greatly multiplied before we have anything like the advantages of Germany in this respect. In this connection we may direct attention to an interesting little volume recently written by Mr. Felkin (a native of Nottingham, by the way) who has carried on the manufacture of hosiery in Chemnitz, Saxony, since 1861, and describes what is being there done in the way of technical instruction, and its results. (Mr. Samuelson criticises the system in the *Fortnightly* this month.) The aspects of such technical education are various, and not the least in importance is that the workman, who is thereby enabled to feel an intelligent interest in his work, to comprehend the scientific principles on which it is based and the conditions of excelling in it, and to seek to do it as well as he possibly can, becomes conscious of mental growth and expansion. He even thus acquires new vistas (to use Prince Leopold's expression), and finds the drudgery of routine materially lightened. For those again who seek culture in different directions (scientific or literary) from that bearing on their daily work, a wide range of subjects is presented for choice. The cultivators of science for its own sake will doubtless not be wanting, and some excellent solid work, we trust, will be done. The youth seeking to be trained for a scientific career, and the working lad ardently pursuing some favourite study in his scanty hours of leisure, may alike resort to the College for stimulus and direction.

In the strong reaction which has become evident in recent years from that neglect of science which was so long prevalent among us, it has appeared to some that there is now an objectionable tendency to onesidedness in education. However this may be, the founders of the new College have determined, and we think wisely, that it should be more than merely a college of science and technical institute, and the purely literary elements of culture are included.

The requirements of the industrial population will be respected by the holding of classes in the evening, and the adoption of lighter fees than those for the day-students. The teaching will be conducted by resident professors, non-resident lecturers, and local teachers; and the student, after passing through the regular course of instruction and training, will, on passing an examination, receive a certificate.

The four professors required for the curriculum have been appointed as follows:—Professor of Language and Literature, Rev. J. E. Symes, M.A.; Professor of Mathematics and Mechanics, Dr. J. A. Fleming, B.A.; Professor of Chemistry, Dr. F. Clowes, F.C.S.; Professor of the Biological Sciences, Rev. J. F. Blake, M.A. One of the professors will act as Principal or Dean, with some extra emolument.

The University College of Nottingham, in fine, begins its career with good promise of usefulness, and it is to be hoped that wealthy and liberal friends of education will respond in a practical way to the appeal of the College Committee, who "desire it to be known that they are prepared to receive endowments in aid of the funds of the College." We hope soon to hear that the burden of maintenance for the townspeople has been thus happily diminished.

ANTHROPOLOGY[1]

TO those readers whose knowledge of ethnology or anthropology has been derived from a perusal of Prichard's "Natural History of Man," or the compilations of Wood, Brown, Peschel, or Brace, the present work will present a surprising amount of freshness and originality. They will in fact find themselves introduced to a new and very captivating science. Instead of the disconnected, and often confusing accounts of the numerous races, families, and tribes into which mankind have been divided, with separate details of the appearance, manners, customs, houses, implements, weapons, and ornaments of each, the reader of the present work will be shown how

[1] "Anthropology: an Introduction to the Study of Man and Civilisation, by Edward B. Tylor, D.C.L., F.R.S. With Illustrations. (London: Macmillan and Co., 1881.)

mankind may be studied in a logical, connected, and far more interesting manner, by the method of comparison, and by tracing the growth or development of those faculties which more especially distinguish him from the lower animals. Everywhere he will find proofs of the essential unity of man; whether in the close similarity of the forms of the stone implements and weapons found in the most remote parts of the earth, and among the most varied races; in the identity of signs and gestures, and the striking resemblances even among the most diverse languages; or in the wonderful similarity and often identity, of habits, customs, ideas, beliefs, and religions among all savages, and the curious way in which traces of these can often be found in the very midst of modern civilised society.

It is very difficult to give any adequate idea of a work of this kind, which, in a moderate compass, contains the essence and outcome of all modern research on the various branches of the study of man and civilisation; but we shall perhaps best exhibit its wide scope and systematic treatment by an enumeration of the subjects discussed in the several chapters, adding a few remarks or criticisms where called for.

The first chapter contains a brief sketch of what we learn from history, archæology, and geology, as to man's antiquity and early condition; and in the next we are shown man's relation to the lower animals both in bodily structure and mental characteristics. These two chapters might, with advantage, have been considerably enlarged, as they constitute the foundation, and, to many persons, the most interesting portions of the modern study of man. The results hitherto arrived at by these branches of study, are, besides, both suggestive and important, and might, we think, have been more expressly referred to. The numerous remains now discovered of prehistoric man, and of his works, dating back to an undoubtedly vast antiquity, show us in no case any important deviation from the existing human type, nor any indication that his mental status was lower than (if so low as) that of many living races. At the same time the increasing rudeness of his implements as we go back, undoubtedly indicates that we have made some approach towards the period when he first emerged from the purely brute state and became "a tool-using animal." We find him in the remote past surrounded by a number of huge mammalia, including many carnivora of greater size and destructive power than any that now exist, and we know that at a still earlier period these animals were even more abundant and more destructive; yet man must have held his own against them during the time when he had not yet begun to make tools or use fire. How did he do this without the possession of some additional natural weapons or faculties, of which nevertheless we find no trace in the earliest remains yet discovered? Again, the whole bearing of the evidence as to the development of man, indicates that the point of union or of common origin of man and the anthropoid apes, is enormously remote. Each of the existing types of these great apes possesses some specially human characteristic wanting in the others (for an enumeration of which see Mivart's "Man and Apes"), and this indicates that the common origin of these apes is of less remoteness than the common origin of them all and of man. How immensely remote, then, must be this point of common origin, and what a long and complex series of diverging forms must have existed, always in sufficient numbers to hold their own against their numerous competitors and enemies! The evolutionist *must* postulate the existence of this long series of divergent forms, yet notwithstanding the richness of the Tertiary deposits in many parts of the world no trace whatever of their actual existence has yet been discovered. The extreme remoteness of the origin of man is also shown by the facts, that neither the size nor the form of the cranium of the prehistoric races shows any inferiority to those of existing savages, while the approximate equality of their mental powers is shown by the ingenious construction of weapons and implements, and the artistic talent which we find developed at a period when the reindeer and the mammoth inhabited the south of France. It has been argued that the inferiority of the early implements shows mental inferiority, but this is palpably illogical. Did Stephenson's first rude locomotive—the *Rocket*—show less mind in its constructor than the highly-finished products of our modern workshops? Or were the Greeks mentally inferior to us because they had rude cars instead of locomotives, and had no clocks, water-mills, steam-engines, or spinning-jennies? It is forgotten that arts are a growth, and have little relation to the mental status of the artificer. A number of European infants brought up among savages would not, probably, in many generations, invent even the commonest implements and utensils of their ancestral homes; and it is difficult to say how slow may have been the development of the arts in their earliest and by far most difficult stages. It is therefore by no means impossible that the makers even of the palæolithic implements may have been fully equal, mentally, to existing savages of by no means the lowest type.

In the next chapter we have an excellent sketch of the chief races of man copiously illustrated by portraits, mostly from photographs and very characteristic. Among the best are those of the Andaman Islanders and the Dyaks, which we here reproduce. The Malays are less characteristic, this race being in fact better represented by the cut of the two Cochin Chinese at p. 98.

The four chapters on Language, whether manifested by gestures and signs, by articulate speech, by pictures, or by written characters, are exceedingly interesting and instructive, especially the account of the gesture language and the illustrations of how connected stories may be told to the deaf-and-dumb quite independently of any knowledge of alphabetical or even verbal signs. Picture-writing, as exhibited in the works of savages, in Egyptian hieroglyphics and in the modern Chinese characters, is also well explained, and is so interesting that one wishes the subject were more fully gone into. In treating of the origin of language Mr. Tylor doubts the sufficiency of the theory that emotional, imitative, and suggestive sounds were the basis on which all languages were founded, though he gives tolerably full illustrations of how roots thus obtained became modified in an infinite variety of ways to serve the growing needs of mankind in expressing their wants or their feelings. He impresses on his readers the important fact that language is always growing and that new words are continually made "by choosing fit and proper sounds." He shows how words once imitative or emotional have been often so changed and modified as to have their original character totally concealed; yet he concludes, that—"it would be unscientific to accept all this as a complete explanation of the origin of language"—because "other causes may have helped." It seems, however, to the present writer, that the imitative and emotional origin of language is demonstrated by a body of facts almost as extensive and complete as that which demonstrates the origin of species by natural selection; and that the "other causes" are in both cases exceptional and subordinate. As the examples of imitative words given by Mr. Tylor are comparatively trivial and altogether inadequate, it may be well to call attention to the wide and far-reaching character of such words, and to show how much of the force, expressiveness, and beauty of our language (as of most others) depends upon them.

Putting aside all mere representations of animal sounds—as the *whinny* of the colt, the *mew* of the cat, or the *bleat* of the sheep—let us consider what an immense number of natural sounds are named by words which we at once see to be appropriate representations or imitations of them. Such are—*crash, whizz, fizz, hiss, creak, whistle, rattle, bang, clang, flop, thud, clap, roar, snore,*

groan, *moan*, *wail*, *thunder*. In other cases sights, sounds, or feelings, are represented by their accompanying or appropriate sounds. We see a *splash*, or a *slop;* we feel a thing to be *smooth* or *rough*, or to *vibrate;* and we *shiver* with cold or *terror*. Again, how many actions and qualities are represented by words expressing the sounds which sometimes accompany them—as *knock*, *shock*, *crack*, *snap*, *ring*, *whisper*, *hush*, *sigh*, *sob*, *wash*, *squash*, *crush*, *crunch*, *rip*, *rend*, *grind*, *scratch*, *split*, *spit*, *cough*, *sneeze*, *wheeze*. How characteristic are such words as *sticky*, *flicker*, *flutter*, *hurry*, *flurry*, *stumble*, *hobble*, *wobble*. Here we have not only sound, but motion and quality, represented by the arrangement of letters and syllables. How clearly do such words as *slide*, *glide*, and *wave* imply slow and continuous motion, the movement of the lips while pronouncing the latter word being a perfect double undulation. How curiously do the tongue and palate seem to be pulled apart from each other while pronouncing the words *glue* or *sticky*. How marked is the contrast between the harsh consonants used to express *rough*, *rugged*, and *gritty*, as compared with the soft flow of sounds in *smooth*, *oily*, *even*, *polished*. Look again at

Andaman Islanders.

the sense of effort and feeling of grandeur in pronouncing the words *strong*, *strength*, *power*, *might*, as compared with the opposites, *weak*, *faint;* or the open-mouthed sounds of *grand*, *huge*, *monstrous*, *vast*, *immense*, *giant*, *gigantic*, as contrasted with the almost closed lips with which we say *small*, *little*, *tiny*, *minute*, *pigmy*, *midget*. So *crawl* and *drag* are pronounced slowly as compared with *run*, *fly*, or *swim;* while *difficult* and *easy* express their own meaning while we pronounce them. Many objects and substances have names curiously corresponding with their qualities. We have already noticed *glue* as indicating stickiness, but no less clearly is *oil* smooth; while *brass* and *glass* indicate resonance; *tin* a tinkling sound; *lead* and *wood* a dull sound or *thud;* in *bell* we imitate its sound, while the word *jelly* indicates the shaking of the substance. In *ice* we hear the interjectional *sh* of shivering with cold; in *fire* the flicker of the ascending flame. In other cases the motion of the breath gives an indication of meaning; *in* and *out*, *up* and *down*, *elevate* and *depress*, are pronounced with an inspiration and expiration respectively, the former being necessarily accompanied with a raising, the latter with a depression, of the head. When we name the *mouth* or *lips* we use labials; for *tooth* and *tongue*, dentals; for the *nose* and things relating to it, nasal sounds; and this peculiarity is remarkably constant in most languages, civilised and savage. Among the Malay races, for instance, we find such words as *mulut*, *bawa*, *mohon*, and *moda* for mouth; *gigit*, *nisinen*, *nigni*, and *niki* for teeth; and *idong*, *ugerun* and *usnut*, for nose. So in words for *large* we find a prevalence of broad sounds involving a wide opening of the mouth, as *busār*, *bākè*, *bāgut*, *lāmu*, *elāmo*, *ilāhé*, *eràāmei*, *aiyuk*, *mäina*—and for *small*, words that are pronounced quickly and with slight opening of the lips, as *kichil*, *chili*, *kidi*, *köi*, *roit*, *kemi*, *anan*, *kiiti*, *fek*, *didiki*, all taken from languages of the Malay Archipelago.

Dyaks.

These few examples, which might be greatly increased, indicate the variety of ways in which, even now, after all the modifications and development which language has undergone, sound still corresponds to sense; and if the reader will turn to Dr. Farrar's suggestive little work on the "Origin of Language," he will find how wonderfully, by the help of analogy and metaphor, the uses and meanings of simple words and sounds have been indefinitely increased, so as to subserve the growing need of mankind to express more and more complex ideas. Mr. Tylor is rather unfortunate in his illustration of words for the form of which no cause can be assigned, when he says: "There is no apparent reason why the word *go* should not have signified the idea of coming, and the word *come* the idea of going." But, in accordance with the examples already

given, there *is* a very good and sufficient reason. We pronounce *come* with a closure and contraction of the lips and usually during inspiration, *go* with open and protruding lips and usually during expiration. Now many savages point with the lips as we do with the finger, signifying *there*, by protruding the lips in the direction to be indicated; and any one who has seen this curious gesture must be struck with its close similarity to the protrusion of the lips in pronouncing the word *go*. The same difference of the nearly closed or open lips characterises the words for these two ideas in many other languages. In French we have *viens* and *va*, in German *komm* and *geh*, in Italian *vieni* and *vai*, showing that words in distinct languages differing greatly in spelling and pronunciation may yet have a common character in the mode of speaking which indicates their common meaning.

The five following chapters treat of the Arts of Life, a subject which Mr. Tylor has to a great extent made his own, and which he discusses in a very interesting manner. The doctrine of development in the arts is however somewhat strained when it is implied that the modern gun is an outgrowth of the South American or Indian blow-tube; while the origin of bank notes, and the account of the rise and progress of mathematics are hardly anthropology.

The next two chapters discuss the ideas of savage man as to the spirit-world, and the origin and development of myths; while the final chapter gives an admirable sketch of man as a social being, and of the development of that complex organism, Society. This thoughtful chapter cannot be epitomised, but the reader will find in it much curious information as to the sources of many of the customs, laws, and observances of civilised life, which are shown to be often traceable among the lowest savages. The following passage will serve to illustrate the author's style and treatment of his subject:—

"Much of the wrong-doing of the world comes from want of imagination. If the drunkard could see before him the misery of next year with something of the vividness of the present craving, it would overbalance it. Oftimes in the hottest fury of anger, the sword has been sheathed by him across whose mind has flashed the prophetic picture of the women weeping round the blood-stained corpse. The lower races of men are so wanting in foresight to resist passion and temptation, that the moral balance of a tribe easily goes wrong, while they are rough and wantonly cruel, much as children are cruel to animals through not being able to imagine what the creatures feel. What we now know of savage life will prevent our falling into the fancies of the philosophers of the last century, who set up the 'noble savage' as an actual model of virtue to be imitated by civilised nations. But the reality is quite as instructive, that the laws of virtue and happiness may be found at work in simple forms among tribes who make hatchets of sharpened stones and rub sticks together to kindle fire. Their life, seen at its best, shows with unusual clearness the great principle of moral science, that morality and happiness belong together—in fact that morality is the method of happiness."

The reader who wishes to know what is the outcome of modern research into the nature, characteristics, and early history of man; and into his progress in the arts of life, in morality, and in social economy, will find a store of valuable information and much suggestive remark in this carefully-written but unpretending volume.

ALFRED R. WALLACE

NOTES

WITH regard to the forthcoming session of the American Association in Cincinnati, to begin August 17, we have to add to information already given (p. 146) that all the meetings, general and sectional, will be held under one roof, that of the Music Hall and Exposition Buildings. On the evening of the first day of meeting there will be a citizens' reception. An afternoon is to be devoted to visiting the Zoological Gardens. An exhibition of scientific apparatus, appliances and collections will be held during the Association meeting. The objects displayed will be kept over for the ninth Cincinnati Industrial Exposition in September. After the adjournment of the Association excursions will be organised on the Cincinnati Southern Railroad, and also, it is hoped, to the Mammoth Cave.

THE Prince of Wales is expected to lay the foundation-stone of the Central Institution of the City and Guilds of London Institute, on Monday next, at 3.30 p.m. His Royal Highness and the Princess of Wales were present at the Lord President's reception on Wednesday night at the South Kensington Museum. Prior to the reception the Prime Minister and several members of the Cabinet visited the Science Schools.

WE regret to announce the deaths of Dr. E. Zaddach, director of the Zoological Museum at Königsberg, who died on June 5 last; of Dr. Wilhelm Gottlob Rosenhauer, Professor of Philosophy at Erlangen University, who died on June 13, aged sixty-eight (on the same day on which Medical Science lost Josef Skoda at Vienna); of Dr. Matthias Jakob Schleiden, the well-known botanist, and author of many works on natural history (amongst which we may point out as standard works "Die Pflanze" and "Das Meer"), who died at Frankfort on June 23, aged seventy-seven; of Dr. Theodor Benfey, Professor of Philosophy at Göttingen University, a celebrated orientalist and linguist, whose death occurred on June 26 at the age of seventy-two; and of Dr. Rudolf Hermann Lotze, Professor of Philosophy at Berlin University, author of the "Mikrokosmus," who died on July 1, aged sixty-four years.

MESSRS. SIEMENS have received advice of the completion of the new Atlantic cable recently constructed by them. The reports of insulation and working speed are highly satisfactory. The cable connects Sennen Cove, Land's End, with Dover Bay, Nova Scotia, direct, a length of 2500 nautical miles.

M. PASTEUR has received the Grand Cross of the Legion of Honour.

M. WURTZ, the present president of the Academy of Science, has been appointed Life Senator by a very large majority. This highly-approved appointment raises to three the number of members of the Academy of Sciences who now belong to the Upper House of the French Republic; the two others are M. Robin and M. Dupuy de Lome. M. Berthelot, another member of the section of chemistry, has been proposed for a seat which is at present vacant, and his election is considered quite certain. A large number of the French senators belong to the other section of the Institute, which is now taking such a prominent part in French politics. This influence of the Institute was contemplated by M. Thiers, and his views are advocated principally by Mr. Barthélemy St. Hilaire, the Minister for Foreign Affairs and Member of the Academy.

SIXTY French members of the Congress of Electricians have been appointed by M. Cochéry, the Minister of Telegraphs, who has been made President. M. Ferry, Minister of Public Instruction, has been appointed Vice-President, and four other members of the Cabinet will be chosen by the Congress. The Academy of Sciences and other public scientific institutions will appoint their own representatives, as well as foreign nations.

WE have received the sixth report of Mr. Crookes and Professors Odling and Tidy, to the President of the Local Government Board, on the London Water Supply. It relates to the quality of water supplied from May 20 to June 30, and is highly favourable. "The results of our six months' work" (say the authors),

"and the examination during this period of 1127 samples, enable us to state that as an excellent drinking supply it [*i.e.* the water supplied to London] leaves nothing to be desired."

THE Royal Archæological Institute, of which Lord Talbot de Malahide is president, holds its annual congress at Bedford this year from Tuesday, July 26, to Monday, August 1. Elstow Church, Woburn Abbey, the Roman camp and amphitheatre near Horbury and Sandy, St. Alban's Abbey, and the ruins of Old Verulam, are among the places set out in the programme to be visited.

IN the Archives of the Observatory of Stockholm the assistant, M. Lindhagen, has made a highly interesting discovery. It consists of a copy of a treatise by Copernicus which is more complete than all those known hitherto, and which thus fills a gap in the works left by the great astronomer. The treatise bears the title, "Nicolai Copernici de hypothesibus motuum cœlestium a se constitutis commentariolus." It is bound with a copy of Copernicus' "De revolutionibus orbium cœlestium," which formerly belonged to Hevelius, the Danzig astronomer. The treatise, with an introduction by Lindhagen, will shortly be published in the *Transactions* of the Stockholm Academy of Sciences.

THE Annual Report of the Royal Society of New South Wales for 1880 states that thirty-six new members were elected during the year; the actual increase is twenty-two, and the present number of members 452. One honorary member, Sir J. D. Hooker, was elected; and Mr. Hyde Clarke, Major-General Sir E. Ward, and Mr. F. B. Miller were elected corresponding members. The Clarke Medal for 1881 has been awarded to Prof. McCoy of Melbourne University, for his distinguished researches in the Palæontology of Europe and Australia; (Prof. Owen, Mr. G. Bentham, and Prof. Huxley have been the three previous recipients). The finances of the Society are in a satisfactory condition. At the annual meeting on May 4, Prof. Smith, the retiring president, gave an address, in which he reviewed the twenty-five years of the Society's existence (eleven years of which it had the name of the Philosophical Society). Up to 1875 the Society had a somewhat chequered career. It entered the new building that year, and the tide of prosperity still enjoyed is largely due to the zeal and energy of Prof. Liversidge and Dr. Leibius, the secretaries then appointed. During the past year twenty-eight papers were read by thirteen members, many of them involving much laborious research. Mr. H. C. Russell was elected president for the coming year.

CONSIDERABLE progress has been made with the building for the zoological station at Watson's Bay, near Sydney, due to the initiative of Baron Maclay. The building is a neat cottage providing five workrooms and two bedrooms, besides storeroom and bathroom in the basement. It is not intended to make a charge for each table or workroom as at Naples; but every naturalist will be expected to contribute a small sum (say five shillings a week) towards paying a caretaker. Other current expenses will have to be met by subscriptions. The Government has agreed to double the subscriptions for establishing the station up to 300*l*. The Royal Society of New South Wales may be expected to carry forward the enterprise with spirit, and assistance has been promised by the Royal Society of Victoria and other bodies there.

THE French Government have sent a scientific expedition to Mesopotamia and Assyria. An architect and an engineer accompany the expedition.

AN Astronomical Congress will be held at Strassburg during September next, and will be visited by many eminent astronomers from all parts of the civilised world. Strassburg was chosen because in its new observatory the best and most modern astronomical apparatus are to be found.

IT is said that MM. Siemens have renounced the idea of constructing an electrical railway in Paris, as the Municipal Council has not granted to them the concession they required. We believe that the railway which is to be made will be worked with Faure accumulators.

WITH reference to Mr. Newberry's letter on American cretaceous flora, in our issue of 30th ult., we are requested to state that Mr. J. Starkie Gardner is at present travelling in Iceland, and his silence may be thus accounted for.

THE meeting of Austrian Anthropologists and Antiquaries will be held at Salzburg on August 12 and 13 next.

THE Committee of the Liebig Institution at Munich has made an award of two gold medals for 1881: one to Prof. G. Hanssen of Göttingen, the other to Prof. H. Settegast of Berlin, in recognition of their great merit in the furtherance of German agriculture.

THE Berlin Medical Society are now making preparations for celebrating the twenty-fifth anniversary of Dr. von Virchow's professorship. The celebration will probably take place on October 13 next, Virchow's sixty-first birthday.

AN International Alpine Congress will be held at Salzburg in the latter half of August, upon the occasion of the ninth annual meeting of the German and Austrian Alpine Club. The following subjects will probably be discussed:—(1) On the method of surveying Alpine territory and the multiplication of Alpine maps, with an exhibition of maps executed in Bavaria, England, France, Italy, Austria, and Switzerland. (2) On glaciers and the various methods of studying the same, with special reference to the observations at the Rhone glacier and to the glacier-book of the Swiss Alpine Club. (3) On the construction of shelter-huts and their interior arrangement, with an exhibition of models and plans.

AT Hermannstadt a Transsylvanian Carpathian Club has just been formed after the model of the German and Austrian Alpine Clubs. Its object is the scientific investigation of the Transsylvanian Alps with their glens and caves. The new club numbers a good many members already, and branches have been established at Broos, Kronstadt, Mühlbach, and Schässburg.

AT Leipzig a new Ornithological Society has been formed, which numbers amongst its objects the general protection of birds.

DURING the last days of May the whole neighbourhood of Kamenz was visited by strange guests. Enormous swarms of *Libellula quadrimaculata* passed over the valley, here and there in dense masses, and extending from five to ten miles in breadth. The first swarm arrived about noon on May 30, its passage occupied two hours; in the evening a second swarm came from the direction of Weisswasser. The third swarm arrived on the morning of the 31st. Swarms of this description have not been observed since June, 1825. At Dresden the strange phenomenon was also observed.

A BURIALPLACE has been discovered in the neighbourhood of Naumburg, which proves to be a rich store of antiquities. Up to the present some ninety clay vessels and bronze objects have been excavated, amongst which is a very large ash-urn.

IN a peat bog near Triebsee (Stralsund district) a discovery of flint implements has been recently made. Some four or four and a half feet below the surface eight lance-points and fourteen edge tools were found lying in a heap together. Although the whole neighbourhood and the Island of Rügen are rich in objects of the kind, the large size of the present specimens and

the perfection of the workmanship cause general surprise. The objects found have been forwarded to the Stralsund Museum.

THE Thuringian Fisheries Union had a meeting at Jena on June 7, when the Grand Duke was present. The proceedings proved the satisfactory progress of pisciculture in Thuringia.

A NEW commentary to Kant's "Kritik der reinen Vernunft" will be published by Spemann of Stuttgart, upon the occasion of the centenary of that great work. The author is Dr. H. H. Vaihinger of Strassburg, and the commentary will be in four volumes. It will give a detailed explanation of the text, a logical analysis of the contents, and an abstract of all the works published during the century with reference to Kant's masterwork.

SIMILAR devastations to those which we reported from the Caucasus some time ago are now caused in Turkey by grasshoppers. The Turkish Government is compelled to employ extraordinary measures to overcome the plague. A particularly voracious species has appeared in the Bodirum district (Smyrna), and the whole population is employed to combat the insects. At Angora all business was suspended for three days by order of the Governor-General, and all the inhabitants were ordered to march out into the fields to destroy the grasshoppers. Every inhabitant was compelled to deliver 20 oka (about ½ cwt.) of dead grasshoppers to the officials. The swarms are said to emanate principally from Persia.

THE Epping Forest and County of Essex Naturalists' Field Club has held three field-meetings this year. On April 2 the Club visited Waltham Abbey under the guidance of Mr. George H. Birch, who communicated a paper on this interesting building. On May 14th the Club united with the Geologists' Association for the purpose of visiting the chalk-pits at Gray's Thurrock. The conductor for the occasion was Mr. Henry Walker, F.G.S. Prof. Morris, who was also of the party, gave a series of most instructive addresses on the ground. The last field-meeting, held on June 25, was microscopical, the conductor being Mr. W. Saville Kent, F.L.S. The Club met at Chigwell, where they were hospitably entertained by the Rev. Linton Wilson, M.A., at Oakhurst. Mr. Kent read a paper entitled "Infusoria—what are they?—their Collection and Investigation." Field-meetings in conjunction with the Hertfordshire Naturalists' Field Club and with the Essex Archæological Society are under arrangement. The Essex Field Club has recently been making excavations in the ancient earthwork in Epping Forest known as Ambresbury Banks, under the superintendence of General Pitt-Rivers, F.R.S., who will shortly give an account of the results obtained.

IN the Poserna district, between Weissenfels and Lützen, saline springs have been discovered by the Mining Engineer, Herr C. Reyher of Halle. The spring near the village of Poserna comes from an old shaft which is said to be eighty yards deep, but is now filled with *débris*. The water is effervescent. Another spring was discovered near Stösswitz at a depth of 19 metres, and rose with such force that it could only be stopped with great difficulty. Some 100 yards from the latter a third spring was discovered. The water of the three springs is strongly saline, and as they contain principally potash salts, their discovery is valuable. It is now found that during the fifteenth century salt works existed in this neighbourhood.

M. THOREL, President of the General Council of the Seine, has received an official answer to his inquiries relating to the reasons why the Paris gas companies refused to sell their commodity to Parisian aëronauts. It is probable that an arrangement will soon be entered into, and that public ascents will be resumed shortly as in former years, under the supervision of the municipal authorities.

THE Kant Society at Königsberg inaugurated a chapel dedicated to the memory of Kant on June 19. The small Gothic building touches the cathedral on the north side and forms a fitting substitute for the "Stoa Kantiana," which has become useless since the opening of the new University building. The interior of the chapel is formed by a double cross vault. On the left the same tombstone is let into the floor which covered the grave in the "Stoa Kantiana," and which was originally presented by Herr Scheffner. Underneath this the remains of Kant are contained in a double zinc coffin.

AT Zamoly, in the Hungarian Comitat of Stuhlweissenburg, two tombs have been discovered which contained coins from the time of Diocletian. One was the grave of a boy, the other that of a very tall man. Interesting remains of bas-reliefs and portraits were found in the tombs. They were on pieces of wood; one shows the words "Bibite hoc."

THE *Journal Télégraphique* of Berne, the organ of international telegraphy, has expressed its approval of the proposal to establish an international code for the protection of submarine telegraph property, both during war and peace.

THE German Geometrical Society held its tenth annual meeting at Karlsruhe in the third week of June.

ON the 16th inst. an International Agricultural Exhibition will be opened at Hanover. The exhibitors number over 1600.

MR. MURRAY has in hand, and will shortly publish, the following works of interest to scientific men:—"The Land of the Midnight Sun," being an account of Summer and Winter Journeys through Sweden, Norway, Lapland, and Northern Finland; with Descriptions of the Inner Life of the People, their Manners and Customs, the Primitive Antiquities, by Paul B. du Chaillu. In two vols.; with map and numerous illustrations. "The Formation of Vegetable Mould through the Action of Worms," with Observations on their Habits. By Charles Darwin, F.R.S. "The White Sea Peninsula;" a Journey to the White Sea, and the Kola Peninsula. By Edward Rae. With illustrations. "The Life of Sir Charles Lyell;" with Selections from his Journals and Correspondence. Edited by his sister-in-law, Mrs. Lyell. With portrait, two vols.

DURING the demolition of some old buildings at 406 and 407, Oxford Street, last week, the workmen on reaching the foundations came on a quantity of old armour and weapons—helmets, breastplates, spears, swords, and daggers, some very curious in shape. On opening a stone vault they found also some plate, including church utensils, such as a monstrance and a chalice, the workmanship of which is thought to be of the fourteenth century. The monstrance had a Latin inscription.

AN Agricultural Exhibition will be held at Strassburg from September 11-18 next. Over 2000*l.* will be distributed in prizes.

THE additions to the Zoological Society's Gardens during the past week include a Weeper Capuchin (*Cebus capucinus*) from Brazil, presented by Mr. J. S. Chapperton; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Mr. Arthur Tower; a Central American Agouti (*Dasyprocta isthmica*) from Central America, presented by Mr. A. Melhuish; two Pileated Jays (*Cyanocorax pileatus*) from La Plata, presented by Mr. A. A. Dawley; a Berg Adder (*Vipera atropos*) from South Africa, presented by Mr. Borrodaile Pillans; a Cullen's Eagle (*Aquila culleni*), South European, eight American Menobranchs (*Menobranchus lateralis*) from N. America, purchased; a Common Rhea (*Rhea americana*) from South America, on approval; a Reeves' Muntjac (*Cervulus reevesi*), born in the Gardens; two Scarlet Ibis (*Eudocimus ruber*), three Common Widgeons (*Mareca penelope*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

THE COMET.—By favour of Dr. W. L. Elkin of the Royal Observatory, Cape of Good Hope, we are able to subjoin observations of the great comet made at that establishment before the perihelion passage, which it is stated will admit of improvement when the places of the comparison-stars have been more accurately determined :

	Cape M.T.	R.A.	Decl.
	h. m. s.	° ′ ″	° ′ ″
May 31 ...	6 19 24 ...	75 46 25 ...	−29 42 19
June 3 ...	5 53 47 ...	76 12 30 ...	26 25 57
4 ...	5 59 57 ...	76 21 55 ...	25 4 53
9 ...	5 31 18 ...	77 16 24 ...	−15 44 53

From the positions on May 31, June 4 and 9, Dr. Elkin has calculated the following elements of the comet's orbit, by the side of which we place for comparison others deduced by Mr. Hind, from post-perihelion observations up to July 1 :—

	ELKIN	HIND
Perihelion passage, June	16·29839 G.M.T.	June 16·41519 G.M.T.
	° ′ ″	° ′ ″
Longitude, perihelion..	264 55 13	265 9 4
,, node ...	270 54 27	270 58 0
Inclination...	63 27 4	63 29 9
Log. perihelion dist....	9·866656	9·865516
	Direct.	Direct.

The longitudes are reckoned from the mean equinox of 1881·0. Mr. Hind's orbit gives the following expressions for the comet's heliocentric co-ordinates x, y, z to be used with the X, Y, Z of the *Nautical Almanac* in the calculation of geocentric right ascensions and declinations ; they apply to apparent equinox 1881·5.

$$x = r\,[9{\cdot}65000]\ \sin.\ (v + 356^\circ\ 22'{\cdot}5)$$
$$y = r\,[9{\cdot}99187]\ \sin.\ (v + 243\ 20'{\cdot}7)$$
$$z = r\,[9{\cdot}96142]\ \sin.\ (v + 328\ 24'{\cdot}3).$$

Here, v is the true anomaly, r the radius vector, and the quantities within square brackets are logarithms.

We may take this opportunity of correcting a singular misstatement with which Admiral Mouchez, the director of the Observatory at Paris, is credited in the *Comptes rendus* of the Academy of Sciences. He is there made to say that the period of revolution of the comet of 1807, which had elements resembling those of the present comet, was found by Bessel to have been reduced to 174 years after he had taken account of "new perturbations." Any one who refers to Bessel's treatise will see that this is an error. Bessel fixed the period of revolution at 1713½ years, on September 22, 1807, and in continuing the computation of the perturbations by the planet Jupiter to March, 1815, when they had become very small, he found that the revolution had been diminished thereby, about 170 years; he considered that the period he had assigned for September 22, 1807, was not liable to a greater error than 100 years. In the *Comptes rendus* the effect of perturbation on the period appears to have been quoted, instead of the revolution itself, as perturbed to March, 1815. In the communication to which we refer, the identity of the comet of 1881 with that of 1807, is pretty distinctly assumed, but the weight of evidence is certainly in the other direction.

THE VARIABLE STAR U CEPHEI.—Prof. Julius Schmidt has published an ephemeris of the last variable star discovered by Ceraski in Cepheus, extending to the end of the present year. From his later observations he has found that the gradual increase of period which he had formerly suspected is not confirmed, and he now fixes the period at 2d. 11h. 49m. 33·35s. On August 18 commences a series of minima, which may be observed at intervals of something less than five days to the end of December : the following are the Greenwich mean times to the end of October :—

	h.	m.		h	m.		h.	m.
Aug.	18, 14	44·9 ...	Sept.	12, 13	0·8 ...	Oct.	7, 11	16·6
	23, 14	24·0 ...		17, 12	39·9 ...		12, 10	55·8
	28, 14	3·2 ...		22, 12	19·1 ...		17, 10	35·0
Sept.	2, 13	42·4 ...		27, 11	58·3 ...		22, 10	14·2
	7, 13	21·6 ...	Oct.	2, 11	37·5 ...		27, 9	53·4

The letter T, at first used to designate this star, will be properly applied to another variable also discovered by Ceraski, the place of which for 1855·0 is in R.A. 21h. 7m. 33s., Decl. + 67° 54′·4, which seems to have a period of about 400 days, and was at a maximum on December 30, 1880.

PHYSICAL NOTES

IN the *Journal* of the Franklin Institute Prof. S. W. Robinson has recently described some experiments upon the effect produced upon sound-waves by repeated oblique reflections at membranes forming the boundary of two gaseous media. These experiments, as far as they go, would appear to show that after repeated reflection at oblique surfaces set in vertical planes a sound-wave acquires new properties by virtue of which it is reflected at another such oblique surface with an intensity which is a maximum if this surface be also in a vertical plane, and a minimum if the surface be equally inclined to the direction of propagation of the wave, but turned through a right angle about that direction as an axis. If this be indeed established as an experimental result it is equivalent to a proof that sound-waves can be *polarised* by reflection. The apparatus consisted of a series of L-shaped tubes of tin plate, one inch in diameter and three inches long, the parts joined at an obtuse angle, but having the outer angle cut away and covered by a thin membrane. This membrane was fixed so that a sound-wave coming in either direction should be incident on it at the angle of supposed maximum polarisation, the angle being calculated by Brewster's Law so that its tangent should represent the ratio between the velocities of wave-propagation in the two media, namely, coal-gas within, air without (14 : 11). The series of tubes was so set that at first the membranes were all parallel, and then a "pulse" was sent along the tube in the following manner :—The initial and final openings were closed by membranes stretched across the tubes orthogonally. Against each a small ball of ivory or glass was hung by a thread. The ball at one end was raised to a given height and dropped on to the membrane, and the impulse given to the ball at the other end was noted. Then the second half of the system was turned round so that the membranes of this portion were at right angles to their former position, and the ball was again dropped. The impulses received on the second ball were in general feebler when the second system, or "analyser," stood at right-angles to the first system, or "polariser," the diminution varying in different experiments from 16 to 38 per cent. No diminution was observable when the interior of the tube was filled with air instead of coal-gas. It remains to be seen whether the results are capable of being reproduced under other circumstances, or whether they are due to some mechanical peculiarity of Prof. Robinson's apparatus. Whether this be so or not we must absolutely reject the very unwarranted conclusion at which Prof. Robinson arrives, namely, that the vibrations of light as well as of sound are longitudinal until they are polarised, and that they become transversal only in the act of polarisation.

M. MERCADIER has examined the resistance of selenium at different temperatures, using for this purpose a photophonic receiver of selenium spread between the edges of platinum sheets, the resistance being measured in the dark by the ordinary bridge-method. The receiver, which had been well annealed, had at 15° C. a resistance of 54,000 ohms. This amount decreased as the temperature rose with great regularity to 36° C., when its resistance was less than 1500 ohms. From this point the diminution of resistance was less rapid ; but at about 125° C. it had fallen to less than 500 ohms, rising slightly to 163° C., from which it again fell as the temperature was raised to 208°. These results accord with the earlier experiments of Werner Siemens.

M. LIPPMANN finds (*Jour. de Phys.*, May) that galvanic polarisation, which modifies so much the capillary properties of a metallic surface, causes no perceptible variation of its optical properties. He directed a beam of polarised light towards a platinum or silver mirror in acidulated water, or copper sulphate solution, and it was received, after reflection, in a Jamin quartz compensator, followed by an analyser-Nicol. The dark fringe in the compensator was not displaced when the mirror was included in the circuit of a Daniell or Bunsen element, and the current passed. Again, Newton's rings, formed by a glass plate on the platinum surface, and observed under various incidences, showed no displacement when the polarising current passed. (M. Lippmann adds some observations as to the mode of production of gas-bubbles by electrolysis.)

A FEW years ago M. Montigny called attention to the fact that the scintillation of stars is considerably increased during aurora borealis. Further data on this subject are afforded in a recent issue of the Belgian Academy's *Bulletin*, No. 3. *Inter alia*, he has observed that the phenomenon is more pronounced in winter than in summer, and that stars in the northern region

show the increased scintillation most. The author's general conclusion is that the effect is not one due to direct influence of the electro-magnetic light of aurora on the scintillation itself, but to disturbances (probably a cooling) which coincide with the appearance of aurora in the upper regions of the air, traversed by the star-rays.

An acoustical apparatus for lecture purposes, devised by Dr. Maschke (*Wied. Ann.* No. 5), consists of a longish graduated piece of wood on adjustable supports, and having a longitudinal groove in in its upper surface, in which a glass tube is placed. At the end of the wooden piece is a screw arrangement supporting a thin steel rod which enters the tube, and has at its end a (vertical) ring with collodion membrane, against which hangs a little ball of shellac by a cocoon-fibre from the upper border. The tube may be made a closed one by means of a felt-covered piston. When the tube is sounded by means of a suitable tuning-fork, the shellac ball shows pendulum-motions, if not at a nodal point. The effects may be projected on a screen.

The passivity of iron has been studied under new conditions by M. Bibart (*Jour. de Phys.*, May), and he considers it is not produced by a layer of insoluble sub-nitrate, as some physicists have thought, since the previous action of nitric acid is not necessary. Still less is it due to a formation of bioxide of nitrogen. It is produced by any cause which tends to oxidise iron, and destroyed by any cause which tends to deoxidise it. It is due then either to a layer of oxide or a layer of oxygen. The oxides formed on the surface may preserve it by their very presence, furnishing a sort of unattackable varnish, or they may preserve it like platinum, liberating, on the denuded parts, a protective layer of oxygen. The passivity of iron from contact of platinum seems to be produced at first by a simple layer of oxygen condensed on the platinum surface (a simple shock destroys it). But by degrees a layer of oxide is formed, and the iron then loses its passivity much less readily than before.

GEOGRAPHICAL NOTES

Dr. Schweinfurth, who left Suez for Socotra on February 23, returned on June 19. From the *Egyptian Gazette* we learn that his voyage to the island in a native vessel lasted one month (with calls). He was a month on the island. The rich flora yielded many new species. The mountains are well wooded, and covered with a more luxuriant vegetation than Mount Etna. The climate is exceptionally temperate, and the natives are inoffensive, greater security being experienced everywhere than in any part of uncivilised Africa On the approach of the south-west monsoon Dr. Schweinfurth had to leave, and in a miserable native vessel he tried to reach the Arabian coast opposite Socotra. It was found impossible to get to the east of Aden, and in H.M.S. *Dragon*, which was met, the explorer was conveyed to that place. Dr. Schweinfurth has brought with him a rich botanical collection, including some living plants which he will try to acclimatise in his garden at Cairo.

The Polar relief ship *Rodgers*, Lieut. Berry, sailed from San Francisco on June 16 in search of the *Jeannette*. She will first cruise to St. Berry, then proceed to Petropaulovsky, then cross to St. Michael's in Alaska to coal, thence to St. Lawrence Bay and along the coast of Northern Siberia, making inquiries of the natives; then from Cape Serge to Kamon, where letters will be left with some natives; then north to Herald Island, hunting well over for cairns. It is intended next to go along the southern shore of Wrangel Land, and seek a harbour to winter in. The north-east and west coasts will be examined in sledge parties. Lieut. Berry means to return, if possible, by the second year.

Instructions have now been issued by Brigadier-General Hazen, of the U.S. Signal Office, to the commanding officers of the two expeditionary forces about to be sent out to establish permanent stations of observation in Polar regions. Lieut. Greely commands one of these forces, which goes to the neighbourhood of the coal-seam discovered near Lady Franklin Bay in 1875. The steamer will directly return (with a transcript of observations during the voyage), and the party landed will proceed to erect dwelling-houses and observatories, after which a sledge party will proceed to the high land near Cape Joseph Henry. It is intended that the permanent station shall be visited in 1882 and 1883 by a steam-sealer or other vessel with stores, &c., but directions in case of failure are supplied. Lieut. Ray commands the other expedition, which will sail from San Francisco for Point Barrow, Alaska Territory, and establish there a permanent station to be occupied till the summer of 1884 and visited annually. A great variety of observations will be made by both parties, and the instructions drawn out by the recent Hamburg Conference (with added notes from the U.S. Chief Signal Office) are furnished.

Dr. Gerard Rohlfs delivered an interesting lecture at the meeting of the Berlin Gesellschaft für Erdkunde regarding his last journey in Abyssinia. He was received in a friendly manner by the inhabitants, and he is quite charmed with the hospitality of the Abyssinians. At Debratabor he was received kindly by Negus (Emperor) Johannes, and this was of great importance for his subsequent tour. Rohlfs travelled in a northerly direction to the ancient Portuguese capital Gondar, the residence of the late King Theodore. By means of a pass given to him by the ecclesiastical chief of the city he was able to inspect all the ancient historical buildings of the city. He continued his journey to the north, and after crossing the Takkaze River he reached Artum (Axum?), the ancient former royal residence, with its monuments dating from the period of Ptolemy. In April Rohlfs reached the Nassaur mountain chain, the boundary of Abyssinia, whence he proceeded to Cairo by boat.

The expedition sent out by the French Secretary for Public Instruction to investigate the east coast of Finmarken has arrived at Vadsö after a journey of twenty-one days. The expedition, which is under the command of M. Georges Pouchet, has for its special object to study the natural history of the Varanger Fjord, which is situated at the boundary of the Atlantic and Arctic Oceans. The keeper of the Christiania Royal Zoological Collections joined the expedition at Hammerfest.

The Emperor of Germany has honoured Dr. Oscar Lenz, the well-known African traveller, with the Order of the Crown.

Mr. Sandford Fleming, C.M.G., Engineer-in-Chief of the Canadian Pacific Railroad, is to attend the International Geographical Congress at Venice in the interests of the question of standard time, coupled with which is that of a prime meridian. The former of these subjects is attracting much attention on the other side of the Atlantic, and a paper on it was lately read by Mr. Fleming before the American Society of Civil Engineers at a convention in Montreal, which brought out an interesting discussion, and a committee, consisting of leading railway officials in Canada and the United States, was appointed to examine and report at a future meeting. Dr. Barnard, the President of Columbia College, New York, is to represent the American Meteorological Society on the same subject at a meeting of the Association for the Reform and Codification of the Law of Nations, which is to be held at Cologne in August.

Col. Perrier, a well-known French topographer, has lately been for some time engaged in survey work in the Regency of Tunis, and has prepared a map of the Kroumir country, which will shortly be published by the Dépôt de la Guerre.

Messrs. S. Clarke and J. H. Riley, of the China Inland Mission, whose station is at Chungking, formerly Mr. Colborne Baber's head-quarters, have each lately made important journeys in the Szechuen province. Mr. French, accompanied in one of his journeys by Mr. Broumton, has visited nearly every city in Eastern Yünnan, and has lately started again for the same region. In the course of their journey from Burmah Messrs. Soltan and Stevenson also made extensive journeys in the western part of the Yünnan province.

The steamer *Nordenskjöld* is to start this week for the Gulf of Obi to the assistance of the *Oscar Dickson* and the *Nordland*. The crews of these vessels were all safe on April 23, when five men from the former left for Tobolsk, which they have lately reached.

A letter from Mussuca, on the Lower Congo, states that a Jesuit missionary expedition has been set on foot to penetrate into the far interior. Père Argourd has been sent from the French mission station at Landana to organise a party of about thirty to proceed to Stanley Pool. He tried to procure carriers at Boma, Mussuca, and Noki, but not succeeding there, he went some thirteen miles inland to King Kangan Pecca, with a view to secure his aid. This was readily obtained by a truly missionary present of two gallons of rum, and Père Argourd returned with eight men and the promise that seventeen more should be sent shortly. The men however ran away the next day, and, yielding to circumstances, Père Argourd has resolved to proceed to Stanley Pool by M. de Brazza's route up the Ogowé.

MR. CRUDGINGTON, of the Baptist Congo Expedition, has just returned to England for a short time, and reports that by now Messrs. Comber and Bentley will have formed a first station at Isangila, Mr. Stanley's second post, and will at once push on to Mbu, some sixty or seventy miles further along the north bank of the Congo, where the the second station will be erected. It is for this navigable portion of the river that a steel boat is required, so as to avoid the Basundi. In his late journey up the Congo Mr. Crudgington found these people warlike and troublesome, as Mr. Stanley had done, and they were a source of perpetual anxiety to him. The practicability of utilising this part of the river is shown by the fact that Mr. Crudgington and his party went over it in heavy, clumsy, native canoes; but from Mbu the expedition will have to go to Stanley Pool by land, as the rapids and falls render the river quite unnavigable. The plans of the expedition are now on such an extended scale that six additional missionaries will be required—two for San Salvador, one for the depot at Mussuca on the Lower Congo, one each for Isangila and Mbu, and four for Stanley Pool, so that occasional journeys may be made higher up the Congo. The steel boat required by the expedition has been presented by an anonymous donor at a cost of about 400*l*. It has been built in London from drawings furnished by Mr. H. M. Stanley.

THE *Times* last week published an exceedingly interesting letter on trade and exploration on the Congo from a private correspondent at the mouth of the Ogowé. Speaking of M. Savorgnan de Brazza, the writer says that he has done much to open up the country between the Ogowé and the Congo, that he purchased a large tract of country near the sources of the former river at a very cheap rate, erected a station, and left a white man in charge. He is said to have purchased villages as they stood, freed a great many slaves, and engaged them at monthly wages to cultivate the plantations and keep the ground in order. He seems to have been regarded as the apostle of freedom in the country; troops of slaves came flocking to him to be freed, and his visit is regarded as having struck a blow at slavery in West Africa. The writer gives a very different picture of the state of affairs on the Belgian road along the north bank of the Congo. It may be interesting to mention, the observations respecting the light in which M. de Brazza is viewed by the natives are fully confirmed by a letter from a Roman Catholic missionary who accompanied him up the Ogowé last December.

WHIRLED ANEMOMETERS[1]

IN the course of the year 1872 Mr. R. H. Scott, F.R.S., suggested to the Meteorological Committee the desirability of carrying out a series of experiments on anemometers of different patterns. This suggestion was approved by the Committee, and in the course of the same year a grant was obtained by Mr. Scott from the Government grant administered by the Royal Society for the purpose of defraying the expenses of the investigation. The experiments were not however carried out by Mr. Scott himself, but were intrusted to Mr. Samuel Jeffery, then Superintendent of the Kew Observatory, and Mr. G. M. Whipple, then First Assistant, the present Superintendent.

The results have never hitherto been published, and I was not aware of their nature till on making a suggestion that an anemometer of the Kew Standard pattern should be whirled in the open air, with a view of trying that mode of determining its proper factor, Mr. Scott informed me of what had already been done, and wrote to Mr. Whipple, requesting him to place in my hands the results of the most complete of the experiments, namely, those carried on at the Crystal Palace, which I accordingly obtained from him. The progress of the inquiry may be gathered from the following extract from Mr. Scott's report in returning the unexpended balance of the grant:—

"The comparisons of the instruments tested were first instituted in the garden of the Kew Observatory. This locality was found to afford an insufficient exposure.

"A piece of ground was then rented and inclosed within the Old Deer Park. The experiments here showed that there was a considerable difference in the indications of anemometers of different sizes, but it was not possible to obtain a sufficient range of velocities to furnish a satisfactory comparison of the instruments. Experiments were finally made with a rotating apparatus, a steam merry-go-round, at the Crystal Palace, which led to some results similar to those obtained by exposure in the Deer Park.

"The subject has however been taken up so much more thoroughly by Doctors Dohrandt and Thiesen (*vide* "Repertorium für Meteorologie," vols. iv. and v.), and by Dr. Robinson in Dublin, that it seems unlikely that the balance would ever be expended by me. I therefore return it with many thanks to the Government Grant Committee.

"The results obtained by me were hardly of sufficient value to be communicated to the Society."

On examining the records it seemed to me that they were well deserving of publication, more especially as no other experiments of the same kind have, so far as I know, been executed on an anemometer of the Kew standard pattern. In 1860 Mr. Glaisher made experiments with an anemometer whirled round in the open air at the end of a long horizontal pole,[2] but the anemometer was of the pattern employed at the Royal Observatory, with hemispheres of 3·75 inches diameter and arms of 6·725 inches, measured from the axis to the centre of a cup, and so was considerably smaller than the Kew pattern. The experiments of Dr. Dohrandt and Dr. Robinson were made in a building, which has the advantage of sheltering the anemometer from wind, which is always more or less fitful, but the disadvantage of creating an eddying vorticose movement in the whole mass of air operated on; whereas in the ordinary employment of the anemometer the eddies it forms are carried away by the wind, and the same is the case to a very great extent when an anemometer is whirled in the open air in a gentle breeze. Thus, though Dr. Robinson employed among others an anemometer of the Kew pattern, his experiments and those of Mr. Jeffery are not duplicates of each other, even independently of the fact that the axis of the anemometer was vertical in Mr. Jeffery's and horizontal in Dr. Robinson's experiments; so that the greater completeness of the latter does not cause them to supersede the former.

In Mr. Jeffery's experiments the anemometers operated on were mounted a little beyond and above the outer edge of one of the steam merry-go-rounds in the grounds of the Crystal Palace, so as to be as far as practicable out of the way of any vortex which it might create. The distance of the axis of the anemometer from the axis of the "merry" being known, and the number of revolutions (n) of the latter during an experiment counted, the total space traversed by the anemometer was known. The number (N) of *apparent* revolutions of the anemometer, that is, the number of revolutions *relatively to the merry*, was recorded on a dial attached to the anemometer, which was read at the beginning and end of each experiment. As the machine would only go round one way the cups had to be taken off and replaced in a reverse position, in order to reverse the direction of revolution of the anemometer. The *true* number of revolutions of the anemometer was, of course, $N + n$, or $N - n$, according as the rotations of the anemometer and the machine were in the same or opposite directions.

The horizontal motion of the air over the whirling machine during any experiment was determined from observations of a dial anemometer with 3-inch cups on 8-inch arms, which was fixed on a wooden stand in the same horizontal plane as that in which the cups of the experimental instrument revolved, at a distance estimated at about 30 feet from the outside of the whirling frame. The motion of the centres of the cups was deduced from the readings of the dial of the fixed anemometer at the beginning and end of each experiment, the motion of the air being assumed as usual to be three times that of the cups.

The experiments were naturally made on fairly calm days, still the effect of the wind, though small, is not insensible. In default of further information, we must take its velocity as equal to the mean velocity during the experiment.

Let V be the velocity of the anemometer, W that of the wind, θ the angle between the direction of motion of the anemometer and that of the wind. Then the velocity of the anemometer relatively to the wind will be—

$$\sqrt{V^2 - 2VW\cos\theta + W^2} \quad . \quad . \quad . \quad . \quad . \quad (a)$$

The mean effect of the wind in a revolution of the merry will be different according as we suppose the moment of inertia of the anemometer very small or very great.

If, as is practically the case, W be small as compared with V, the correction to be added to V on account of the wind may be

[1] "Discussion of the Results of some Experiments with Whirled Anemometers." Paper read at the Royal Society, May 12, by Prof. G. G. Stokes, Sec. R.S.

[2] "Greenwich Magnetical and Meteorological Observations," 1862, Introduction, p. li.

shown to be $W^2/4V$ on the first supposition, and $3W^2/4V$ on the second.

Three anemometers were tried, namely, one of the old Kew standard pattern, one by Adie, and Kraft's portable anemometer. Their dimensions, &c., were as follows :—

(α) *The Old Kew Standard.*—Diameter of arms between centres of cups 48 inches ; diameter of cups 9 inches. Fixed to machine at 22 3 feet from the axis of revolution.

(β) *Adie's Anemometer.*—Diameter of arms between centres of cups 13·4 inches ; diameter of cups 2·5 inches. Fixed to machine at 20·7 feet from the axis of revolution.

(γ) *Kraft's Portable Anemometer.*—Diameter of arms between centres of cups 8·3 inches ; diameter of cups 3·3 inches. Fixed to machine at 19·10 feet from the axis of revolution.

With each anemometer the experiments were made in three groups, with high, moderate, and low velocities respectively, averaging about 28 miles an hour for the high, 14 for the moderate, and 7 for the low. Each group again was divided into two subordinate groups, according as the cups were direct, in which case the directions of rotation of the merry and of the anemometer were opposite, or reversed, in which case the directions of the two rotations were the same.

The data furnished by each experiment were : the time occupied by the experiment, the number of revolutions of the merry, the number of *apparent* revolutions of the anemometer, given by the difference of readings of the dial at the beginning and end of the experiment, and the space S passed over by the wind, deduced from the difference of readings of the fixed anemometer at the beginning and end of the experiment.

The object of the experiment was of course to compare the mean velocity of the centres of the cups with the mean velocity of the air relatively to the anemometer. It would have saved some numerical calculation to have compared merely the spaces passed through during the experiment ; but it seemed better to exhibit the velocities in miles per hour, so as to make the experiments more readily comparable with one another, and with those of other experimentalists. In the reductions I employed 4-figure logarithms, so that the last decimal in V in the tables cannot quite be trusted, but it is retained to match the correction for W., which it seemed desirable to exhibit to 0·01 mile.

On reducing the experiments with the low velocities I found the results extremely irregular. I was subsequently informed by Mr. Whipple that the machine could not be regulated at these low velocities, for which it was never intended, and that it sometimes went round fast, sometimes very slowly. He considered that the experiments in this group were of little, if any, value, and that they ought to be rejected. They were besides barely half as numerous as those of the moderate group. I have accordingly thought it best to omit them altogether.

In the complete paper tables are then given containing the reduced results of the individual experiments, and from them the mean results for the high and moderate velocities are collected in the following table, in which are also inserted the mean errors :—

Anemometer.	Directions of rotation.	High velocities.				Moderate velocities.			
		Mom. inert. small		Mom. inert. large.		Mom. inert. small.		Mom. inert. large.	
		p. c.	m. e.	p. c.	m. e.	p. c.	m. e.	p. c.	m. e.
Kew.	Opposite ...	122·6	2·4	121·9	2·3	115·1	4·9	113·2	5·2
	Alike	118·4	2·9	117·5	2·8	109·7	4·5	108·5	5·1
	Mean ...	120·5	...	119·7	...	112·4	...	110·8	
Adie.	Opposite ...	95·1	2·3	94·2	2·3	88·5	4·5	86·8	5·0
	Alike	98·0	6·5	97·3	6·5	82·6	7·3	81·0	7·3
	Mean ...	96·5	...	95·7	...	85·5	...	83·9	
Kraft.	Opposite ...	101·5	2·6	100·8	2·5	89·1	4·8	86·9	5·1
	Alike	100·8	1·2	99·4	1·3	87·8	5·0	86·0	6·0
	Mean ...	101·1	...	100·1	...	88·4	...	86·4	

The mean errors exhibited in the above table show no great difference according as we suppose the moment of inertia of the anemometer small or large in correcting for the wind. From the mean errors we may calculate nearly enough, by the usual formulæ, the probable errors of the various mean percentages for rotations opposite and alike. The probable errors of these mean percentages come out as follows :—

Kew,	1·0	for high velocities ;	2·7	for moderate velocities.		
Adie,	1·5	,, ,,	2·0	,,	,,	
Kraft,	0·9	,, ,,	1·8	,,	,,	

These probable errors are so small that it appears that for the high and even for the moderate velocities the experiments are extremely trustworthy, except in so far as they may be affected by *systematic* sources of error.

It may be noticed that the difference of the percentages according as the directions of rotation of the anemometer and of the merry are opposite or alike is greatest for the Kew, in which the ratio of r to R is greatest, r denoting the radius of the arm of the anemometer, and R the distance of its axis from the axis of revolution of the machine, and appears to be least (when allowance is made for the two anomalous experiments in the group "Adie H + ") for the Kraft, for which r/R is least. In the Kraft indeed the differences are roughly equal to the probable errors of the means. In these whirling experiments r/R is always taken small, and we might expect the correction to be made on account of the finiteness of R to be expressible in a rapidly converging series according to powers of r/R, say—

$$A'\frac{r}{R} + B'\left(\frac{r}{R}\right)^2 + C'\left(\frac{r}{R}\right)^3 + \cdots$$

We may in imagination pass from the case of rotations opposite to that of rotations alike, by supposing R taken larger and larger in successive experiments, altering the angular velocity of revolution so as to preserve the same linear velocity for the anemometer, and supposing the increase continued until R changes sign in passing through infinity, and is ultimately reduced in magnitude to what it was at first. The ideal case of $R = \infty$ is what we aim at, in order to represent the motion of a fixed anemometer acted on by perfectly uniform wind by that of an anemometer uniformly impelled in a rectilinear direction in perfectly still air. We may judge of the magnitude of the leading term in the above correction, provided it be of an odd order, by that of the difference of the results for the two directions of rotation. Unless therefore we had reason to believe that A′ were 0, or at least very small compared with B′, we should infer that the whole correction for the finiteness of R is very small, and that it is practically eliminated by taking the mean of the results for rotations opposite and rotations alike.

We may accept, therefore, the mean results as not only pretty well freed from casual irregularities which would disappear in the mean of an infinite number of experiments, but also, most probably, from the imperfection of the representation of a rectilinear motion of the anemometer by motion in a circle of the magnitude actually employed in the experiments.

Before discussing further the conclusions to be drawn from the results obtained, it will be well to consider the possible influence of systematic sources of error.

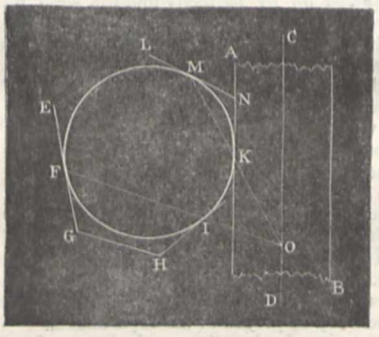
1. *Friction.*—No measure was taken of the amount of friction, nor were any special appliances used to reduce it ; the anemometers were mounted in the merry just as they are used in actual registration. Friction arising from the weight is guarded against as far as may be in the ordinary mounting, and what remains of it would act alike in the ordinary use of the instrument and in the experiments, and as far as this goes, therefore, the experiments would faithfully represent the instrument as it is in actual use. But the bearings of an anemometer have also to sustain the lateral pressure of the wind, which in a high wind is very considerable ; and the construction of the bearing has to be attended to in order that this may not produce too much friction. So far the whirled instrument is in the same condition as the fixed. But besides the friction arising from the pressure of the artificial wind, a pressure which acts in a direction tangential to the circular path of the whirled anemometer, there is the pressure arising from the centrifugal force. The highest velocity in the experiments was about thirty miles an hour, and at this rate the centrifugal force would be about three times the weight of the anemometer. This pressure would considerably exceed the former, at right angles to which it acts, and the two would compound into one equal to the square root of the sum of their squares. The resulting friction would exceed a good deal that arising from the pressure of the wind in a fixed anemometer with the same velocity of wind, natural or artificial, and would

sensibly reduce the velocity registered, and accordingly raise the coefficient which Dr. Robinson denotes by *m*, the ratio, namely, of the velocity of the wind to the velocity of the centres of the cups. It may be noticed that the percentages collected in the above table are very distinctly lower for the moderate velocities than for the high velocities. Such an effect would be produced by friction; but how far the result would be modified if the extra friction due to the centrifugal force were got rid of, and the whirled anemometer thus assimilated to a fixed anemometer, I have not the means of judging, nor again how far the percentages would be still further raised if friction were got rid of altogether.

Perhaps the best way of diminishing friction in the suppport of an anemometer is that devised and employed by Dr. Robinson, in which the anemomeser is supported near the top on a set of spheres of gun-metal contained in a box with a horizontal bottom and vertical side which supports and confines them. For vertical support this seems to leave nothing to be desired, but when a strong lateral pressure has to be supported as well as the weight of the instrument, it seems to me that a slight modification of the mode of support of the balls might be adopted with advantage. When a ball presses on the bottom and vertical side of its box, and is at the same time pressed down by the horizontal disk attached to the shaft of the anemometer which rests on the balls, it revolves so that the instantaneous axis is the line joining the points of contact with the fixed box. But if the lateral force of the wind presses the shaft against the ball the ball cannot simply roll as the anemometer turns round, but there is a slight amount of rubbing.

This however may be obviated by giving the surfaces where the ball is in contact other than vertical or horizontal direction.

Let A B be a portion of the cylindrical shaft of an anemometer; C D the axis of the shaft; E F G H I a section of the fixed box or cup containing the balls; L M N a section of a conical surface fixed to the shaft by which the anemometer rests on its balls; F I K M a section of one of the balls; F, I, the points of contact



of the ball with the box; M the point of contact with the supporting cone; K the point of contact, or all but contact, of the ball with the shaft. The ball is supposed to be of such size that when the anemometer simply rests on the balls by its own weight, being turned perhaps by a gentle wind, there are contacts at the points M, F, I, while at K the ball and shaft are separated by a space which may be deemed infinitesimal. Lateral pressure from a stronger wind will now bring the shaft into contact with the ball at the point K also, so that the box on the one hand and the shaft with its appendage on the other will bear on the ball at four points. The surface of the box, as well as that on the cone L N, being supposed to be one of revolution round C D, those four points will be situated in a plane through C D, which will pass of course through the centre of the ball.

If the ball rolls without rubbing at any one of the four points F, I, K, M as the anemometer turns round, its instantaneous axis must be the line joining the points of contact F, I, with the fixed box. But as at M and K likewise there is nothing but rolling, the instantaneous motion of the ball may be thought of as one in which it moves as if it were rigidly connected with the shaft and its appendage, combined with a rotation over L N A B supposed fixed. For the two latter motions the instantaneous axes are C D, M K respectively. Let M K produced cut C D in O. Then since the instantaneous motion is compounded of rotations round two axes passing through O, the instantaneous axis must pass through O. But this axis is F I. Therefore F I must pass through O. Hence the two lines F I, M K must intersect the axis of the shaft in the same point, which is the condition to be satisfied in order that the ball may roll without rubbing, even though impelled laterally by a force sufficient to cause the side of the shaft to bear on it. The size of the balls and the inclinations of the surfaces admit of considerable latitude subject to the above condition. The arrangement might suitably be chosen something like that in the figure. It seems to me that a ring of balls constructed on the above principle would form a very effective upper support for an anemometer whirled with its axis vertical. Possibly the balls might get crowded together on the outer side by the effect of centrifugal force. This objection, should it be practically found to be an objection, would not of course apply to the proposed system of mounting in the case of a fixed anemometer. Below, the shaft would only require to be protected from lateral motion, which could be done either by friction wheels or by a ring of balls constructed in the usual manner, as there would be only three points of contact.

2. *Influence on the Anemometer of its own Wake.*—By this I do not mean the influence which one cup experiences from the wake of its predecessor, for this occurs in the whirling in almost exactly the same way as in the normal use of the instrument, but the motion of the air which remains at any point of the course of the anemometer in consequence of the disturbance of the air by the anemometer when it was in that neighbourhood in the next preceding and the still earlier revolutions of the whirling instrument.

It seems to me that in the open air, where the air impelled by the cups is free to move into the expanse of the atmosphere, instead of being confined by the walls of a building, this must be but small, more especially as the wake would tend to be carried away by what little wind there might be at the time. On making some inquiries from Mr. Whipple as to a possible vorticose movement created in the air through which the anemometer passed, he wrote as follows:—"I feel confident that under the circumstances the tangential motion of the air at the level of the cups was so small as not to need consideration in the discussion of the results. As in one or two points of its revolution the anemometer passed close by some small trees in full leaf, we should have observed any eddies or artificial wind had it existed, but I am sure we did not."

3. *Influence of the Variation of the Wind; first, as regards Variations which are not Rapid.*—During the twenty or thirty minutes that an experiment lasted there would of course be numerous fluctuations in the velocity of the wind, the mean result of which is alone recorded. The period of the changes (by which expression it is not intended to assert that they were in any sense regularly periodic), might be a good deal greater than that of the merry, or might be comparatively short. In the high velocities, at any rate, in which one revolution took only three or four seconds, the supposition that the period of the changes was large compared with one revolution is probably a good deal nearer the truth than the supposition that it is small.

On the former supposition the correction for the wind during two or three revolutions of the merry would be given by the formulæ already employed, taking for W its value at the time. Consequently the total correction will be given by the formulæ already used if we substitute the mean of W^2 for the square of mean W. The former is necessarily greater than the latter, but how much we cannot tell without knowing the actual variations. We should probably make an outside estimate of the effect of the variations if we supposed the velocity of the wind twice the mean velocity during half the duration of the experiment, and nothing at all during the remainder. On this supposition the mean of W^2 would be twice the square of mean W, and the correction for the wind would be doubled. At the high velocities of revolution, the whole correction for the wind is so very small that the uncertainty arising from variation as above explained is of little importance, and even for the moderate velocities it is not serious.

4. *Influence of Rapid Variations of the Wind.*—Variations of which the period is a good deal less than that of the revolutions of the whirling instrument act in a very different manner. The smallness of the corrections for the wind hitherto employed depends on the circumstance that with uniform wind, or even with variable wind, when the period of variation is a good deal greater than that of revolution of the merry, the terms depending on the first power of W, which letter is here used to denote the momentary velocity of the wind, disappear in the mean of a revolution. This is not the case when a particular velocity of wind belongs only to a particular part of the circle described by

the anemometer in one revolution. In this case there will in general be an outstanding effect depending on the first power of W, which will be considerably larger than that depending on W^2. Thus suppose the velocity of whirling to be thirty miles an hour, and the average velocity of the wind three miles an hour, the correction for the wind supposed uniform, or if variable, then with not very rapid variations, will be comparable with 1 per cent. of the whole; whereas, with rapid variations, the effect in any one revolution may be comparable with 10 per cent. There is, however, this important difference between the two: that whereas the correction depending on the square leaves a positive residue, however many experiments be made, the correction depending on the first power tends ultimately to disappear, unless there be some cause tending to make the average velocity of the wind different for one azimuth of the whirling instrument from what it is for another. This leads to the consideration of the following conceivable source of error.

5. *Influence of Partial Shelter of the Whirling Instrument.*—On visiting the merry-go-round at the Crystal Palace, I found it mostly surrounded by trees coming pretty near it, but in one direction it was approached by a broad open walk. The consequence is that the anemometer may have been unequally sheltered in different parts of its circular course, and the circumstances of partial shelter may have varied according to the direction of the wind. This would be liable to leave an uncompensated effect depending on the first power of W. I do not think it probable that any large error was thus introduced, but it seemed necessary to point out that an error of the kind may have existed.

The effect in question would be eliminated in the long run if the whirling instrument were capable of reversion, and the experiments were made alternately with the revolution in one direction, and the reverse. For then, at any particular point of the course at which the anemometer was more exposed to wind than on the average, the wind would tend to increase the velocity of rotation of the anemometer for one direction of revolution of the whirling instrument just as much, ultimately, as to diminish it for the other. Mere reversion of the cups has no tendency to eliminate the error arising from unequal exposure in different parts of the course. And even when the whirling instrument is capable of reversion it is only very slowly that the error arising from partial shelter is eliminated compared with that of irregularities in the wind; of those irregularities, that is to say, which depend on the first power of W. For these irregularities go through their changes a very great number of times in the course of an experiment lasting perhaps half an hour, whereas the effect of partial shelter acts the same way all through one experiment. It is very desirable therefore that in any whirling experiments carried on in the open air, the condition of the whirling instrument as to exposure or shelter should be the same all round.

The trees, though taller than the merry when I visited the place last year, were but young, and must have been a good deal lower at the time that the experiments were made. Mr. Whipple does not think that any serious error is to be apprehended from exposure of the anemometer during one part of its course and shelter during another.

From a discussion of the foregoing experiments it seems to me that the following conclusions may be drawn:—

1. That, at least for high winds, the method of obtaining the factor for an anenometer, which consists in whirling the instrument in the open air, is capable, with proper precautions, of yielding very good results.

2. That the factor varies materially with the pattern of the anemometer. Among those tried, the anemometers with the larger cups registered the most wind, or in other words required the lowest factors to give a correct result.

3. That with the large Kew pattern, which is the one adopted by the Meteorological Office, the register gives about 120 per cent. of the truth, requiring a factor of about 2·5, instead of 3. Even 2·5 is probably a little too high, as friction would be introduced by the centrifugal force, beyond what occurs in the normal use of the instrument.

4. That the factor is probably higher for moderate than for high velocities; but whether this is solely due to friction the experiments do not allow us to decide.

Qualitatively considered, these results agree well with those of other experimentalists. As the factor depends so much on the pattern of the anemometer it is not easy to find other results with which to compare the actual numbers obtained, except in the case the Kew standard. The results obtained by Dr. Robinson, by rotating an anemometer of this pattern without friction purposely applied are given at pp. 797 and 799 of the *Phil. Trans.* for 1878. The mean of a few taken with velocities of about 27 miles an hour in still air gave a factor 2·36, instead of 2·50, as got from Mr. Jeffery's experiments. As special anti-friction appliances were used by Dr. Robinson, the friction in Mr. Jeffery's experiments was probably a little higher. If such were the case the factor ought to come out a little higher than in Dr. Robinson's experiments, which is just what it does. As the circumstances of the experiments were widely different with respect to the vorticose motion of the air produced by the action of the anemometer in it, we may, I think, conclude that no very serious error is to be apprehended on this account.

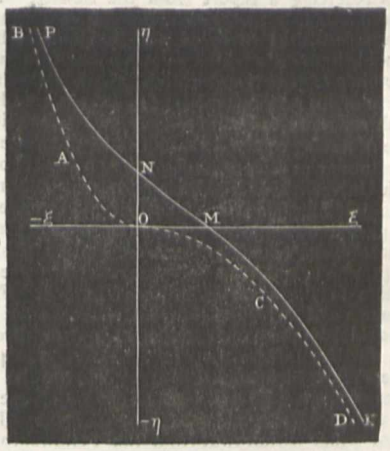
In a later paper (*Phil. Trans.* for 1880, p. 1055), Dr. Robinson has determined the factor for an anemometer (among others) of the Kew pattern by a totally different method, and has obtained values considerably larger than those given by the former method. Thus the limiting value of the factor m corresponding to very high velocities, is given at p. 1063 as 2·826, whereas the limiting value obtained by the former method was only 2·286. Dr. Robinson has expressed a preference for the later results. I confess I have always been disposed to place greater reliance on the results of the Dublin experiments, which were carried out by a far more direct method, in which I cannot see any flaw likely to account for so great a difference. It would be interesting to try the second method in a more favourable locality.

I take this opportunity of putting out some considerations respecting the general formula of the anemometer, which may perhaps not be devoid of interest.

The problem of the anemometer may be stated to be as follows:—Let a uniform wind with velocity V act on a cup anemometer of given pattern, causing the cups to revolve with a velocity v, referred to the centre of the cups, the motion of the cups being retarded by a force of friction F; it is required to determine v as a function of V and F, F having any value from 0, corresponding to the ideal case of a frictionless anemometer, to some limit F_1, which is just sufficient to keep the cups from turning. I will refer to my appendix to the former of Dr. Robinson's papers (*Phil. Trans.* for 1878, p. 818), for the reasons for concluding that F is equal to V^2, multiplied by a function of V/v. Let

$$V/v=\xi, \qquad F/V^2=\eta,$$

then if we regard ξ and η as rectangular co-ordinates we have to determine the form of the curve, lying within the positive quadrant $\xi O\eta$, which is defined by those co-ordinates.



We may regard the problem as included in the more general problem of determining v as a function of V and F, where V is positive, but F may be of any magnitude and sign, and therefore v also.[1] Negative values of F mean, of course, that the cups, instead of being retarded by friction, are acted on by an impelling force making them go faster than in a frictionless anemometer, and values greater than F_1 imply a force sufficient to send them round with the concave sides foremost.

[1] Of course v must be supposed not to be so large as to be comparable with the velocity of sound, since then the resistance to a body impelled through air, or having air impinging on it, no longer varies as the square of the velocity.

Suppose now F to be so large, positive or negative, as to make v so great that V may be neglected in comparison with it, then we may think of the cups as whirled round in quiescent air in the positive or usual direction when F is negative, in the negative direction when F is greater than F_1. When F is sufficiently large the resistance may be taken to vary as v^2. For equal velocities v it is much greater when the concave side goes foremost than when the rotation is the other way. For air impinging perpendicularly on a hemispherical cup Dr. Robinson found that the resistance was as nearly as possible four times as great when the concave side was directed to the wind as when the convex side was turned in that direction (*Transactions* of the Royal Irish Academy, vol. xxii. p. 163). When the air is at rest and the cups are whirled round, some little difference may be made by the wake of each cup affecting the one that follows. Still we cannot be very far wrong by supposing the same proportion, 4 to 1, to hold good in this case. When F is large enough and negative, F may be taken to vary as v^2, say to be equal to $-Lv^2$. Similarly, when F is large enough and positive, F may be taken equal to $L'v^2$, where in accordance with the experiment referred to, L' must be about equal to 4 L. Hence we must have nearly—

$\eta = -L\xi^2$, when ξ is positive and very large;
$\eta = 4L\xi^2$, ,, negative ,, ,,

Hence if we draw the semi-parabola O A B corresponding to the equation $\eta = 4L\xi^2$ in the quadrant $\eta O -\xi$, and the semi-parabola O C D with a latus lectum four times as great in the quadrant $\xi O -\eta$, our curve at a great distance from the origin must nearly follow the parabola O A B in the quadrant $\eta O -\xi$, and the parabola O C D in the quadrant $\xi O -\eta$, and between the two it will have some flowing form such as P N M K. There must be a point of inflection somewhere between P and K, not improbably within the positive quadrant $\xi O \eta$. In the neighbourhood of this point the curve N M would hardly differ from a straight line. Perhaps this may be the reason why Dr. Robinson's experiments in the paper published in the *Phil. Trans.* for 1878 were so nearly represented by a straight line.

FELLOWSHIPS AT OWENS COLLEGE, MANCHESTER

A SCHEME of Science and Literature Fellowships, modelled very closely after the pattern of the Fellowship Scheme of the Johns Hopkins University, Baltimore, has been organised in Owens College, Manchester. The Council propose, early in October next, to appoint to five Fellowships on the terms and conditions following:—1. The appointment will be made by the Council, after receiving a report from the Senate, not on the results of examination, but after consideration of documentary or other evidence furnished to them. 2. Application by persons desiring to hold these fellowships must be made, in writing, on or before October 1. In his application the candidate should indicate the course of his previous reading and study, and his general purposes with reference to future work. 3. The candidate must give evidence of having received a sound and systematic education either in literature or in science, such as the possession of a degree of an English University, or a certificate from the authorities of an English School of Medicine or Science, of good repute, showing that he has passed through his curriculum with distinction, or, in default thereof, such other evidence as shall be satisfactory to the Council that he is qualified to prosecute some special study or investigation in the manner indicated in § 6. Finally, he should produce a satisfactory testimonial of character and conduct, and should give the names of not more than three persons from whom further information may be sought. 4. In the award of the Fellowships regard will be had to the pecuniary circumstances of the candidates. 5. The value of each Fellowship will be 100*l.* for the academical year 1881-82. In case of resignation or other withdrawal from the Fellowship, payment will be made for the time during which the Fellowship may have been actually held. 6. Every holder of a Fellowship will be expected to devote his time to the prosecution of some special study, with the approval of the Council after receiving a report from the Senate; and before the close of the year to give evidence of progress by the preparation of a thesis, the delivery of a lecture, the completion of some research, or in some other method. He will study under the direction of the Professor of the subject in which he is appointed, and will be required to pay such fees as the Council shall in each case determine. 7. He may be called on by the Council, after report from the Senate, to render some service to the College, either as an occasional examiner or by giving instruction in lectures or otherwise, to students in the College—provided always that he shall not, during his tenure of the Fellowship, hold any regular or salaried post as Assistant Lecturer or Demonstrator in the College—but he may not engage in teaching elsewhere. 8. He must reside in Manchester during the academical year. 9. He may be re-appointed at the end of the Session for a second and, in like manner, for a third year. 10. Candidates are invited to apply for appointment in any one of the following nine departments:—(1) Classics; (2) English Language and Literature; (3) History; (4) Philosophy; (5) Pure Mathematics; (6) Applied Mathematics (including Engineering); (7) Physics; (8) Chemistry; (9) Biology (including Physiology)

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 16.—"On Stratified Discharges. VI. Shadows of Striæ," by William Spottiswoode, P.R.S., and J. Fletcher Moulton, F.R.S.

One of the most interesting questions connected with the subject of stratified discharges is this: What is the physical, as distinguished from the electrical, nature of the striæ themselves? Are they, in fact, to be regarded as aggregations of matter possessing greater density than the gas present in the dark spaces, or are they to be considered as indicating merely special local electrical conditions? The fact of their having a definite configuration, especially on the side which is turned towards the negative terminal of the tube, that of their temperature being higher than that of the dark spaces, the manner in which they are affected by solid bodies, and other considerations, all tend to give support to the view that the striæ are loci of greater density than the dark spaces. Still it can hardly be said that as yet any experimental proof of this has been given sufficiently decisive to decide the question conclusively. And it is in the hope of contributing something towards the solution of this question that the following experiments are submitted to the notice of the Royal Society.

The two terminals of a Holtz machine were connected in the usual way with the two terminals of the tube, so as to produce a stratified discharge. A narrow strip of tin-foil, or a wire, was stretched along the tube opposite the column of striæ. The positive terminal of a second Holtz machine (in practice we used for this purpose a Töppler machine) was connected with the tin-foil, and the negative terminal with one (either) terminal of the tube. An air-spark, or interval across which sparks could pass, was interposed in the part of the circuit between the machine and the tin-foil. The effect of this arrangement was this: In the interval between two sparks the tin-foil and tube became charged like a Leyden jar; the tin-foil being the outer coating, charged positively, and the gas inside serving as the inner coating, charged negatively. When the spark passed across the interval mentioned above, the jar (*i.e.* the tube) became discharged, and the electricity previously held bound on the two coatings was set free.

When the first (say the "internal") machine was not working, or when it was disconnected, *i.e.*, when no regular discharge was passing through the tube, then, whenever a spark passed at the second (or "external") machine, a negative discharge with its accompanying Crookes' radiation took place from the inside of the tube next the tin-foil, and the opposite side of the tube became covered with a sheet of green phosphorescence (the tube being of German glass).

When, however, other things remaining as before, a discharge from the internal machine was sent through the tube, and a good stratified column was produced, it was found that the green phosphorescence was entirely cut off from the parts of the tube opposite to the striæ, while on the parts opposite to the dark spaces it remained, in the form of phosphorescent rings, as brilliant as before. The experiment was repeated with various tubes with various degrees of strength of current, and with various densities of gas (produced by heating a chamber of potash in connection with the tube). It may be added that when, as is sometimes the case, through greater exhaustion, the striæ became feebler in illumination and less compact in appearance, the shadows cast by them lost proportionally in sharpness of definition and in completeness of extinction of the phosphorescent light.

The brilliancy and definition of the phosphorescent rings may be increased by inserting a small Leyden jar in the circuit, care being taken that the jar shall discharge itself completely each time. If this is not the case the main discharge is followed by

subsidiary discharges, which tend to blur the effect. The angle of dispersion may be increased, or rather supplemented, by placing more than one strip on the tube, distant from one another by an angle of 90° or 120°. By this means the rings may be made to comprise the entire circumference of the tube.

It thus appears that the striæ are competent to cast shadows in the radiant showers issuing from the inside of the tube adjacent to the tin-foil, which part acts as a negative terminal. Many experiments have contributed to show that these radiant showers, although accompaniments of the discharge, are not carriers of the discharge; and that, having once issued from their source, they continue their own course irrespective of that of the discharge proper. They are in fact material showers, and, although not improbably charged with electricity, yet their ulterior course does not appear to depend on their electrical condition. Under these circumstances the simplest explanation appears to be that they have been arrested by a material obstacle, and consequently the phenomena above described may be considered as furnishing an experimental proof that the striæ represent local aggregations of matter, and not merely special electrical conditions of the gas.

June 16.—"On Stratified Discharges. VII. Multiple Radiations from the Negative Terminal." By William Spottiswoode, P.R.S., and J. Fletcher Moulton, F.R.S.

On examining the image of a negative terminal as traced out in tubes of great exhaustion, by the phosphorescence due to Crookes' radiations, we have often noticed that the image was not a simple figure, but that more than one outline of the contour of the terminal might be traced. From the fact of the double contour having been first remarked when the terminal was of a conical form, it was at first supposed that the second image might be due to internal reflection, or to some property appertaining to the edge of the cone. But this supposition led to no satisfactory explanation of the phenomenon.

It was however thought that, inasmuch as the two images implied different systems of radiation, a magnet suitably disposed might affect them in different degrees, and thereby throw some light on their origin. For this purpose we used a large electromagnet with its coils so coupled up as to give the two poles similar polarity. By bringing the two poles together, inclined at a moderate angle, a single pole and a field of great magnetic strength was produced.

The tube was then placed in the plane containing the axis of the two poles, and in the direction of a line bisecting their directions. The tubes first used were of great exhaustion, and were placed sometimes with the positive, sometimes with the negative terminal towards the magnet. When the tube was placed in a comparatively weak part of the field the two images of the cone were seen in their usual positions relatively to each other, except that they were slightly more separated. But as the tube was brought gradually into a stronger part of the field the two images became further separated, and by degrees a third, a fourth, and even more images were brought out on the side of the tube. In one tube of very high exhaustion, for which we are indebted to Mr. Crookes, as many as eight images became visible.

We have then, as an experimental fact, a series of images, each formed by a system of rays issuing from the surface of the negative terminal. The images being distinct, the system of rays must be distinct also. Now, as it seems hardly possible to imagine that, from every point of a surface, there can issue at one and the same instant of time a variety of systems of radiations, each system ranging over a finite angular distance, and each differently directed in space, we are driven to the conclusion that these radiations must have issued successively and not simultaneously from the terminal. In other words, the various images are formed in succession. Now, the entire series of images are present whenever a discharge passes through the tube; and when a "continuous" discharge (such as that from a Holtz machine) is passing, they are all as steady and as persistent as are any other features of the discharge. From this it follows that the radiations are not a continuous phenomenon, but that they are composed of a recurrent series of discharges, each having its own angular range, and its own direction in space; and as the electricity, which is the motive power, and the metallic terminal, which is the directing machinery, are the same in kind for each image, we are led to the conclusion that the positions of the images are determined by the force with which the radiations are projected. In fact, we understand that the various images are due to a succession of discrete discharges of successively diminishing strength.

The phenomenon of multiple images of the negative terminal as explained above has an important bearing on the nature of electrical discharges in vacuum tubes. For, if the phosphorising radiation consists of a recurring series of discrete discharges, the radiation in each series, and *à fortiori* the radiation as a whole, is discontinuous; and consequently the electrical discharge, to which it is due, must itself be discontinuous or "disruptive." We appear, therefore, in these phenomena to have an experimental proof, independent of and in addition to those adduced by Mr. De La Rue and others, of a fundamental point in the theory of these discharges, namely, their disruptive character.

Geological Society, June 8.—R. Etheridge, F.R.S., president, in the chair.—The meeting was made a special general meeting for the election of a Member of the Council in the room of the late Sir P. de Malpas Grey-Egerton, Bart., M.P., F.R.S., F.G.S.—The President announced that the late Sir Philip Egerton had bequeathed to the Society all the original drawings made from specimens in his collection for the illustration of Prof. Agassiz's works on Fossil Fishes. The Society had long possessed the drawings made for the same purpose from the Earl of Ellesmere's collection, and some years ago the Earl of Enniskillen presented those which had been prepared from specimens in his possession. Sir Philip Egerton's kind bequest would complete this interesting series.—Sir John Lubbock, Bart., M.P., F.R.S., was elected a new Member of Council. Messrs. Grenville A. J. Cole and J. L. Roberti were elected Fellows, and Il Commendatore Quintino Sella of Rome a Foreign Member of the Society.—The following communications were read:—The reptile-fauna of the Gosau formation, preserved in the Geological Museum of the University of Vienna, by Prof. H. G. Seeley, F.R.S., with a note on the geological horizon of the fossils, by Edward Suess, F.M.G.S. The collection of reptiles described in this paper was obtained at Neue Welt, near Wiener Neustadt, by tunnelling into the freshwater deposits which there yield coal. A part of the collection was described by Dr. Bunzel in 1871; but the author's interpretation of the fossils rendered a re-examination of the whole collection necessary. All the species hitherto discovered are new, and, with the exception of those referred to *Crocodilus*, *Megalosaurus*, *Ornithochirus*, and *Emys*, are placed in new genera. Nearly all the bones are more or less imperfect. The *Iguanodon Suessii*, of Bunzel, was referred to a new genus, *Mochlodon*, characterised by the straight anterior end of the ramus of the lower jaw and by the vertical bar in the middle of the teeth of the lower jaw. There appear to be two teeth in the ramus. The tooth referred to the upper jaw has several uniform parallel vertical bars. A small parietal bone, referred by Bunzel to a lizard, is considered by the author to belong probably to the same species, and, with some doubt, he associated with it the articular end of a small scapula. Bunzel's *Struthiosaurus Austriacus* was re-described by the author, who indicated that the bones of the base of the brain-case, regarded by Bunzel as the quadrate bones, really belong to the occipital region, which necessitates a different interpretation. The foramina along the base of the skull were also described as presenting one of the characteristics of the Dinosaurian order. The base of the skull of *Acanthopholis horridus* was described to show its relation to the above type, with the view of demonstrating its Scelidosaurian affinities. The greater part of the remains were referred by the author to a new genus, *Cratæomus*; some of these had been figured by Bunzel as "Crocodili ambigui," and others as belonging to *Scelidosaurus*, and to a new Lacertilian genus, *Danubiosaurus*. To *Cratæomus* he referred mandibles, teeth, vertebræ from all parts of the column except the sacrum, dermal armour, and the chief bones of the limbs. Two species were distinguished, *C. Paulowitschii* and *C. lepidophorus*. The former, which is much the larger, was named in honour of M. Paulowitsch, who voluntarily superintended the work at the Neue Welt. The author stated that he regarded these animals as carnivorous, and that, unlike the typical Wealden Dinosaurs, they were not kangaroo-like in habit, but had strongly developed fore limbs, as indicated in the proposed generic name. Two teeth belonging to *Megalosaurus* were described as representing a new species, *M. Pannoniensis*, characterised by the crown being shorter and broader than in previously described forms. A fragment, regarded by Bunzel as the thoracic rib of a lizard, was interpreted as the distal end of the femur of a Dinosaur, and named *Ornithomerus gracilis*. The lower jaw, described by Bunzel as *Crocodilus carcharidens*, of which a maxillary bone also occurs, was made the basis of a new genus, *Doratodon*,

probably Dinosaurian, judging from the lateral position of the apertures of the skull and the characters of the teeth. The genus *Rhadinosaurus* was founded upon the humerus and femur, the latter having been regarded by Bunzel as the dorsal rib of a crocodile; the species was named *R. alcimus*. *Oligosaurus adelus* was described as presenting Lacertilian characters in combination with some Dinosaurian peculiarities. The remains include the humerus, femur and scapula, and two vertebræ, which were regarded by Bunzel as fœtal vertebræ of a Dinosaur. The genus *Hoplosaurus* was founded on some vertebræ, fragments of limb-bones, and dermal armour; it shows, with distinctive peculiarities, a certain resemblance to *Hylæosaurus*. A procœlian crocodile was represented by many parts of the skeleton; some figured by Bunzel as Lacertilian, others as Crocodilian. It is remarkable for having a buttress supporting the transverse process in the lumbar region. The author calls it *Crocodilus proavus*. The specimen figured by Bunzel as the ilium of his *Danubiosaurus anceps*, was stated by the author to be a costal plate of a large Chelonian, in which, apparently, the margins of these plates remained separate through life. Skull bones, believed to belong to the same animal, are strongly sculptured; the author named the species *Pleuropeltus lissus*. Three or four species of Emydians were said to be indicated by isolated plates, the largest of which was named *Emys Neumayri*. The only specimen referable with certainty to a lizard is a small vertebra of elongated form, regarded as indicating a new genus and species, named *Spondylosaurus gracilis*. Of Pterodactyls there are but few remains; but these certainly represent two genera. The author only describes one species, to which he gives the name of *Ornithochirus Bunzeli*. There are, in all, probably ten genera of Dinosaurs, and five genera of other groups, making fifteen in all. The paper was supplemented by a note by Prof. Suess on the geological relations of the beds at Wiener Neustadt to those of the Gosau Valley, in which he comes to the conclusion that they are older than the true Turonian deposits, and especially older than the zone of *Hippurites cornu vaccinum*.—On the basement-beds of the Cambrian in Anglesey, by Prof. T. McKenny Hughes, M.A., F.G.S. In this paper the author first pointed out that there was in Anglesey:—(1) An upper slaty group, in which he had fixed two live zones, which showed that the series belonged to the Silurian (Sedgwick's classification), and (2) a lower group of slates and sandstones in which Arenig fossils had been found in several localities, and Tremadoc had been less clearly recognised, while by the correction of the determination of a species of *Orthis*, there was now a suspicion of even Menevian forms. These all rested upon the basement-beds of the Cambrian, of which the paper chiefly treated. They were made up of conglomerates, grits, and sandstones, with Annelids and Fucoids. The basement-beds varied in thickness and character according to the drift of currents along the pre-Cambrian shore and the material of the underlying rocks. Near Penlon, where they rested on a quartz-felspar rock, they consisted chiefly of a quartz-grit and conglomerate, almost exactly like that of Twt Hill. Near Llanerchymedd, where there was a mass of greenish schistose rock succeeding the Dimetian, the Cambrian basement-bed contained a large number of fragments of that rock, certain bands being chiefly composed of it. Near Bryngwallen, where the underlying Archæan consisted of gneissic rocks, the Cambrian basement-beds were made up of quartz conglomerate. Tracing it still further to the south-west he found bosses of conglomerate among the sand dunes of Cymeran Bay, full of fragments of green schistose rock like that of Bangor, and telling of the further development of Pebidian at the south-west end of the Anglesey axis. In several localities these conglomerates were associated with and passed into fossiliferous grits and sandstones. He exhibited slices of the more important rocks, which he showed confirmed the results arrived at from other evidence. He pointed out that the observations now made confirmed the views he had expressed on a former occasion with regard to the basement-beds of the Cambrian between Caernarvon and Bangor, where the deposits which rested upon the granitoid rocks of Twt Hill were either a kind of arkose or chiefly composed of quartz with a few pieces of mica-schist and jasper; but as he followed them a few miles to the north-east he found that the quartz had got pounded into smaller grains, and the larger pebbles were chiefly of felsite, which here formed the shore, while further towards Bangor fragments of the still higher Bangor volcanic series helped to make up the Cambrian shingle-beach.—Description and correlation of the Bournemouth beds. Part II. Lower or freshwater series, by J. S. Gardner, F.G.S. This was in continuation of a former paper by the author (*Q.J.G.S.* vol. xxxv. p. 209). The beds described are exposed east and west of Bournemouth and near Poole harbour, over a distance of about four miles. The author referred them to the Middle Bagshot, and stated that they are distinguished from the Lower Bagshot by the absence of the extensive pipe-clay deposits and the presence of brick-earths, and from the overlying beds by the absence of flints. They reach their extreme limit in the western area of the London basin, and are represented by the lignitic beds 19–24 of Prof. Prestwich's section. Lignites can be traced partly across the bay. The cliffs present an oblique section across a delta divisible roughly into four masses, one of which, from its confused bedding and want of fossils, is supposed to have been formed by the silting up of the main channel. The total thickness of the series was estimated at 600 to 700 feet. The inferences drawn by the author were as follows:—(1) From the beds cut through showing a steep side to the west, that the river flowed from that direction; (2) from the absence of boulders or coarse sediment, that the area was flat; (3) from the absence of lignite, that there were catchment basins; (4) from the absence of flint, and the quartzose nature of the beds, that no chalk escarpments were cut through, and that the deposits came from a granitic area; and (5) from the presence of wood bored by *Teredo* that the beds belong to the lower part of the river in proximity to tidal water. The flora was stated to be confined to local patches of clay. Those at the western end of the section are very rich, and distinguished from the rest by absence of palms and rarity of ferns. The beds near Bournemouth are still richer and very distinct; those east of Bournemouth are characterised by *Eucalypti*, Aroids, and *Araucariæ*; and those at the western end of the section by abundant Polypodiaceæ. It is remarkable that nearly every patch contains a flora almost peculiar to it; but the flora as a whole seems to pass upward to the Oligocene, but not down to the Lower Bagshot.

Sanitary Institute of Great Britain, June 21.—Dr. A. Carpenter in the chair.—A paper was read by Prof. W. H. Corfield, M.A., M.D., on the present state of the sewage question. In the discussion which followed Mr. W. C. Sillar, Mr. E. F. Bailey Denton, Mr. Douglas Onslow, Mr. R. W. P. Birch, Mr. G. B. Jerram, and Mr. Wilson Grindle took part. The Chairman made a few remarks relative to the successful working of the sewage farm at Croydon, and Prof. Corfield replied briefly to some of the points raised in the discussion.

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