THURSDAY, JANUARY 14, 1897.

CELLULOSE.—THE CHOICE OF PAPER FOR BOOKS.

Cellulose: an Outline of the Chemistry of the Structural Elements of Plants with reference to their Natural History and Industrial Uses. By Cross and Bevan. Pp. 320. (London: Longmans, Green, and Co., 1895.)

NO more aggravating book could be placed in the hands of a reviewer: inchoate in the highest degree, it deals with a subject of extraordinary interest and importance in an absolutely original manner; it teems with suggestions which those who can read between the lines will find of the greatest value; but it is disfigured by an obscurity of diction which must materially diminish its usefulness, and to do it justice a degree of patience and long-suffering must be exercised which probably few possess. Certainly it has taken me a long time to screw up my courage to the point of venturing to publicly discuss its merits; but the delay has served a good purpose: had I recorded my first impressions, they would have been highly unfavourable; whereas I can now say that the more often I take the book in hand the more it fascinates me, and the more I realise how important are the problems it presents for consideration. In fact, whatever the faults of the work, all who are in any way concerned with the manifold uses which cellulose subserves, whether in nature or art, must seek to appreciate its contents, and must study it as by far the most important contribution to the subject published since the appearance in 1876 of the magnificent fragment, entitled, "Die Pflanzenfaser und ihre Aufbereitung für die Technik," by Dr. Hugo Müller. A comparison of the two books shows how extraordinary is the progress made during the past twenty years; and yet how absolutely ignorant we remain of the nature of cellulose.

Many may ask, What is cellulose? To which we must reply, We cannot say! It is impossible at present to define it more exactly than as being the main element of the cellular structure of plants; as the structural basis of the vegetable world—to use Messrs. Cross and Bevan's expression, so that its German appellation, cell-stuff, gives in a single word the best definition possible. But whereas formerly we thought of it always in connection with cotton-wool, it is now becoming customary to associate the name with a variety of substances, and to regard cotton-wool cellulose as only the most highly developed term of a series of celluloses.

Cellulose belongs to the great secret society we term *carbohydrates*—I say secret, because all but the inferior members are sealed books to us. A carbohydrate is a compound in which carbon is associated with oxygen and hydrogen, these elements being present in the proportions in which they occur in water; an important consideration to be borne in mind when the attempt is made to consistently define a cellulose. For years we lived under the comfortable conviction that the carbohydrates contained, if not six, some integral multiple of six carbon atoms in the molecule, and they were all natural products; but then it was discovered that ordinary gum arabic affords a carbohydrate containing only five atoms of carbon—*i.e.* the pentose arabinose; and more recently we have learnt to improve on nature, and have shown how vastly greater are our powers by raising the number of hexaldoses isomeric with ordinary honey glucose, $C_6H_{12}O_6$, from three—the number obtained from natural sources—to eleven; the maximum number possible being, we believe, sixteen: a sufficiently wonderful achievement; in fact, probably the greatest feat recorded in the history of chemical discovery, and the more so when we consider that we have not only made them, but have also, we venture to believe, successfully allocated to the atoms in the molecule of each of the forms their relative positions in space. It may be added that we are now acquainted with a complete series of homologous "glucoses" containing from one up to nine carbon atoms, most of them being artificial products.

Nature, however, has hitherto baffled us in the case of so well-defined a carbohydrate as ordinary sugar—call it, as we may, either cane or beet sugar, since but one and the same substance is procurable from either source, although many "educated" folk still insist on the contrary. Notwithstanding that we know the size of its molecule, we have not yet precisely determined its structure, which is proof that our analytic powers are after all but very limited, and that there is no relation between cheapness and constructiveness: as if there were, we should long ago have entirely mastered a material tons upon tons of which may be had in an almost pure state at about twopence a pound—in itself a sufficiently noteworthy circumstance; indeed, no other article of commerce illustrates in so striking a manner the perfection attained in modern manufacturing processes. Above cane sugar, higher in the series, all is chaos: of dextrin, glycogen, inulin, starch and the celluloses, &c., we know no more than that in some way they are, with very few exceptions, derived from ordinary glucose; it is generally supposed that their molecules are *highly* complex, but the evidence on this point is by no means complete. Progress is barred by the absence of methods of attacking such problems, and we must patiently await the arrival of the pioneers who will successfully penetrate into regions which we have hitherto always failed in exploring beyond the frontiers. From this point of view, especially, men like Messrs. Cross and Bevan are particularly deserving of encouragement, as they have given clear proof of ability in opening up new lines of inquiry—by far the most valuable office to render at such a juncture.

Cane sugar, $C_{12}H_{22}O_{11}$, and its congeners are with great facility resolved into two hexose molecules by hydrolysis; and all other higher carbohydrates, excepting the celluloses, are without difficulty simplified by the action of dilute mineral acids and a number of enzymes. The behaviour of starch is altogether remarkable: when subjected to the action of an extract of malt, it is very rapidly attacked, even at ordinary temperatures, if previously gelatinised; in the first instance, it is converted into soluble starch, and then into "dextrins" and maltose, the isomeride of cane sugar. This is not the place to enter into any discussion of the various "dextrins," or of the peculiarities which they manifest:

suffice it to say that the subject is still enshrouded in mystery.

Although some, if not all, of the celluloses more or less readily undergo hydrolysis under natural conditions in plants, the difficulty with which cotton cellulose is resolved by acid hydrolysts is surprising in comparison with the readiness with which starch is attacked; and when hydrolysis takes place, the tendency is to form dextrose: in no case has the production of a substance corresponding to that of maltose from starch been observed. How are these and other peculiarities to be explained? At present the only thing clear to us is that although fundamentally both dextrose derivatives, cellulose and starch are seemingly constructed on different types; so that the conversion of one into the other, in whichever direction it may occur, involves a passage through dextrose.

Messrs. Cross and Bevan attach great importance to the formation from cellulose of a large quantity—30 to 35 per cent.—of acetic acid on fusing it with alkali, a behaviour which no other carbohydrate exhibits; to account for this, they assume that cellulose contains the group $CO.CH_2$, and they are inclined to think that this forms part of a closed chain of six carbon atoms constituting the fundamental C_6 group of the carbohydrate; but in the absence of definite evidence, so unconventional a view can only be regarded as a working hypothesis put forward with the object of emphasising the peculiarities of cellulose in comparison with other carbohydrates.

There are, at least, two other types of cellulose which are far more widely distributed in the plant world than is that of the cotton type, viz. those obtained from woods and ligneous tissues generally, and those from cereal straws, esparto, &c.; but such celluloses contain a larger proportion of oxygen, and are in fact *oxycelluloses*—so that, strictly speaking, they are not carbohydrates: they are characterised by yielding more or less furfuraldehyde on distillation with muriatic acid, wood cellulose giving from two to six per cent., and esparto as much as twelve. The ligno-celluloses constitute another class, belonging, however, to the group of compound celluloses, of which there seem to be many varieties; they contain a non-cellulose constituent almost of a benzenoid character. All these are much less resistant than cotton cellulose. In a recent communication to the Chemical Society Messrs. Cross, Bevan, and Smith have shown that it is possible, by a process of regulated hydrolysis, to resolve the cereal straws into a resistant cellulose and a substance which they believe to be a formal-pentose, $C_5H_8O_3\begin{matrix}O\\ \diagup\\ \diagdown\\ O\end{matrix}\!\!>\!CH_2$; they regard this as the primary source of the furfural obtained on hydrolysing many celluloses. Furthermore, they find that the substance of this type varies in character with the stage of growth, being completely fermentable at an early stage, but not in the later stages. This discovery marks an important advance in our knowledge, and its development may be looked forward to with the greatest interest.

Finally, it is to be noted that in addition to celluloses primarily derived from ordinary dextrose, others exist in the formation of which isomerides of dextrose have taken part—vegetable ivory, for example, yields instead of dextrose the closely related substance mannose on hydrolysis, mannose differing from dextrose only in the relatively different position of the groups associated with the asymmetric carbon atom next the COH group.

These illustrations will suffice to show how complex a chapter in organic chemistry we have to deal with in considering the celluloses; but it is only in recent times, and in no small measure owing to Messrs. Cross and Bevan's work, that we have been led to appreciate this fact. A perusal of their book will show how, as yet, we have but touched the outermost fringe of the inquiry into their nature, metamorphoses and origin, and how fertile, but at the same time infinitely difficult, a field they present for research.

It is almost impossible to exaggerate the value of a thorough knowledge of all that relates to the celluloses, when we consider the astonishing variety of uses to which they are put, and the importance of the industries in which they constitute the raw material. Thus we not only clothe ourselves largely with cellulose in the form of cotton and linen fabrics, and make from it the paper on which we write and on which we print our books, besides using it for a multitude of other peaceful purposes, but even convert it into guncotton, and from this fashion smokeless powder wherewith to confound our enemies: indeed, no more striking illustration of the revolution in our practices that science is effecting could be given than is afforded by the fact that a material like gunpowder, after being in use during so many centuries, should have been suddenly, almost entirely, displaced by the cellulose nitrates and the closely related nitro-glycerin—the glycerin, from which the latter is made, also being obtained largely from vegetable sources as well as from animal fats, and being procurable as a bye-product, in large quantity, because our modern civilisation has imposed upon us the fashion of constantly washing with the aid of soap, which we are impelled to buy by ubiquitous advertisements.

Now that the plastic nature of the celluloses is becoming understood, it is to be expected that they will be made use of in many other equally striking novel ways: the projected manufacture of a substitute for silk through the agency of nitrated cellulose is a case in point.

Messrs. Cross and Bevan have much to say on the quality of paper on which permanent records should be printed—undoubtedly a question of great importance, which has in no way received the attention it deserves. Their book is printed upon a paper carefully selected as composed of "normal" celluloses, to the exclusion of the inferior celluloses ordinarily employed in the manufacture of printing papers; and it certainly affords an agreeable contrast in this respect to the majority of books issued at the present day. Formerly, when paper was made of rags, and china clay was used with a very sparing hand, the material was both strong and little liable to undergo deterioration under ordinary influences—*mais nous avons changé tout cela.* Nowadays not only is a prodigal use made of china clay, but the place of rags is very largely taken by wood and straw. As already pointed out, the celluloses derived from such sources are far less resistant than cotton cellulose; in fact, all papers made from such materials are liable to suffer discolouration under the

ordinary conditions of wear and tear, and as they undergo oxidation somewhat readily, they gradually perish and become rotten. Yet, as Messrs. Cross and Bevan point out, in the case of papers used for writing and printing, permanence is a first desideratum:—

"Books and records have more than a passing value, and it is essential that they should be committed to pages suitably resistant both to chemical and mechanical wear and tear . . . *there is no public opinion in this country upon this important subject.* Where preferences for high-class papers exist, they are based rather upon æsthetic and other recondite considerations than upon any judgment as to composition and the relation of their constituents to the destructive agencies of the natural world. On this basis, while papers admit of a very simple classification into three main groups: (A) Those composed of the normal and resistant celluloses only—*e.g.* cotton, linen; (B) those composed of celluloses containing oxidised groups or oxycelluloses—*e.g.* wood-cellulose, esparto and straw celluloses; (C) those containing, in admixture with the above, ground wood or mechanical wood pulps (ligno-cellulose) . . . Class A stands beyond criticism. . . . fibres of Class B have been introduced in response to the enormously increased consumption of paper in this century. . . . their use in books is open to the very obvious objection that the books are more perishable. Of course, it is perfectly true that a large amount of literature is of the ephemeral kind, and in this province such questions as we have raised do not enter; on the contrary, paper being very much cheapened by the use of these celluloses, a great advantage is gained. It must be insisted upon, however, that authors and publishers should have a definite judgment as to the papers to which they commit their productions, and it would be of the greatest utility to exhaustively investigate these particular celluloses from the point of view of their resistance to the natural processes of decay. Class C: The presence of ligno-cellulose is a more extreme departure from the sound basis of composition represented by Class A . . . papers of this class are only permissible where lasting properties are a question of no moment whatever. . . . The practice of loading papers with china clay . . . is also another of the causes which lead to disintegration of modern papers as compared with those of former days. There is, of course, the other side to this question, the addition of these mineral diluents having certain positive advantages not to be overlooked. The danger of any practices of this kind only enters when they are not measured at their proper utility. *Paper is largely taken for granted by consumers.* In a great many, perhaps the majority of cases, this uninquiring consumption is not attended with any serious consequences; but, on the other hand, it is quite obvious that it is attended with dangers of a very grave character, when we are dealing with records of value for all time. This, of course, is largely a question for posterity, to whom we are handing down a literature produced upon grounds for the most part of mere commercial expediency. *It is high time, as we have said before, that a public opinion should be formed upon this subject*, and it can only be formed upon a recognised classification of papers, based upon the mechanical and chemical constants, which are determinable by laboratory investigation." (The italics are introduced by me.)

But there is a sunny side to Messrs. Cross and Bevan's disclosures, as they appear to offer a method of overcoming some of the difficulties introduced by the plethora of publications with which we are overwhelmed at the present day, and foreshadow a course of action by which readers of scientific papers might be greatly helped. If we remember that cotton cellulose is unaffected by aniline salts, which colour the oxycelluloses yellow to red, we can imagine what the result might be if all books worth preserving, and just those parts of our scientific papers which are really worth consideration, were printed on sound rag paper. On receipt of a journal, a light wash of aniline solution might be applied to each page: soon afterwards a rosy blush would pervade the greater number, only a few here and there, or those just at the beginning or the end of a paper, retaining their virgin purity of tone: we should at once know what was padding, copied from the note-book to produce an impression of much labour expended and of deep learning! Works could be avoided by budding authors who in the process of self-education had given birth to compilations to "satisfy wants" felt by themselves alone, and the choice of students restricted to trustworthy sources of information. And the joy of the reviewer would also be great, as he could ascertain what value author and publisher placed on a book, especially if a standard series of tints, corresponding to the several varieties of paper, had been agreed to; moreover, it would not be necessary to read reviews, and advertisements could be curtailed—as the words "Printed on Class A paper" would serve as a recommendation far better than any garbled "Opinions of the Press." I do not propose to protect the idea, but offer it freely to our Royal and other Societies, although I am aware that a patent is said to be a good advertisement, and the best means of enforcing use. Indeed, I trust that, in making the suggestion, I am but showing that I have derived profit from Messrs. Cross and Bevan's invaluable book, which is most properly printed on Class A paper.

As they truly remark at the close of their work, the chemistry of cellulose

"is a province of applied chemistry where, as in many others, the distinctions between 'science' and 'practice' exist only in the minds of those who grasp neither the one nor the other. Manufacturers and technical men, if they will only take the trouble to inform themselves, must see that an enormous field of natural products and processes about to be explored has a number of industrial prizes and surprises in store; scientific men who have to undertake the pioneering work in this field will find sufficient stimulus to effort in the promise of discovery." H. E. A.

EARLY CHALDEAN CIVILIZATION.

Cuneiform Texts from Babylonian Tablets, &c., in the British Museum. Part I. By L. W. King, M.A. Printed by order of the Trustees. Pp. iv + 50 plates. (Kegan Paul, Longmans, and others, 1896.)

RUMOURS must have reached the general reader from time to time of the "finds" of tablets which have been made by the natives in Southern Babylonia; and it is a matter for congratulation that, judging by what we see in the volume before us, the results of these "finds" have been acquired by the Trustees of the British Museum. We have long been familiar with tablets of Assyria and Northern Babylonia, and it has long been evident that their contents were taken from clay documents which belonged to a much older period, and were the literary offsprings of a people whose early history had then disappeared in the mists of a remote antiquity. The

copies of the tablets, cones, &c., which Mr. King has just given us confirm this opinion, and we are brought face to face with a class of tablets to which, hitherto, we have been strangers. And just as the tablets are new to us, so, too, is their shape—for they are round, and resemble large bread-cakes more than anything else—and the eras in which they are dated are new, and the characters in which they are written are more complicated than any which we have hitherto seen. The texts upon them form public accounts and lists of revenue and produce which were drawn up for the public "record office" of the kings of the second dynasty of the city of Ur, about B.C. 2300; the kings most frequently mentioned are Bur-Sin, Ine-Sin and Gamil-Sin. Curiously, however, these tablets are not dated by regnal years, as are thousands and thousands of other documents, but by important events in the past history of the country, such as the capture of an enemy's city, or the invasion of an enemy, or the completion of some great public work, and unfortunately we have, at present, no means of telling *when* these events took place. Among the miscellaneous texts which Mr. King has given us we find a very important inscription in Accadian (No. 96-4-4, 2) containing an invocation to the goddess Nininsina to preserve the lives of Rim-Aku (Arad-Sin) and his father Kudur-Mabug, who flourished, probably before B.C. 2300, about one hundred years before Khammurabi succeeded in consolidating his kingdom in Babylonia. Another remarkable inscription is found on four clay "cones" (No. 96-6-12, 3), whereon we find recorded the name and titles of Mul-babbar, or if we read it as a Semitic name, Amêl-Shamash, a very early *patesi* or viceroy of Babylonia. We believe that this Mul-babbar is here met with for the first time. Still another most valuable text is found on the stone mace-head (No. 96-6-15, 1), where we have recorded a prayer to a god on behalf of one Nin-kagina, the son of Ka-azaggid, and of the viceroy under whom he served; the name of the latter is Nam-maghani, and he ruled over the city of Lagash, or Shirpurla, about B.C. 2500. It is an important fact that the name of Nin-kagina's father is given, and it would seem as if hereditary offices of high rank had already been established at that early period.

Want of space forbids our calling the reader's attention to many other important details in connection with these early texts; but it must be mentioned that their true value arises from the fact that they enable us to fill up part of the gap in our knowledge of the period which lies between the reigns of Khammurabi and Sargon I. of Agade. More than that, when worked out, these tablets will help us to understand the social fabric of the civilisation of the period, and will, no doubt, reveal the conditions of land tenure in Babylonia. It seems as if the land was managed for the kings or viceroys by the priests, and as if much of the administrative work of the country was deputed to them; that kings themselves also held priestly rank is also most probable. But although the forty tablets, &c., here published, yield so many results, it must never be forgotten that our knowledge of this period must be always fragmentary as long as a single tablet remains unpublished. We are very glad to see from the prefatory note to Mr. King's work, that other volumes of a similar character are to be issued by the Trustees of the British Museum, and we can only hope that the intervals between the appearance of the parts will not be long. They had already laid all cuneiform students under a debt of gratitude for their liberality in the publication of unremunerative books of Assyrian and Babylonian texts, and the present volume will make that debt greater.

In conclusion it may be mentioned that Mr. King's copies have been reproduced by photo-lithography, and that the work is therefore free from misprints which so often puzzle the reader, and lead him, sometimes, astray; the handwriting is clear, and neat, and careful—three qualities which should not be lightly esteemed.

HANDBOOKS OF PHYSIOLOGY.

Kirkes' Handbook of Physiology. By Prof. W. D. Halliburton, F.R.S. Fourteenth edition. Pp. 851. 8vo. (London: John Murray, 1896.)

IT is not very many years ago since "Kirke," as the book before us has been familiarly termed by many generations of students of medicine, had the field all to itself as a physiological handbook. During many years it had no rival; for the "Principles of Physiology" of the late Dr. W. B. Carpenter, although co-existent with it, was far too bulky to be regarded as in any sense a handbook. How different are matters in this respect now! What with Waller, Starling, McKendrick, Stewart, to say nothing of Foster, of Landois and Stirling, and of even bigger books looming in the distance, the student at the present day can take his choice; which he could not do then, for the only book offered to him in the days we are speaking of was the compilation by Dr. Kirkes, which, unlike most text-books, has been destined long to survive its original author. And an excellent compilation it was, founded upon the best work on physiology of its time, and, as some think, of all time, that by Johannes Müller; written, moreover, in a readable manner, so that the attention of the reader was easily maintained, and his interest in the subject never allowed to flag. But, alas! science is progressive, and a book on physiology may be ever so readable to-day but will not be read to-morrow, unless means are taken to bring its material "up to Saturday night." Thereafter comes the inevitable "editing," which may be all well enough so long as the author can himself undertake the repairs of his own fabric, but which is apt to render that fabric a very patchwork quilt of a book when it consists of the paste and scissors work of inserting a paragraph here and deleting a paragraph there, as was to all appearance the manner of preparing a good many of the round dozen of editions which intervened between the original book and the one we are considering.

The result was that the work became full of inconsistencies, amounting in some cases to grave errors; and at a certain period of its career it was so unfavourably regarded by the professors of physiology, that one of the most eminent of these is reported to have addressed his class in the following terms:—"If any gentleman present has purchased a copy of a book called 'Kirkes' Physiology,' I would advise him to take it out with him when he goes for a walk . . . and throw it over the highes

wall he can find." Nevertheless, in spite of this disfavour on the part of the professors, the book held its own in the favour of the student, although whether it did so entirely on its merits, or whether it was assisted by the deeply-rooted conviction which used to be current in the medical schools that "Kirke" was the book that was wanted by the examiners at "the College," is a question which we prefer to leave undecided.

But all this has now been changed. The patching process has been arrested; "Kirke" has been rewritten. And Mr. Murray may be congratulated on the choice he has made of an author—the term "edited" is very justly dropped altogether from the title-page. At the same time we may be permitted to drop a tear of regret that the long and original connection of the editorial staff of "Kirkes' Physiology" with "Bart's" should be ended, and that no one should have been found in that particular school worthy or willing, whichever it may have been, to undertake the task which Prof. Halliburton has now performed. We fancy that the late Dr. Kirkes would be no little taken aback could he behold the transformation which has been effected in his book. The whole arrangement is altered, so far as the physiology proper is concerned; the so-called "animal" functions are now taken first, and the "organic" functions next, while the general phenomena of nutrition are considered last of all. And the book bears the stamp—as is only natural it should do—of being written by one who is himself practically familiar with what he talks about; and this must be always the most important point in a text-book. Not that we would be supposed to undervalue "style," nor have we any particular fault to find with that of this book. But Prof. Halliburton has handicapped himself at the outset by endeavouring to keep up the reputation of "Kirke" for providing all that a student may require in histology and embryology, as well as physiology proper. In this he has, in our opinion, committed an error of judgment, for the chapters upon these subjects occupy a considerable bulk of the volume, which might reasonably have been devoted to considering some of the facts of physiology proper at greater length. The result is that the author has had in many subjects to adopt a style which is too concise to be thoroughly readable; and, indeed, the small amount of space which he has been compelled to devote to some subjects of considerable importance is a decided blemish on the book. Most subjects are quite as fully, and many subjects are much more fully treated of in the "Elements of Physiology" of Dr. Starling than in this one, although Starling's is a very much smaller book; and the difference between the treatment of physiological problems by Waller and our author is not less striking, and is in great measure due, no doubt, to want of the extra space which the omission of histology and embryology would have afforded. Nor has the student any real countervailing benefit, for he will be sure to go for his histology and embryology to books devoted entirely to those subjects, and which give the requisite information more thoroughly and satisfactorily than it can possibly be given in a general treatise of this kind. Although in this respect we think it may with advantage be modified, Prof. Halliburton has, nevertheless, produced an excellent book, and one which will be welcomed by many teachers and students. There are, however, one or two special points which ought not to pass uncriticised. One of these is the tendency of the author to describe a multiplicity of methods for obtaining particular results, irrespective of the relative value of such methods; and to give a multiplicity of opinions of physiologists on knotty subjects, without always taking a decided line himself. This tendency ought, we think, to be avoided in an elementary text-book, since the result is only to confuse the young student. Another point which we wish to notice is that the author has not, in our opinion, given full credit to other authors from whom he has borrowed either ideas or illustrations. Dr. Halliburton has, it is true, not carried this practice as far as is frequently done, and in most instances gives credit to whom credit is due: it is, indeed, probably by inadvertence that the immediate sources of his information are not everywhere acknowledged. But it is due to every author, and not less to the author of a text-book than to the author of a monograph, that, if his work be in any way appropriated, there should always be the completest acknowledgment of such appropriation. Probably no scientific authors would object to their work being thus utilised, while, on the other hand, most of them might naturally experience annoyance at its utilisation without acknowledgment.

OUR BOOK SHELF.

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India. Edited by W. T. Blanford. *Moths.* Volume IV. By Sir G. F. Hampson, Bart. Pp. xxviii + 594. 8vo. (London: Taylor and Francis, 1896.)

THE present volume includes the *Pyralidæ*, and an appendix to the earlier families of moths, thus completing the review of all the Indian moths, except the *Tortrices*, *Tineæ* and Plume Moths. The total number of species regarded as valid, exclusive of races or subspecies (many of which latter, it is reasonable to surmise, may hereafter be proved to be specifically distinct from the forms with which they are at present associated), amounts to 5618. The next volume of the "Fauna," it is announced by the editor, will likewise be devoted to insects, and will commence the series of descriptions of Indian Hymenoptera with those of the bees and wasps, by Lieut.-Colonel C. T. Bingham.

We congratulate Sir George Hampson on the completion (so far as the larger moths are concerned) of the important and useful work which he has undertaken. Of the execution of the present volume we need not say much, as we have already expressed our opinion freely, as regards the volumes which have preceded it; and the author's method, and the style of the work have undergone no alteration. We notice no falling off in either respect, nor are we more inclined to approve of such a dogmatic way of stating what cannot at present be more than an hypothesis, as the following:

"From the lower *Pyraustinæ*, with porrect palpi, and the third joint naked, arose also the other groups of *Pyralidæ*:

"The *Hydrocampinæ*, with vein 10 of the fore-wing stalked with 8 and 9:

"The *Pyralinæ*, with vein 7 stalked with 8 and 9, and vein 8 of the hind-wing free, giving rise to (*a*), the *Endotrichinæ*," &c.

We think that cautious evolutionists should simply confine themselves to saying that such and such groups

as exhibit a simpler structure than others, have probably diverged least from the primitive stock. We cannot too strongly insist upon the general recognition of the fact (self-evident though it be) that, in the present state of our knowledge, and in the almost total absence of palæontological evidence, our sketches of insect phylogeny, however useful and suggestive, cannot but be, to a large extent, purely tentative.

Some recent authors have regarded the *Crambidæ* as a totally distinct family from the *Pyralidæ*. Sir George Hampson recombines them, and divides the *Pyralidæ* into the following twelve sub-families: *Galleriinæ*, *Crambinæ*, *Schœnobiinæ*, *Anerastiinæ*, *Phycitinæ*, *Epipaschiinæ*, *Chrysauginæ*, *Endotrichinæ*, *Pyralinæ*, *Hydrocampinæ*, *Scopariinæ*, and *Pyraustinæ*.

Die Minerale des Harzes: eine auf fremden und eigenen Beobachtungen beruhende Zusammenstellung der von unserem heimischen Gebirge bekannt gewordenen Minerale und Gesteinsarten. Von Dr. Otto Luedecke. Pp. 643. Mit einem Atlas von 27 Tafeln und 1 Karte. (Berlin: Gebrüder Borntraeger, 1896.)

THIS elaborate Treatise on the Minerals of the Harz will be very useful, as a work of reference, to those who are in charge of mineral collections, and to all who are specially interested in those species with which the treatise deals. In it the author has placed on record the results of the observations made by him in the course of the last eighteen years, during which period he has examined the private and public collections of the region, and has visited the Harz localities both to satisfy himself on the spot as regards the existence of the minerals at the places mentioned, and to obtain information as to the modes of occurrence; these visits were facilitated by the nearness of the district to Halle, of which University Dr. Lüdecke is a distinguished professor. Further, the author has incorporated the results of the study of Harz minerals by other mineralogists. In the case of the more important species, such as Galena and Copper-pyrites, a brief sketch is given of the geological features of the districts in which the minerals occur. The treatise is accompanied by an atlas of twenty-seven plates (chiefly crystal figures and stereographic projections) and a very clear map of the region, photographically reduced from the one prepared by Borchers in 1865. Prof. Lüdecke has done a considerable service to Mineralogy by the publication of the results of so thorough an examination of this important mineral region.

The Wonderful Universe. By Agnes Giberne. Pp. 128. (London: Society for Promoting Christian Knowledge, 1897.)

TO the class of readers which finds pleasure in being oppressed and bewildered with information as to the "wondrous far distances," and especially to the members of it possessing a sentimental bias, Miss Giberne's book will successfully appeal. Among the titles of the eleven chapters are "The Silver Moon," "Fair Venus," "Red Mars," "Twin Giants," and "Stars of Light." What Miss Giberne has to say on these and other subjects comprised in her book can usually be depended upon; and, as might be inferred from the quoted titles, she aims at making her descriptions attractive. In the latter attempt, however, she is not altogether successful. A sprinkling of poetical extracts, a few lapses into the religious aspects of astronomy, some lugubrious humour, and a number of statements as to how long it would take to go to the moon and other places in an express train, make up much of Miss Giberne's latest volume. Still, the fact that the information can be trusted, and that it is very simple, is a recommendation.

There are no illustrations, not even in the chapter on "How to Learn the Heavens," and there is no index. A book on astronomy published with such omissions hardly possesses the qualifications for success.

The Story of Forest and Stream. By James Rodway, F.L.S. Pp. vi + 202. (London: George Newnes Limited, 1897.)

IN this little book Mr. Rodway sketches, in his best style, the life of trees in wood and forest, and indicates the lessons that it teaches. He points out the benefits derived by man and other animals from forests and streams, imparting the information in pleasing language, and presenting nature in many instructive aspects. The twenty-seven illustrations are the best that have yet appeared in any of the volumes in the Library of Useful Stories, to which series the present book belongs.

Mr. Rodway naturally devotes the largest share of attention to the forests of South America, for he is most familiar with the conditions which obtain in them. On this account, however, the plant-life described is somewhat limited, though here and there comparisons are made between the floras of the old and new worlds. A more appropriate title for the book would have been "The Story of Tropical Forest and Stream."

Quelques observations sur les Muscles Peauciers du Crane et de la Face dans les Races Humaines. By Théophile Chudzinski. Pp. 90. (Paris: Masson, 1896.)

THIS work gives an account of the arrangement of the superficial muscles of the head and neck in the different races of men. The muscles are described, and a series of measurements given for each in the different races. The general conclusion is what one would expect; namely, that these muscles of the superficial fascia are most marked in the black races, least so in the white, while in the yellow races they are intermediate in their development. The facial muscles of the negro are found to closely resemble those of the gorilla in their great development. M. Chudzinski draws attention to the diagramatic manner in which the muscles of expression are usually figured, and notes particularly certain very superficial layers which it is customary to remove in defining the edges of the muscles. The twenty-five figures, which are given at the end of the text, illustrate the comparative development of the muscles as seen in dissections of the heads of different races.

LETTERS TO THE EDITOR.

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

The Meaning of the Symbols in Applied Algebra.

IF I had made a slip of the pen of the kind suspected by Mr. Cumming (p. 198), it would have been a serious error, because it constituted the essence of what I was writing about. I was sure that a number of teachers did not believe it, and I am obliged to Mr. Cumming for giving me another opportunity of emphasising what I believe to be a vital matter. He says "the multiplication of one length by another length [or, more generally, of one concrete quantity by another] is abhorrent to the mind of" certain mathematicians. Quite true, I know it. The idea was abhorrent to the mind of the late Mr. Todhunter, and I think that Prof. Greenhill has expressed himself in the same sense. But what then? That is exactly why the idea requires driving home; and until it is driven home there will be no real clearness or simplicity in dealing either with physical quantities themselves or with their numerical specification in terms of given "units."

Mr. Cumming says that "$2Rh = d^2$ is an algebraic equation, and as such its symbols express numbers, not things." Whereas I say that truly it is an algebraic equation, and as such its symbols may express things and not numbers. A relation between numbers is an arithmetical equation, and is appropriate to the pure mathematician; by him algebra was first used, and he still clings to the ancient practice; but physicists have now made a perfectly legitimate step onwards and extended the scope of the science. Applied mathematics is concerned with things, and its symbols may properly be taken to represent concrete quantities (see, for instance, NATURE, vol. xxxviii. p. 282).

Mr. Cumming says that the equation is true in any units; but if he gave his boys R in metres, h in inches, and d in yards, or if he used it for finding the curvature of a lens, or the thickness of a Newton's-ring film, telling them at the same time that the symbols only represent numbers, they might be in a fog. A perfectly unnecessary fog, and that is the serious part of the business. Artificial difficulties obstruct the path of the beginner in regions which are quite easy, and hence it is that his progress into higher regions is so slow. Such difficulties need not exist. The golfer who keeps on the straight course is untroubled by bunkers and obstacles which infest the path of the wild driver.

If Mr. Cumming can spare time to reconsider the question, I know it needs an effort, *experto crede*, I am sure it will repay him.

I call the attention of those physicists who are already familiar with the straightforward mode of dealing with concrete quantities to the remarkable letter, by Mr. C. S. Jackson of the R.M. Academy, Woolwich, immediately preceding Mr. Cumming's; and, as he asks me a definite question, I answer $s = w/v$.

January 4. OLIVER J. LODGE.

The Force of a Pound.

MAY I suggest to Prof. Perry that it might be well to imitate the enemy's tactics and give a name to the unit of inertia on the pound-force system.

I would propose that, on this system, any piece of matter having the unit quantity of inertia or sluggishness be, for dynamical purposes, termed a "slug."

The foot-pound (force)-second system might then be equally well styled the foot-slug-second system, and under the aspect implied by this name would stand on precisely the same footing as the centimetre-gram-second, or the foot-pound (mass)-second system.

A "slug" would be an instructive object to contemplate. Its virtues would be pretty accurately embodied in a a 32-lb. shot, which, in fact, is manufactured solely for the sake of its inertia, and is a body not unfamiliar even to athletic undergraduates in our universities.

I have taught dynamics for many years, both to unprofessional students and to engineers, and have remarked that the unit difficulty is felt far most strongly by the latter. This I attribute in part to the relative inadequacy of the linguistic training which many of my engineering students have received before entering on their professional studies. They are not well able to disentangle verbal confusions, and are resentful of them. Consequently a liability to trip, arising from some ambiguity of terms, which would be a stimulating challenge to a student of wider training, is an unmitigated nuisance to the engineer, who has no interest in this kind of thing, and does not wish to be bothered by it.

The difficulty is one of language and not of dynamics, and I am quite in sympathy with Prof. Perry's desire to get rid of it, and should adopt without hesitation a good text-book which employed the pound as the only unit of force, if I knew of such.

It should always be remembered that, to most students, the study of dynamics is the study of the new and unfamiliar property of inertia, and it is only reasonable that the new quantity should have a unit with a new and unfamiliar name.

Torquay, January 4. A. M. WORTHINGTON.

Sir William MacGregor's Journey across New Guinea.

IN NATURE of December 17, p. 157, you publish an article describing Sir William MacGregor's interesting journey across the South-eastern Peninsula of New Guinea, by Mr. J. Thomson. As he has introduced some reference to my work in the Possession, perhaps you will kindly allow me space for a few observations. The names of seven travellers, besides my own, are mentioned whose attempts "to explore the Alpine region of the Owen Stanley Range" have "resulted in signal failure." More than one of us, however, *did* reach the Alpine regions of the range, though none of us ascended Mount Owen Stanley. And I cannot think that any of those who made the attempt will feel any discredit attaching to them on that account, any more than attaches to Sir William MacGregor that he could not reach the mountains beyond the sources of the Fly River. That Sir William was the first to scale Mount Owen Stanley is true, and he deserves all the *kudos* he has received for his exploit. Yet the success which attended his efforts was in no small measure due to the information gathered by his forerunners, and even by their "signal failures." Each traveller made it easier for his successor; and Sir William mounted on the backs of all who had preceded him, however much the historiographer for New Guinea may try to ignore their efforts. The reason why some of us who made a not ill-considered effort at great personal expense to reach the summit of the Mount, failed in accomplishing all we desired, was chiefly one of money. Sir William, who has the resources, the steamers and the launches of the Possession at his back, and has besides the prestige of "Great Chief" over the natives—no mean factor in the exploration of such a country—and can call upon his officials in all quarters for aid, is in a very different position from a private traveller dependent very largely (I speak for myself) on his own resources, and *ought* to accomplish far more than any other traveller.

Mr. Thomson goes on to say: "It may be pointed out that there seems no doubt that Mr. Forbes did not see the highest crest of the mountain from his nearest approach to it, and it is almost certain that he could not have obtained access to the crown of Mount Victoria [Mount Owen Stanley] along the south-eastern spur of it. Concerning this accessible spur, which Mr. Forbes proposed ascending, Sir William MacGregor says, it is a mighty precipitous buttress, exceeding 12,000 feet in height, 'bristling with peaks and pinnacle-like rocks, and contains hundreds of inaccessible crags and precipices.'" Mr. Thomson's doubts about what I saw or did not see from my nearest approach to Mount Owen Stanley, are merely the expression of one having no personal knowledge of the country. But if Sir William MacGregor—for whose explorations I have the highest admiration—has said what Mr. Thomson puts into his lips at the close of the above extract, it is quite plain that he is not referring to the same feature that I have described. I took—and, if I mistake not, have published—a round of bearings upon "the highest crest," the most familiar object in my horizon for months. I approximately fixed the positions of and placed on my map names to these same crags and peaks; but the Lieutenant-Governor, following a custom not infrequent with him in regard to the geographical nomenclature of his predecessors in this and other regions of New Guinea, has renamed them. The "accessible spur" mentioned by me, however, was not "a mighty precipitous buttress"— a feature, according to the description, one would think, not altogether unrecognisable as such—nor yet a Primrose Hill; but it was a negotiable slope all the same, and on a less incline than some others ascended by me in the same country.

In conclusion, I cannot help again drawing the attention of cartographers and geographers to the fact that Sir W. MacGregor, after all that has been expressed at the Royal Geographical Society, and publicly by many writers, on the point, still claims for himself the honour of naming the chief mountain in the Possession, by persistently calling it Mount Victoria, instead of Mount Owen Stanley as it was christened nearly half a century ago by Huxley, and has been so inscribed on every map all those years. Prof. Huxley himself told me that the feature on which he bestowed the name Owen Stanley—in honour of as distinguished a commander and explorer as has ever sailed in those waters—was not the range, but the mountain, whose summit he saw rising clear above the clouds one early morning when the *Rattlesnake* was lying in Redscar Bay. Its position and altitude were then accurately determined.

HENRY O. FORBES.

The Museums, Liverpool, January 4.

Shooting Stars of January 2.

THE shower of shooting stars seen by Dr. H. C. Sorby on the morning of January 2, formed evidence of the return of a well-known meteor stream which has its radiant in Bode's modern

constellation *Quadrans Muralis*, about 20° north of Corona, and between Boötes and Draco. The shower seems to have been in pretty strong evidence at its recent return, for Prof. Herschel observed some fine long-pathed meteors from it during the hour preceding midnight on January 1, and Mr. Milligin, of Belfast, writes me that, on the morning of January 2, he recorded twelve of its meteors indicating a radiant in the usual position at 230° + 52°. Though often escaping notice, the January meteor stream sometimes furnishes a really active display, and an observer may count thirty or forty shooting stars in an hour. They are brighter than the average of such objects, and the radiant being low during the greater part of the night, they have very extended flight, which adds to their conspicuous appearance.

Bristol, January 8. W. F. DENNING.

The Svastika.

IN your report of the Presidential Address, Section H, Anthropology, at the British Association, I observe on p. 529 that, "It is in the same Anatolo-Danubian area—as M. Reinach has well pointed out—that we find the original centre of diffusion of the Svastika motive in the old world."

I trust that you will permit me to point out that this type of ornament is not uncommon among our Pre-Aryan savage races, and I enclose a rubbing of one, off a large flat engraved hair-pin

worn by the women and grown-girls of the extreme eastern Naga group, near Margharita, Upper Asam.

These bone hair-pins are peculiar, and the patterns do not vary. I describe them on p. 6 of my paper in the *Journal of the Asiatic Society of Bengal* (vol. lxv. part iii. No. 1, 1896), copy of which I send.

A complete costume of one of these Naga women has been sent to Dr. E. B. Tylor, Oxford Museum, and I have no doubt a *Svastika* will be found on one of the hair-pins.

As the Aryan influence has not yet reached these hill savages, many tribes of whom are still head-hunters, I presume the dictum above quoted as to the home of the Svastika will be modified.

In your issue of April 30 last, on p. 605, I drew attention to the fact that "Megalithic folk-lore" still survives here among our Junglis. No notice has, I see, been taken of the matter: surely it is noteworthy? S. E. PEAL.

Sibsagar, Asam, December 5, 1896.

A Critic Criticised.

THERE is a tendency among critics to condemn a book for not comprising what it was not intended to contain. Such critics have a preconceived notion of what a writer should have included in his treatise; they glance through the pages in a superficial manner for what they think should be there, and not finding such topics expressed to their mind immediately condemn the treatise.

This pernicious habit of critics is well illustrated by recent criticisms (NATURE, p. 545, October 8, 1896; *The Electrician*, p. 637, September 11, 1896), of Prof. Bedell's book, "The Principles of the Transformer," by Frederick Bedell, 1896, on the theory of the transformer. A writer in NATURE sees nothing good in the treatise because it does not enter fully upon the practical details of transformers with iron cores. To do this, Prof. Bedell would have been compelled to greatly increase the size and scope of his book. It was plainly his object to outline, so to speak, the scaffolding of the edifice, and to give in a clear manner the fundamental equations upon which the discussions of transformers rest, and to illustrate the use of graphical methods in such discussions.

Before the appearance of Prof. Bedell's treatise, the student was compelled to rely upon books which were illogical collections of articles originally published in electrical journals, and hastily thrown together in a book form. A just critic should recognise the endeavour of Prof. Bedell to bring order out of chaos, in presenting the fundamental equations used in discussions of alternating currents in such a clear and instructive manner. JOHN TROWBRIDGE.

Harvard University, Cambridge, Mass.

IN the mind of a reader acquainted with the literature of the subject, and having read also the book, to which reference is made in Prof. Trowbridge's letter, the somewhat exaggerated statements in his note can only excite surprise. An author must, to a large extent, be judged by the claims he makes for his work. If the book in question had been entitled "A Mathematical Treatise on Harmonic Currents," it would have been placed on unassailable ground. The writer of it, however, selected a title which certainly claims for it a practical character. His treatment of the subject is largely confined to a discussion of the properties of transformers and condensers in which the real magnetic and dielectric qualities are ignored. The result of such a mode of dealing with the subject is to present a series of interesting mathematical problems, but they have the same relation to the real apparatus that problems concerning weightless pulleys and levers have to the operations of the block, tackle, and crowbars of actual life. THE REVIEWER.

The Union of Nerve Cells.

TO a note by Mr. Alfred Sanders, in a recent number of NATURE (p. 101), criticising the assertion by Ramon y Cajal, that the nerve cells are independent units, and never form anastomoses between one another, I would like to remark that Cajal is not alone in forming such a conclusion. The general consensus of opinion of many other practical neuro-histologists favours the same conclusion. There is no doubt that many cases, such as that which Mr. Sanders mentions finding in *Tropidonotus natrix*, occur; I have found more or less similar ones in the brain of the honey-bee. But when one considers that two fibres in contact would, if thoroughly impregnated, present the appearance of continuity, it is more or less evident that one cannot be guided in forming a decision by such cases as those cited, and that one must depend upon the immensely larger number of cases in which the terminations of fibres are found near, but not in contact with, one another. This is to be said of all preparations by either the various Golgi, or by the methylen-blue, methods, and is something to which I have elsewhere called attention ("The Brain of the Bee," p. 161-2, *Journal of Comparative Neurology*, vol. vi.). F. C. KENYON.

Philadelphia Academy of Natural Science.

I MAY remark, in reference to Mr. Kenyon's letter, that my object in sending the communication on p. 101 was not to criticise Ramon y Cajal's conclusion that no cells of the nervous system ever anastomose, which I have no doubt is, as a rule, correct, but simply to place on record a rare exception, the only one that I have found in several hundred sections, prepared either by the chrom-osmium silver or mercurial methods, of the nervous system of the lower vertebrata. There is a slight misunderstanding on Mr. Kenyon's part, due, probably, to the way I put it. The two cells to which I referred were not joined by the extremity of each dendrite, but by the dendrite of one cell joining, after a short course, the body of the other cell, and even projecting into it. I found a case somewhat similar to this some years ago in the Ceratodus, where two cells of the spinal cord were joined by a broad protoplasmic band; but this specimen was treated in the old way, by being stained with some aniline dye. A. SANDERS.

Two Corrections.

THERE is a slip of the pen, or of memory, in the description of the shrine of Boro Budur, in Java, as "rock-hewn," in your issue of yesterday (p. 228). The shrine is indeed a natural hill, but cased in cut masonry, which bears all the sculptures. I happen to possess the great Dutch work on it, with plans, so can speak with some confidence. Another slight "erratum" in the same number (p. 234), is the description of the Bombay Observatory Staff as native "with the exception of Mr. Moos." Mr. Moos must, by his name, be a Parsi of Western India. There are many Parsis of that surname, and, particularly, several scholars and scientific men. W. F. SINCLAIR.

January 8.

CELESTIAL EDDIES.

I PROPOSE in the present paper to discuss the question whether the long-exposure photographs of Dr. Roberts and others, justify or negative the view, founded upon a large mass of spectroscopic evidence, which I put forward in 1887, before any of them had been published.

The view in question was thus stated :[1] "The brighter lines in spiral nebulæ, and in those in which a rotation has been set up, are in all probability due to streams of meteorites, with irregular motions out of the main streams in which the collisions would be almost *nil*."

I was careful to state that Prof. G. Darwin, when discussing the gaseous hypothesis of Laplace, had already pointed out that "the great mass of the gas is non-luminous, the luminosity being an evidence of condensation along lines of low velocity, according to a well-known hydrodynamical law. From this point of view the small nebula may be regarded as a luminous diagram of its own stream-lines."[2]

At the time I wrote in 1887, the nebula in Andromeda was not considered to be a spiral nebula. The most striking representation of it was due to Bond, who drew special attention to two black streaks running nearly parallel to the longer diameter.

It may also be added that in 1887 we knew nothing for certain about its spectrum.

In 1888, Dr. Isaac Roberts published his most admirable long-exposure photographs, which at once established the spiral nature of the nebula ; and in the same year the complete discussion of the spectroscopic observations made up to that time led me to predict that if the nebulæ were carefully observed we should find in them, sooner or later, indications of the substance which makes the comet spectrum so very distinct and special. In 1889, that is in the next year, the spectrum of carbon was discovered by Mr. Fowler and Mr. Taylor in the nebula of Andromeda.

I will take the photograph first. The plane of movement in the spiral system is so situated that from our point of space we look at it obliquely ; hence the nebula appears very elliptic. Still there is no difficulty in seeing that the various streams round the centre of condensation are all of them of a spiral form, with certain condensations interspersed here and there along them.

We have a condensation in the prolongation of one of the spirals, and there is considerable clustering of apparent stars along the stream lines. It is important to indicate that we have in these appearances, not signs which tell us of the existence of matter merely—so that when we have not the appearances we would be justified in supposing that there was no matter—but an indication of *movement* in matter, so that we may imagine that this nebula and others like it do probably consist of something extending enormously in space beyond the indications which we see, for the reason that near the centre the movements are more violent than they are towards the outside. We are there face to face with the idea that we have to deal with orderly movements. If the movements are orderly, it means that the movements of the constituent particles of the swarm, all of them, or most of them, will be in the same direction ; in that case we have the condition of minimum disturbance, and therefore the condition of minimum temperature.

In short, not only have we regular spirals, but in addition to the spiral system there seems to be revealed irregular masses of nebula near both ends of the major axis. Where more than one stream seems to be contending, the brilliancy is enhanced, and much irregular luminosity is apparent. On the other hand, in the part of the main nebula most free from these irregularities the spirals are almost invisible.

[1] *P.R.S.*, November 17, 1887, p. 153.
[2] NATURE, vol. xxxi. p. 25.

Next for the spectroscopic observations.

The chief argument urged in favour of the gaseous nature of the nebulæ now is the existence of hydrogen and helium in the planetary nebulæ and in such a nebula as that of Orion ; the unknown form of nitrogen has no longer any votaries.

But if the spiral nebulæ be gaseous, why do they not give us the spectra of hydrogen and helium? The spectrum of the nebula of Andromeda is practically the spectrum of a comet, and therefore we are justified in considering it as built up of cometary materials. Now these, as is generally conceded, are meteoritic in their nature.

But this is not all the evidence bearing upon this question, even so far as regards the nebula we are now discussing. Not many years ago a new star was observed

FIG. 1.—Nebula of Andromeda, 1887.

in the nebula, and the difference between the spectra of the new star and of the nebula itself was merely the addition of the lines of hydrogen! On the meteoritic hypothesis this is easily explained by an increased number of collisions lasting for a time : on the gaseous hypothesis an explanation is not so easy.

If it be granted that we are really dealing with streams of meteorites, all the new phenomena revealed to us by Dr. Roberts' photographs receive a simple and sufficient explanation, especially the apparent condensations here and there, which are not condensations of matter necessarily but *loci* of greater disturbances caused by crossing streams.

The next considerable revelation was obtained from the photograph, taken in 1889, of the spiral nebula—long recognised as such—in Canes Venatici, certainly one of the most wonderful spiral nebulæ in the heavens. It is all the more striking because this is a nebula which we look down upon; we see it in plan; we are, so to speak, at the pole of the system, so that it is not foreshortened.

There is no question about the wonderful spirals being connected with the central condensation and stretching towards it. I call attention to the points of condensation along one of the spiral branches, and where we get the possible intrusion of two spirals one on the other we see a confused mass of light. Now, if we imagine ourselves dealing there with a mass of pure gas, whether it is hydrogen or nitrogen or ammonia—that is, a combination of both—or any other, it would be extremely difficult to see why there should be any change of temperature in different parts of that mass; but the moment we assume that we are dealing with cool materials—meteoritic dust—we see that such a picture as this is important, for the reason not that it shows us what is there, but because it shows us what is going on there, as already pointed out in relation to the nebula of Andromeda. The bright spots do not represent the presence of matter merely, and the dark ones its absence; but the brighter portions represent the intersection of stream lines where collision is possible—the intervals those regions where collisions are less likely. We can gather from the very configuration of this system that if all the dust, or meteorites, or conglomerations of particles, whatever they may be, are going the same way, there will be a condition in which we shall get a minimum of collisions, and therefore a minimum of temperature. If the movements are quite orderly and in the same direction, we must not expect to get any very great disturbance, and therefore—if these disturbances produce high temperatures—we shall not expect to get indications of any particularly high temperatures.

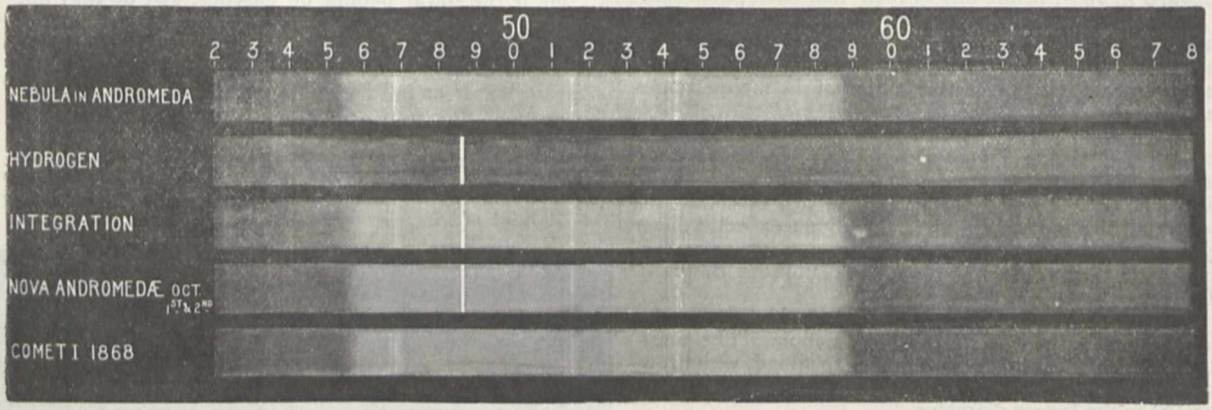

FIG. 2.—Spectrum of the nebula in Andromeda compared with Nova Andromedæ and comet. The flutings common to all are those of carbon.

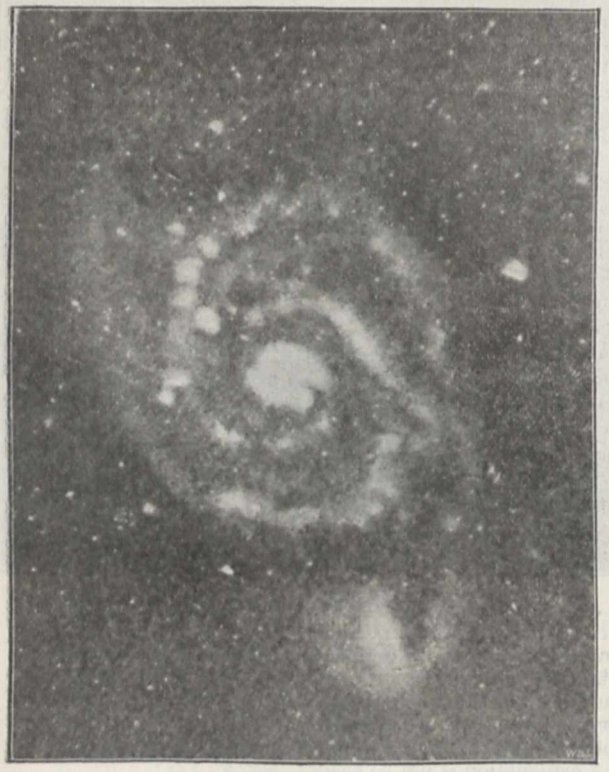

FIG. 3.—The spiral nebula in Canes Venatici, from a photograph by Dr. Roberts, 1889.

The important point is that here we get apparent stars arranged along the spirals.

Dr. Roberts writes as follows:—

"The photograph shows both nuclei of the nebula to be stellar, surrounded by dense nebulosity, and the convolutions of the spirals in this as in other spiral nebulæ are broken up into star-like condensations with nebulosity around them. Those stars which do not conform to the trends of the spirals, have nebulous trails attached to them."[1]

Strikingly similar to the above is the photograph of M 74 Piscium taken by Dr. Roberts in December 1893; and here again it is also a question of apparent stars.

"The photograph shows the nebula to be a very perfect spiral, with a central stellar nucleus and a 15 mag. star close to it on the south side. The convolutions of the spiral are studded with many stars and star-like condensations, and on the north preceding side there is a partial inversion of one of the convolutions, which conveys the idea of some irregular disturbing cause having interfered with the regular formation of a part of that convolution."[2]

In Messier 101 Ursæ Majoris, which was photographed in May 1892, we have another case in which the convolutions are broken up into star-like condensations.[3]

[1] Roberts' photographs, p. 85. [2] *M. N.*, vol liv. p. 438
[3] Roberts' photographs, p. 89.

I wish to point out that from the centre of the condensation the luminosity gradually gets less and less until at last we have no luminosity greater than that of the surrounding sky. In the nebula itself we find exquisite spirals, starting apparently from different points, and

FIG. 4.—Messier 74 Piscium, 1893.

gradually coming towards the centre, and if we look along these spirals we see that the star-like masses, *which may not be stars*, are in many cases located on the spirals, representing apparently minor condensations, each itself

FIG. 5.—Spiral nebula, Messier 101 Ursæ Majoris.

being probably brighter than the other parts because it is more disturbed.

So much, then, for the autobiographical records we now possess of some of the most perfect spiral nebulæ in the heavens.

We see that they all resemble perfect *eddies* in appearance; the question arises, are they perfect eddies in fact? On the meteoritic hypothesis they may well be so, for if moving streams of meteorites encounter resistance to their motion due to disturbances by other masses, the sheets of meteorites are bound to behave like sheets of water; in any case, the *onus probandi* lies with those who hold the contrary view. But in these celestial maëlstroms there are bound to be smaller eddies; and, if Swift had had the opportunity of studying Dr. Roberts' photographs, a more grandiose image might have replaced that in his well-known lines—

> "So naturalists observe, a flea
> Has smaller fleas that on him prey,
> And these have smaller still to bite 'em,
> And so proceed *ad infinitum*."

The question is well worth asking, not only to enable us to explain the photographic and spectroscopic phenomena, but also because we seem to be in presence of forces which must ultimately result in a true star *with rotation*, a concomitant of star life which is not easy to explain,

FIG. 6.—M 33 Trianguli.

and which Lord Kelvin has shown would certainly *not* be produced by collisions of two finished cosmical bodies.[1]

There is another spiral nebula, however, which may carry us a little further along the same line.

In M 33 Trianguli we have something apparently different from those that have preceded; so much so, that Dr. Roberts, who till quite recently has remained silent with regard to the physical origin of the more regular spirals, has suggested that we may here be in presence of meteoritic collisions.[2] He writes:—

"It will be observed that there are two large, very prominent spiral arms, with their respective external curvatures facing north and south, and that the curves are approximately symmetrical from their extremities to their point of junction at the centre of revolution, where there is a nebulous star of about tenth magnitude with dense nebulosity surrounding it, and elongated in *north* and *south* directions. Involved in this nebulosity are three bright stars and several faint nebulous stars; the two arms also are crowded with well-defined stars and faint nebulous stars with nebulosity between them; and

[1] *Proc. R.I.*, xii. p. 15. [2] *M. N.*, vol. lvi. p. 70.

it is to the combined effect of these that the defined forms of the arms are due. Besides these two arms there are subsidiary arms, less well defined, and likewise trending towards the centre of revolution, and are constituted of interrupted streams of faint stars and nebulosity intermingled together; many of the stars are nebulous, and many are well defined but small. The interspaces between the convolutions are more or less filled with faint nebulosity, having curves, rifts, fields, and lanes, without apparent nebulosity in them. They are like the interspaces in clouds of smoke, and cannot be classified.

"There are outliers of nebulosity with many small well-defined and nebulous stars involved in them, and there are also isolated nebulous stars on the extreme boundaries of the nebula; but the evidence is strong that they are all related to the nebula.

"It is by the study of the photographs, and not by descriptive matter, that we can form a true conception of the character of this nebula; from which we shall be justified, even now, in drawing some inferences as to its formation and further developments. To this end I may be permitted to suggest the following.

FIG. 7.—H 84 Comæ.

"We know, with a reasonable amount of certainty, that both nebulous and meteoric matters exist in space; and we also have some evidence that bodies in space have come into collision.

"From these premises we may infer that this nebula is the result of a collision of some kind; and we can imagine collisions of at least three kinds possible; namely, (1) between two stars, (2) between two nebulæ, (3) between two swarms of meteorites.

"In the case of this nebula, which (if any) of the three possibilities mentioned seems to us the one most probable to have happened? Much might be said in favour of each of these suggestions, but I shall not at present enter into details, though I think we could readily imagine that the collision of two swarms of meteorites, moving in opposite directions, one from the *south following* and the other from the *north preceding*, would account for the spiral appearance, the rotatory motion, and the smashed and scattered state in which the nebula is shown to us upon the photographs."[1]

[1] *M. N.*, vol. lvi. p. 70.

It is worth while to point out, in connection with the argument in favour of the meteoritic nature of spiral nebulæ, that there are other nebulæ representing streams in space to which it seems almost impossible to attribute a purely gaseous origin.

This branch of work is so young, that there has not yet been time to bring a crucial test to bear on these "stellar condensations" to which reference has been made. *If they could be shown to be short-period variables, then their true stellar nature would be at once negatived.*

We have already in two instances obtained important evidence on this point. In 1889, Dr. Roberts was good enough to allow me to enlarge a photograph of the nebula of Orion, on which there had been a double exposure. I pointed out to Dr. Roberts that the variability in some of the stars was suggested. Although the exposure was a double one, some of the images were single and there were *inversions* in the intensities of the double images. Dr. Roberts made a minute examination with the following results:[1]

"On examination of the dual stellar images on the photograph the eye immediately detects that ten of them have undergone considerable change in brightness or

FIG. 8.—Nebula near 52 (*k*) Cygni.

magnitude during the interval of five days which elapsed between the two exposures. In three of the ten stars, the brightness has increased to the extent of from one-fourth to one-third the measured diameter of the stellar photo-image, and one star appears on the second exposure where none is shown on the first exposure. Six of the ten stars have diminished in brightness during the interval to the extent of from one-fourth to four-tenths, the measured diameter of the photo-image." . . .

"I have with due care examined the film of the negative under the microscope in order to see if any defect or evidence of defective sensibility on parts of the film could be traced so as to account for the variability in the brightness of the stellar images, but I could not find any such evidence, and I would of course have repeated the photographic experiment if the state of the sky at any time during the past twelve months had permitted. Those who possess the necessary telescopic power may study by eye observations the variability in these stars, and it is one of the functions of the photographic method to point out where eye observations can with advantage

[1] *M. N.*, vol. l. p. 316.

be applied in search for special knowledge, and these ten stars are now indicated for that purpose."

The next cases are those afforded by the variability of stars in some globular star-clusters recently photographed at Arequipa with the 13-inch Boyden telescope. An extraordinary number of variable stars was discovered. The *Harvard Circular*, No. 2,[1] states :—

"At least eighty-seven of the stars in the cluster M 3 (N.G.C. 5272), in Canes Venatici, have been found to be variable, and in some cases the change of light amounts to two magnitudes or more. In the cluster M 5 (N.G.C. 5904), forty-six variables were found, out of 750 stars examined, so that they form about 6 per cent. of the whole ; of the sixteen stars, contained in a circle 110″ in diameter, six are variable. Smaller numbers of variables have been found in other clusters, but in other cases not a single variable has been detected out of the hundreds of stars which have been photographed ; the conditions of the search, however, not taking account of long period changes. In general, no variables have been found within about one minute from the centres of the clusters, on account of the closeness of the stars, and none are more than ten minutes distant from the centres. Some of the newly-discovered variables have short periods, in some cases of only a few hours. Thus, five photographs of N.G.C. 5904, taken at intervals of an hour on July 1, 1895, give for the magnitude of a star about three minutes of arc preceding the centre of the cluster, 14·3, 13·5, 13·8, 13·9, and 14·3 ; four plates, taken at similar intervals on August 9, gave the magnitudes 14·2, 14·6, 14·8, and 15·0."

A special investigation has since been made of the variables forming part of the cluster M 5 Serpentis, N.G.C. 5904 (*Ast. Nach.*, 3354). Forty-five photographs of this cluster have been measured by Miss Leland, and the measures include the greater portion of the forty-six variables previously discovered. The periods of these variables are in general very short, not exceeding a few hours. One of these, designated No. 18, which follows the centre of the cluster about 6′ and is south 5′, has a probable period of 11h. 7m. 52s., or 0·4638 days. The coordinates of the light curve of this variable are as follows :—

Days.		Mag.	Days.		Mag.
0·00	...	13·50	0·25	...	14·73
0·05	...	13·87	0·30	...	13·73
0·10	...	14·35	0·35	...	14·72
0·15	...	14·70	0·40	...	14·65
0·20	...	14·72	0·45	...	13·56

It thus appears that the star remains about minimum brightness during half the period, while the maximum luminosity is of relatively short duration ; the decrease in light is rapid, but the rate of increase is still more rapid, as it should be. The succession of changes does not seem to correspond with those of any previously known class of variable stars.[2]

Now, since the presence of real nebulous material in some star clusters is accepted by many authorities, there seems ground for ascribing the phenomena in the nebula of Orion and in the star clusters to the same cause, and in attributing them to mere star-like appearances due to collisions. A variability of the kind described extending over a few hours or a few days is to me unthinkable in a "star," properly so-called, that is, a body like our sun, and I have no hesitation in expressing my firm conviction that such variability can only be simply and sufficiently explained by the cause assigned for it by the meteoritic hypothesis—a clashing together of streams of meteorites.

If the evidence that the apparent stars are really denser and more disturbed meteoritic swarms is accepted, the view that the nebulæ are gaseous must fall to the ground, because the denser material of the "stars" must be the same as that which was least dense, that is, sparse in the first instance.

I am glad, finally, to be able to state that Dr. Roberts, to whose continuous activity and marvellous skill the world of science is so much indebted, in a paper read at the meeting of the British Association at Liverpool this year, stated his opinion that the origin of the various star-like condensations in the spiral nebulæ is "more probably" meteoritic than gaseous in its origin. The line of argument which has led him to this conclusion will be gathered from the following brief analysis of his communication :—

He draws attention to the remarkable groups, curves and lines of stars that are clearly shown upon a photograph of the sky in the constellation Auriga, which was taken with an exposure of the plate during ninety minutes. Some of them are constituted of bright stars of nearly equal mignitude ; some are of faint stars, also of nearly equal magnitude ; some are of both bright and faint stars, and there is much regularity in the spacing distance between the stars in the several groups. These appearances are persistently found upon all photographs taken with long exposures of the plates in any part of the sky where the stars are numerous, such as Cassiopeia and Argo.

"What explanation," he asks, "can be offered to account for the grouping of the stars other than the assertion that they were from the beginning so placed?" He then brings forward the evidence furnished by the spiral nebulæ similar to that I have given above, and which I brought together more than a year ago.

He then goes on :

"I would submit that the evidence, part of which has now been laid before us, is reasonably conclusive that some, if not many, of the stars which we see in curves and in groups strewn over the sky have been formed in the manner which I have pointed out. There are, besides this, other methods of stellar evolution pointed out on other photographs, such as condensations into stars of nebulæ which have not, at present, symmetrical structures and of globular and annular nebulæ. . . .

"The question will naturally present itself to us : If it be true that stars are evolved from spiral and other forms of nebulosity, whence came the nebulous matter? We can answer with confidence that it exists very largely and over extensive areas in many parts of the sky ; and that it exists there in the form of gas, or, more probably as Prof. Norman Lockyer urges in his 'Meteoritic Hypothesis,' of meteors or meteoric dust."

Dr. Roberts' reference to my work is very encouraging, since there are few workers in science whose researches have so close a bearing on the views I have put forward. For my own part I feel that the totality of the observations above recorded is all highly suggestive of meteoritic action, and I can only in conclusion express my belief that before very long as striking evidence of variability will be found in the stars in the spiral nebulæ, as the Harvard observers have obtained from the globular star clusters. J. NORMAN LOCKYER.

THE THEORY OF SOLUTIONS.

AS some recent *viva voce* remarks of mine have received an interpretation more wide than I intended, I shall be glad to be allowed to explain that when (now several years ago) I became acquainted with the work of van t' Hoff I was soon convinced of the great importance of the advances due to him and his followers. The subject has been prejudiced by a good deal of careless phraseology, and this is probably the reason why some distinguished physicists and chemists have refused their adhesion. It must be admitted, further, that the arguments of van t' Hoff are often insufficiently set out, and

[1] NATURE, November 28, 1895. [2] *Ibid.*, June 4, 1896.

are accordingly difficult to follow. Perhaps this remark applies especially to his treatment of the central theorem, viz. the identification of the osmotic pressure of a dissolved gas with the pressure which would be exercised by the gas alone if it occupied the same total volume in the absence of the solvent. From this follows the formal extension of Avogadro's law to the osmotic pressure of dissolved gases, and thence by a natural hypothesis to the osmotic pressure of other dissolved substances, even although they may not be capable of existing in the gaseous condition. If I suggest a somewhat modified treatment, it is not that I see any unsoundness in van t' Hoff's argument, but because of the importance of regarding a matter of this kind from various points of view.

Let us suppose that we have to deal with an involatile liquid solvent, and that its volume, at the constant temperature of our operations, is unaltered by the dissolved gas—a question to which we shall return. We start with a volume v of gas under pressure p_0, and with a volume V of liquid just sufficient to dissolve the gas under the same pressure, and we propose to find what amount of work (positive or negative) must be done in order to bring the gas into solution reversibly. If we bring the gas at pressure p_0 into contact with the liquid, solution takes place irreversibly, but this difficulty may be overcome by a method which I employed for a similar purpose many years ago.[1] We begin by expanding the gas until its rarity is such that no sensible dissipation of energy occurs when contact with the liquid is established. The gas is then compressed and solution progresses under rising pressure until just as the gas disappears the pressure rises to p_0. The operations are to be conducted at constant temperature, and so slowly that the condition never deviates sensibly from that of equilibrium. The process is accordingly reversible.

In order to calculate the amount of work involved in accordance with the laws of Boyle and Henry, we may conveniently imagine the liquid and gas to be confined under a piston in a cylinder of unit cross-section. During the first stage contact is prevented by a partition inserted at the surface of the liquid. If the distance of the piston from this surface be x, we have initially $x=v$. At any stage of the expansion (x) the pressure p is given by $p=p_0v/x$, and the work gained during the expansion is represented by

$$p_0v\int_v^x \frac{dx}{x} = p_0v\log\frac{x}{v},$$

x being a very large multiple of v. During the condensation, after the partition has been removed, the pressure upon the piston in a given position x is less than before. For the gas which was previously confined to the space x is now partly in solution. If s denote the solubility, the available volume is practically increased in the ratio $x : x + sV$, so that the pressure in position x is now given by

$$p = p_0v/(x + sV),$$

and the work required to be done during the compression is

$$p_0v\int_0^x \frac{dx}{x+sV} = p_0v\log\frac{x+sV}{sV}.$$

On the whole the work lost during the double operation is

$$p_0v\left\{\log\frac{x+sV}{x} + \log\frac{v}{sV}\right\},$$

and of this the first part must be omitted, as x is indefinitely great. As regards the second part, we see that it is zero, since by supposition the quantity of liquid is such as to be just capable of dissolving the gas, so that $sV=v$. The conclusion then is that, upon the whole, there is no gain or loss of work in passing reversibly from the initial to the final state of things.

The remainder of the cycle, in which the gas is removed from solution and restored to its original state, may now be effected by the osmotic process of van t' Hoff.[1] For this purpose one "semi-permeable membrane," permeable to gas but not to liquid, is introduced just under the piston which rests at the surface of the liquid. A second, permeable to liquid but not to gas, is substituted as a piston for the bottom of the cylinder, and may be backed upon its lower side by pure solvent. By suitable proportional motions of the two pistons, the upper one being raised through the space v, and the lower through the space V, the gas may be expelled, the pressure of the gas retaining the constant value p_0, and the liquid (which has not yet been expelled) retaining a constant strength, and therefore a constant osmotic pressure P. When the expulsion is complete, the work done upon the lower piston is PV, and that recovered from the gas is p_0v, upon the whole $PV - p_0v$. Since this process, as well as the first, is reversible, and since the whole cycle has been conducted at constant temperature, it follows from the *second* law of thermo-dynamics that no work is lost or gained during the cycle, or that

$$PV = p_0v.$$

The osmotic pressure P is thus determined, and it is evident that its value is that of the pressure which the gas, as a gas, would exert in space V.

The objection may perhaps be taken that the assumption of unaltered volume of the liquid as the gas dissolves in it unduly limits the application of the argument. It is true that when finite pressures are in question, an expansion (or contraction) of the liquid would complicate the results; but we are concerned only, or at any rate primarily, with the osmotic pressure of *dilute* solutions. In this case the complications spoken of relate only to the second order of small quantities, and in our theory are accordingly to be dismissed.

January 8. RAYLEIGH.

[1] "On the Work that may be gained during the Mixing of Gases," *Phil. Mag.* vol. xlix. p. 311, 1875.

THE BOG-SLIDE OF KNOCKNAGEEHA, IN THE COUNTY OF KERRY.

AT about three a.m. on Monday, December 28, 1896, a catastrophe occurred some twelve miles north-east of Killarney, of which mention has been already made in these columns (NATURE, vol. lv. p. 205). A bog gave way at its lower edge, and precipitated itself as a black peaty flood into the valley of the Ownacree River. In the upper part of its course it unfortunately overwhelmed the cottage of Cornelius Donnelly, carrying away the structure and its eight occupants. Five of the bodies were recovered, with considerable difficulty, by January 3, when the mass had come practically to a standstill. In the lower part of its course, it flooded a number of farm-lands upon the slopes of the valley, and seriously threatened the cottage of Jeremiah Lyne, rising some five feet against its wall. Even at the junction of the Ownacree and the Flesk, one of the great feeders of the Lower Lake of Killarney, the banks were smeared over with a peaty mud, ten miles from the point of origin of the bog-slide; while a quantity of the material was carried another nine miles west into the Lower Lake itself.

While the first accounts of the disaster were naturally exaggerated, and even contradictory, coming as they did from places on opposite sides of the peaty watershed, an inspection of the area leaves no doubt as to the magnitude of the bog-slide. Such phenomena are not unknown in Ireland, one being recorded from the County of Galway in 1745, and another

[1] *Phil. Mag.*, vol. xxvi. p. 88 1888

having been reported on by Sir R. Griffith in 1821 ("Report Relative to the Moving Bog of Kilmaleady in the King's County," *Journ. Roy. Dublin Soc.*, vol. i.). In the latter case, 150 acres became covered with the products to a depth of eight to ten feet, and the flow extended from the edge of the bog one and a half miles down a valley. Probably in all cases such flows are merely a rapid extension of those "creeping" processes which produce rifts and areas of subsidence in bogs formed upon a slope.

The scene of the present bog-slide lies among Carboniferous rocks, and is included in Sheet 174 of the 1-inch Ordnance Map of Ireland (Fig. 1). A perfectly straight road runs N.N.W. from Shinnagh House, which is near the railway; at the cottages of Lisheen a branch runs west, meeting four other roads in the grass-grown quarries of Carraundulkeen. (I use the spelling of the Ordnance Sur-

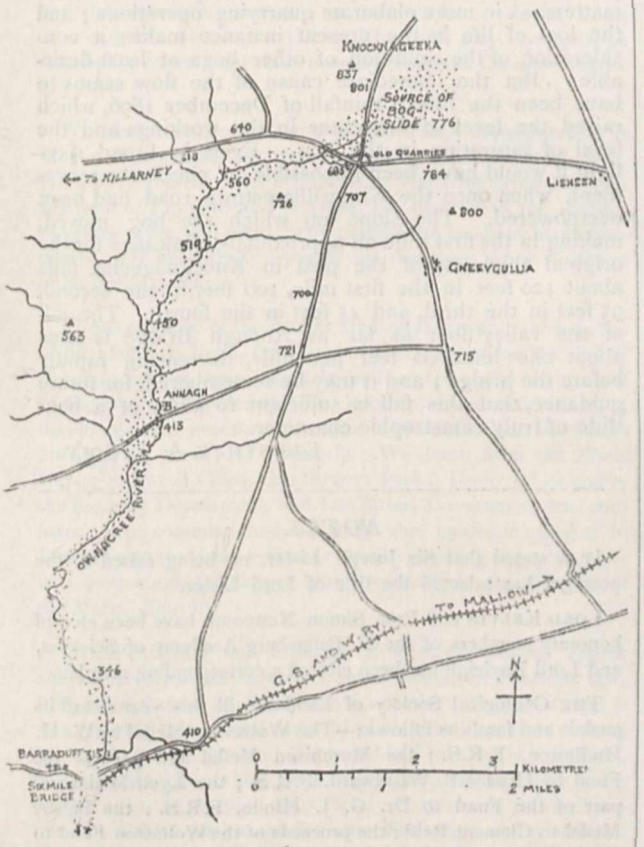

FIG. 1.—Sketch-map showing the site of the Bog-slide, from the maps of the Ordnance Survey. Heights in feet. The course of the flow is indicated by the dotted area.

vey throughout.) The bog in which the slip occurred lies between the road from Lisheen and that running almost north from the quarries, which is locally known as the Kingwilliamstown road. It is a brown almost level upland, a mile across, mainly in the townland of Knocknageeha, and is bounded on the north and south by enclosed and cultivated hills, which rise from 780 feet to 847 feet above the sea. The highest point recorded in the bog is 776 feet, and there is a fall of 1 in 38 between this and the bridge between the quarries. The streams on this side flow to the west coast, while the east side of the bog drains direct into the Blackwater.

Several deep peat-cuts existed in the bog, perpendicular to the direction of its subsequent flow, and these have the appearance of rifts or "faults" at a distance. But the lost portion seems to have oozed out from below a large area of the superficial peat, lowering the surface into a series of hummocky and very irregular steps. At the same time, great masses of the surface, with tufts of grass adhering to them, were floated down and hurried into the valley, looking, as one man told me, "as large as houses."

The flow appears to have been rapid and silent, though the noise of the storm which raged through Sunday night kept many of the cottagers awake. Even within a few hundred yards of Donnelly's house, no suspicion of the fate of the unhappy family was raised, until dawn revealed the black flood tossing, and still hurrying down the valley. A young peasant, living close to the edge of the flow, told me that he was roused only by the bellowing of his cow; in another case, a man went at about 4 a.m. to a point three miles down the valley to remove two calves, which he intended to drive into Killarney. He was then almost overtaken by the rise of the peat-flood at Annagh Bridge. I conclude, therefore, that no unusual sound or movement of the earth occurred, such as might have warned him of the coming danger.

FIG. 2.—Broken roadway, with meadows submerged by the peat-flow, at Annagh Bridge. Foreground of heaped-up peat-mud and bog-timber. Lyne's cottage in the distance.

The full flood first attacked the Kingwilliamstown road, on the east side of which the bog abutted. It filled up the hollow, climbed the embankment, and fell over the western side like a very fluid lava-flow. The guiding-line here was the course of the streamlet that drained the bog into the Ownacree River. Probably the road itself has been carried away beneath the thick mass now covering its site, and communication with the north is likely to remain cut off for some weeks. On January 3, movement had ceased at this point, but the embankment on which the road runs alone prevented a further down-rush.

Donnelly's cottage stood on the west side of this road, and was totally swept away. Its thatched roof was seen floating for a time, but the house is said to have been built of loose stones, and rapidly succumbed. The bodies recovered were found at various points in the first four miles of the flow.

The Royal Dublin Society have appointed a Commission, consisting of Prof. Sollas, F.R.S., and Messrs. De Lap, A. F. Dixon, and R. Lloyd Praeger, who may be trusted to give us an accurate survey of the flow; the

present paper will therefore be concerned with its broader geological aspects. Viewed from any of the neighbouring spurs, the valley of the Ownacree (the "Quagmire River" of the Ordnance Survey) now seems occupied by a black flood, winding with the course of the original stream. Here and there lake-like expansions occur, with pools of water on their surface; and, lower down the valley, the stream asserts itself, and is now cutting out a channel through the débris, or, rather, is washing out its original course. Without an intimate acquaintance with the country, it is difficult to know what changes have occurred in the form of the true valley-floor; but the local constabulary assert (*Freeman's Journal*, January 2, 1897) that a considerable deepening of the valley has resulted in places from the scouring action of the flow. This obviously applies only to the first two miles or so below the quarries, where the stream originally ran over a flank of the great Annagh bog. At and below Annagh Bridge no trace of any deepening is to be seen; the torrent is merely washing its way clean again, and revealing the original boulders on its floor.

To return to details, the passage of the flow across the western road, between Quarry Lodge and the older quarries, resulted in the filling up of a limestone-quarry and the destruction of the embankment of the road, together with its double hedges. Judging by the state of things at Annagh Bridge, the upper bridge may perhaps be found also standing, when the peat-flood can be cleared away. The destruction here is, however, considerable, and the oozing of the material through the hedges reminds one of the behaviour of some of the thin lava-sheets of Hawaii. Great stems and roots of timber, formerly buried in the upper bog, have been floated down, and stick up fantastically, like arms waving from the flood.

The main road to Killarney is thus effectually breached; and a still more striking scene occurs on the parallel road at Annagh Bridge (Fig. 2). Here the floor of the valley was flat for nearly half a mile west of the bridge, and was divided into a number of fields. The peat has covered the whole of these, and climbed, as has been said, against the wall of Lyne's cottage. The road is broken into sections and seems utterly destroyed; and bog-timber, which is abundant in this district, juts out everywhere above the slime. The peat has left traces on the top of the buttresses of the bridge, six feet above the present level of the water; and movements were noticed here in the subsiding flow a week after the catastrophe.

After this wild scene, the valley narrows, and the black borders to the stream show the height to which the flood first rose; every boulder has a bank of débris behind it, and islets of peat, bog-timber, and grassy tussocks have risen in the middle of the stream. The piers of Six-Mile Bridge, close to Barraduff, six miles from the original bog, are still clogged with timber, and show peat-patches a good five feet above the stream. Even travellers by rail can trace from this point downwards the black deposits on the banks of the Ownacree, down to the viaduct before Headford Junction.

As to the origin of the bog-slide, it must be compared, as already hinted, with the phenomena of surface-creep, which are strikingly illustrated by the stone rivers of the Falkland Isles and the constantly occurring landslides of the taluses of Tyrol. The ridging of soils upon steep hillsides is a well-known and milder form of this sliding motion; and a field laid out upon a slope, in an even moderately rainy climate, may be considered as being always added to at the upper end, and carried away down-hill at the lower. In peat-bogs, the water finds its way out in numerous channels into the main stream of some neighbouring valley; and the banks of these channels are always in a state of flux. During stormy weather, the black saturated lower layers of the bog are washed out in far larger quantity than the brown and drier upper layers. Rifts and signs of movement in the latter will then readily occur.

As Sir R. Griffith pointed out in 1821, there is little cohesion between the water-logged lower layers and the impermeable clay or other material which underlies the whole, and which allows, in the first instance, of the accumulation of the bog. The moving bog in the King's County was accounted for by the occurrence of a dry season, during which extraordinary cuttings were made, giving a face of thirty feet. The pulpy lower layers were thus reached, and were set free, carrying away the upper masses on their surface. The process is analogous to that which forms caverns in many lava-flows, the fluid lower portion becoming liberated and rushing out from under the upper part.

Similarly, the deep cutting of the bog of Knocknageeha may have been injudicious in so wet an area. It is possible that official inspection is required in these matters, as in more elaborate quarrying operations; and the loss of life in the present instance makes a consideration of the condition of other bogs at least desirable. But the immediate cause of the flow seems to have been the heavy rainfall of December 1896, which raised the level of the water in the workings and the level of saturation in the bog. Even in broad daylight it would have been impossible to check the movement, when once the Kingwilliamstown road had been overpowered. The slope on which the bog moved, making in the first mile an approximate allowance for the original thickness of the peat in Knocknageeha, falls about 120 feet in the first mile, 100 feet in the second, 95 feet in the third, and 45 feet in the fourth. The fall of the valley-floor as far as Annagh Bridge is thus about one hundred feet per mile, decreasing rapidly before the bridge; and it may be remembered, for future guidance, that this fall is sufficient to allow of a bog-slide of truly catastrophic character.

GRENVILLE A. J. COLE.

NOTES.

IT is stated that Sir Joseph Lister, on being raised to the peerage, has selected the title of Lord Lister.

LORD KELVIN and Prof. Simon Newcomb have been elected honorary members of the St. Petersburg Academy of Sciences, and Lord Rayleigh has been elected a corresponding member.

THE Geological Society of London will this year award its medals and funds as follows:—The Wollaston Medal to W. H. Hudleston, F.R.S.; the Murchison Medal and part of the Fund to Horace B. Woodward, F.R.S.; the Lyell Medal and part of the Fund to Dr. G. J. Hinde, F.R.S.; the Bigsby Medal to Clement Reid; the proceeds of the Wollaston Fund to F. A. Bather; the balance of the proceeds of the Murchison Fund to S. S. Buckman; the balance of the proceeds of the Lyell Fund to W. J. Lewis Abbott and J. Lomas.

ANOTHER instance of the interest which the German Government takes in the advancement of science is afforded by the fact that an item in the Prussian estimates is a vote of 50,000 marks to the Ministry of Public Instruction for investigations with the Röntgen rays. The vote (says the Berlin correspondent of the *Times*) is justified by a reference to the importance which the new invention has been shown to possess in the spheres of physics, anatomy, physiology, zoology, botany, and kindred sciences. The object of the grant is to enable institutes and certain men of science to procure the necessary apparatus, and to defray the expense of exhaustive experiments.

THE Royal Academy of Sciences of Turin announces that the term for competition for scientific works and discoveries made in the four previous years 1893-96, to which only Italian authors

and inventors were entitled, was closed on December 31, 1896. The Academy now gives notice that the new term for competition for the eleventh Bressa Prize, to which scientific men and inventors of all nations will be admitted, has begun. A prize will, therefore, be awarded to the scientific author or inventor, whatever his nationality, who during the years 1895–98, "according to the judgment of the Royal Academy of Sciences of Turin, will have made the most important and useful discovery, or published the most valuable work on physical and experimental science, natural history, mathematics, chemistry, physiology, and pathology, as well as geology, history, geography, and statistics." The term will be closed at the end of December 1898. The sum fixed for the prize, deducting income tax, will be of 9600 francs. Competitions, which must be in print, must be sent in within the above-stated time, accompanied by a letter to the President of the Academy. Unsuccessful competitive works are not returned. None of the national members, resident or non-resident, of the Turin Academy can obtain the prize. The prize may, however, be awarded to a non-competitor if he is considered the most worthy to receive it.

WE have it on the authority of the *Times* correspondent at Monte Video, that the report is fully confirmed that Prof. Giuseppe Sanarelli, who is director of the Uruguayan National Institute of Experimental Hygiene, has discovered the bacillus of yellow fever, and will shortly publish the result of his experiments. He has already reported his discovery to the Academy of Medicine in Rome.

IN consequence of the danger for Russia caused by the spread of the plague in India, the Russian Government has decided to appoint a special commission, under the presidency of the chief of the sanitary department, Dr. Rogozin, whose task will be to decide upon the necessary measures of precaution and the means for carrying them out promptly. We learn from the *Times* correspondent at Cairo, that Rogers Pasha, Director-General of the Sanitary Department, and Dr. Bittar, Government bacteriologist, are commissioned to study the epidemic plague in Bombay and the best measures for safeguarding Egypt against its introduction, the danger lying especially in the infection of the Mecca pilgrims.

THE Peninsular and Oriental Company's steamer *Nubia* arrived in Plymouth Sound, from Calcutta, on Saturday last, with a detachment of the North Lancashire Regiment, and it was reported that several cases of cholera had occurred among the troops a few days after the vessel had touched at Port Said. Seven deaths have taken place, and eight cases are now under treatment in the hospital ship *Pique*; but there is no suspicion that the disease will extend further. The origin of the outbreak of the disease on board the ship is at present doubtful, but medical officers of the Local Government Board are actively engaged in investigating it. Dr. Bulstrode has given it as his opinion that there was no fault in the water supply of the ship. It is suggested that fruit consumed at Port Said was the source of the disease, but little support can be found for this theory. As the outbreak occurred among men of a regiment at present stationed at Ceylon, possibly it originated at Colombo, where there was a sharp attack of cholera shortly before Christmas.

MR. HORATIO HALE, of Canada, the well-known anthropologist, died on December 29. He was vice-president of the American Association for the Advancement of Science, for the Anthropological Section in 1886, at the third Buffalo meeting. We regret also to record the deaths of Johann August Streng, the mineralogist, at Giessen; Dr. John William Stubbs, Senior Fellow of Trinity College, Dublin; Dr. P. Binet, Deputy Professor of Therapeutics in the University of Geneva, and author of numerous researches on the action of drugs, aged forty-one; Dr. Ferdinand Morawitz, founder of the Entomological Society of St. Petersburg; and Dr. Modest Galanin, editor of the St. Petersburg *Journal of Public Hygiene*.

THE large male Patagonian Sea-lion (*Otaria jubata*), which has been one of the great attractions in the Zoological Society's Gardens since its arrival in 1866, having died of old age, its place has been temporarily filled by a small female of the Cape Sea-lion (*Otaria pusilla*). But measures are being taken, we believe, to obtain another representative of one of the larger species of this group.

DURING his recent adventurous journey across British New Guinea (see *Geogr. Journ.*, 1897, p. 93), Sir William MacGregor discovered a fine new Bird of Paradise on the heights of Mount Scratchley. An example of this bird has arrived in England to be figured in the next number of the *Ibis*, and will be exhibited by Mr. Sclater at the next meeting of the British Ornithologists' Club on the 20th inst.

THERE are now in this country, says the *British Trade Journal*, a number of Japanese experts appointed by their Government to study the iron and steel making processes and plant of the leading European and American works. They will leave shortly for the continent, to examine the principal iron and steel centres of France, Belgium, and Germany, and probably of Austria and Sweden, returning to this country to visit South Wales prior to their departure for Japan *viâ* the United States. At the end of their tour they are to decide upon the processes and plant best adapted for the production of steel and iron from Japanese coal and ore, the Japanese Government having voted 500,000*l.* for the establishment of works for this purpose near Shimonoseki. The building of these is to begin next autumn, and they will, when finished, have an output of 100,000 tons a year.

ON Tuesday next, January 19, Prof. Augustus D. Waller, F.R.S., will deliver the first of a course of twelve lectures on "Animal Electricity," at the Royal Institution. On Thursday, January 21, Prof. Henry A. Miers, F.R.S., will begin a course of three lectures on "Some Secrets of Crystals." The Friday evening meetings of the members will commence on January 22, when Prof. Dewar will deliver a lecture on "Properties of Liquid Oxygen." Prof. J. C. Bose will deliver his discourse, on "The Polarisation of the Electric Ray," on Friday evening, January 29, and not on February 5, as previously announced.

THE second series of the Sunday Lecture Society's programme commences on January 17, when Prof. Norman Collie, F.R.S., will lecture on "The Mountains of Britain." Among the other lecturers who will discourse on Sunday afternoons at St. George's Hall, Langham Place, between now and the end of of next month, are Prof. L. C. Miall, F.R.S., on "Life on the Surface of Water"; Dr. C. W. Kimmins, on "Ancient and Modern Views of Fire"; and Mr. Arthur W. Clayden, upon "The Light of the Stars."

NO excuse is needed in again directing attention to the appeal which has been made for funds to defend the public right of access to the Giant's Causeway, County Antrim, Ireland. It seems almost incredible that an attempt should be made to enclose such a wonderful natural formation as the Giant's Causeway, which has been open to the public from time immemorial, and is annually visited by about 80,000 persons. A few persons have, however, lately formed themselves into the Giant's Causeway Company, Limited, and leased from the owners the soil over which the Causeway is approached, claiming the right to close public access to it. The Company has

instituted proceedings in the Court of Chancery to establish their claim, and restrain the defendants (members of the public who recently visited the Causeway) from trespassing on the Company's ground. The costs of defending the public rights may amount to 400*l.* or more, and this has to be raised by subscription. We hope and believe that when the general public come to know how matters stand, and that prompt and decisive action is necessary, they will rally to support the Defence Committee, and contribute to defray the expense involved in defending the suit. Subscriptions are earnestly appealed for, and may be forwarded to Sir William M'Cammond, Town Hall, Belfast, Treasurer; or, Seaton F. Milligan, Bank Buildings, Belfast, Hon. Sec. The National Footpath Preservation Society has prepared a leaflet containing a tracing of the Causeway and neighbourhood from the 6-inch Ordnance Map, and views of the basaltic formations. These illustrations, with the text which accompanies them, should be successful in gaining subscriptions for the righteous cause which the Defence Committee has in hand.

THE epidemic of bubonic plague at Bombay has assumed very alarming form. According to the official returns there have been up to the present 2850 cases of plague and 2028 deaths. The mortality for the past week from all diseases was 1711. The exodus from Bombay has now amounted to between 100,000 and 150,000 persons. The plague is also rapidly increasing at Karachi, where, up to January 10, there had been 220 cases and as many as 214 deaths. In connection with the question of the spread of plague, some remarkable information is contained in a lecture delivered by Dr. James Cantlie before the Epidemiological Society, and printed in the *Lancet*. Rats appear to be particularly susceptible to plague. There was a great mortality amongst rats in the Hong-Kong epidemic, and in Canton the rats entirely disappeared from districts of the city where the diseases had lasted for some time; as many as 22,000 dead rats were collected in a few weeks. But more remarkable than this tremendous mortality is the fact that a month before the plague broke out in Bombay, it was known that the rats were dying in thousands. The rat, therefore, seems to be affected before the human being; and the fact of dead rats being found about a house during the plague epidemic is, Dr. Cantlie thinks, a true warning that the inmates of the house will, in all probability, be attacked. Not only rats, but pigs, dogs, snakes, jackals, and pigeons are affected by a fatal malady whilst plague is epidemic among human beings. What Dr. Cantlie concludes from the study of infection of animals is: (1) that the rat is the animal most liable to be attacked by plague; (2) that rats suffering from, or dead from plague may infect other animals, such as snakes and jackals, who consume them; (3) that rats are always affected by a disease similar to plague at the same time man suffers; (4) that the rat may infect man, but the means of conveying the contagium is not known. As to the high mortality of rats before the plague, it seems doubtful whether rats are really infected before human beings, or whether only the incubation period is shorter in them than in man.

TO our previous brief note (p. 159) on Mr. J. E. S. Moore's work at Lake Tanganyika, where he spent some months in the study of the fish and fresh-water medusæ of the lake, we now add the following particulars from the *Central African Gazette*, published at Zomba:—"Mr. Moore spent most of his time at the station of Nyamkolo, on the southern shore of Lake Tanganyika, and from there he made various journeys by boat and by land, travelling up the west coast as far as Muliro's, and up the east shore of the lake as far as the Belgian station Karema. He also crossed over from the south end of Tanganyika to the mountains overlooking the north-western end of Lake Rukwa, and saw this lake in the distance. It is a curious fact that although five or six Europeans have seen Lake Rukwa, only two have been able to reach its waters. Dr. Cross in 1889 made his way through the swamp and reeds near the southern end of the lake, and Mr. Nutt in 1895 just reached the shore at the south-western side. Mr. Moore verified the report, which travellers on Tanganyika have heard from time to time, that there is a large fish in the lake which rushes at the paddles of a canoe passing through the water. He actually say this take place. He also discovered a large electric fish which gives a severe shock on being touched. Tanganyika, indeed, appears to be full of fish. By trailing a line with an artificial minnow behind the boat, Mr. Moore caught enormous numbers of fish, some of them up to sixty pounds in weight—bright clean fish with silvery scales. The heaviest fish which was seen in the lake weighed over ninety pounds; this was a sort of mud fish. Sponges were also discovered in Tanganyika, which, though of no great size, were undoubtedly real sponges. On the east side of the lake, in a bay where the striped leech was very common, Mr. Moore found a small fish about the size of a small minnow, whose back was striped in imitation of the leech, and this seemed to protect it against the raids of the kingfishers which, while constantly picking up other small fish, avoided this particular one."

IN the current number of the *Astrophysical Journal* (December 1896), Mr. L. E. Jewell gives us the results of his investigation of the relative quantities of aqueous vapour in the atmosphere determined by means of the absorption lines in the spectrum. The method of observation was to estimate the intensity of the water vapour lines in terms of the solar lines most nearly equal to them in intensity, and close enough to render the comparisons exact. The work was found to be considerably facilitated by making a scale, the use of which eliminated several otherwise necessary computations and reductions. Among some of the results may be mentioned the following:—The intensities for the summer months were much greater than for the winter months. A comparison of the curves (deduced from monthly means) representing these intensities, and one representing oxygen, shows that water vapour is very differently distributed in our atmosphere from oxygen, and is also greatly different at different seasons. The curves of intensity indicated "a remarkable difference between the conditions prevailing during cold waves and very warm humid weather." Mr. Jewell is of opinion that observations made with small spectroscopes having insufficient dispersion to easily see the various lines distinctly, are worse than useless for weather forecasting, as the region of the rain band contains many solar lines which cannot be distinguished from water vapour lines without good definition and considerable dispersion. With sufficient dispersion, however, the study of the distribution of water vapour in the atmosphere is of great value, but hardly sufficient to justify the use of spectroscopes at most meteorological stations.

WRITING in the *Monthly Weather Review*, Prof. Cleveland Abbe says:—Many persons still fail to realise the fact that the weather proverbs which pass down from generation to generation as unquestioned as are the nursery stories, belong to what may be properly called mythology. Like the myths and legends of ancient times, they may, possibly, have had some slight basis of fact; they may possibly have applied satisfactorily to some far-off period and some far-distant land, or to one special occasion, but do not, necessarily, hold good to-day and in our own country. At a recent meeting of the Meteorological Society of France, the members discussed the popular proverb: "When it rains on St. Medard's day it will rain for forty days unless fine weather returns on

the day of St. Bernabe." M. Teisserenc de Bort showed that M. Lancaster, who, several years ago, examined this question, found no results tending to verify this saying to predict in advance a rainy period; thus in examining the data collected from 1863 to 1896, he finds that in the first days of June the rain is, on the average, a little more abundant, and diminishes towards the end of that month. He himself had also studied the records, but could not find any systematic grouping of the days of rain around the day of St. Medard. M. Renou said that M. Elie de Beaumon. has called attention to the fact that the proverb relative to St. Medard dates from the middle ages, and that since then the order of the saints' days in the calendar has been changed, and that now the day of St. Gervais is the one to which the proverb should be applied. M. de Beaumont, therefore, examined the question of the grouping of days of rain according to the new date, but did not find any verification of the proverb.

THE *Monthly Weather Review* (Washington) for September last contains, among various other interesting notes, one upon he first attempt to measure wind force. Prof. Marvin points out that Sir Isaac Newton in his boyhood made a rough determination of the force of a great gale which occurred on September 3, 1658, by jumping first in the direction in which the wind blew, and then in opposition to the wind, and afterwards measuring the length of the leap in both directions. An account of this will be found in Sir David Brewster's "Memoir" of Sir Isaac Newton. The first piece of apparatus applied to the measurement of the wind was probably the pendulous plate anemometer introduced by the Royal Society on the recommendation of Sir Christopher Wren and others, about 1665. This instrument gave a measurement of the effect of moving air on a resisting plate. The question of the measurement of the pressure or velocity of the wind by anemometers is still in a condition far from satisfactory, and the recent annual reports of the Meteorological Council show that the subject is still engaging the attention of that body.

MR. G. H. KNIBBS, Lecturer on Surveying in the University of Sydney, has communicated to the Royal Society of New South Wales, a note on recent determinations of the viscosity of water by the efflux method. From his tables it would appear that, for temperatures from 0° to 50° C., the relative fluidity has been ascertained to within 1 per cent., but that from 50° to 100° C. the uncertainty increases to 5 per cent. This large uncertainty is apparently not explained by possible errors of observation either of temperatures, efflux times, or of the dimensions of the apparatus. These conclusions are derived from a comparison of the observations of Poiseuille, Graham, Rosenkranz, Shotte, Traube, Noack, and Thorpe and Rodger.

THE importance of the study of the ceremonies of the Australians can scarcely be over-estimated, and it is with pleasure that we draw attention to the recent work in this direction done by R. H. Mathews, who as a professional surveyor has good opportunities for study, of which we are glad to find he makes so excellent a use. In a paper contributed to the Queensland Branch of the Royal Geographical Society of Australasia (vol. x. p. 18, pl. 1), he dealt with the Kamilaroi Class System of the Australian aborigines. The initiation or Bora ceremonies of the Kamilaroi tribes were described in the *Journal of the Anthropological Institute* (vols. xxiv., xxv. pp. 411, 318), and in the *Journ. Roy. Soc. N.S.W.* (vol. xxviii. p. 103); the analogous Burbung ceremonies of the Wiradthuri tribes in the *Journ. Anth. Inst.* (vol. xxv. p. 295); and the similar Bunan ceremony of the south-east coast of New South Wales in *The American Anthropologist* (vol. ix. p. 327). The careful descriptions are supplemented by plans of the grounds where the ceremonies took place, and sketches of the various animals and designs that are carved on neighbouring trees, or cut on the surface of the ground. Mr. Mathews has also published several accounts of the rock paintings and carvings of the Australian aborigines, and we would refer the reader to the following papers: *Journ. Roy. Soc. N.S.W.* (vol. xxvii. p. 353) (for the one in vol. xxix. he obtained the Society's medal), *Proc. Roy. Geogr. Soc. Aust. Queensland Branch* (vol. x. p. 46), *Proc. Roy. Soc. Victoria* (vol. vii. n.s. p. 143), *The American Anthropologist* (vol. viii. p. 268), *Journ. Anth. Inst.* (vol. xxv. p. 145). It is evident that Mr. Mathews has taken a great deal of pains to be accurate, and his training has been valuable for this special kind of work. All the drawings are necessarily reproduced on a very small scale; but it is to be hoped that the original drawings will be preserved in some convenient public institution, where they will be available for future students. We hope that he will be encouraged to continue his labours, and trust that he and others who have the opportunity will find out, *from the natives themselves*, the significance of all the designs and patterns which they come across. With a few more workers like Mr. Mathews, the reproach of the neglect of Australian anthropology would largely be taken away.

MR. C. H. TYLER TOWNSHEND has recently contributed to the *Transactions* of the Texas Academy of Science an essay on the Bio-geography of Mexico, Texas, New Mexico, and Arizona. In this, he criticises Dr. Merriam's division of the life-zones of Eastern North America, "which he has had constant and abundant opportunities of studying during the past five years." Mr. Townshend recognises seven zones of altitude in the district to which he has devoted his attention, and, commencing at the highest, calls them respectively the Arctic, Hudsonian, Canadian, Arid-Transition, Upper-Sonoran, Lower-Sonoran, and Tropical Zones. These he proceeds to define, chiefly by reference to their different and characteristic forms of vegetation.

WE have received Nos. 2 and 3 of the eighteenth volume of *Notes from the Leyden Museum*, which were published on December 24 last. Besides many entomological and several conchological papers, the publication contains an article by Dr. J. Büttikofer on the birds of Nias, the largest of a long series of islands flanking the west coast of Sumatra, and situated at a distance of about seventy miles from its north-west coast, which has, of late years, been more than once the subject of zoological investigations. Dr. Büttikofer bases his paper on a splendid series of bird-skins collected in this island by Mr. J. Z. Kannegeiter, but takes the opportunity of giving a complete list of the birds of Nias, so far as they are known up to the present time, which are 128 in number. The relationship of this Avifauna is with that of Sumatra, but there are eleven species of birds in Nias which have not been found anywhere else as yet.

AT the Liverpool meeting of the British Association, the Committee for the Study of the Marine Zoology, Botany, and Geology of the Irish Sea presented its fourth and final report, drawn up by Prof. Herdman, a printed copy of which has now reached us. It contains, besides a brief account of the year's work, a complete list of all the species the Committee has recorded from the area. The total number of species included is 2133, and the list comprises all the chief marine subdivisions of the animal kingdom, and also Algæ and Diatomacea. Each name is followed by a reference to the publication of the Liverpool Marine Biology Committee in which the species was recorded or described. The British Association Committee is dissolved, not because the work is finished, but because it was decided that the Association could best render effective help by supporting the Port Erin Biological Station, which is now established and equipped, or by giving grants for special researches.

THE formation of organic bases by plants of the orchid family appears first to have been investigated by M. de Wildemann, who in 1892 observed the presence of an akaloïdal product in *Dendrobium nobile*, *D. Ainsworthii*, and other Orchidaceæ. These researches have now been generalised by Dr. E. de Droog, whose investigations are published in the *Mémoires* of the Royal Academy of Belgium. Of the 104 species of orchids examined, nine are to be considered as producing alkaloids, some in all their parts, the others locally, and the author seems to favour the view that the function of these alkaloids is for defensive purposes. Dr. de Droog's paper is illustrated by a lithographed plate, in which the alkaloids present in the cells of *Dendrobium nobile*, *Catasetum Hookeri*, *C. macrocarpum*, and the root of *Phalænopsis Luddemanniana* are coloured red.

M. CAMILLE FLAMMARION has sent us his interesting annual for the present year, and it is a mine of knowledge, both astronomical and meteorological. The information is not presented in too concentrated a form, but varied in places by explanations and summaries, together with excellent illustrations (fifty-six in number). Some of the main points which call for especial notice may be stated as follows. Under eclipses two clear diagrams are given, showing the most favourable points for viewing the two annular and only solar eclipses of the year. In addition to the ephemeris of each planet, charts are given showing their apparent tracts among the stars. For each day of the year the most interesting phenomena to be observed are inserted in calendar form, and diagrams are added showing the positions of the constellations for each month. A list of the minor planets, arranged in order of their perihelia distances, forms an interesting table. Among the *Notices Scientifiques* may be mentioned a chart of the movement of the terrestrial pole from 1890-95, a note on helium, and a brief reference to the recent total solar eclipse, with Dr. Brester's drawing of the corona. Lowell's chart of Mars on a reduced scale, and some planetary drawings, as well as a short summary of the eclipse cycle of fifty-four years, are also inserted. Besides being serviceable to astronomers, this annual should prove a valuable *vade-mecum* to amateurs, as they have at hand all the information for observing, at the right time, the most interesting celestial phenomena.

WE have received from the compiler, Mr. Arthur Mee, an almanac of moderate size for the use of amateur astronomers. The information is arranged in the form of a calendar, and shows the observer, at a glance, the sequence of the more important phenomena that will occur throughout the year. In addition to data referring to the positions of the sun and moon, attention is drawn to the most favourable times for viewing the planets, variable star and satellite phenomena, besides a selection of special clusters and nebulæ most suitable for small apertures. The arrangement of the information is simple and clear, so that this card almanac supplies a really serviceable daily reference sheet to those for whom it is specially intended. There is also a very good reproduction of the moon, taken from a photograph made at the Paris Observatory. One cannot help mentioning that as the almanac is intended for actual observers, the type of both figures and letters will most probably be found too small to be read in any but very good light. As amateurs would be very likely to consult this sheet when observing, it would not be an easy matter to read it by means of the light of an ordinary observatory lamp. It seems to us, however, that the utility of the sheet would be increased if larger and clearer type were in future used. The almanac, nevertheless, contains just that information which an amateur wishes to have at hand, and it should therefore be found to supply a real want.

MR. C. A. BARBER shows, in *Science Progress*, that the present condition of the sugar industry is peculiarly a matter of British interest. The depressed condition of the British colonies engaged in growing the sugar-cane is due to various causes; chief among these are the competition of European-grown beet and the various diseases at present attacking the canes. In his paper, Mr. Barber deals more especially with the first of these causes. The paper on the cell and some of its constituent structures, read at the Liverpool meeting of the British Association by Prof. J. B. Farmer, is printed in full in the same number of *Science Progress*. Dr. John Beddoe continues his paper on "Selection in Man." From the facts he adduces it seems that dark-complexioned men have a bias towards sedentary and indoor employments, while a certain number of the blond type prefer the outdoor employments connected with the land or with the care of animals. The statistics he gives support the conclusion that, in this country, more criminals than honest men are of dark complexion. Other contributions are:—"The Glossopteris Flora," by Mr. A. C. Seward; "Condensation and Critical Phenomena," by Prof. J. P. Kuenen; "The Origin of Lakes, by Mr. J. E. Marr, F.R.S.; and "The Causes of Variation," by Mr. H. M. Vernon.

FROM Prof. E. Cosserat, of Toulouse, and M. F. Cosserat, of Paris, we have received the first part of their memoir "Sur la Theorie de l'Elasticité," in which the principles of the subject are well put forward.

BY the publication of Part v. of the "Bibliography of American Economic Entomology," the task of bringing together the more important writings of Government and State Entomologists, and other contributions to American economic entomology, is completed up to the year 1888. Efforts will be made to bring the bibliography up to date by publishing occasional supplements. The work is published by the authority of the U.S. Secretary of Agriculture, and the present part of it has been prepared by Mr. S. Henshaw.

THE additions to the Zoological Society's Gardens during the past week include a Pig-tailed Monkey (*Macacus nemestrinus*, ♂) from Java, presented by Mrs. Baillie; two Leopards (*Felis pardus*, ♂ ♀) from Ceylon, presented by the Hon. Sir Joseph West Ridgeway; a Moluccan Kestrel (*Tinnunculus moluccensis*) from Triton Bay, New Guinea, presented by the Hon. Walter Rothschild; two Roseate Cockatoos (*Cacatua roseicapilla*) from Australia, presented by Mr. Richard J. L. Price; a Yellow-backed Lory (*Lorius flavo-palliatus*) from Batchian, presented by Miss A. M. Elwood; a Derbian Zonure (*Zonurus giganteus*), three Angola Frogs (*Rana angolensis*) from South Africa, presented by Mr. J. E. Matcham; seven Common Squirrels (*Sciurus vulgaris*), British; two Indian Dial Birds (*Copsychus saularis*) from India, purchased; a Bennett's Wallaby (*Macropus bennetti*), a Rufous Rat Kangaroo (*Œpyprymnus rufescens*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE ALGOL VARIABLE + 17° 4367 W DELPHINI.—Prof. E. C. Pickering publishes in the *Astrophysical Journal* for December the ephemeris and light equation of this variable for the present year. No modification is made in the formula of reduction (JD 2412002·500 + 4·8064 E), although the observations indicate a slight change in the period, making the minima occur about fifteen minutes before the computed times. Prof. Pickering adds, however, that by diminishing the period by about two seconds this difference, caused by an inexact knowledge of the light curve when the ephemeris was first computed, would disappear. A set of photometric measurements with the adjacent star + 17° 4368, exceeding four thousand in number, and made by Mr. O. C. Wendell, has given a very accurate

light curve, which Prof. Pickering reproduced in his note. The average deviation between the photometric measurements and the smooth curve amounts to between one or two hundredths of a magnitude. The observations are not, however, quite sufficiently distributed over the whole curve to eliminate all doubt as to its form in some parts. The light curves of U Cephei, β Persei, and U Ophiuchi have also been similarly determined. W Delphini varies 2·71 magnitudes, a variation greater than any other star of the same class. U Cephei comes second, with a variation of 2·44 magnitudes, while those of β Persei and U Ophiuchi are 1·04 and 0·66 respectively.

COMET NOTES.—The comet discovered by Mr. Perrine, on December 8 last year, is gradually diminishing in brightness; but the ephemeris shows that its now southern declination is beginning to diminish. For those wishing to follow the comet further, Dr. F. Ristenpart has computed some parabolic elements from observations made on December 10, 22, and 27, and the ephemeris obtained from these is as follows (*Astr. Nachr.*, No. 3394, Beilage):—

Berlin Midnight.

1897.	R.A. h. m.	Decl. ° ′	Br.
Jan. 11 ...	4 2·8 ...	−0 53·4 ...	0·27
15 ...	17·4 ...	54·3 ...	·22
19 ...	30·7 ...	47·1 ..	·18
23 ...	43·1 ...	34·9 ..	·15
27 ...	54·5 ...	19·1 ...	·12
31 ...	5 5·2 ...	−0 0·6 ...	0·10

The elements are stated to be not very satisfactory, as the calculation of the "mean position" discloses an error of too great a magnitude to be neglected.

The comet, on the other hand, discovered by Mr. Perrine on November 2, is, according to the ephemeris given by Herr Otto Knopf (*Astr. Nachr.*, No. 3394), increasing rapidly in brightness, and by April 5 will be six times brighter than it was at the time of its discovery. The comet, however, will soon be lost in the sun's rays, but on its reappearance will be visible only from southern latitudes, its southern declination rapidly increasing.

THE UNIVERSAL MERIDIAN.—Among many of the subjects referred to at the meeting of the Société Astronomique de France, on December 2 last year, that of the choice of a universal meridian raised considerable discussion. The subject was brought up owing to the proposition made by M. Deville, before the Chambre des Deputés, concerning "the adoption of the meridian of Greenwich by France." M. Bouquet de la Gyre commenced the proceedings by saying that the question was one which touched science as a whole, and that the Academy had not been consulted. He then proceeded to state his opinion, which was to the effect that for theoretical reasons Greenwich should not be adopted as the zero meridian. M. Callandreau, who followed him, took the practical side of the question, and pointed out what progress had already been accomplished in the adoption of the Greenwich meridian. After an able statement of the case by the President, M. Janssen, the question was put to the vote, the great majority adhering to the adoption of the Greenwich meridian. The proceedings of the meeting will be found in the *Bulletin* of the Society for January.

PRIZE SUBJECTS OF THE PARIS ACADEMY OF SCIENCES.

THE following subjects for prizes are announced by the Academy for 1897 and following years; prizes for years other than 1897 are specially indicated. In Geometry, the Grand Prize in the Mathematical Sciences (1898) will be awarded for the best memoir extending the part played in analysis by divergent series; the Bordin Prize (3000 fr.) for a study of the questions relating to the determination, properties, and applications of systems of orthogonal curvilinear coordinates of n variables, indicating particularly the degree of generality of these systems (1898); the Francœur Prize (1000 fr.), and the Poncelet Prize (2000 fr.), for work contributing to the progress of pure or applied mathematics. In Mechanics, the Extraordinary Prize of 6000 fr. is offered for work increasing the efficiency of the French naval forces; a Montyon Prize (700 fr.) for the invention or improvement of instruments useful in agriculture or the mechanical arts; the Plumey Prize (2500 fr.), for improvements in steam navigation; the Fourneyron Prize, for a complete discussion of the motion and stability of bicycles. In Astronomy, the Lalande Prize (540 fr.) will be given for the observation or work most useful to the progress of the science; the Damoiseau Prize (1500 fr.), for calculations connecting the appearances of Halley's comet, taking into account the attraction of Neptune, and giving the exact time of its next appearance in 1910; also, for 1898, for a study of the perturbations of Hyperion, the satellite of Saturn, deducing the mass of Titan; the Valz Prize (460 fr.), for the most interesting astronomical observation made during the year; and the Janssen Prize (for 1898), for the most important discovery in Astronomical Physics.

In Physics, a La Caze Prize (10,000 fr.), in Statistics, a Montyon Prize (500 fr.), and in Chemistry, a La Caze Prize (10,000 fr.), and the Jecker Prize (10,000 fr.) will be awarded in 1897. In Mineralogy and Geology, for the Grand Prize in the Physical Sciences (3000 fr.), question proposed for 1897, "New experiments and studies on the higher parts of mountains, especially experiments bearing on Meteorology and the conditions of life"; for the Bordin Prize (3000 fr.), "Physical, chemical, and zoological studies of the bottom of the seas touching the coast of France"; for the Vaillant Prize (4000 fr.), question for 1898), "To make known and discuss the indications which complete the microscopical study of the sedimentary rocks (especially secondary or tertiary rocks) from the point of view of their genesis and the modifications they have undergone since their deposit in their structure and composition"; the Delesse Prize (1400 fr.), for work in Geology or Mineralogy; and the Fontannes Prize (2000 fr.) in 1899, for the best palæontological publication.

In Botany, the Barbier Prize (2000 fr.) is offered for a discovery of medical value; the Desmazières Prize (1600 fr.), for the best work on Cryptogams published during the year; the Montagne Prizes (1000 fr. and 500 fr.), for important discoveries bearing on the anatomy, physiology, and development of the lower Cryptogams; the De la Fons Melicocq Prize (900 fr.), in 1898, for work on the Botany of the North of France; and the Thore Prize (200 fr.), for the best memoir on the Cellular Cryptogams. In Anatomy and Zoology, the Savigny Prize (975 fr.) will be given in aid of young zoologists who have specially occupied themselves with the study of the Invertebrates of Egypt and Syria; and the Da Gama Machado Prize (1200 fr.), for the best memoirs on the coloured parts of the tegumentary system of animals. In Medicine and Surgery, there is offered a Montyon Prize; a Barbier Prize (2000 fr.); the Bréant Prize (100,000 fr.), for the discovery of a remedy which shall cure Asiatic cholera in the great majority of cases; the Godard Prize (1000 fr.), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; the Serres Prize (7500 fr.), in 1899, for work on General Embryology applied as far as possible to Physiology and Medicine; the Chaussier Prize (10,000 fr.), in 1899, for a work advancing legal or practical Medicine; the Parkin Prize (3400 fr.), for researches on the curative effects of carbon; the Bellion Prize (1400 fr.), for work especially profitable to the public health; the Mege Prize, for an essay on the progress of Medicine; the Dusgate Prize, in 1900, for the best means of preventing premature burial; the Lallemand Prize (1800 fr.), for work on the nervous system; and the Baron Larrey Prize (1000 fr.), for work on Military Hygiene, Medicine, or Surgery.

In Physiology, the Prizes proposed are those of Montyon (700 fr.), La Caze (10,000 fr.), Pourat (1400 fr.), Martin-Damourette (1400 fr.), and Philipeaux (890 fr.), and in Physical Geography, the Gay Prize (2500 fr.).

Of the General Prizes, there will be awarded in 1897, a Montyon Prize for a means of ameliorating an unhealthy trade or occupation; the Cuvier Prize (1500 fr.), for a work on Geology; the Trémont Prize (1100 fr.) and the Gegner Prize (4000 fr.); the Petit D'Ormoy Prize (10,000 fr.), for work in Pure and Applied Mathematics, and in the Natural Sciences; the Tchihatchef Prize (3000 fr.), for work on the less known parts of Asia; the Gaston Plante Prize (3000 fr.), for an important invention in Electricity; and the Cahours Prize (3000 fr.), for assisting young chemists in chemical researches.

Of these prizes those bearing the names of Lalande, La Caze, Delesse, Desmazières, and Tchihatchef, are specially stated to be given without distinction of nationality. All memoirs for this year must be sent to the Academy before June 1.

THE OLD TURKISH INSCRIPTIONS IN MONGOLIA.[1]

ABOUT 170 years ago it became known in Europe that there are, on the Upper Yenisei, inscriptions on stone monuments which are written in some unknown language, and are relics of an unknown population. Various hypotheses were made as to the origin of these inscriptions; but it was only in 1893 that the Copenhagen Professor, Wilhelm Tomsen, succeeded in deciphering them.[2] Although Prof. Tomsen attributes the discovery of these inscriptions to Heikel and Dr. Radloff, who visited the spot—the former in 1890–1891, and the latter in 1891—they were discovered in reality by the late N. M. Yadrintseff, who was sent out in 1889 by the Irkutsk Geographical Society for a journey to Mongolia.[3] Heikel's collection was luxuriously edited by the Finnish-Ougrian Society,[4] and the collection of reproductions made by MM. Radloff and Yadrintseff was published by the Russian Academy of Sciences.[5] However, neither of these three explorers succeeded in reading the inscriptions, and it was only Prof. Tomsen who, taking advantage of the names of rulers, which were written in Chinese characters, and stood by the runic inscriptions, found the cue for reading the mysterious writings. It became thus known that the inscriptions belonged to a Turkish stem which formerly inhabited the upper parts of the Yenisei and the Orkhon. The cue having been discovered, Prof. Radloff set at once to decipher and to translate the inscriptions—a task which involved very great difficulties at the outset, as the vowels were not written in this alphabet; but with all that, Dr. Radloff succeeded in finding out the meaning of the inscriptions and in translating them, and his researches are now embodied in a work issued by the Russian Academy of Sciences.[6] In this work Dr. Radloff analyses, first, the alphabet of the old Turkish monuments, and, next, the Chinese monuments on Lake Kosho-tsaidam; he then gives an eighty-page long list of words; the translation of the Chinese Kosho-tsaidam inscriptions, by Prof. Vasilieff; and the translations of the inscriptions found in different places of Mongolia and on the Yenisei, on both Chinese and Russian territory, followed by a study on the morphology of the old Turkish dialect. Thirty inscriptions in all have been deciphered; they are written phonetically, in vertical columns following each other from the right to the left. The letters are angular; they contain only four vowels and thirty-four consonants—different consonants being used in the words which contain guttural vowels, and in those words which have palatal vowels.

The Chinese inscription at Kosho-tsaidam was written on a monument erected in 732, to honour the Turkish ruler Kyulteghin, under the Chinese Emperor Kai-yuang, who reigned A.D. 713 to 742. A people named "Turk" is mentioned in it, and the monument was erected on that people's territory, to order the inhabitants to live in peace with the Tibet, Kirghiz ("Kyrkyz"), Chinese ("Tapkach," or "renowned"), and Tatar peoples ("Tatar"). Another monument, unhappily broken in three pieces, stands to the south of the former; it dates from 733. A third monument of importance was found by Yadrintseff on the Onghin River, and it is concluded that it was erected in 692, in honour of Moghilian-khan. A monument on the Ikheaset seems to be of a later date than the two just mentioned. Twenty more monuments were erected in honour of different relatives of the Turkish Khan, Kyul teghin, who resided at Kara-balgasun. They have been found in the Minusinsk region, by Stralenberg, in the early part of the last century, and have been described since by several explorers, including Castrén. The reading of these inscriptions offers many difficulties, and Prof. Tomsen and Dr. Radloff are not quite agreed together as to the proper way of reading; so that more materials are wanted, and the Irkutsk Geographical Society is now busily at work to collect them.

Dr. Radloff, who thoroughly knows the old and the new Turkish dialects, has edited the book in a thoroughly scientific spirit; and if his readings are doubtful in certain places, this chiefly depends upon the incomplete preservation of the inscriptions themselves. From the dictionary and grammar given by Dr. Radloff, it appears that the language is a true Turkish dialect, quite harmonic, and nearly akin to the old Uigur dialect. In certain respects it even seems to be older than this latter, and the shades of sounds can be better rendered in the alphabet of the inscriptions than in the old Uigur alphabet. The old Turks had two alphabets in use: a variety of the Syrian, which goes under the name of Uigur alphabet, and the Arabian. A third alphabet must be added now to these two, and to the four which are in use amongst the modern Turks. It is worth noticing that, according to the Chinese historians, Indian writing was in use in East Turkestan; while in West Turkestan some other alphabet, "khu-shu"—*i.e.* barbarian—was in use. It was written in vertical columns, and it may have been the alphabet of the Orkhon and Yenisei inscriptions.

[1] From a paper by the Kazan Professor, N. Katanoff, in the *Izvestia* of the East Siberian Branch of the Russian Geographical Society, vol. xxvi. 4 and 5. Irkutsk, 1896 (Russian).

[2] "Déchiffrement des Inscriptions de l'Orkhon and de l'Yenissei" (Copenhagen, 189.), in the *Bulletin* of the Danish Academy of Sciences.

[3] "Memoirs of the Oriental Branch of the Russian Archæological Society," vol. viii. p. 324. St. Petersburg, 1894 (Russian).

[4] "Inscriptions de l'Orkhon, recueillies par l'expédition Finnoise, 1890, et publiées par la Société Finno-Ougrienne" (Helsingfors, 1892).

[5] "Atlas der Altherthümer der Mongolei, im Auftrage der Kaiserlichen Akademie der Wissenschaften herausgegeben," von Dr. Radloff.

[6] "Die alttürkischen Inschriften der Mongolei," von Dr. W. Radloff. 460 pp. 4to. (St. Petersburg, 1895).

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BY the will of the late Mr. Henry L. Pierce, Harvard University and the Massachusetts Institute of Technology each receive 50,000 dollars.

THE following are among recent announcements:—Dr. F. B. Peck to be associate professor of geology and palæontology at Lafayette College; Mr. Richard Rathbun to be assistant in charge of the Smithsonian Institution, in succession to the late Mr. W. C. Winlock.

A NUMBER of professors of the University of Berlin have addressed the Senate in order to obtain its approval for a movement in the nature of University extension, and it appears that the same course has been adopted in Jena and Leipzig. The Berlin correspondent of the *Times* states that the movement has met with an unexpectedly strong and widespread opposition. Many members of the classes which have themselves enjoyed University education object to the proposed extension, on the ground that the persons who are likely to take advantage of it will only receive from their attendance at the proposed lectures a most superficial kind of instruction, both in point of quality and of quantity.

A SKETCH of recent progress of technical education in England forms part of the ninth annual report of the National Association for the Promotion of Technical and Secondary Education. From this we learn that, in spite of the efforts made from time to time to secure for general county purposes certain portions of the funds belonging to education, the total sum annually set aside and utilised for educational purposes increases year by year. Of the forty-nine County Councils in England, forty are now giving all, and nine are giving part of their grants to educational purposes; while of the sixty-one county boroughs, fifty-five are devoting all, and five are devoting part of the fund in a like manner. The county borough of Preston is the only instance of an authority devoting all its grant to the relief of the rates. In considering the total amount of money devoted one way and another, it appears that of the 742,000*l.* annually available in England alone, no less a sum than 662,000*l.* is being spent on education. This is an advance of 62,000*l.* upon last year's figures, and is chiefly due to the rapid development of the work of the Technical Education Board of the London County Council. There thus remains a sum of 80,000*l.* still unappropriated to the purposes for which the fund was originally intended. Of this sum, however, London is responsible for 51,000*l.*, an amount which, there is every reason to believe, will shortly be required for the organisation of technical and secondary education in the metropolis.

THE number of technical schools which have been transferred to local authorities for municipal management and control has increased by four during the year covered by the above report, thus bringing up the total to 44. The four schools referred to are at Bradford-on-Avon, Gloucester, Leicester, and Lichfield. In the county borough of Huddersfield this matter is under consideration. Attention may also be directed to the operations of those local authorities in England which, upon their own initiative, have built, or are building, or are about to build, in the aggregate 115 technical schools, 101 of which involve an expenditure of 1,317,000*l.* This sum is derived from (1) the accumulation of funds under the Local Taxation Act, (2) loans raised by local authorities, (3) local subscriptions; the greater

proportion, however, is undoubtedly raised by loan. At the same time it is pointed out in the report that in two or three localities the entire fund was raised by donations and subscriptions, and in one instance, that of St. Helens, a site and 20,000*l.* was presented by Colonel Gamble, C.B., to the corporation for the establishment of a technical school and free library. Of the large number of technical schools mentioned above, 57 are already at work, 32 new schools having been opened since last year's report. There remain, therefore, 58 schools which, according to the latest information, are still incomplete. Dairy institutes or agricultural schools or colleges have been established by nine English County Councils. In addition to these, the establishment of a central agricultural school is under consideration in Cornwall, and the County Councils of the East, North, and West Ridings of Yorkshire are taking joint action with a view to forming a rural agricultural centre.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 19, 1896.—"Preliminary Report on the Results obtained with the Prismatic Camera during the Eclipse of 1896." By J. Norman Lockyer, C.B., F.R.S.

The author first states the circumstances under which Sir George Baden-Powell, K.C.M.G., M.P., with great public spirit, conveyed an eclipse party to Novaya Zemlya in his yacht *Otaria*, to which party was attached Mr. Shackleton, one of the computers employed by the Solar Physics Committee.

The prismatic camera employed, loaned from the Solar Physics Observatory, was carefully adjusted before leaving England, and a programme of exposures was drawn up based upon the experience of 1893. As the station occupied lay at some distance from the central line, this programme was reduced by Mr. Shackleton.

Two of the photographs obtained are reproduced for the information of other workers, as some time must elapse before the discussion of all the results can be completed. This discussion and Mr. Shackleton's report on the local arrangements and details of work, are promised in a subsequent communication.

The lines photographed in the "flash" at the commencement of totality—happily caught by Mr. Shackleton—the wave-lengths of which lines have been measured by Dr. W. J. S. Lockyer, show interesting variations from those photographed by Mr. Fowler in the cusp during the eclipse of 1893.

With the exception of the lines visible in the spectra of hydrogen and helium, and the longest lines of many of the metallic elements, considerable differences of intensity from the lines of Fraunhofer are noticeable.

The coronal rings have been again photographed, and the results of 1893 have been confirmed.

EDINBURGH.

Royal Society, January 4.—Prof. Chrystal in the chair.—Mr. T. S. Muir read the report of the intermediate station on Ben Nevis. He was stationed there from September 1 to September 23, and during that time he took 186 observations, or eight readings per day. Out of twenty-two times that the barometer at the intermediate station (reduced to 32° and sea-level) read higher than that at Fort William, fourteen occurred close together during the first four days of the month, and were followed by a period of fine weather. On the average the intermediate barometer read one-hundredth of an inch lower than the Fort William barometer, and the weather of the month generally was bad. The mean day-difference of temperature between the intermediate, summit, and Fort William stations was as nearly as possible half of that between the summit and the base. But it is probable that during the night the intermediate temperature comes closer to that of the summit, and that the average for the twenty-four hours is closer to that of the summit than Fort William. When the station was enveloped in fog, or between two fog-systems, or close to the fog, the temperature approximated to that of the summit, and when there was no fog visible, or, if it were, at a great height, it approximated to that of the base. Also, when the sky was overcast, or nearly so, the middle temperature was closer to that of the summit; when the sky was clear, to that at Fort William. During the period, the rainfall at the summit was 6½ inches, at the intermediate station 6 inches, and at Fort William 4½ inches.—Dr. Munro read a paper on intermediary links between man and the lower animals. He maintained that by the attainment of the erect posture and the consequent conversion of the limbs into hands and feet man became *Homo sapiens*, and inaugurated a new phase of existence, by means of which the manipulative organs became correlated with the progressive development of the brain. In the evolutionary career of man two stages were therefore to be recognised. First, that during which his physical transformation had been effected, so as to adapt him to bipedal locomotion; second, that during which his mental organisation had become a new governing force in the universe. The one, being readily effected according to the laws of morphological adaptation, had a short duration. The other, an extremely slow process, consisted of small increments to his knowledge, acquired by repeated experiences, and reasoning from causes to effects, and from means to ends. The one was merely an adjustment of physical contrivances to physical ends, comparable to that by which the bird, the bat, or the whale had converted its limbs to their special purposes. The other had to be relegated to the mystic laboratory where thought was converted into its material equivalent in the form of increased brain substance. The transition from the semi-erect to the erect posture could not, in point of duration, be at all paralleled with the ages during which this erect being had lived on the globe. It was also probable that this transformation took place in a limited area; so that the chances of finding the intermediary links of this stage were very small. On the other hand, the probability of finding erect beings with skulls in all grades of development, from a slightly changed Simian type up to that of civilised man, was enormously greater. He regarded the erect posture as the most conspicuous line of demarcation between man and the lower animals. From this standpoint, the Java skeleton would come under the category of human; but if this line of distinction was to be dependent in any degree on mental phenomena, Dr. Dubois was perfectly justified in regarding it as a transitional form, because it was a long time after the attainment of the erect posture, before his religious, moral, and intellectual faculties became human characteristics. Dr. Munro believed that many fossil remains of man were intermediary links which marked different stages in the history of mankind, and the further back such investigations carried them, the more Simian-like did the brain-case become. If the geological horizon of the Java man was correctly defined as the borderland between the Pliocene and Quaternary periods, they could form some idea how far back they had to travel to reach the common stock from which men and anthropoid animals had sprung. The lower races of to-day were also survivals of intermediary links which had been thrown into the side eddies of the great stream of evolution.

PARIS.

Academy of Sciences, January 4.—M. A. Cornu in the chair.—Researches on the physiology of muscular action, by MM. A. Chauveau and J. Tissot. When the weight sustained by a muscle and the amount by which it shortens increase together, it is shown experimentally that the respiratory exchanges which represent the energy spent, that is, the oxygen absorbed and the carbon dioxide exhaled, increase as the product of the shortening by the weight.—On a generating and distributing apparatus for acetylene, by M. H. L. Lechappe.—Observations on the new Perrine comet (December 8, 1896) made at the Observatory of Algiers, by MM. Rambaud and F. Sy.—On the consumption of water in locomotives, by M. E. Vicaire. On the basis of some experiments carried out on the Orleans system of railways, a general expression is deduced for the consumption of water on any given section.—Variation of the accidental double refraction of quartz with the direction of the compression, by M. R. Dongier. It is found that the same pressure, applied in two independent directions normal to the ternary axis, affects the wave-surface differently. The experiments will be continued with a view of determining the exact relation between the direction of pressure and the double refraction produced.—The action exercised upon solutions of the haloid salts of the alkalis, by the bases that they contain, by M. A. Ditte. An experimental study of the decrease of solubility of KBr by the addition of a solution of caustic potash, and of NaBr, by caustic soda.—Action of ammonia upon tellurium chloride. Tellurium nitride, by M. René Metzner. At 200°—250° C., $TeCl_4$ is slowly but completely reduced to metallic tellurium, ammonium chloride and nitrogen being formed. At

0° C. the action is quite different, the compound $TeCl_4 : 3 NH_3$ being produced. Under certain conditions, somewhat difficult to realise, tellurium nitride, TeN, arises by the spontaneous decomposition of this ammoniacal chloride. The nitride is unstable, detonating violently when struck or heated, but is not attacked by water or by dilute acetic acid.—On the absorption of sulphuretted hydrogen by liquid sulphur, by M. A. H. Pélabon. Liquid sulphur at 440° C. absorbs hydrogen sulphide, which it gives out on solidifying. This can scarcely be a true case of a solution of a gas in a liquid, as it is found that the amount absorbed increases with the temperature, and is only given out on solidifying, no gas being given out by the solution in liquid sulphur even into a vacuum.—On the production of vanilline with the aid of vanilloylcarboxylic acid, by M. Ch. Gassmann.—On the transformation of eugenol into isoeugenol, by M. Ch. Gassmann.—On the principal varieties of wheat consumed in France, by M. Balland. Analyses of wheat from various sources.—Influence of the nervous system on the effects obtained by the injection of serum from vaccinated animals, by MM. Charrin and Nittis. As a general result it was found that lesions of the nervous system, which, as a rule, favour infection, also interfere with the protective power of a serum.—Influence of the different psychic processes upon the blood pressure in man, by MM. A. Binet and N. Vaschide. In all the experiments the blood pressure was increased. This effect was produced by pain, a strong mental effort, conversation, and a fatiguing muscular effort.—The Malpighian tubes of the Orthoptera, by M. L. Bordas.—On the *Spirorbis*; asymmetry of these annelids and in the classification of this and allied species, by MM. Maurice Caullery and Félix Mesnil.—Remarks on the above note, by M. Edmond Perrier.—On the geological history of the Vosges, by M. A. de Lapparent.—On the period of formation of the phosphatic sands at the surface of the brown chalk, by M. Stanislas Meunier. Some remarks on a note by M. de Mercey.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 14.

MATHEMATICAL SOCIETY, at 8.—Supplementary Note on Matrices: J. Brill.—The Partition of a Number into Primes: Prof. Sylvester, F.R.S.—Some Properties of Bessel's Functions: Dr. Hobson, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address of the President, Sir Henry Mance.

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY.—Some Marine Mimics: E. Step.

FRIDAY, JANUARY 15.

EPIDEMIOLOGICAL SOCIETY, at 8.—Age Incidence in Relation with Cycles of Disease Prevalence: Dr. Hamer.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On "Monier" Girders and Arches: Walter Beer.

SUNDAY, JANUARY 17.

SUNDAY LECTURE SOCIETY, at 4.—The Mountains of Great Britain: Prof. Norman Collie, F.R.S.

MONDAY, JANUARY 18.

SOCIETY OF ARTS, at 8.—Material and Design in Pottery: William Burton.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Character of the London Water Supply: W. J. Dibdin.

VICTORIA INSTITUTE, at 4.30.—On the Assouan Embankment; Prof. Hull, F.R.S.

TUESDAY, JANUARY 19.

ROYAL INSTITUTION, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 4.30.—Sand Dunes; Vaughan Cornish.

ZOOLOGICAL SOCIETY, at 8.30.—Revision of the West Indian Micro-lepidoptera, with Description of New Species: Lord Walsingham, F.R.S. On some Points in the Anatomy of the Manatee lately living in the Society's Gardens: F. E. Beddard, F.R.S.—On the Classification of the Primates from the Ophthalmoscopic Appearance of the Fundus oculi: Dr. G. Lindsay Johnson.

ROYAL STATISTICAL SOCIETY, at 5.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Paper to be further discussed: Superheated Steam Engine Trials: Prof. W. Ripper.—Papers to be read, time permitting: The Diversion of the Periyar: Colonel J. Pennycuick, C.S.I., R.E.—The Periyar Tunnel: M. P. Roscoe Allen.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—The History of the Half-tone Dot: W. Gamble.

GRESHAM COLLEGE, at 6.—Minute Organisms as Causes of Disease: Dr. Symes Thompson.

WEDNESDAY, JANUARY 20.

SOCIETY OF ARTS, at 8.—The Roller Boat of M. Bazin: Emile Gautier.

GEOLOGICAL SOCIETY, at 8.—On Glacial Phenomena of Palæozoic Age in the Varanger Fjord; The Raised Beaches and Glacial Deposits of the Varanger Fjord: Aubrey Strahan.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report of the Council; Election of Officers and Council.—Address on Shade Temperature: E. Mawley, President.

ROYAL MICROSCOPICAL SOCIETY, at 8.—President's Address.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.

GRESHAM COLLEGE, at 6.—Bacteria in Air and Water: Dr. Symes Thompson.

THURSDAY, JANUARY 21.

ROYAL SOCIETY, at 4 30.—The following Papers will *probably* be read:—On Cheirostrobus, a New Type of Fossil Cone from the Calciferous Sandstone: Dr. D. H. Scott, F.R.S.—(1) Experiments in Examination of the Peripheral Distribution of the Fibres of the Posterior Roots of some Spinal Nerves, Part II.; (2) Cataleptoid Reflexes in the Monkey; (3) On Reciprocal Innervation of Antagonistic Muscles (third note): Prof. Sherrington, F.R.S.

ROYAL INSTITUTION, at 3.—Some Secrets of Crystals: Prof. H. A. Miers, F.R.S.

LINNEAN SOCIETY, at 8.—On the Origin of the Corpus callosum; a Comparative Study of the Hippocampal Region of the Cerebrum of Marsupialia and certain Cheiroptera: Dr. G. Elliott Smith.—On the Minute Structure of the Nervous System of the Mollusca: Dr. J. Gilchrist.

CHEMICAL SOCIETY, at 8.—Studies of the Properties of Highly Purified Substances. I. The Influence of Moisture on the Production of Ozone from Oxygen and on the Stability of Ozone. II. The Behaviour of Chlorine, Bromine, and Iodine with Mercury. III. The Behaviour of Chlorine under the Influence of the Silent Discharge of Electricity and in Sunlight: W. A. Shenstone.—Action of Diastase on Starch, Part III.: A. R. Ling and J. L. Baker.—The Solution Density and Cupric-reducing Power of Dextrose, Levulose, and Moist Sugar: Horace T. Brown, F.R.S.; Dr. G. Harris Morris; J. H. Millar.—Derivatives of Maclurin, Part II.: A. G. Perkin.

GRESHAM COLLEGE, at 6.—Milk, Meat, and Oysters as Carriers of Disease: Dr. Symes Thompson.

FRIDAY, JANUARY 22.

ROYAL INSTITUTION, at 9.—Properties of Liquid Oxygen: Prof. Dewar, F.R.S.

PHYSICAL SOCIETY, at 5.—An Exhibition of some Simple Apparatus by W. B. Croft.—On the Passage of Electricity through Gases: E. C. Baly.

GRESHAM COLLEGE, at 6.—Diphtheria: Dr. Symes Thompson.

CONTENTS.