THURSDAY, OCTOBER 31, 1901.

PTERODACTYLES.

Dragons of the Air: an Account of Extinct Flying Reptiles. By H. G. Seeley. Pp. xiii + 239. Illustrated. (London: Methuen and Co., 1901.) Price 6*s*.

EVER since the study of fossil remains was taken up in earnest, pterodactyles, or, as the author elects often to call them, ornithosaurs, have attracted the deepest attention on the part of anatomists on account of the many puzzling problems connected with their organisation and affinities, while from their weird form, peculiar attributes, and the huge dimensions attained by some of their later representatives they have appealed more strongly to popular interest than is the case with many of their extinct contemporaries. Among all the diligent students of the organisation of these strange creatures (so far as it can be worked out from their bones alone) none has been more constant or more persistent than Prof. H. G. Seeley, who commenced his investigations when a student at Cambridge during the late 'sixties. At that time the so-called coprolite-works in the Cambridge Greensand were in full swing; and the rich, albeit much broken, material thus obtained afforded opportunities for studying the structural details of pterodactyle bones in a manner impossible when dealing with the embedded skeletons of the smaller forms from the lithographic limestone of the Continent. Of these opportunities—both as regards study and collecting—Prof. Seeley availed himself to the full; and from that time to this, as occasion presented itself, he has, we believe, continued faithful to his favourite study. During the latter years of Prof. Sedgwick's tenure of the Woodwardian Chair at Cambridge, Prof. Seeley delivered a series of lectures at various centres—including the Royal Institution—on pterodactyles; and the present volume purports to be a reissue of these lectures in an expanded form, with such revision as has been rendered advisable by the progress of investigation.

In this volume Prof. Seeley appeals, as he tells us in the preface, alike to the general public and to the man of science. To achieve success in this double *rôle* is by no means an easy matter; and it may be questioned whether he has not given too much elementary explanation to suit the latter class of readers and not enough for the needs of the former. This, however, is a matter which concerns an author and his publisher rather than a reviewer.

All who have been occupied in investigating the osteology of pterodactyles can scarcely fail to be struck with the marked similarity presented in many respects—especially in the skull and cervical vertebræ—to birds. And this avian resemblance seems to have impressed itself with peculiar force on the mind of the author, who has all along contended that these creatures are not entitled to be ranked as reptiles, but form an outstanding group by themselves, displaying very widespread affinities with other groups of animals. So widespread, indeed, does Prof. Seeley regard the relationships of pterodactyles that it is by no means an easy matter to understand what his opinions on this subject really are, especially as his sentences are not unfrequently so involved that it is difficult to grasp his meaning. Even, however, if they cannot agree with them (or in some cases even understand them), the views of such an experienced and earnest investigator on a subject he has made specially his own should command respectful attention on the part of those whose knowledge in this respect is less extensive than that of the author.

Perhaps the best way of endeavouring to convey an idea of the author's views on pterodactyle relationship—which is the leading feature of the book—will be to quote his own words.

Selecting a few passages in serial order, we find it stated on p. 58 that[1]—

"While these animals are incontestably nearer to birds than to any other animals in their plan of organisation, thus far no proof has been found that they are birds, or can be included in the same division of vertebrate life with feathered animals."

On p. 188 we are told that—

"It is not so much that they mark a transition from reptile to bird, as that they are a group which is parallel to birds, and more manifestly *holds an intermediate place than birds do between reptiles and mammals*."

Again, on p. 210 we find the following:—

"Therefore there is a closer fundamental resemblance between some carnivorous dinosaurs [*e.g. Coelurus*] *than might have been anticipated*."

On the following page it is stated that—

"The dinosaurs, like pterodactyles, must be regarded as *intermediate* in some respects *between reptiles and birds*."

Finally, on p. 223, we have the following:—

"It would therefore appear from the vital community of structures with birds, that pterodactyles and birds *are two parallel groups*, which may be regarded *as ancient divergent forks* of the same branch of animal life, which became distinguished from each other by acquiring the different condition of the skin, and the structures which were developed in consequence of the bony skeleton ministering in different ways; and with different habit of terrestrial progression, this extinct group of animals acquired some modifications of the skeleton which birds have not shown. There is nothing to suggest that pterodactyles are a branch from birds, but their relation to birds is much closer, so far as the skeleton goes, than is their relation with the flightless dinosaurs, with which birds and pterodactyles have many characters in common."

Other passages might be quoted, but the foregoing are sufficient to indicate the extreme complexity of pterodactyle relationship according to the author. Personally we must confess to a total incapacity to draw a mental picture of the relationships thus indicated; and we have also failed in the attempt to construct a diagram which will show how groups that are divergent are yet parallel.

We have also yet to learn that birds are in any respect intermediate between reptiles and mammals; while we totally fail to see how any animals can be, *even in some respects*, intermediate between reptiles and mammals on the one hand, and reptiles and birds on the other. That is to say, in the sense in which we understand the term "intermediate," as indicative of descent.

[1] The italics introduced into these quotations are the reviewer's.

Again, as suggestive of prejudice, we must take the strongest exception to the author's use of the expression "than might have been anticipated" in connection with the affinities between pterodactyles and dinosaurs. What right had anybody to form "anticipations"?

If the author really intends to imply that birds and pterodactyles are divergent and specialised branches from groups of reptiles which cannot yet be identified (at all events in the latter case) with any approach to certainty, we can agree with him. But this by no means implies any intimate relationship between the two branches in question, the structure of the limbs of which is alone amply sufficient, in our opinion, to demonstrate their totally different origin. In urging an affinity between birds and pterodactyles, Prof. Seeley, in addition to the (may we say superficial?) resemblances between their skulls and brains, lays stress on the fact that both have pneumatic bones. This feature is taken as an indication that pterodactyles probably possessed warm blood, from which is drawn the further inference that they were also furnished with a four-chambered heart. Even if the first inference be well founded, the second by no means follows, the author himself quoting the fact that the blood of the tunny has a temperature of 90°. And even if pterodactyles were warm-blooded and furnished with an avian type of heart, we should be none the more inclined to admit their affinity with birds.

Apparently the author takes no account of similar modes of life leading to the development of superficially similar bodily structure in totally different groups of animals, and the consequent "convergent" resemblance between them. And if this be so, his premises are so widely different from those on which the investigations of others are based that it is little wonder irreconcilable diversity of view results.

An instance of this nature occurs on p. 219, where we find the statement that "a few characters of ornithosaurs are regarded as having been *acquired*, because they are not found in any other animals, or have been developed only in a portion of the group." In one sense all characters are acquired; but the use which the author makes of the term "acquired characters" does not correspond with its ordinary scientific acceptation. From this we may perhaps infer that in other instances the signification attached to terms is different from that usually in vogue—which would account for much.

It is not, however, solely in regard to the affinities of these reptiles, as we still take leave to call them, that the author differs so much from current views. He likewise attributes to pterodactyles a bodily form quite unlike that with which they are generally credited; and one, it may be said, which makes them the most grotesque and bizarre creatures that ever walked this earth. But could they walk at all, as thus restored? is a question which can scarcely fail to occur to those who look on these wonderful pictures. In most or all other restorations, as in the plate by Smit in Hutchinson's "Extinct Monsters," pterodactyles, when not flying, are shown crawling on rocks or cliffs, or sitting up on their hind legs on some prominence preparatory to taking flight. Prof. Seeley will, however, have nothing to say to such crouching attitudes, and represents the creatures standing on all fours, with the greatly elongated wing-finger bent back alongside the fore-arm and projecting above the hind-quarters, and the wing folded like an inverted Chinese sun-shade. Whether such slender hind-limbs as are shown in the restoration are capable of supporting the weight of the body in this position we will not pause to inquire. Our difficulty is in connection with the fore-limb, the raising of which would apparently cause the wings to strike against the ground at every step, even if they did not become entangled with the hind-legs. Moreover, the creature is represented as actually standing on the joint between the metacarpus and the wing-finger, and as this joint must certainly have been a highly delicate and complex structure, it appears impossible to conceive how it could have escaped injury in walking if carried in the position shown in the restoration. Possibly the author has an explanation of these difficulties, but if so it would have been more satisfactory had it been given to the public.

To revert, in conclusion, to the main argument of the book, we fully realise the amount of labour that Prof. Seeley has expended on a very difficult subject, and at the same time are prepared to admit the advantage which often accrues to the progress of science from the presentation of opinions widely different from those generally entertained. Nevertheless, we scarcely think that he will persuade those of his readers whose verdict is worth having to agree with him in regarding pterodactyles and birds as in any way near akin, or will convince them that the former creatures are no longer entitled to be classed as reptiles. Aberrant they are, no doubt, but not so much so as, in our opinion, to be excluded from the limits of a class comprehensive enough to embrace such diverse types as dinosaurs, turtles, ichthyosaurs and snakes. As to the alleged relationship between the "dragons of the air" and the egg-laying mammals, we are fain to confess that it requires a greater power of imagination to realise the nature of the affinity than it falls to our own lot to possess. R. L.

ELEMENTARY DYNAMICS.

Theoretical Mechanics: an Elementary Treatise. By W. Woolsey Johnson, Professor of Mathematics, U.S. Naval Academy. Pp. xv+434. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1901.) Price 3 dollars net.

THE author states in his preface that "the study of mechanics is here supposed to follow an adequate course in the differential and integral calculus." Hence it is difficult to see how it can appeal to any class of students—at least in this country—especially as, in addition to both branches of the calculus, the conceptions of geometry of three dimensions are also introduced at the outset. The student who has already progressed thus far in mathematics does not require to be introduced to the parallelogram of forces and all the elements of the composition and resolution of coplanar forces and velocities. There is nothing distinctively novel in the work, which is, on the whole, a careful compilation from the works of the best writers on the subject, without any acknowledgment of the sources.

The first two chapters deal with forces acting on a particle, and make free use of the calculus and geometry

of three dimensions. In chapter iii. the author settles down to the composition, resolution, and equilibrium of a general system of coplanar forces, and gives a very good exposition of the subject; but in this chapter, of nearly fifty pages, no use of either the calculus or three-dimensional geometry is made, except in three pages devoted to the common catenary. Now the understanding of this very important and extensive section of dynamics is well within the power of any student even if he is quite ignorant of these branches of pure mathematics, so that it seems a pity that he should be kept back in his dynamical studies until he has passed through "an adequate course in the differential and integral calculus."

Passing over chapters devoted to the determination of centres of gravity and the composition of forces which are not coplanar, we come to chapter vii., which treats of the principle of work. This chapter is somewhat meagre, consisting mainly of what is known as "book-work," and not containing sufficient illustration of the applications of the principle to concrete cases. Until the student comes to chapter viii. he will experience no difficulty in the author's treatment of the subject; but when he reaches this chapter, on "motion produced by constant force," he will find a good deal about the nature of "inertia regarded as a force" which will be very perplexing. His main difficulty will be to decide whether the author means the "force of inertia" to be one exerted *by* a body or *upon* it by some agent or medium. Thus, at the beginning of art. 288 it would appear to be a force exerted *by* the body:—

"The property of matter through which *it resists* any change of motion, in accordance with the First Law of Motion, is called Inertia."

But a few lines farther on we have the sentence:—

"Now, just as the resistance of a fixed body in contact with that upon which the force acts, and preventing its motion, is regarded as a force equal and opposite to the force which would otherwise produce motion, so the resistance to motion in the body when free is regarded as a force equal and opposite to the active force which produces the motion."

Let us suppose a particle M acted upon by forces whose resultant is P and kept from moving by the resistance, N, of a fixed surface B; then the force N is exactly equal and opposite to the force P. Again, imagine the body M acted upon by the same force P and unresisted by any fixed surface; M will have an acceleration a, and the statement is that there is acting on M a force resisting the acceleration a—this force being clearly produced by something which in our thoughts replaces the above fixed surface B—that this force is equal and opposite to "the active force which produces the motion." So far, what this "active force" is is not clear; but the next sentence defines it:—

"Thus the force of inertia acts upon a particle of mass m only when there is an acceleration a, and its value is ma, while its direction is opposite to that of the acceleration."

Now observe that if the particle had no acceleration, this force would be zero, while in the first part of the analogy (where also $a = 0$) the supposed analogous force, N (the resistance of the surface B) is not zero.

However, from this and from subsequent statements it is clear that, in the author's view, a force of inertia really acts on a particle m which has an acceleration a, and that this force is scalarly and vectorly equal to $-ma$; that is to say, it is D'Alembert's fictitious "reversed effective moving force." But this is not in accordance with the statement at the top of p. 288:—

"And the inertia which acts upwards is, at that point, simply the resistance of the body to being moved away from the tangent at O."

It is certainly strange that a force acting *on* a body should be the resistance of the body to being moved. The author, however, clearly defines his conception, which he calls that of "kinetic equilibrium," at the top of p. 244:—

"For example, suppose a man whose weight is W to be standing on the floor of an elevator which begins to descend with the known acceleration a. The forces acting on the man are his weight, $W = mg$, acting downward, his inertia, ma, acting upward because the acceleration is downward, and the resistance R of the floor of the elevator acting upward. Since the forces are all vertical, there is but one condition of equilibrium, namely, $W = R + ma$."

The objection which a student will raise to this is that if the man is really acted upon by the upward force ma, the man is really at rest and not in motion at all.

D'Alembert never attributed anything but a fictitious existence to his "reversed effective forces," and he was right and consistent all through. The real objection to his principle is that it teaches us to be dissatisfied with the actuality (viz. motion), and to seek refuge in a fiction (viz. rest). The teaching of Newton's second axiom is quite different: it accepts motion as a fact and deals with it.

The remainder of the book gives somewhat short and easily readable discussions of central orbits, motion (especially uniplanar) of rigid bodies, moments of inertia, and impulses.

OUR BOOK SHELF.

The Earliest Inhabitants of Abydos; a Craniological Study. By D. Randall-Maciver. Plates viii + tables 16. (Oxford: Clarendon Press, 1901.) Price 10*s.* 6*d.* net.

IN the present work Mr. Randall-Maciver presents to the public the craniological material which he obtained in Upper Egypt in the winter of 1899-1900, and the results which he has deduced from it. In a series of eight plates he gives us photographs of a large number of skulls which he obtained from two cemeteries at Abydos, which, he says, belonged to the earliest and the latest stages of the pre-dynastic period, and to these he adds some sixteen tables of minute craniological measurements. The first cemetery contained only pottery of the earliest forms, black-topped, polished red, and white ornamented red, and the second degraded wavy-handled vases and other pottery of well-defined classes. The remarks which Mr. Randall-Maciver makes in his short preface may be regarded as a continuation of those expressed in his "Libyan Notes," and we observe that he still holds the view that the theory of the Libyan origin of the pre-dynastic or proto-dynastic Egyptians is "based on wholly inadequate evidence." The pre-dynastic Egyptians were, he thinks, a mixed race, but as a whole that race was not Berber; on the other hand, he does not deny the existence of an original Berber substratum,

though he believes that its existence requires to be proved. A question of the kind must be decided by "expert anthropologists," for "archæology has its own place, and should recognise its own limitations; it can prove connections of culture, but not identities of race." We can only hope that the archæologists who hold different views from those of Mr. Randall-Maciver will take these observations to heart and turn from the error of their ways. It is, we must confess, a little disconcerting to find such a strictly scientific authority as Mr. Randall-Maciver reduced to suggesting that "it is well worth considering whether the pre-dynastic race of Egypt is not in the main a blending in various proportions of Semite and Negro." It is much to be hoped that his promised work on the whole subject will clear up some of its difficulties, but it seems doubtful, judging by the work of Mr. Randall-Maciver and Prof. Sergi, whether the archæologist will obtain much useful help from the craniologist.

The New Basis of Geography. A Manual for the Preparation of the Teacher. By Jacques W. Redway. Pp. xvi+226. (New York: The Macmillan Company. London: Macmillan and Co., Ltd., 1901.) Price 4*s.* 6*d.* net.

NOT that the basis is really "new," for the author, who is perhaps the most successful writer of geographical school-books in the English tongue, knows a great deal better. In his preface he says in effect that the novelty of his basis is only apparent to the ignorance of the average teachers, and the newer they find it the more shame to them. "This book," he explains, "is intended to set forth in an elementary manner the relations between human activities and geographic environment." It does so very well. The style is facile and free, permeated by an air of genial familiarity with the subject, and with the class of reader appealed to. There is a tendency to semi-epigrammatic sentences, shattered fragments of which will be recognisable in the breccia of the pupil-teacher's examination papers for a generation to come:—"War has its horrors, but it is less horrible than ignorance." "Accuracy is the one virtue that cannot possibly belong to a flat map." "It is not necessary to worry about the plane of the ecliptic."

The last proposition will probably be popular, if one may say so without disrespect to other "imaginary lines."

Mr. Redway has produced a thoroughly practical, well-informed and thoughtful book; one which can not only be read with pleasure by the teacher in the study, but practised with profit in the school. True, it does not accord with any of the "codes" in this country, but the principles it lays down will be found perfectly amenable to any pattern of red-tape harness. Stress is laid on the superiority of the method of teaching by letting the pupil discover his own facts—"The reading method might fit a young man to be a private secretary; the discovery method fits him to be the employer of private secretaries."

References to books are given as well as hints on method, and Mr. Redway is generous in commending the works of other writers. We feel sure that his strongly practical exposition of the nature and value of geographical principles will do more to promote sound geographical education than any amount of learned advocacy by theorists can ever accomplish.

Expertises et Arbitrages. By F. Rigaud. Pp. 177. (Paris: Gauthier-Villars. Masson and Co., 1901.)

IN this volume, which belongs to the Encyclopédie scientifique des Aide-Mémoire series, the author gives a *précis* of standard legal works on reports and arbitrations, and summarises the principles and laws which should be considered by arbitrators and experts more familiar with technical knowledge than law. From this practical point of view the book may prove of service.

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.*]

Note on a Point of Chemical Nomenclature.

SENIER AND GOODWIN have, in a recent paper (*Journ.* Chem. Soc. vol. lxxix. p. 258), made use of the term "alphyl" as a generic name for the aromatic radicles. The continued use of this term with the meaning attached to it by the above authors is one which may lead to some confusion. It is undoubtedly of advantage to be able to distinguish by special names fatty from aromatic radicles. With this end in view Bamberger proposed some time ago (*Berichte*, xxvii. 2583) "*alphyl*" as a general term for aromatic radicles, such as phenyl, tolyl, &c. He derived this word from "alkyl-phenyl," and as it supplied a want it was speedily adopted by investigators and appeared in scientific papers and text-books. Vorländer in 1899 (*Jour. für praktische Chemie*, lix. 247) drew attention to the possibility of error centred in the new name. As he remarked, every student of chemistry on hearing the word "alphyl" for the first time would think, not of an aromatic compound, but of one belonging to the fatty or aliphatic division. He then pointed out that *alphyl* was, on the contrary, a thoroughly suitable name for a monovalent hydrocarbon radicle of the fatty series, and that an aromatic radicle might be designated by "*arryl*."

For monovalent fatty radicles we have the name "*alkyl*" suggested years ago by J. Wislicenus and derived from "alcohol." There is no reason for superseding that term, but its meaning might with advantage be enlarged. Vorländer's proposal was that *all* monovalent hydrocarbon radicles, whether fatty or aromatic, should be called "*alkyl*" groups, this term being in opposition to "*acyl*" used by Liebermann (*Berichte*, xxi. 3372) for acid-radicles. We may then subdivide the alkyl group into fatty and aromatic divisions, giving each a special name.

The following scheme sets forth the proposed nomenclature:—

I. *Alkyl.* All monovalent hydrocarbon radicles.

(*a*) *Alphyl.* Aliphatic radicles (CH_3, C_2H_5, &c.)

(*b*) *Arryl.* Aromatic radicles (C_6H_5, &c.)

(*c*) *Alpharryl.* Aromatic radicles possessed of a fatty character (benzyl, &c.)

II. *Acyl.* Acid radicles in general ($CH_3.CO$, $C_6H_5CH_2CO$).

Bamberger, the proposer of the term "alphyl" for aromatic radicles, acknowledged the ambiguity and adopted Vorländer's proposal (*Lieb. Ann.* cccv. 289). One modification he suggested, and this was the change from "arryl" to "aryl." Since that time he has used in all his work the term "aryl" where he previously used "alphyl." This is a custom which now generally obtains in Germany, and "alphyl" in its original sense has almost altogether disappeared from papers and text-books. Should now the term "alphyl" be used in England for an aromatic radicle, it will creep again into such reference periodicals as the *Centralblatt* and there occur side by side with "alphyl" and "aryl" in their later meanings, as has already been the case, and this will lead to manifest lack of clearness and confusion. Some English chemists use "aryl" for an aromatic radicle (*cf.* Sudborough, on acetylation of arylamines, *Proc.* Chem. Soc. xvii. p. 45). It would therefore be of great advantage to agree on a uniform use of these different terms.

A. T. DE M.

Folklore about Stonehenge.

I REMEMBER, when I was a child, between seventy and eighty years ago, being told that the stones could be successfully counted only by laying a loaf of bread beside each. To mark each stone by something to prevent one being missed or counted twice over seems natural; but why a loaf of bread? Is this an idea surviving from the "*cultus lapidum*" referred to in your review of "Carnac and Stonehenge" in NATURE of September 12? I think it probable that I had this from a nursery-maid who came from Mere in Wiltshire, and who had a taste for the marvellous.

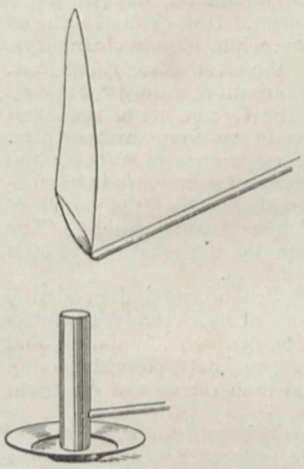
O. FISHER.

Harlton, Cambridge, October 19.

A Curious Flame.

THE following experiment with a Bunsen flame may interest some of your readers.

A Bunsen burner is lighted below and turned down so that the escaping gases will no longer burn at the upper end of the tube. The end of a glass rod is placed in the stream of gas and a lighted taper applied to it. The gas now burns steadily and the flame takes the form of a finger-stall attached by one point to the rod. A little adjustment of the gas supply may be required. A glass tube filled with water will not serve, which suggests that the rod must have a temperature of more than 100° C. Wires of any common metal may be used instead of the glass rod. It is a beautiful experiment.



The above came under my notice about six months ago when experimenting with flames, and I can find no reference to it in any book or journal. Perhaps some of your readers can give me information.

L. L. GARBUTT.

Winchester College, October 20.

THE LONDON FOG INQUIRY.

THE action of the County Council of London in devoting a sum of money for the purpose of aiding the Meteorological Council in making an inquiry into the occurrence and distribution of fogs in the London district has attracted public attention to an undertaking which is in itself of a very unambitious character. The discomforts and dangers of a London fog are indeed a loud challenge to the scientific and practical intelligence of Londoners, but what is aimed at in the present case is not any heroic attempt to deliver London from its insidious enemy, but the collection of information as to the best mode of attacking the purely meteorological question of local forecasts. In the language of the hour, it is a scouting expedition and not an attack in force.

Whether such a preliminary inquiry will of itself yield results that are either novel or valuable is still to some extent a matter of opinion. It originated in a request from the electric lighting authorities of several districts to be supplied, for obvious reasons, with forecasts or warnings from the Meteorological Office of the probable occurrence of serious fogs. Very much is already known about fogs. Apart from the special investigations of Dr. Russell and others, the students of weather maps are quite familiar with the general meteorological conditions under which fogs are likely, and recognise even more easily the conditions when they are unlikely. Besides this more or less technical knowledge, there is a large and increasing store of experience of fogs amongst the millions of dwellers in the London district. From recent circumstances I am able to say that he who would select an abode in London can obtain much curious information on the subject from friends, scientific and otherwise. It may take the form of testimony as to the relative prevalence of fog in other people's localities or its intolerable prevalence in his own, according to the temperament of the witness. It must, perhaps, be allowed that it is a rash undertaking to controvert the statement that the phenomena of London's fogs are well known.

Yet when one is brought face to face with the practical question, "Can you give us an hour's warning of the approach of a fog in any particular district?" one is driven to realise that, after all, the abundant knowledge based on the prolonged experience of many observers lacks coordination. If conditions are favourable for the occurrence of fog, which part of London will be the first to experience it? and at what rate will it spread or move to other parts? and where will it be most dense? Will it begin on the river and gradually extend to the heights, as a sea fog pours over the land? or will the heights first cover themselves with mist rolling down to the valleys? or if some locality is specially favoured as compared with others, by what numerical or percentage estimate should the advantage be estimated?

Statistical answers to these questions are clearly within reach. One year's experience will give no final statistical results, but it may at least give an indication of the possibility and prospect of obtaining such results. Some preliminary understanding must be arrived at as to the method of describing the experience of the different observers. There are fogs of many colours and of diverse character and density; some are on the surface, others, which do not come so low even as the tops of buildings, produce at noonday the darkness of night. It may be assumed that these differences of type, as well as differences of distribution, are not entirely capricious, but are related to some specific difference in the meteorological conditions, general or local, the local topography and conditions of the surface, or the local geology. All these things can also be ascertained, but whether the differences are sufficiently marked as to be recognisable in individual cases and to form a basis for forecast work is a question which, with all deference to the opinion of those who regard the phenomena of fogs as known, is worthy of investigation. Nor is it even easy, when one considers the difficulty of securing uniformity of convention among observers and uniformity of exposure of thermometers and other instruments. It is a question that requires to be approached, if confusion is to be avoided, with the intelligence of trained scientific scepticism.

The County Council, while authorising the organisation of observations at the fire stations by the staff of the fire brigade and possibly at other institutions under the control of the Council, have assigned to the Meteorological Office the responsibility for the conduct of the investigation and for providing all necessary instruments. The Office is also expected to make arrangements for observations outside the administrative County of London. The organisation of the details of such cooperation is not without its difficulties, but the cordiality with which the County Council has expressed its desire to cooperate is a weighty element in favour of the success of the attempt. It is obvious that without such cooperation the organisation of an efficient system of volunteer observations would be a matter of great labour and prolonged delay.

I have been careful to indicate the limitation of the immediate scope of the present inquiry to the collation of local observations of fog, and perhaps of temperature of air and water, with other local data and the general meteorological conditions. This is mainly a matter of appropriate organisation. There are, however, some physical aspects of the formation of vapour in the atmosphere which may be of service as a guide to the classification of the conditions of distribution of fog. In the foreefront I would place the question as to what is the source of supply of the water which is the main constituent of those fogs which are not simply wreaths of smoke. Does the water come from the ground on which the fog lies? or the air in contact with it? or from some higher or more distant region? It is a matter of common observation that a surface of relatively hot

water covers itself with drifting clouds of so-called steam. There are doubtless surface fogs which correspond to this condition, though when the evaporation is very rapid there may be, as Mr. C. T. R. Wilson has shown, a clear layer immediately in contact with the water surface. Fogs which have their origin in this mixture of the rising vapour with cooler air may be called "steaming water fogs." On the other hand, if any surface is sufficiently cold the absorption of heat from the air in contact with it may cause condensation in the air close to the surface, and fogs arising in this way may be called, for the sake of brevity, "cold-surface fogs." Vigorous radiation such as takes place on a clear night from grass may cause a fog of this character, and in regard to the persistence of a fog under these circumstances the transparency, or rather translucence, of fog for radiation is an important but not well-known factor. In these cases the source of the water supply is easily identified as being the water surface in the one case and the air in contact with the surface in the other.

Clouds, consisting of more or less detached masses of fog formed in either of these two ways, may drift like the steam from a locomotive or a sea fog over land, and a fog may thus visit a locality which has had no share in supplying the water. There is, moreover, another possibility which may be connected with the question as to why fogs are more prevalent in winter than in summer, in spite of the fact that the store of moisture in the air is larger and changes of temperature are more pronounced in the warmer months. Rain has been defined as a falling cloud which reaches the surface before the evaporation of the globules is complete. The rate of fall depends on the size of the particles, but in still atmosphere even the smallest particles make their way downward. In summer the falling cloud may consist of anything between a thunder shower and drizzling rain. In winter, when the supply of moisture is less and, over towns, the supply of nuclei for condensation is greater, the counterpart of the summer drizzle may be so light as to be classed as fog or mist, and fall with extreme slowness. In this case the water supply comes from strata above the surface. There are certainly some fogs in which there seems to be a gradual deposit of moisture on horizontal surfaces, and not merely on specially cold surfaces. It is true that winter fogs are often associated with high barometric pressure, generally a fine weather association, but under similar conditions of pressure very light rainfalls on our eastern and northern coasts are sometimes experienced. Whether electrical conditions, which are exceptional in foggy weather, may account for the formation or accelerate the falling of the cloud in such circumstances I cannot say.

If we call this third form of fog, due either to the surface drifting or the downward descent of a cloud formed above the surface, a "cloud fog," we have altogether three forms—"steaming water fogs," "cold-surface fogs" and "cloud fogs." It is evident that, of these three, two depend upon local conditions which may possibly be identified, while the third is at least much more independent of local conditions and its incidence may be as capricious as the summer cloud.

The consideration of the observations from this point of view requires more than mere organisation. It involves a special knowledge of the physics of the atmosphere applied to observations of a somewhat special kind, and may need some appropriate apparatus. It is hoped that circumstances will allow the statistical investigation to be combined with the consideration of such physical questions as those which I have indicated; but the time for arrangement is short, and it is possible that the physical side of the investigation may have to wait for a more favourable opportunity. The primary consideration at present is the suitable organisation of trustworthy observations. W. N. SHAW.

ALUMINIUM AND ITS USES.

THE number of metals available in large quantities for industrial purposes is so very small, that the successful introduction of a new one must be of the greatest interest. The affinity of aluminium for oxygen much exceeds that of iron at a red heat. Iron oxide is reduced by carbon at that temperature, while alumina cannot be reduced in this way except in the electric arc. And thus, though the ores of aluminium are more widely distributed even than those of iron, yet the former metal remained for long unknown, and until lately was comparatively rare.

About fifty years ago, the researches of Wöhler and Deville led to the latter's process for the production of aluminium on a commercial scale, in which the vapour of aluminium chloride was led over heated sodium. The price of the new metal fell rapidly, but was always high and dependent upon that of sodium.

In 1854, Bunsen and Deville showed independently that aluminium could be obtained by electrolysis from a bath containing the chlorides of both aluminium and sodium in a state of fusion, the latter chloride acting merely as a flux. But at that time the cost of electrical energy was prohibitive.

The first successful electrical process was that of Cowles, in which alumina is reduced by carbon in the electric furnace. It rapidly superseded the old chemical method, in spite of the reduction in the price of sodium by the Castner process, but had soon in its turn to give place to the processes of Hall and Héroult discovered in 1886 (though not successfully worked until some years later). In these, a bath of the fused fluorides of aluminium and sodium is employed. They occur naturally combined as cryolite; and serve, when melted, as a solvent for alumina, which by itself would, of course, be almost infusible. The alumina is electrolysed by a current introduced at a carbon anode, and further alumina is added as the metal collects at the other pole. The bath must be maintained at a red heat, and an electromotive force of somewhere about five volts is needed.

It is this process which has brought down the cost of aluminium so much of late. Other methods, as those of Blackmore and Gooch, depending upon the preparation and subsequent electrolysis of fused aluminium sulphide, are said to be yet more economical, the sulphide being much more readily decomposed than the oxide. But the saving in electrical energy does not yet seem to make up for the greater expense of working materials.

The cost of water-power, even in situations offering great natural advantages, cannot be indefinitely reduced, owing to the great capital outlay needed for hydraulic works. There is, then, little doubt that the present cost of aluminium, about eighteenpence a pound, represents roughly the lowest figure at which the Hall and Héroult processes can profitably be worked. With a density 30 per cent., and a conductivity 60 per cent. that of copper, pure aluminium conductors can transmit the same electrical energy over a given distance with only half the weight of metal. As an electrical conductor, therefore, aluminium at eighteenpence is equivalent to copper at ninepence a pound, or 84*l.* a ton, a figure considerably below what it lately reached.

It is curious to observe how entirely dependent the electrical engineering industry is upon the price and the conductivity of copper. The former largely determines the degree of success, or at all events the method of carrying out, of electrical power transmission schemes; while the latter, in conjunction with the permeability of iron, actually decides the scale upon which our electrical machinery must be built, since the output or effort for a given speed of running is always limited by the heating which occurs; and this, at full load, arises mainly from the imperfect electrical conductivity of copper.

Aluminium offers, it is true, no prospect of reduced

size of our machinery, owing to its bulk (*diameter* nearly 30 per cent. greater than equivalent copper); but it will now always act as a check upon the artificial raising of the price of copper.

The high cost of insulating materials renders it unlikely that aluminium with its greater size will ever replace copper in insulated cables. And even as a bare conductor, it is doubtful what advantage in price (together with whatever saving may come from having wires only half as heavy to handle and support) will compensate for the many disadvantages as compared with hard-drawn copper—greater liability to corrosion, difficulty of making joints, less tensile strength (even of aluminium bronze), lack of uniform quality, greater surface exposed to the wind, greater unsightliness owing to size (for trolley wires), &c.

Still, the excessive price of copper which has obtained during the last two years, and indeed till a few months ago, has led to the putting down of between one and two thousand tons of bare aluminium conductors for electric-power transmission—chiefly in America, and for very high-tension, long-distance schemes—schemes, in fact, in which the cost of the lines represents the greatest proportion of the whole expenditure.

The experience as to the behaviour of aluminium already gained from these installations is very valuable, as may be gathered from a perusal of two recent papers—one read by Messrs. Perrine and Baum before the American Institution of Electrical Engineers, and the other by Mr. Kershaw before our own similar Institution. The former writers find that, owing to a large temperature change in the elastic constant, the true coefficient of expansion of the new metal is not applicable in calculations of stresses in suspended wires having a given sag, the apparent temperature effects being much less than those calculated. Again, in the latter paper it is suggested that aluminium will not weather so well in this country as in the drier climate of America. It would seem also as if, while good soldered joints are quite possible with the metal, only welded or "burnt" joints involving no solder are durable out-of-doors, the metal being so highly electropositive, and the alloys formed near soldered joints unstable. Mechanical joints are generally used in America. The McIntyre joint is made by slipping the ends into a flat aluminium sleeve, the whole being then twisted round twice or thrice. It is doubtful whether such joints retain their initial high conductivity, in view of experience with similar joints in telegraph work. As an electrical conductor, then, it is only in those rare cases where conducting power for a given weight is wanted, *irrespective of volume*, that aluminium is without question the best material to use.

For structural purposes, the new metal has up to the present proved a little disappointing. In the first place, the pure metal is useless, being too soft. This, however, was to be expected. Pure iron is also soft. The alloys with copper up to a density of 3 include some which seem fairly strong; but the fact that cycle frames are still made of steel shows that, where strength and lightness are required together, and cost is not of great moment, steel can still hold its own, apart from its relative cheapness. No doubt, however, there is yet much to be learnt about the metallurgy of the alloys with copper, and with other elements also—nickel, tin, magnesium, &c.

A considerable demand for aluminium has grown up in connection with the manufacture of a great variety of small articles, instruments, &c. The most important uses of the metal from a commercial point of view are based upon the activity of its reactions at a high temperature. Added in small quantities to molten iron just before a cast is made, the metal is rendered more fluid and the quality of the casting thereby improved.[1] This result appears to be due to the reduction by the aluminium of any iron oxide which may be present, and to the raising of temperature of the iron itself by the heat of the action. It was stated by Swan, in a recent presidential address in Glasgow, that this use of the metal formed one of the chief outlets for the 6000 odd tons of aluminium which were manufactured last year.

The Goldschmidt process, by which the most intense heat can be produced in any required amount at a given point also depends upon the same fact, that aluminium can reduce iron oxide with energy to spare. A mixture of finely-divided aluminium and iron oxide, known as "thermit," can be ignited by a suitable fuse, and results in a quantity of molten iron heated far above the melting-point and protected from combustion by a layer of alumina. This iron, being so very greatly superheated, will serve for a variety of purposes, and its quality can be varied as required by suitable additions to the "thermit." This process was lately described and demonstrated at the Royal Institution by Roberts-Austen,[1] to whom, indeed, it is largely due. It has been applied to the welding of rail joints in position for electric traction, and to the repairing of broken and of faulty steel castings. The process has, in fact, many of the possibilities of the electric furnace, without the drawback of being dependent upon a fixed and costly electrical installation.

1 See "The Relations of Aluminium to Iron," by Godfrey Melland (*Proc.* Staff. Iron and Steel Inst., 1900).

THE OCTOBER ORIONIDS.

IN many previous years the Orionid radiant has been well defined at a point very close to, if not coinciding with, the position of the star ν Orionis (mag. 4½). The shower was very successfully observed by Prof. A. S. Herschel on about October 18–20 in the years 1864, 1865 and 1867, when the centre of divergence was found to be at 90° + 15°. A number of observations were obtained at Bristol in 1877, 1879, 1887 and other years, and the radiant derived from them was at 91° + 15°. The meteors of this shower belong to the swifter class, and they leave streaks which enable their directions of flight to be so correctly noted that the centre of emanation not only appears sharply defined, but can be very accurately located. The streaks frequently linger for two or three seconds and will sometimes very perceptibly brighten up after the heads of the meteors have vanished.

The observations in 1900 and 1901 made at Bristol show that the true Orionids were feebly represented and that, in fact, the annual shower-meteors from the old position at ν Orionis had been supplanted by a more active radiant of Geminids agreeing in place with the star ξ Geminorum (mag. 3½). On October 23–27, 1900, and October 20, 1901, I recorded about twice as many meteors from 100° + 13° as from 91° + 15°. The observations were not very numerous, but had they been far more complete there is no reason to suppose that the conclusions would have been materially affected.

The difference of 9° in the positions of the radiants at ν and ξ Orionis is sufficiently large to be immediately detected by meteoric observers though their materials are merely eye estimations. The latter are, however, unusually trustworthy, not only in the case of the Orionid display, but also in regard to some of its bordering and contemporary showers which furnish similar objects. The flash of a meteor's head as it darts rapidly along in a state of combustion attracts the eye to the point of appearance, and the streak which immediately glows along the path enables the observer to fix the apparent direction of flight with almost instrumental precision.

In the *Monthly Notices* for December 1895 (vol. lvi. p. 74) I mentioned the γ Geminids as one of the most prominent companion radiants of the Orionids and gave

1 "Metals as Fuel," Royal Institution Lecture (NATURE, August 8, 1901).

the mean position of the centre as 97°·1 + 15°·2 from thirteen observations by various observers. In the "General Catalogue of Radiant Points" (*Memoirs* R.A.S., vol. liii.) this shower forms No. lxxix. and the radiant is given at 96°·6 + 16°·5, based on nineteen observations. But there is now reason to believe that these positions are two or three degrees north of the correct place and that instead of corresponding with the star γ Geminorum it really agrees with ξ Geminorum. Certainly in 1900 and 1901 the most conspicuous shower of rapid streak-leaving meteors was directed from 100° + 13°, the position of the star ξ Geminorum for January 1901 being α = 6h. 39m. 44·0s., δ = 13° 0′ 9″·1 +.

It will be interesting to watch future returns of the October meteors in order to ascertain whether the formerly strong shower at ν Orionis has only been temporarily weak during the few past years or whether it has finally withdrawn in favour of its easterly companion radiant at ξ Geminorum. Possibly the swarm of Orionids has been recently disturbed by planetary attraction and the node displaced sufficiently to bring about a change of 9° in the radiant. If so, the principal meteoric display of October must henceforth be known as Geminids instead of Orionids. But the more probable supposition appears to be that the Orionids have been very scantily distributed along those parts of their orbit traversed by the earth in late years, whereas the neighbouring shower in Gemini has been so much stronger than usual as to form the principal display of the epoch. The Orionid system used to present itself with considerable regularity like the August Perseids, though it exhibited variations of strength in part no doubt attributable to the different atmospheric conditions prevailing, to the position and age of the moon and to other circumstances capable of affecting the visible aspect of the stream.

W. F. DENNING.

ARMOUR-CLAD WHALES.

AMONG the many wonderful palæontological discoveries that have startled the scientific world during the last few years, none, perhaps, is more unexpected than the revelation that the ancestral whales were protected from attack by a bony armour analogous to that with which the armadillos of South America are covered. Scarcely less marvellous is the fact that vestiges of this ancient coat of mail are still borne by such familiar cetaceans as the porpoise and its near relative the Japanese porpoise (*Neophocaena phocaenoides*), the latter species being distinguished by the absence of a back-fin. That creatures like the modern pelagic whales and porpoises, or even the river dolphins, could ever have been invested with a complete bony armour is, of course, an absolute impossibility. The rigidity of such a panoply would have interfered far too much with the mobility of their supple bodies, while its weight would have impaired their buoyancy. Consequently it is necessary to assume that in even the earlier representatives of these types the armour must have been in a condition of degradation and elimination, so that we must go back to still earlier forms to find it in its full development. As every one knows nowadays, whales and dolphins trace their ancestry to land animals, and it appears highly likely that when such ancestral creatures began to take to an amphibious life on the sea-shore, or at the mouth of a large river, they may have developed a dermal armour which would serve to protect them alike from the breakers and from the attacks of sharks and other marine monsters. For the idea that the terrestrial ancestors of the cetaceans were clad in armour cannot for a moment be entertained, since the primitive mammals were not so protected and the American armadillos afford an instance of the development *de novo* of such a bony panoply at a comparatively recent epoch.

Years ago the late Dr. H. Burmeister described a porpoise from Argentina as *Phocaena spinipinnis*, on account of its possessing a number of spiny tubercles embedded in the skin in the neighbourhood of the back-fin as well as on the fin itself. "Some small spines," he writes, "begin in the middle of the back, at the distance of 25 centimetres in front of the fin, as a single line of moderate spines; but soon another line begins on each side, so that in the beginning of the fin there are already three lines of spines. These three lines are continued over the whole rounded anterior margin of the fin and are augmented on both sides by other small spines irregularly scattered, so that the whole number of lines of spines in the middle of the fin is five." In a section of the skin of the back-fin the tubercles are distinctly seen, many of them being double.

Similar tubercles were described on the back-fin of a porpoise taken in the Thames in 1865; and quite recently a row of no less than twenty-five well-developed tubercles has been detected on the front edge of the back-fin of a fœtal porpoise, these tubercles being nearly white and thus showing up in marked contrast to the dark-coloured skin. Even more distinct are the tubercles in the skin of the finless back of the Japanese porpoise, where they form several rows of polygonal plates.

In a fossil porpoise (*Delphinopsis freyeri*) from the middle Tertiary deposits of Radoboj in Croatia, the tubercles were still more strongly developed, and formed a series of regularly arranged and parallel rows in the neighbourhood of the back-fin. They clearly indicate one step from the modern porpoises in the direction of a species provided with a functional bony armour in this region of the body. Between the extinct Croatian porpoise and the much more ancient whale known as *Zeuglodon*, some part of whose body was protected by a bony armour as solid as that of the giant extinct relatives of the modern armadillos, the intermediate links are at present unknown, although they may turn up any day. *Zeuglodon* was first discovered in the early Tertiary strata of the United States, but its remains have subsequently been obtained from the equivalent deposits of Egypt and elsewhere, and in early times it was probably the dominant cetacean of the world. Years ago there were discovered with the bones of the internal skeleton of this whale a number of bony plates which originally formed a dermal armour; although they were regarded as belonging to a species of leathery turtle and as having nothing to do with the whale.

But in microscopic structure, as well as in their arrangement, these polygonal bony plates differ altogether from the armour of the leathery turtle; while their structure is generally similar to the undoubted bones of *Zeuglodon* with which they are found in association. Moreover, a fragment covered on one side with armour of this type has been discovered which cannot, apparently, be any part of the shell of a turtle, but which may well be the back-fin of *Zeuglodon*. And as the aforesaid bony tubercles of the porpoises are always found on or near the back-fin, it is a safe assumption that in *Zeuglodon* the entire dorsal fin, as well as some portion of the back, was covered with a complete tessellated armour of bony plates.

The majority of the living toothed whales (inclusive of porpoises and dolphins) are furnished with a dorsal fin, and it is therefore reasonable to suppose (apart from the evidence of the specimen just referred to) that *Zeuglodon* was similarly provided; and if this be so, that cetacean was evidently a pelagic creature. For the function of a dorsal fin is to act as a kind of keel in maintaining the balance of the body, this appendage being most

developed in purely pelagic cetaceans like the killer, while in littoral or fluviatile forms, such as the narwhal, the white whale and the Japanese porpoise, it is either small or wanting. It is, further, noticeable that cetaceans with pointed muzzles (of which *Zeuglodon* is one) nearly always have a larger back-fin than those in which the muzzle is short and rounded. In the whalebone bones, among which the dorsal fin is either small or wanting, its function may be discharged by the keel on the middle of the upper jaw, or, owing to corporeal bulk, no such function is required at all.

If, then, we are right in regarding *Zeuglodon* as a pelagic cetacean, it is evident that it could not have been completely armoured, but that such armour as it retained was merely a survival from a fully armoured non-pelagic ancestor. For it is almost impossible to believe that the ancestral cetacean was not invested in a complete panoply, at least on the dorsal region.

The whole argument is tersely summed up as follows by Dr. O. Abel (*Beitr. Pal. Öster.-Ung.*, vol. xiii. pt. 4, 1901), to whom naturalists are indebted for these interesting researches.

In their earliest stage of development the toothed whales were fully armoured. The object of the armour was as a defence against enemies, such as sharks, such an armour being also very valuable to animals exposed to the force of a strong surf on rocky shores. As the creatures took more and more to an aquatic life, the acquisition of greater speed would be of greater value to them, and this would be accomplished by diminishing the specific gravity and friction of the body, the shortening of the extremities and the development of a caudal fin to serve as the sole instrument of locomotion.

t Accordingly the armour would very soon be lost by lhe pelagic cetaceans in order to diminish friction and ighten the specific gravity. Only among certain types, which diverged at an early epoch from the ancestral stock and took to a fluviatile or estuarine life, did vestiges of the armour persist, while the dorsal fin remained undeveloped (*Neophocaena*). That in this form, as well as in the closely allied true porpoises (*Phocaena*), we have the most primitive type of living toothed whales, is confirmed by the nature of their dentition, as well as by the circumstance that in this group alone the premaxilla is toothed. The relation of the interparietal to the parietals is likewise confirmatory of the antiquity of the porpoises.

As many of our readers are aware, *Zeuglodon* differs from modern cetaceans by the characters of its teeth, those of the lateral series being double-rooted and having compressed and serrated crowns, distantly recalling those of the leopard-seal. Between *Zeuglodon* and the shark-toothed dolphins (*Squalodon*) the gap is very great, but still one which might readily be bridged were the missing links forthcoming; and as it is the molars of the one type seem derivable from those of the other. In *Squalodon* the molars alone retain the double-rooted character of *Zeuglodon*, and a transition from the former, in respect of tooth characters, to the modern dolphins and porpoises is afforded by *Saurodelphis*, of the Argentine Pliocene, in which the roots of the teeth, although single, are elongated antero-posteriorly and thus display clear evidence of their original duality. By Dr. Abel, *Saurodelphis* is indeed regarded as occupying the middle position between *Squalodon* and the modern dolphins; but the porpoises are considered to form a side branch which diverged from the main stem at an earlier date than the appearance of the genus first named.

In conclusion, it may be mentioned that modern investigations tend to connect the ancestral toothed whales with the Carnivora, and in no wise support Sir William Flower's favourite idea that these cetaceans trace their descent from early Ungulates. R. L.

TIBET AND CHINESE TURKESTAN.[1]

THE geographical area illustrated by Captain Deasy's book lies in one of the most remote and, at the same time, one of the most interesting regions (regarded politically) in the whole continent of Asia.

British India (represented by Kashmir) lies south and west of it; to the north, north-east and east stretch the shadowy outlines of the "new dominion" of China and the lofty uplands of Tibet; Russia looms large to the north-west; and a long thin slice of Afghanistan reaching out an arm eastwards nearly touches it on the western border. It is an area which bristles with the physical difficulties presented by a vast array of gigantic mountain chains interspersed with flat spaces of desolate upland and salt marsh, and it is an area which those high authorities who regulate international boundaries will sooner or later find it necessary to discuss in close detail; for hereabouts exists one of the nebulous corners of the Empire. Boundary commissions have come and gone, but they have still left undecided the question how far China extends south, or Kashmir north; nor can anyone give final shape to Russia's line of boundary where she leaves Afghanistan and spreads eastward towards China. Consequently Captain Deasy's geographical work, and the interesting book in which it is described, possess a value which can only be regarded as unique. It is only by the light of his excellent map that any conclusions can be drawn as to the physical nature of this rugged no man's land, and only by the light of his description of it can any value be assigned to its apparently desolate hills and valleys. It is no small achievement for a cavalry officer to carry the principles of scouting on scientific geographical lines into such a field of difficulty and desolation as is presented by the buttressed spurs of the Kuen Lun and the Muztagh ranges.

Captain Deasy has set a most excellent example to aspiring travellers in remote regions—an example which has been lately emphasised strongly by the methods of the great traveller Sven Hedin—in the careful preparations which he made for the scientific prosecution of his work. He is not merely an observer. He has proved himself to be an advanced geographical surveyor. He first armed himself with all available data on which to base his exploration, and then attached himself to the best of all possible schools of instruction in order to learn how to make the best use of it. The result is a map which is probably quite accurate enough to take its place as the standard geographical reference for all that part of High Asia with which it deals, and which must be regarded as the most important result of his combined literary and field efforts. His observations were all worked out by the professional computers of the Indian Survey, and the results are tabulated and a record made of their value, in the appendix to his book; so that the indefinite haze which usually envelops similar records by less careful workmen is absent in Captain Deasy's work, and we know precisely what to make of it. The book, which embraces the narrative of his travels (illustrated by an excellent series of photographs), is written with the traditional modesty of a soldier, and gives a faithful and graphic account of the extraordinary difficulties which beset the travellers in the Tibetan borderland. There is no occasion to exaggerate these difficulties, or to draw on the imagination for thrilling episodes and situations. They are formidable enough to tax all the resources of ability and determination which the best of explorers may have at his command. If Captain Deasy's own description of them hardly does justice to the extraordinary obstructiveness of the ugly passes of the gigantic Tibetan ranges, his illustrations at least do not fail to make it plain. It is almost

[1] "Tibet and Chinese Turkestan." By Captain Deasy. Pp. xvi + 420. (London: T. Fisher Unwin, 1901.) Price 21*s*.

inconceivable to anyone who has not witnessed the experiment, that such passes should be negotiable at all, even if the gymnastic capacity possessed by the yak or by the coarse-bred and clumsy Yarkandi pony be duly appreciated.

Captain Deasy's narrative is a plain and simple record of a very remarkable series of explorations. It cannot fail to be interesting to all who love adventure, or who discern a future of political difficulty looming on the borders of Tibet. It is interesting to the geographer for many reasons, not only because it illustrates certain methods which should be adopted by every modern scientific traveller in Asia, but because it solves many an old geographical problem and suggests one or two new ones. Amongst other important determinations, that of the altitude of the Muztagh-Ata of Sven Hedin (which is now definitely ascertained to be 24,000 feet above sea-level) fixes the height of the highest peak north of the Himalaya. T. H. H.

FIG. 1.—Scene in the Takla Makan.

NOTES.

THE president of the Board of Education has appointed Prof. Hugh L. Callendar, F.R.S., to the professorship of physics in the Royal College of Science, South Kensington, in succession to Prof. Rücker, who, as already announced, has become principal of the University of London.

THE Duke of Devonshire has suggested a reason for the tentative way in which the problem of our educational organisation has been attacked. In opening the new Central Technical School at Liverpool on Saturday he placed the responsibility for the present state of affairs upon educational authorities, religious and political bodies, employers, workmen, parents and other representatives of the community, because "the only source of strength by which the Government could hope to surmount the difficulties would be the conviction of public opinion of the importance of education itself and the necessity for its extension and organisation." He anticipated the criticism that must be passed upon such a statement by saying "He would probably be told he was whistling for a wind; that he was asking for an expression of public opinion which would guide the Government in forming either large or small proposals on the subject of education. He did not altogether resent the imputation." It is clear from this that our Ministers acknowledge that they are not leaders so far as education is concerned. The Lord President's reference to whistling for a wind is unhappy when other nations are going full speed ahead under steam. Dr. Macnamara puts the case very forcibly in a letter to Tuesday's *Times*, where he remarks that what the British people ought to give the Government is, not a breeze, but a tornado. Something should be done to bring about this storm and so waken our rulers into activity. The education question is too important to be permitted to drift along as it has done; and even now it will be a hard task to make up the leeway. Our educational deficiencies are obvious to everyone who has given consideration to the subject. Report after report has been published showing that we only occupy a fifth-rate position when considered from the point of view of provision made to equip people for the industrial struggles of the future. The Government knows this, but it can scarcely appreciate the fact that national progress depends upon intellectual equipment, or it would hasten to do something to organise and extend our educational system.

THE following is the text of the address of congratulation presented to Prof. Virchow, on the occasion of his eightieth birthday, by those members of the Anthropological Section of the British Association who were present at the recent Glasgow

meeting:—"British Association for the Advancement of Science: the Section of Anthropology to Prof. Rudolph Virchow:—It seldom falls to the lot of one man to establish a position, as you have done, as a leader in two great branches of science. Throughout the world you are generally recognised as the founder of modern pathology, whilst in the domain of anthropology your services have been hardly less remarkable. Whenever anthropologists meet together, your name is mentioned with the respect a d reverence that are due to a great master. At the present moment the British Association for the Advancement of Science is holding its annual meeting in Glasgow, and the members of the Anthropological Section, aware that you celebrate your eightieth birthday on October 14, desire to convey to you their affectionate greetings, and to express the hope that you may be spared to add yet further to the indebtedness which they owe to you as a worker in the same field. Signed on behalf of the committee of the Anthropological Section, D. J. Cunningham, president, J. L. Myers, recorder. Glasgow, September 11, 1901." The address, richly engrossed, was presented personally to Prof. Virchow by Lord Lister in the course of the celebration ceremony at Berlin.

To remove any misapprehension as to his opinion upon the result of M. Santos Dumont's recent aërial performance, M. Deutsch has written him a letter stating that he considers the trip to have been completely successful and that the prize has been won. M. Deutsch sent M. Santos Dumont at the same time the sum of 1000*l.*, which the latter has handed to the Prefect of Police for distribution among the poor of Paris. The committee's decision concerning the prize of 4000*l.* has not yet been announced.

SIR H. TRUEMAN WOOD will deliver the next Christmas Juvenile Lectures at the Society of Arts, the subject being "Photography and its Applications." The idea will be to show in what a large number of cases photography has been applied to scientific observation, and how varied are the applications. The subject is an interesting one and ought to prove very attractive. The dates of the lectures are January 1 and 8.

SIR HIRAM S. MAXIM confirms the observation mentioned in our issue of October 17 (p. 607) of the attraction which certain sounds have for mosquitoes. Writing to the *Times*, he states that one of the electric lamps which he put up at Saratoga Springs, New York, in 1878, emitted a musical note; or rather the note proceeded from the box containing the dynamo machine under the lamp. One evening whilst examining the lamp he found that everything in the immediate vicinity was covered with small insects. They did not appear to be attempting to get into the globe, but into the box that was giving out the musical note. A close examination of these insects showed that they were all male mosquitoes. Although there were certainly 200 times as many female mosquitoes on the ground as males, not a single female mosquito was found to have been attracted in the least by the sound. Sir Hiram Maxim remarks that "when the lamps were started in the beginning of the evening every male mosquito would at once turn in the direction of the lamp, and, as it were, face the music, and then fly off in the direction from which the sound proceeded. It then occurred to me that the two little feathers on the head of the male mosquito acted as ears, that they vibrated in unison with the music of the lamp, and as the pitch of the note was almost identical with the buzzing of the female mosquito the male took the music to be the buzzing of the female."

PROF. E. RAY LANKESTER has been elected a corresponding member of the Royal Society of Sciences of Göttingen.

THE exhibits of the German Chemical Industry Section at the Paris Exposition, valued at 30,000*l.*, have, it is said, been presented to the Technological Institute of the Berlin University.

MR. G. W. DE TUNZELMANN has been appointed editor of *Science Abstracts* in succession to Mr. W. R. Cooper, and will take over the duties of the office on January 1 next.

A SICILIAN agricultural exhibition is, according to a Consular Report, to be held at Palermo from March to May next. There will be a class for international agricultural machinery.

THE new specimens added to the Museum of Anatomy and Pathology at University College, Gower Street, will be on view until November 2.

THE Bradshaw lecture will be given before the Royal College of Physicians on November 5 at 5 p.m., by Dr. J. S. Bury. The subject will be "Prognosis in Relation to Disease of the Nervous System."

On Tuesday next, November 5, the president of the Institution of Civil Engineers will deliver his inaugural address, distribute the council's awards, and hold a reception. The meeting will take place at 8 p.m.

THE Lettsomian lectures of the Medical Society of London will be delivered on February 17 and March 3 and 17 next, at 9 p.m., by Mr. A. Pearce Gould, who will take as his subject "Certain Diseases of the Blood Vessels." The annual oration will be delivered on May 26 by Dr. Stephen Mackenzie.

ACCORDING to the *British Medical Journal*, Surgeon-Gen. Wyman, of the U.S. Marine Hospital Service, proposes to establish an institute for the study of yellow fever. The work will be divided into four departments or sections, viz., history and statistics, etiology, transmission, quarantine and treatment. An executive board is to have general charge of the investigations and the publication of reports.

A DETAILED account of the relationship between mosquitoes and the spread of yellow fever is given in the Paris *Bulletin Medical* by Dr. H. de Gouvèa, who studied the subject for many years in Brazil. Dr. Gouvèa shows that the conditions of propagation of the disease have always been such as to fulfil the requirements of the mosquito hypothesis, and to afford abundant indirect evidence in favour of the belief which has now been reached by more direct methods. In conclusion, he formulates a series of propositions—namely, that yellow fever is never conveyed by either direct or indirect contagion; that the actual cause of it, at present unknown, will in all probability be discovered in the human blood; that it is diffused only by the agency of the mosquito, *Culex toeniatus* or *fasciatus*; and that immunity from it may be secured by the destruction of these insects, or by avoidance of their haunts during the periods of their activity.

A DIFFICULTY has arisen concerning the site on which the new Pasteur statue in Paris shall be erected. The use of a space in the Square Médicis in the Quartier Latin has been granted, but this spot is being tunnelled for a railway, and it is feared, in consequence, that the statue may be too weighty for it. Other places, such as the Place du Panthéon, the Place de la Sorbonne, and the entrance of the Avenue de l'Observatoire, are under consideration.

A COMMITTEE of the Association of Chambers of Commerce meeting recently unanimously adopted the following resolutions:—"(1) That, after considering various suggestions, this committee is unanimously of opinion that the Chambers should unite in urging upon the Government the compulsory adoption of the metrical system of weights and measures, leaving matters of detail to be considered later. (2) That the committee is unanimously of opinion that a British decimal system of coinage must be on the basis of retaining the sovereign, with the florin as a unit, divided into a hundred cents or farthings. (3) The

committee recommends that there should be nickel coins of five and ten cents, and bronze coins of one, two and four cents or farthings."

MEETINGS of the committee appointed by the Board of Trade to inquire and report as to the best means by which the State or local authorities can assist scientific research as applied to problems affecting the fisheries of Great Britain and Ireland took place on Tuesday, Wednesday and Thursday of last week for the purpose of taking evidence. Sir Herbert Maxwell, M.P., presided. Dr. T. Wemyss Fulton, scientific superintendent to the Scottish Fishery Board, and Mr. E. W. L. Holt, scientific adviser to the fisheries branch of the Department of Agriculture, &c., Ireland, were examined, and Mr. G. C. Bompas and Prof. G. B. Howes gave evidence with regard to the Buckland fish collection at South Kensington. Prof. E. Ray Lankester, the president, and Mr. E. J. Allen, the director, of the Marine Biological Association, and Mr. R. A. Dawson, superintendent under the Lancashire and Western Sea Fisheries Committee, also attended. Prof. Herdman, who is a member of the committee, submitted a scheme for fishery investigations in the Irish Sea, and the committee adjourned till December 3.

MR. J. STIRLING, Government Geologist, &c., Victoria, is to lecture at the Imperial Institute on November 18, on "Brown Coal Beds of Victoria, their Characters, Extent and Commercial value"; on December 9 Mr. D. Hutcheon, chief veterinary surgeon for Cape Colony, is to speak on "Agricultural Prospects of Cape Colony," and on December 16 Mr. H. N. Ridley, director of the Botanic Gardens, Singapore, will deliver an address on "The Economic Resources of the Straits Settlements and the Malay Peninsula." All the meetings will take place at 8.30 p.m.

THE provisional programme of the new session of the Royal Geographical Society has just been issued and contains the following arrangements:—November 11, the opening address by the president, and "The Uganda Protectorate, Ruwenzori and the Semliki Forest," by Sir Harry Johnston, K.C.B.; November 25, "Four Years' Travel and Survey in Persia," by Major Molesworth Sykes; December 9, "The Glaciers of Kanchinjunga," by Mr. Douglas W. Freshfield. Among the other papers which it is expected will be delivered during the session may be mentioned:—"A Journey from Omdurman to Mombasa by Lake Rudolf," by Major H. H. Austin, R.E.; "The Maldives," by Mr. J. Stanley Gardiner; "Journeys in Western China," by Dr. R. L. Jack; "The Influence of Geographical Conditions on History and Religion, with special reference to Asia Minor," by Prof. W. M. Ramsay; "An Expedition across Abyssinia, through Kaffa and the Region to the West and North," by Mr. Oscar Neumann; "Southwards on the Antarctic Ship *Discovery*," by Mr. George Murray, F.R.S., and Dr. H. R. Mill; "The Bedford Level and Experimental Demonstration of the Rotundity of the Earth," by Mr. H. Yule Oldham; "The Snows of Canada," by Dr. Vaughan Cornish; "A Journey from Quetta to Meshed by the new Nushki Trade Route," by the Earl of Ronaldshay; "The Ice Conditions of the Antarctic," by M. Henryk Arctowski; "Methods and Appliances in the Teaching of Geography. Special Lecture for Teachers," by Mr. A. W. Andrews.

AN exhibition of scientific apparatus constructed by pupils and teachers of the London School Board for the purpose of teaching and illustrating some of the branches of experimental science is opened to-day at the Examination Hall, Victoria Embankment, and will remain open until Monday next. No charge is made for entrance, and the Board invite the inspection of the exhibits. Among the latter are to be found induction coils, telegraph instruments, motors, voltameters, galvanometers, Boyle's tubes, balances, and lantern and microscopic slides. There will also be shown dissections in a preservative spirit, such as a skate's ear, sheep's kidney, rabbit's lung, &c.

PROF. BASHFORD DEAN, says *Science*, has returned to Columbia University, bringing with him from the east an almost complete series of developmental stages of the Port Jackson shark, *Heterodontus japonicus*, a number of stages in the development of Chlamydoselachus, two new Myxinoids, a new Chimæra, together with a general zoological collection. During a visit to the Hokkaido (Yezo), he brought together several hundred specimens of Aino antiquities, which are now deposited in the American Museum of Natural History in New York. He also secured a collection of interesting glass sponges from the region of Misaki, which are also destined for the American Museum. Among other specimens are included a number illustrating artificial selection, a series of the highly specialised varieties of Japanese gold fishes, together with a number of the long-tailed fowls of Tosa, whose tail feathers sometimes reach the extraordinary length of fifteen feet. For the Columbia collection he obtained during a visit in southern Negros, P.I., a series of dissections of Nautilus, prepared from fresh material.

THE steam yacht *Antarctic* called at Falmouth on Saturday last and left on the same day with the members of the Swedish Antarctic Expedition on board. The leader of the expedition is Dr. Otto Nordenskjöld, whose work in Tierra del Fuego and Spitsbergen is well known to geographers. Other members are Captain Larsen; Dr. A. Ohlin and Mr. K. Anderson, zoologists; Mr. C. Skottsberg, botanist; Dr. G. Bodman, magnetician and hydrographer; and Dr. E. Ekelöf, medical officer and bacteriologist. From an article in the *Times* we learn that the vessel will proceed direct to Buenos Ayres, and thence by Staten Island (where the instruments will be compared with those of the Argentine scientific station) and the Falkland Islands, to the South Shetlands and the east coast of Graham Land (King Oscar Land), where, if a suitable spot for the winter quarters can be found, a station will be established for six or seven persons, under the command of Dr. Nordenskjöld himself, and observations carried out in harmony with those of the British and German expeditions. If, however, suitable quarters cannot be obtained, the winter station will be established somewhat further north. In any case, the ship, with two or three of the scientific observers, will return to South America and the Falkland Islands for the winter, after the best possible use has been made of the Antarctic summer.

A SHORT account of Antarctic exploration, and of the problems which still await solution by systematic observations in South Polar regions, is contributed to the October *Quarterly Review*. The German and British ships, the *Gauss* and the *Discovery*, have each been described as the best which have ever left on voyages of discovery, but the *Quarterly* reviewer demurs to this estimate, and remarks that Admiral Makaroff regards both the vessels as at least half a century behind the times. A steel ship like the great icebreaker *Ermack* is suggested as more serviceable than wooden vessels. "All who have inspected the *Ermack*, or have made a voyage in her, will probably admit that she is the most powerful and efficient vessel afloat for exploration, and the best equipped and most convenient for scientific observation and research. Should the Tzar send this splendid ship to the Antarctic seas next season her operations would most certainly result in large additions to knowledge in directions which cannot be attempted by the *Discovery* and the *Gauss*."

FROM the point of view of modern shipbuilding, the opinion expressed in the foregoing note upon the *Discovery* as a ship for scientific exploration is probably correct, but for obvious reasons it was impossible to design and build a vessel regardless of

expense. From despatches just received by Sir Clements Markham from the Cape, it appears that the *Discovery* must be accounted a poor sailer, though she has proved to be a good sea boat. Her coal consumption is, however, disappointing, the economy of the engines being less than was expected. The ship leaked from causes which can no doubt be obviated, but the defect has necessitated clearing the holds to construct floors with an ample bilge space beneath, so that the provision cases be preserved from injury. These facts accentuate the importance of providing a relief ship to communicate with the *Discovery* at the end of the first winter, to take out coals and stores, and to render assistance in other ways. A strong appeal is to be made to supplement the funds already subscribed for this purpose. The sum of 6680*l.* has been obtained, but a further amount of 10,000*l.* is required, and this should be secured without delay.

A STRIKING testimony as to the value of Dr. Calmette's antivenene is to be found in an extract from a report by the medical officer on an Indian railway line which the current issue of the *Lancet* contains. "On the night of the 23rd [of August] I was called," says the medical man in question, "to see a coolie woman who had been bitten by a large snake supposed to be a cobra. She was said to have been bitten at about 7 p.m. and I did not see her till two hours later. She was then practically moribund, the throat paralysed, and consciousness completely lost. All the symptoms of poisoning by colubrine venom were well marked. I injected a full dose of Dr. Calmette's antivenene, but was not sanguine as to the result, the patient's condition being apparently hopeless. The effect of the remedy was marvellous; consciousness returned in fifteen minutes, and I was so encouraged by the result of the first injection that I decided to give another dose of the serum. It acted like magic and within three hours of the first injection the patient was well."

WE have received from Signor Palazzo, director of the Italian Meteorological Service, an account of the organisation of special stations for the study of hail and thunder storms and for carrying on further experiments as to the possibility of dispersing thunder clouds by gun firing. Although scientific men are very sceptical about the efficacy of the practice, the majority of Italian agriculturists are very enthusiastic in the matter, and the Government has consequently voted 10,000 lire for the establishment of two shooting stations in the most suitable localities and has provided them with the most sensitive instruments for predicting the advance of the storms, and with means for tracing their course and the amount of damage caused. Up to the present time the results obtained are contradictory; in some cases the firing appears to have had a favourable effect, while in others the firing apparatus itself has been choked by the falling hail. The inquiry will, at all events, be useful in throwing light upon the propagation and characteristics of thunderstorms.

THE twenty-third annual report of the Deutsche Seewarte, for the year 1900, shows that the subject of maritime meteorology has been prosecuted with increased activity; 75 complete log-books were received from the Navy and 472 from the mercantile marine, in addition to which 299 abstract logs containing less complete observations were received. The consulates in various parts of the world, including several in this country, act as agencies for meteorological purposes. The observations are published in the form of tabular results referring to ten-degree squares, or districts of the ocean, and are utilised in the construction of the daily synoptic weather charts of the North Atlantic. The department dealing with weather telegraphy is also very active, and has made great endeavours to improve the service by the introduction of direct interchange of reports made at 7h. instead of 8h. a.m., a practice which is being followed by most countries, whereby weather information is disseminated earlier than before, with a consequent increase of utility. In this matter Dr. Neumayer has been very ably supported by Dr. van Bebber, the superintendent of the section engaged in weather prediction.

MANY attempts have been made to generalise the methods of "casting out" the nines or elevens so as to obtain in a simple form the criterion of divisibility of high numbers by factors other than 9 or 11. For example, we have the well-known test for divisibility by 7 or 13 which consists in pointing the given number off in thousands and subtracting the sum of the numbers in one set of alternate groups from the sum of those in the other set. Such generalisations date as far back as a paper in the works of Blaise Pascal published in 1779. Prof. Gino Loria, writing in the *Atti dei Lincei*, x. 7, now gives an investigation of the criteria of divisibility by any integer in a comparatively simple form.

A SERIES of experiments on the period of a rod vibrating in a liquid is described by Mary J. Northway and A. Stanley Mackenzie in the *Physical Review* for September. The lowering of pitch, which is, of course, due mainly to the inertia of the fluid particles, is found in these experiments to conform to the following general approximate results:—The interval of lowering for a rod of given cross section is independent of the length. It is also approximately the same for brass and steel and is probably independent of the material within the range of substances ordinarily used. The interval of lowering for a rod of given width is approximately inversely proportional to the thickness, while for a rod of given thickness it is approximately directly proportional to the width. From the experiments, which were made both in water and cotton-seed oil, the authors calculate for the rods of different section the coefficient by which the mass of the displaced liquid must be multiplied in order, when added to the mass of the solid, to represent the effect of fluid inertia, *i.e.* the well-known coefficient which is proved in hydrodynamics to be unity for a cylinder and one half for a sphere moving in perfect fluid. The rods used in these experiments appear to have had a rectangular cross section. It would be interesting to inquire whether they had sharp edges, and under what conditions such edges tend to increase the damping of the oscillations.

THOSE engaged in or about to commence the production of coloured pictures by means of a camera will find much to interest them in the catalogue of apparatus, material and appliances which has just been received from Messrs. Sanger Shepherd and Co. In the process under consideration, many of the difficulties that were conspicuous in the Ives process have been eliminated, so that the procedure is in the reach of every photographer and the equipment required reduced to a minimum. By using the very carefully adjusted colour filters and printing-colours of exactly the correct absorption, which are here placed within the reach of anyone, and by providing oneself with the repeating back for the three separate negatives, a perfectly efficient outfit is secured. To make the coloured pictures, full instructions are added in a special pamphlet. The ordinary lantern may be used for throwing the pictures on the screen, and brilliant discs up to 12 feet diameter can be shown with the ordinary oxyhydrogen limelight; and with the electric arc discs up to 20 or 30 feet. A further pamphlet of Messrs. Cadett and Neall, Ltd., contains a concise account of the object of orthochromatic photography and the principles underlying its use.

WE have received reprints of an important paper by Mr. Thomas H. Holland on the Sivamalai series of elæolite-syenites and corundum-syenites in the Coimbatore district, Madras Presidency (*Mem.* Geol. Surv. India, vol. xxx. part iii., 1901). The elæolite-syenites are accompanied by augite-syenites containing

olivine and other minerals. These rocks are also associated with others made up principally of felspar (albite and orthoclase), containing large quantities of well-crystallised, generally tabular, corundum, which is extracted by the villagers near the junction of the felspar-rock with the elæolite-syenite. It is remarked that the association of rocks is remarkably similar to that described in eastern Ontario, and also in the Urals.

THE methods of improving ocean bars are discussed by Mr. Lewis M. Haupt in the *Proceedings* of the American Philosophical Society for July in connection with the proposed improvements at Brunswick Outer Bar, Georgia. There are at least five methods available for creating navigable channels, namely, by the use of dynamite, by a single jetty, by a single curved breakwater, by twin jetties, and by dredging. Of the several methods proposed for bar removal by the use of single or double jetties or by the reaction breakwater, the latter, so far as it has been tested, fulfils better than any other the conflicting requirements of harbour entrances, costs less than half as much, and is far cheaper to maintain.

M. CHARLES RABOT publishes, in the August and September numbers of *La Geographie*, a full summary of the chief contributions to the literature of limnology which have appeared during the past year. The work done in each country is dealt with under a separate heading, and the paper includes a review of Prof. Forel's "Handbuch der Seenkunde."

THE *National Geographic Magazine* for September contains an article on "German Geographers and German Geography," by Dr. Martha Krug Genthe. A summary is given of the work associated with the names of Behaim, Kant, Humboldt, Ritter, Berghaus, Richthofen and Ratzel, and some account of the present position of geography in German education. The magazine also contains a note by Mr. R. Muldrow on Mount McKinley, in Alaska, the highest mountain in North America. A series of theodolite measurements from points on a stadia line run up the Shushitna River gives the position of the mountain in lat. 63° 5′ N., long. 151° 0′ W., and its height at 20,464 feet.

THE September number of *Naturen*, the excellent popular journal issued by the Bergen Museum, contains an article on the dipper, and a second on the European bison.

IN the *Memorias y Revista* "Antonio Alzate," Señor L. Herrera publishes the second instalment of his remarkable scheme for an abbreviated biological and mineralogical nomenclature.

IN the October issue of the *Zoologist* Mr. L. J. Bevir discusses Dante as a naturalist, while the Rev. H. A. Macpherson contributes some interesting particulars with regard to the work of early ornithologists.

The Zambesi Mission Record usually contains one or more articles dealing with science in a popular manner. The issue for the current month has a very readable illustrated communication entitled "A Chat about Snakes," from the pen of the Rev. J. O'Neil.

ACCORDING to the October issue of *The Naturalist*, the members of the Yorkshire Naturalists' Club enjoyed a most successful outing at Wykeham, near Scarborough, on June 22. Perhaps the feature of the day was the number of fritillary butterflies seen on the wing.

MESSRS. W. AND G. S. WEST have completed their alga-flora of Yorkshire in the *Transactions* of the Yorkshire Naturalists' Union. The enumeration makes up 1044 species.

AMONG the lectures to be delivered at the Royal Victoria Hall, Waterloo Road, during the month of November we notice the following:—November 5, "Lightning and other forms of the Electric Discharge," by Prof. A. W. Porter; November 26, "Student Life in Germany," by Dr. A. W. Crossley.

THE syllabus of the Hampstead Scientific Society for 1901–2 has reached us, and gives promise of a full and interesting session. The opening meeting will be held on November 1, when the president, Sir Richard Temple, will deliver an address.

THOSE of our readers who are on the look-out for cheap scientific books should see the new catalogue of remainders, &c., which has just been issued by Mr. H. J. Glaisher, of Wigmore Street, W. In it are to be found the titles of very many such works at greatly reduced prices.

THE following American botanical publications have been received:—"The Willows of Alaska," by Frederick V. Colville, from the *Proceedings* of the Washington Academy of Sciences; and the "Violet-rusts of North America," by J. C. Arthur and E. W. D. Holday, reprinted from the *Minnesota Botanical Studies*. They consist of three species, *Aecidium pedatum*, *Puccinia Violae*, and *P. effusa*.

THE *Journal* of the Royal Microscopical Society for October contains a further instalment of Mr. F. W. Millett's report on the recent foraminifera of the Malay Archipelago collected by Mr. A. Durrand. The summary of current researches is noteworthy as indicating the attention now being paid to the construction of microtomes, no less than seven new instruments or improvements on old instruments being described. Abstracts are given of a number of recently published important papers on microscopic metallography, several of them illustrated by half-tone plates.

TWO papers by Ciamician and Silber have appeared in recent numbers of the *Berichte*, which describe a series of interesting experiments on the action of light in promoting mutual oxidation and reduction between organic compounds. This change is specially interesting in connection with the chemical effects brought about by light in plant life. The oxidising agent is represented by a ketone, diketone or aldehyde, those of the aromatic series being the most active. They undergo reduction into alcohol or pinacone. The reducing agent is an alcohol or ordinary ether, the alcohol being converted into aldehyde or ketone. The product of oxidation of ether has not been determined. Thus quinone dissolved in ethyl alcohol, sealed up and exposed to sunlight, gives quinol and aldehyde; quinone and isopropyl alcohol give quinol and acetone; glycerol is oxidised to glycerose (dioxyacetone), erythritol to erythrose, &c. On the other hand, benzophenone in presence of alcohol is reduced to benzopinacone, benzaldehyde to hydrobenzoin, &c. Curiously enough, even such stable substances as the paraffins and benzene undergo oxidation with quinone, black products being obtained, which have not yet been investigated. Still more remarkable is the action of light on ortho-nitrobenzaldehyde either dry or dissolved in various solvents. It is then converted into ortho-nitrosobenzoic acid $C_6H_4(NO_2)COH = C_6H_4(NO).COOH$. In presence of methyl or ethyl alcohol, the corresponding ester is formed. Under like conditions, meta-nitrobenzaldehyde gives resinous products, and the para-compound remains for the greater part unchanged.

THE additions to the Zoological Society's Gardens during the past week include a Ruff (*Machetes pugnax*), European, presented by Mr. W. H. Dobie; six Common Pheasants (*Phasianus colchicus*, white var.), British, presented by Sir J. Haggerston, Bart.; a Bronze-winged Parrot (*Pionus chalcopterus*) from Colombia, a Naked-footed Owlet (*Athene noctua*), European, deposited; four North African Jackals (*Canis anthus*), two Fennec Foxes (*Canis cerdo*) from North Africa, received in exchange.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN NOVEMBER.

Nov. 2. 2h. 55m. to 6h. 8m. Transit of Jupiter's Sat. III.
3. 9h. 33m. Minimum of Algol (β Persei).
3. 12h. 4m. to 12h. 30m. Moon occults ω Leonis (mag. 5·6).
6. 6h. 22m. Minimum of Algol (β Persei).
9. 7h. 13m. Transit (ingress) of Jupiter's Sat. III.
10. Annular eclipse of the sun, invisible at Greenwich.
14–15. Epoch of Leonid meteoric shower (radiant 150° +22°).
15. 8h. Jupiter in conjunction with moon. Jupiter 4° 44′ S.
15. 10h. Saturn in conjunction with moon. Saturn 4° 21′ S.
15. Venus. Illuminated portion of disc = 0·591, of Mars = 0·967.
17. 18h. Venus in conjunction with Jupiter. Venus 2° 45′ S.
18. 19h. Venus in conjunction with Saturn. Venus 3° 12′ S.
20. 17h. Mercury at greatest elongation west, 19° 42′.
23. 11h. 15m. Minimum of Algol (β Persei).
24. Epoch of Andromedid meteoric shower (radiant 24° + 43°).
25. 8h. 11m. to 9h. 0m. Moon occults B.A.C. 1240 (mag. 5·7).
25. 17h. 14m. to 18h. 7m. Moon occults D.M. + 18°, 624 (mag. 5·9).
26. 8h. 4m. Minimum of Algol (β Persei).
27. 10h. 41m. to 10h. 54m. Moon occults 71 Orionis (mag. 5·1).
27. 18h. Jupiter in conjunction with Saturn. Jupiter 0° 27′ S.
28. 19h. 18m. to 20h. 6m. Moon occults 68 Geminorum (mag. 5·0).
30. 9h. 54m. to 10h. 24m. Moon occults κ Cancri (mag. 5·0).

PERIOD OF MIRA (ο CETI).—In the *Astronomische Nachrichten* (Bd. 157, No. 3745), Herr P. Guthnick classifies many of the available observations of this star, and from them deduces a mean value of the period. Sets of specially bright or faint maxima and minima are grouped together, the frequent long gaps, however, making the detailed form of the light curve somewhat uncertain. The minima may be determined from the formula

1883 January 12·09 + 331d·3359 E.

An ephemeris is given showing the predicted times of maxima and minima for the next twenty years.

Maxima		Minima
1901 July 9·0	...	1901 March 5·8
1904 March 30·2	...	1902 Jan. 31·1
1905 Feb. 25·0	...	1902 Dec. 28·5
1906 Jan. 22·4	...	1903 Nov. 24·8
1906 Dec. 19·6	...	1904 Oct. 21·2
	...	1905 Sept. 17·5
	...	1906 Aug. 14·8

THE POSSIBLE IMPROVEMENT OF THE HUMAN BREED UNDER THE EXISTING CONDITIONS OF LAW AND SENTIMENT.[1]

IN fulfilling the honourable charge that has been entrusted to me of delivering the Huxley lecture, I shall endeavour to carry out what I understand to have been the wish of its founders, namely, to treat broadly some new topic belonging to a class in which Huxley himself would have felt a keen interest, rather than to expatiate on his character and the work of his noble life.

That which I have selected for to-night is one which has occupied my thoughts for many years, and to which a large part of my published inquiries have borne a direct though silent reference. Indeed, the remarks I am about to make would serve as an additional chapter to my books on "Hereditary Genius" and on "Natural Inheritance." My subject will be the possible improvement of the human race under the existing conditions of law and sentiment. It has not hitherto been approached along the ways that recent knowledge has laid open, and it occupies in consequence a less dignified position in scientific estimation than it might. It is smiled at as most desirable in itself and possibly worthy of academic discussion, but absolutely out of the question as a practical problem. My aim in this lecture is to show cause for a different opinion. Indeed I hope to induce anthropologists to regard human improvement as a subject that should be kept openly and squarely in view, not only on account of its transcendent importance, but also because it affords excellent but neglected fields for investigation. I shall show that our knowledge is already sufficient to justify the pursuit of this perhaps the grandest of all objects, but that we know less of the conditions upon which success depends than we might and ought to ascertain. The limits of our knowledge and of our ignorance will become clearer as we proceed.

Human Variety.—The natural character and faculties of human beings differ at least as widely as those of the domesticated animals, such as dogs and horses, with whom we are familiar. In disposition some are gentle and good-tempered, others surly and vicious; some are courageous, others timid; some are eager, others sluggish; some have large powers of endurance, others are quickly fatigued; some are muscular and powerful, others are weak; some are intelligent, others stupid; some have tenacious memories of places and persons, others frequently stray and are slow at recognising. The number and variety of aptitudes, especially in dogs, is truly remarkable; among the most notable being the tendency to herd sheep, to point and to retrieve. So it is with the various natural qualities that go towards the making of civic worth in man. Whether it be in character, disposition, energy, intellect, or physical power, we each receive at our birth a definite endowment, allegorised by the parable related in St. Matthew, some receiving many talents, others few; but each person being responsible for the profitable use of that which has been entrusted to him.

Distribution of Qualities in a Nation.—Experience shows that while talents are distributed in endless different degrees, the frequency of those different degrees follows certain statistical laws, of which the best known is the Normal Law of Frequency. This is the result whenever variations are due to the combined action of many small and different causes, whatever may be the causes and whatever the object in which the variations occur, just as twice 2 always makes 4, whatever the objects may be. It therefore holds true with approximate precision for variables of totally different sorts, as, for instance, stature of man, errors made by astronomers in judging minute intervals of time, bullet marks around the bull's-eye in target practice, and differences of marks gained by candidates at competitive examinations. There is no mystery about the fundamental principles of this abstract law; it rests on such simple fundamental conceptions as, that if we toss two pence in the air they will, in the long run, come down one head and one tail twice as often as both heads or both tails. I will assume then, that the talents, so to speak, that go to the formation of civic worth are distributed with rough approximation according to this familiar law. In doing so, I in no way disregard the admirable work of Prof. Karl Pearson on the distribution of qualities, for which he was adjudged the Darwin Medal of the Royal Society a few years ago. He has amply proved that we must not blindly trust the Normal Law of Frequency; in fact, that when variations are minutely studied they rarely fall into that perfect symmetry about the mean value which is one of its consequences. Nevertheless, my conscience is clear in using this law in the way I am about to. I say that *if* certain qualities vary normally, such and such will be the results; that these qualities are of a class that are found, whenever they have been tested, to vary normally to a fair degree of approximation, and consequently we may infer that our results are trustworthy indications of real facts.

A talent is a sum whose exact value few of us care to know, although we all appreciate the inner sense of the beautiful parable. I will, therefore, venture to adapt the phraseology of the allegory to my present purpose by substituting for "talent" the words "normal-talent." The value of this normal talent in respect to each and any specified quality or faculty is such that one-quarter of the people receive for their respective shares more than one normal-talent *over and above* the average of all the shares. Our normal-talent is therefore identical with what is technically known as the "probable error." Therefrom the

[1] The second Huxley Lecture of the Anthropological Institute, delivered by Francis Galton, D.C.L., D.Sc., F.R.S., on October 29, 1901.

whole of the following table starts into life, evolved from that of the "*probability integral.*" It expresses the distribution of

TABLE I.—*Normal Distribution* (*to the nearest* per *ten-thousand and to the nearest* per *hundred*).

	−4°	−3°	−2°	−1°	M	+1°	+2°	+3°	+4°		Total
v and below	*u*	*t*	*s*	*r*	R	S	T	U	V and above.		
35	180	672	1613	2500	2500	1613	672	180	35		10,000
2		7	16	25	25	16	7	2			100

any normal quality, or any group of normal qualities, among 10,000 persons in terms of the normal-talent. The M in the upper line occupies the position of Mediocrity, or that of the average of what all have received: the + 1°, + 2°, etc., and the − 1°, − 2°, etc., refer to normal talents. These numerals stand as graduations at the heads of the vertical lines by which the table is divided. The entries between the divisions are the numbers per 10,000 of those who receive sums between the amounts specified by those divisions. Thus, by the hypothesis, 2500 receive more than M but less than M + 1°, 1613 receive more than M + 1° but less than M + 2°, and so on. The terminals have only an inner limit, thus 35 receive more than 4°, some to perhaps a very large but indefinite amount. The divisions might have been carried much farther, but the numbers in the classes between them would become less and less trustworthy. The left half of the series exactly reflects the right half. As it will be useful henceforth to distinguish these classes, I have used the *capital* or large letters R, S, T, U, V, for those above mediocrity and corresponding *italic* or small letters, *r*, *s*, *t*, *u*, *v*, for those below mediocrity, *r* being the counterpart of R, *s* of S, and so on.

In the lowest line the same values are given, but more roughly, to the nearest whole percentage.

It will assist in comprehending the values of different grades of civic worth to compare them with the corresponding grades of adult male stature in our nation. I will take the figures from my "Natural Inheritance," premising that the distribution of stature in various peoples has been well investigated and shown to be closely normal. The average height of the adult males, to whom my figures refer, was nearly 5 feet 8 inches, and the value of their "normal-talent" (which is a measure of the spread of distribution) was very nearly 1¾ inches. From these data it is easily reckoned that Class U would contain men whose heights exceed 6 feet 1¼ inches. Even they are tall enough to overlook a hatless mob, while the higher classes, such as V, W and X, tower above it in an increasingly marked degree. So the civic worth (however that term may be defined) of U-class men, and still more of V-class, are notably superior to the crowd, though they are far below the heroic order. The rarity of a V-class man in each specified quality or group of qualities is as 35 in 10,000, or say, for the convenience of using round numbers, as 1 to 300. A man of the W class is ten times rarer, and of the X class rarer still; but I shall avoid giving any more exact definition of X than as a value considerably rarer than V. This gives a general but just idea of the distribution throughout a population of each and every quality taken separately so far as it is normally distributed. As already mentioned, it does the same for *any* group of normal qualities; thus, if marks for classics and for mathematics were severally normal in their distribution, the combined marks gained by each candidate in both those subjects would be distributed normally also, this being one of the many interesting properties of the law of frequency.

Comparison of the Normal Classes with those of Mr. Booth.—Let us now compare the normal classes with those into which Mr. Charles Booth has divided the population of all London, in a way that corresponds not unfairly with the ordinary conception of grades of civic worth. He reckons them from the lowest upwards, and gives the numbers in each class for East London. Afterwards he treats all London in a similar manner, except that sometimes he combines two classes into one and gives the joint result. For my present purpose, I had to couple them somewhat differently, first disentangling them as I best could. There seemed no better way of doing this than by assigning to the members of each couplet the same proportions that they had in East London. Though this was certainly not accurate, it is probably not far wrong. Mr. Booth has taken unheard-of pains in this great work of his to arrive at accurate results, but he emphatically says that his classes cannot be separated sharply from one another. On the contrary, their frontiers blend, and this justifies me in taking slight liberties with his figures. His class A consists of criminals, semi-criminals, loafers and some others, who are in number at the rate of 1 per cent. in all London—that is 100 per 10,000, or nearly three times as many as the *v* class: they therefore include the whole of *v* and spread upwards into the *u*. His class B consists of very poor persons who subsist on casual earnings, many of whom are inevitably poor from shiftlessness, idleness or drink. The numbers in this and the A class combined closely correspond with those in *t* and all below *t*.

TABLE II.—*Comparison of Mr. Booth's Classification of All London with the Normal Classes.*

Nos.	Mr. Booth's classes.	Approx	Resorted.	Approx.	Nos.	Normal classes.
97	H. All above G	100	100	100	89	T and above
200	G. Lower middle ... ... F. High-class labour above 30*s.* per week	200	150 50	150	161	S
382	E. Regular standard earnings from 22*s.* to 30*s.* per week	400	200 200	250	250	R
227	D. Regular earnings under 22*s.* per week ... .. C. Intermittent earnings, improvident, poor	200	50 150	250 150	250 161	*r* *s*
94	B. Casual; very poor ... ... A. Criminals, loafers, &c.	100	100	100	89	*t* and below
1000		1000		1000	1000	

The two columns headed "Nos." give respectively the numbers per thousand in Mr. Booth's and in the normal classes.

Class C are supported by intermittent earnings; they are a hard-working people, but have a very bad character for improvidence and shiftlessness. In Class D the earnings are regular, but at the low rate of twenty-one shillings or less a week, so none of them rise above poverty, though none are very poor. D and C together correspond to the whole of *s* combined with the lower fifth of *r*. The next class, E, is the largest of any, and comprises all those with regular standard earnings of twenty-two to thirty shillings a week. This class is the recognised field for all forms of cooperation and combination; in short for trades unions. It corresponds to the upper four-fifths of *r* and the lower four-fifths of R. It is therefore essentially the mediocre class, standing as far below the highest in civic worth as it stands above the lowest class with its criminals and semi-criminals. Next above this large mass of mediocrity comes the honourable class *F*, which consists of better paid artisans and foremen. These are able to provide adequately for old age, and their sons become clerks and so forth. *G* is the lower middle class of shop-keepers, small employers, clerks and subordinate professional men, who as a rule are hard-working, energetic and sober. F and G combined correspond to the upper fifth of R and the whole of S, and are, therefore, a counterpart to D and C. All above G are put together by Mr. Booth into one class H, which corresponds to our T, U, V and above, and is the counterpart of his two lowermost classes, A and B. So far, then, as these figures go, civic worth is distributed in fair approximation to the normal law of frequency. We also see that the classes *t*, *u*, *v* and below are undesirables.

Worth of Children.—The brains of the nation lie in the higher of our classes. If such people as would be classed W or X could be distinguishable as children and procurable by money in order to be reared as Englishmen, it would be a cheap bargain for the nation to buy them at the rate of many hundred or some thousands of pounds per head. Dr. Farr, the eminent statistician, endeavoured to estimate the money worth of an average baby born to the wife of an Essex labourer and thenceforward living during the usual time and in the ordinary way of his class. Dr. Farr, with accomplished actuarial skill, capitalised the value at the child's birth of two classes of events, the one the cost of maintenance while a child and when helpless through old age, the other its earnings as boy and man. On balancing the two sides of the account the value of the baby was found to be five pounds. On a similar principle, the worth of an X-class baby would be reckoned in thousands of pounds. Some such "talented" folk fail, but most succeed, and many succeed greatly. They found great industries, establish vast undertakings, increase the wealth of multitudes and amass large fortunes for themselves. Others, whether they be rich or poor, are the guides and light of the nation, raising its tone, enlightening its difficulties and imposing its ideals. The great gain that England received through the immigration of the Huguenots would be insignificant to what she would derive from an annual addition of a few hundred children of the classes W and X. I have tried, but not yet succeeded to my satisfaction, to make an approximate estimate of the worth of a child at birth according to the class he is destined to occupy when adult. It is an eminently important subject for future investigators, for the amount of care and cost that might profitably be expended in improving the race clearly depends on its result.

Descent of Qualities in a Population.—Let us now endeavour to obtain a correct understanding of the way in which the varying qualities of each generation are derived from those of its predecessor. How many, for example, of the V class in the offspring come respectively from the V, U, T, S and other classes of parentage? The means of calculating this question for a normal population are given fully in my "Natural Inheritance." There are three main senses in which the word parentage might be used. They differ widely, so the calculations must be modified accordingly. (1) The amount of the quality or faculty in question may be known in each parent. (2) It may be known in only one parent. (3) The two parents may belong to the same class, a V-class father in the scale of male classification always marrying a V-class mother, occupying identically the same position in the scale of female classification.

I select this last case to work out as being the one with which we shall here be chiefly concerned. It has the further merit of escaping some tedious preliminary details about converting female faculties into their corresponding male equivalents, before men and women can be treated statistically on equal terms. I shall assume in what follows that we are dealing with an ideal population, in which all marriages are equally fertile, and which is statistically the same in successive generations both in numbers and in qualities, so many per cent. being always this, so many always that, and so on. Further, I shall take no notice of offspring who die before they reach the age of marriage, nor shall I regard the slight numerical inequality of the sexes, but will simply suppose that each parentage produces one couplet of grown-up filials, an adult man and an adult woman.

The result is shown to the nearest whole per thousand in the diagram up to "U and above," and in the table up to "V and

TABLE III.—*Descent of Qualities in a Population.* (*The difference between the sexes only affects the value of the Unit of the Scale of Distribution*).

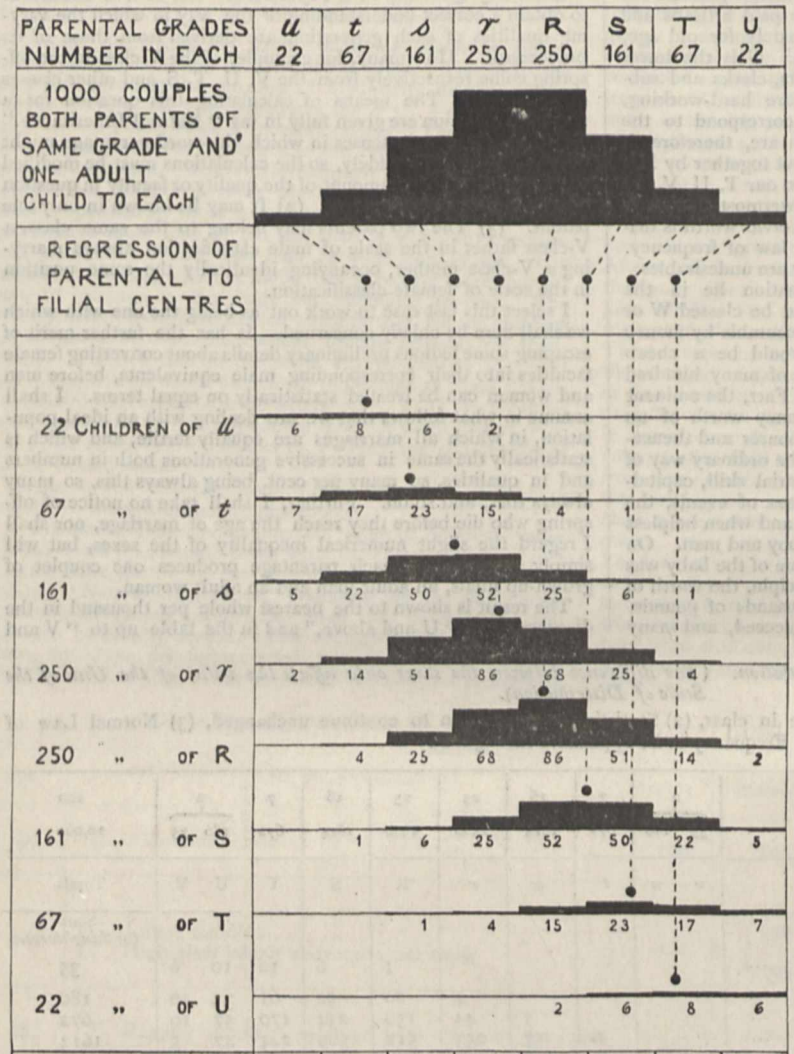
Conditions.—(1) Parents to be always alike in class, (2) Statistics of population to continue unchanged, (3) Normal Law of Frequency to be applicable throughout.

Per 100 Fathers (or *Mothers*).			2		7	16	25	25	16	7	2		100
Per 10,000 ,, ,,			35	180	671	1614	2500	2500	1614	672	180	35	10,000
Names of classes			*v*	*u*	*t*	*s*	*r*	R	S	T	U	V	Totals
Sons (or *Daughters*)	of 35	Fathers (or *Mothers*) of class V ...						1	6	12	10	6	35
,,	180	,, ,, U ...					4	20	52	61	33	10	180
,,	671	,, ,, T ...				7	44	150	234	170	57	10	672
,,	1614	,, ,, S ...			6	57	253	512	509	224	47	5	1613
,,	2500	,, ,, R ..		3	42	248	678	860	510	140	18	3	2502
,,	2500	,, ,, *r* ..	3	18	140	510	860	678	248	42	3		2502
,,	1614	,, ,, *s* ...	5	47	224	509	512	253	57	6			1613
,,	671	,, ,, *t* ...	10	57	170	234	150	44	7				672
,,	180	,, ,, *u* ...	10	33	61	52	20	4					180
,,	35	,, ,, *v* ...	6	10	12	6	1						35
Total 10,000 Fathers (or *Mothers*)			34	168	655	1623	2522	2522	1623	655	168	34	10,004
,, 100 ,, ,, ...			2		7	16	25	25	16	7	2		

Note.—The agreement in distribution between fathers (or *mothers*) and sons (or *daughters*) is exact to the nearest whole per centage. The slight discrepancy in the ten-thousandths is mainly due to the classes being too few and too wide; theoretically they should be extremely numerous and narrow.

above," to the nearest ten-thousandth. They may be read either as applying to fathers and their sons when adult, or to mothers and their daughters when adult, or, again, to parentages and filial couplets. I will not now attempt to explain the details of the calculation to those to whom these methods are new. Those who are familiar with them will easily understand the exact process from what follows. There are three points of reference in a scheme of descent which may be respectively named "mid-parental," "genetic" and "filial" centres. In the present case of both parents being alike, the position of the mid-parental centre is identical with that of either parent separately. The position of the filial centre is that from which the children disperse. The genetic centre occupies the same position in the parental series that the filial centre does in the filial series. "Natural Inheritance" contains abundant proof, both observational and theoretical, that the genetic centre is not and cannot be identical with the parental centre, but is always more mediocre, owing to the combination of ancestral influences—which are generally mediocre—with the purely parental ones. It also shows that the regression from the parental to the genetic centre, in the case of stature at least, would amount to two-thirds under the conditions we are now supposing. The regression is indicated in the diagram by converging lines which are directed towards the same point below, but are stopped at one-third of the distance on the way to it. The contents of each parental class are supposed to be concentrated at the foot of the median axis of that class, this being the vertical line that divides its contents into equal parts. Its position is approximately, but not exactly, half-way between the divisions that bound it, and is as easily calculated for the extreme classes, which have no outer terminals, as for any of the others. These median points are respectively taken to be the positions of the parental centres of the whole of each of the classes; therefore the positions attained by the converging lines that proceed from them at the points where they are stopped, represent the genetic centres. From these the filials disperse to the right and left with a "spread" that can be shown to be three-quarters that of the parentages. Calculation easily determines the number of the filials that fall into the class in which the filial centre is situated, and of those that spread into the classes on each side. When the parental contributions from all the classes to each filial class are added together they will express the distribution of the quality among the whole of the offspring. Now it will be observed in the table that the numbers in the classes of the offspring are identical with those of the parents, when they are reckoned to the nearest whole percentage, as should be the case according to the hypothesis. Had the classes been narrower and more numerous, and if the calculations had been carried on to two more places of decimals, the correspondence would have been identical to the nearest ten-thousandth. It was unnecessary to take the trouble of doing this, as the table affords a sufficient basis for what I am about to say. Though it does not profess to be more than approximately true in detail, it is certainly trustworthy in its general form, including as it does the effects of regression, filial dispersion, and the equation that connects a parental generation with a filial one when they are statistically alike. Minor corrections will be hereafter required, and can be applied when we have a better knowledge of the material. In the meantime it will serve as a standard table of descent from each generation of a people to its successor.

STANDARD SCHEME OF DESCENT



Economy of Effort.—I shall now use the table to show the economy of concentrating our attention upon the highest classes. We will therefore trace the origin of the V class—which is the highest in the table. Of its 34 or 35 sons, 6 come from V parentages, 10 from U, 10 from T, 5 from S, 3 from R, and none from any class below R. But the numbers of the contributing parentages have also to be taken into account. When this is done, we see that the lower classes make their scores owing to their quantity and not to their quality; for while 35 V-class parents suffice to produce 6 sons of the V class, it takes 2500 R-class fathers to produce 3 of them. Consequently the richness in produce of V-class parentages is to that of the R-class in an inverse ratio, or as 143 to 1. Similarly, the richness in produce of V-class children from parentages of the classes U, T, S, respectively, is as 3, 11½ and 55, to 1. Moreover, nearly one-half of the produce of V-class parentages are V or U taken together, and nearly three-quarters of them are either V, U or T. If then we desire to increase the output of V-class offspring, by far the most profitable parents to work upon would be those of the V class, and in a threefold less degree those of the U class.

When both parents are of the V class the quality of parentages is greatly superior to those in which only one parent is a

V. In that case the regression of the genetic centre goes twice as far back towards mediocrity, and the spread of the distribution among filials becomes nine-tenths of that among the parents, instead of being only three-quarters. The effect is shown in Table IV.

TABLE IV.—*Distribution of Sons.* (1) *One parent of class* V., *the other unknown.* (2) *Both parents of class* V (*from Table II., with decimal point and an* 0).

	Distribution of Sons								Total
	t	*s*	*r*	R	S	T	U	V	
One V-parent ...	0·3	1·2	3·5	7·9	9·6	7·5	3·6	1·3	34·3
Two V-parents				3·0	5·0	10·0	10·0	6·0	34·0

Position of the filial centre of (1) = 1·44, of (2) = 2·89. When both parents are T it = 1·58.

There is a difference of fully two divisions in the position of the genetic centre, that of the single V parentage being only a trifle nearer mediocrity than that of the double T. Hence it would be bad economy to spend much effort in furthering marriages with a high class on only one side.

Marriage of Like to Like.—In each class of society there is a strong tendency to intermarriage, which produces a marked effect in the richness of brain power of the more cultured families. It produces a still more marked effect of another kind at the lowest step of the social scale, as will be painfully evident from the following extracts from the work of Mr. C. Booth (i. 38), which refer to his Class A, who form, as has been said, the lowermost third of our "*v* and below." "Their life is the life of savages, with vicissitudes of extreme hardship and occasional excess. From them come the battered figures who slouch through the streets and play the beggar or the bully. They render no useful service, they create no wealth; more often they destroy it. They degrade whatever they touch, and as individuals are perhaps incapable of improvement . . . but I do not mean to say that there are not individuals of every sort to be found in the mass. Those who are able to wash the mud may find some gems in it. There are at any rate many very piteous cases. Whatever doubt there may be as to the exact numbers of this class, it is certain that they bear a very small proportion to the rest of the population, or even to Class B, with which they are mixed up and from which it is at times difficult to separate them. . . . They are barbarians, but they are a handful. . . ." He says further, "It is much to be desired and to be hoped that this class may become less hereditary in its character; there appears to be no doubt that it is now hereditary to a very considerable extent."

Many who are familiar with the habits of these people do not hesitate to say that it would be an economy and a great benefit to the country if all habitual criminals were resolutely segregated under merciful surveillance and peremptorily denied opportunities for producing offspring. It would abolish a source of suffering and misery to a future generation, and would cause no unwarrantable hardship in this.

Diplomas.—It will be remembered that Mr. Booth's classification did not help us beyond classes higher than S in civic worth. If a strong and widely felt desire should arise, to discover young men whose position was of the V, W or X order, there would not be much difficulty in doing so. Let us imagine, for a moment, what might be done in any great University, where the students are in continual competition in studies, in athletics, or in public meetings, and where their characters are publicly known to associates and to tutors. Before attempting to make a selection, acceptable definitions of civic worth would have to be made in alternative terms, for there are many forms of civic worth. The number of men of the V, W or X classes whom the University was qualified to contribute annually must also be ascertained. As was said, the proportion in the general population of the V class to the remainder is as 1 to 300, and that of the W class as 1 in 3000. But students are a somewhat selected body because the cleverest youths, in a scholastic sense, usually find their way to Universities. A considerably high level, both intellectually and physically, would be required as a qualification for candidature. The limited number who had not been automatically weeded away by this condition might be submitted in some appropriate way to the independent votes of fellow-students on the one hand, and of tutors on the other, whose ideals of character and merit necessarily differ. This ordeal would reduce the possible winners to a very small number, out of which an independent committee might be trusted to make the ultimate selection. They would be guided by personal interviews. They would take into consideration all favourable points in the family histories of the candidates, giving appropriate hereditary weight to each. Probably they would agree to pass over unfavourable points, unless they were notorious and flagrant, owing to the great difficulty of ascertaining the real truth about them. Ample experience in making selections has been acquired even by scientific societies, most of which work well, including perhaps the award of their medals, which the fortunate recipients at least are tempted to consider judicious. The opportunities for selecting women in this way are unfortunately fewer, owing to the smaller number of female students between whom comparisons might be made on equal terms. In the selection of women, when nothing is known of their athletic proficiency, it would be especially necessary to pass a high and careful medical examination; and as their personal qualities do not usually admit of being tested so thoroughly as those of men, it would be necessary to lay all the more stress on hereditary family qualities, including those of fertility and prepotency.

Correlation between Promise in Youth and subsequent Performance.—No serious difficulty seems to stand in the way of classifying and giving satisfactory diplomas to youths of either sex, supposing there were a strong demand for it. But some real difficulty does lie in the question—Would such a classification be a trustworthy forecast of qualities in later life? The scheme of descent of qualities may hold good between the parents and the offspring at similar ages, but that is not the information we really want. It is the descent of qualities from men to men, not from youths to youths. The accidents that make or mar a career do not enter into the scope of this difficulty. It resides entirely in the fact that the development does not cease at the time of youth, especially in the higher natures, but that faculties and capabilities which were then latent subsequently unfold and become prominent. Putting aside the effects of serious illness, I do not suppose there is any risk of retrogression in capacity before old age comes on. The mental powers that a youth possesses continue with him as a man; but other faculties and new dispositions may arise and alter the balance of his character. He may cease to be efficient in the way of which he gave promise, and he may perhaps become efficient in unexpected directions.

The correlation between youthful promise and performance in mature life has never been properly investigated. Its measurement presents no greater difficulty, so far as I can foresee, than in other problems which have been successfully attacked. It is one of those alluded to in the beginning of this lecture as bearing on race-improvement, and being on its own merits suitable for anthropological inquiry. Let me add that I think its neglect by the vast army of highly educated persons who are connected with the present huge system of competitive examinations to be gross and unpardonable. Neither schoolmasters, tutors, officials of the Universities, nor of the State department of education, have ever to my knowledge taken any serious step to solve this important problem, though the value of the present elaborate system of examinations cannot be rightly estimated until it is solved. When the value of the correlation between youthful promise and adult performance shall have been determined, the figures given in the table of descent will have to be reconsidered.

Augmentation of Favoured Stock.—The possibility of improving the race of a nation depends on the power of increasing the productivity of the best stock. This is far more important than that of repressing the productivity of the worst. They both raise the average, the latter by reducing the undesirables, the former by increasing those who will become the lights of the nation. It is therefore all important to prove that favour to selected individuals might so increase their productivity as to warrant the expenditure in money and care that would be necessitated. An enthusiasm to improve the race would probably express itself by granting diplomas to a select class of young men and women, by encouraging their intermarriages, by hastening the time of marriage of women of that high class, and by provision for rearing children healthily. The means that might

be employed to compass these ends are dowries, especially for those to whom moderate sums are important, assured help in emergencies during the early years of married life, healthy homes, the pressure of public opinion, honours, and above all the introduction of motives of religious or quasi-religious character. Indeed, an enthusiasm to improve the race is so noble in its aim that it might well give rise to the sense of a religious obligation. In other lands there are abundant instances in which religious motives make early marriages a matter of custom, and continued celibacy to be regarded as a disgrace, if not a crime. The customs of the Hindoos, also of the Jews, especially in ancient times, bear this out. In all costly civilisations there is a tendency to shrink from marriage on prudential grounds. It would, however, be possible so to alter the conditions of life that the most prudent course for an X class person should lie exactly opposite to its present direction, for he or she might find that there were advantages and not disadvantages in early marriage, and that the most prudent course was to follow their natural instincts.

We have now to consider the probable gain in the number and worth of adult offspring to these favoured couples. First as regards the effect of reducing the age at marriage. There is unquestionably a tendency among cultured women to delay or even to abstain from marriage; they dislike the sacrifice of freedom and leisure, of opportunities for study and of cultured companionship. This has to be reckoned with. I heard of the reply of a lady official of a College for Women to a visitor who inquired as to the after life of the students. She answered that one-third profited by it, another third gained little good, and a third were failures. "But what becomes of the failures?" "Oh, hey marry."

There appears to be a considerable difference between the earliest age at which it is physiologically desirable that a woman should marry and that at which the ablest, or at least the most cultured, women usually do. Acceleration in the time of marriage, often amounting to 7 years, as from 28 or 29 to 21 or 22, under influences such as those mentioned above, is by no means improbable. What would be its effect on productivity? It might be expected to act in two ways:—

(1) By shortening each generation by an amount roughly proportionate to the diminution in age at which marriage occurs. Suppose the span of each generation to be shortened by one-sixth, so that six take the place of five, and that the productivity of each marriage is unaltered, it follows that one-sixth more children will be brought into the world during the same time, which is, roughly, equivalent to increasing the productivity of an unshortened generation by that amount.

(2) By saving from certain barrenness the earlier part of the child-bearing period of the woman. Authorities differ so much as to the direct gain of fertility due to early marriage that it is dangerous to express an opinion. The large and thriving families that I have known were the offspring of mothers who married very young.

The next influence to be considered is that of healthy homes. These and a simple life certainly conduce to fertility. They also act indirectly by preserving lives that would otherwise fail to reach adult age. It is not necessarily the weakest who perish in this way, for instance, zymotic disease falls indiscriminately on the weak and the strong.

Again, the children would be healthier and therefore more likely in their turn to become parents of a healthy stock. The great danger to high civilisations, and remarkably so to our own, is the exhaustive drain upon the rural districts to supply large towns. Those who come up to the towns may produce large families, but there is much reason to believe that these dwindle away in subsequent generations. In short, the towns sterilise rural vigour.

As one of the reasons for choosing the selected class would be that of hereditary fertility, it follows that the selected class would respond more than other classes to the above influences.

I do not attempt to appraise the strength of the combined six influences just described. If each added one-sixth to the produce the number of offspring would be doubled. This does not seem impossible considering the large families of colonists, and of those in many rural districts; but it is a high estimate. Perhaps the fairest approximation may be that these influences would cause the X women to bring into the world an average of one adult son and one adult daughter *in addition* to what they would otherwise have produced. The table of descent applies to one son or to one daughter per couple; it may now be read as specifying the net gain and showing its distribution. Should this estimate be thought too high, the results may be diminished accordingly.

It is no absurd idea that outside influences should hasten the age of marrying and make it customary for the best to marry the best. A superficial objection is sure to be urged that the fancies of young people are so incalculable and so irresistible that they cannot be guided. No doubt they are so in some exceptional cases. I lately heard from a lady who belonged to a county family of position that a great aunt of hers had scandalised her own domestic circle two generations ago by falling in love with the undertaker at her father's funeral and insisting on marrying him. Strange vagaries occur, but considerations of social position and of fortune, with frequent opportunities of intercourse, tell much more in the long run than sudden fancies that want roots. In a community deeply impressed with the desire of encouraging marriages between persons of equally high ability, the social pressure directed to produce the desired end would be so great as to ensure a notable amount of success.

Profit and Loss.—The problem to be solved now assumes a clear shape. A child of the X class (whatever X signifies) would have been worth so and so at its birth, and one of each of the other grades respectively would have been worth so and so; 100 X parentages can be made to produce a net gain of 100 adult sons and 100 adult daughters who will be distributed among the classes according to the standard table of descent. The total value of the prospective produce of the 100 parentages can then be estimated by an actuary, and consequently the sum that it is legitimate to spend in favouring an X parentage. The clear and distinct statement of a problem is often more than half way towards its solution. There seems no reason why this one should not be solved between limiting values that are not too wide apar to be useful.

Existing Activities.—Leaving aside profitable expenditure from a purely money point of view, the existence should be borne in mind of immense voluntary activities that have nobler aims. The annual voluntary contributions in the British Isles to public charities alone amount, on the lowest computation, to fourteen million pounds, a sum which Sir H. Burdett asserts on good grounds is by no means the maximum obtainable. ("Hospitals and Charities," 1898, p. 85.)

There are other activities long since existing which might well be extended. I will not dwell, as I am tempted to do, on the endowments of scholarships and the like, which aim at finding and educating the fittest youths for the work of the nation; but I will refer to that wholesome practice during all ages of wealthy persons interesting themselves in and befriending poor but promising lads. The number of men who have owed their start in a successful life to help of this kind must have struck every reader of biographies. This relationship of befriender and befriended is hardly to be expressed in English by a simple word that does not connote more than is intended. The word "patron" is odious. Recollecting Dr. Johnson's abhorrence of the patrons of his day, I turned to an early edition of his dictionary in hope of deriving some amusement as well as instruction from his definition of the word, and I was not disappointed. He defines "patron" as "a wretch who supports with insolence and is repaid with flattery." That is totally opposed to what I would advocate, namely a kindly and honourable relation between a wealthy man who has made his position in the world and a youth who is avowedly his equal in natural gifts, but who has yet to make it. It is one in which each party may well take pride, and I feel sure that if its value were more widely understood it would become commoner than it is.

Many degrees may be imagined that lie between mere befriendment and actual adoption, and which would be more or less effective in freeing capable youths from the hindrances of narrow circumstances; in enabling girls to marry early and suitably, and in securing favour to their subsequent offspring. Something in this direction is commonly but half unconsciouly done by many great landowners whose employments for man and wife, together with good cottages, are given to exceptionally deserving couples. The advantage of being connected with a great and liberally managed estate being widely appreciated, there are usually more applicants than vacancies, so selection can be exercised. The consequence is that the class of men found upon these properties is markedly superior to those in similar positions elsewhere. It might well become a point of honour, and as much an avowed object, for noble families to gather fine specimens of humanity around them, as it is to

procure and maintain fine breeds of cattle and so forth, which are costly, but repay in satisfaction.

There is yet another existing form of princely benevolence which might be so extended as to exercise a large effect on race improvement. I mean the provision to exceptionally promising young couples of healthy and convenient houses at low rentals. A continually renewed settlement of this kind can be easily imagined, free from the taint of patronage, and analogous to colleges with their self-elected fellowships and rooms for residence, that should become an exceedingly desirable residence for a specified time. It would be so in the same way that a good club by its own social advantages attracts desirable candidates. The tone of the place would be higher than elsewhere, on account of the high quality of the inmates, and it would be distinguished by an air of energy, intelligence, health and self-respect and by mutual helpfulness.

Prospects.—It is pleasant to contrive Utopias, and I have indulged in many, of which a great society is one, publishing intelligence and memoirs, holding yearly elections, administering large funds, establishing personal relations like a missionary society with its missionaries, keeping elaborate registers and discussing them statistically with honest precision. But the first and pressing point is to thoroughly justify any crusade at all in favour of race improvement. More is wanted in the way of unbiased scientific inquiry along the many roads I have hurried over, to make every stepping-stone safe and secure, and to make it certain that the game is really worth the candle. All I dare hope to effect by this lecture is to prove that in seeking for the improvement of the race we aim at what is apparently possible to accomplish, and that we are justified in following every path in a resolute and hopeful spirit that seems to lead towards that end. The magnitude of the inquiry is enormous, but its object is one of the highest man can accomplish. The faculties of future generations will necessarily be distributed according to laws of heredity, whose statistical effects are no longer vague, for they are measured and expressed in formulæ. We cannot doubt the existence of a great power ready to hand and capable of being directed with vast benefit as soon as we shall have learnt to understand and to apply it. To no nation is a high human breed more necessary than to our own, for we plant our stock all over the world and lay the foundation of the dispositions and capacities of future millions of the human race.

OCEAN CIRCULATION.[1]

THE investigation carried on by Mr. H. N. Dickson into the distribution of temperature and salinity in the surface water of the North Atlantic is one of great importance. It promises, if continued, to be of considerable value, not only to those who are especially interested in studying the circulation of the surface water of the Ocean, but also to meteorologists generally and particularly to those who see, in a comparison of the varying yearly temperatures of the North Atlantic with that of a mean for the season, the key to a clearer knowledge of the causes which combine to influence the climate of western Europe, and especially of our Islands, and who look hopefully in that direction for information whereby future modifications in the conditions of climate may be foretold for periods some time in advance.

The treatise before us, setting forth the author's method of conducting the research and the results at which he arrived, was contributed to the Royal Society in March, 1900.

In introducing his subject the author says: "The history of our knowledge of the currents of the North Atlantic Ocean up to the year 1870 has been written once for all by Petermann," whom he quotes at some length, remarking "that the conclusions, then arrived at, were not modified by the observations of the next twenty years."

During the years 1896 and 1897 materials were collected for preparing the charts of temperature and salinity, the parallel of 40° N. being selected as the southern boundary of the area for investigation. The observations of temperature were furnished by the Meteorological Office, the Danish Meteorological Department, the United States Hydrographical Department, and the Bureau Central Météorologique de France, and by Prof. Pettersson. The samples of water for the determination of salinity were obtained from the captains of vessels keeping logs for the Meteorological Office and for the Danish Hydrographical Department, specially made bottles being supplied to them for the purpose, and no care being spared in guarding against impurity or the introduction of any matter that could give rise to error in the analytical determinations.

The accuracy of the method adopted in estimating the salinity of the samples was subjected to severe scrutiny. The author states the results of his observations, demonstrating the distribution of temperature and salinity for each month during the year 1896 as shown in the charts prepared by him, in which the isotherms and isohalines are supplemented by a scale of colouring denoting areas having the same range of temperature and the same range of salinity. He calls attention to the general agreement between the distribution of salinity as shown on the one set of charts and that of temperature as shown on the other set when apparent, and notes departures and irregularities when they occur. He then deals in the same manner with the observations of 1897 and compares results.

Taking the means of each month respectively for the two years, the distribution of temperature, as shown on these charts, corresponds fairly well with the distribution of sea-surface temperature given on the quarterly sea-temperature charts on the North Atlantic, issued by the Meteorological Office in 1884.

For the purpose of defining the limits of ocean currents and of arriving at some estimate as to its relative velocity in different localities, the information to be gained by the thermometer is invaluable, for over areas little frequented by shipping where current observations are necessarily sparse, a comparatively insignificant number of sea-surface observations will suffice to indicate the existence or failure of an ocean stream; and if to these detective signs be added observations of salinity, the evidence acquired becomes still more complete.

The effects of the cold water from the north in deflecting the warm stream from the westward are clearly shown on these charts, which, when seasonal variation in temperature has been made allowance for, appear in good agreement (speaking generally) with the monthly current charts of the North Atlantic, published by the Admiralty, as regards the area over which the warm water of the Gulf Stream is distributed each month, and the northern and western limits to which it reaches. The indications of the existence of Gulf Stream water, stated roughly, may be traced on the Admiralty Chart to the following limits in the given months:—

January.—The stream does not reach to the eastward of 20° W., and a south-easterly set is apparent off Ireland.

February.—In 55° N. it reaches 15° W.; a south-easterly set is found to the westward of Ireland, and a south-westerly to the south-westward of the Fastnet Rock.

March.—It has advanced to the coast of Ireland.

April.—In 55° N. its limit has receded to 20° W., and the Iceland south-going current begins to show itself north of 55° N.

May.—The Gulf Stream and Davies Strait cold current commingle in 47° N. 27° W., the Iceland current sets S. and S.W. to 48° N. 30° W.

June.—Gulf Stream to 15° W. in 52° N. Iceland and Denmark Strait cold currents to Irish coast.

July.—To the S. of 50° N. it joins the Iceland and Denmark Strait current in about 48° N. off the Bay of Biscay.

August.—It extends to the north of Ireland but is modified in about 20° W. by a south-going set.

September.—It extends to the north of Scotland.

October.—It is found in 10° W. in 59° N.

November.—The data are insufficient, but the Stream is traceable to 19° W. in 59° N.

December.—It is difficult to trace the Stream eastward of 40° N. in 45° W. A south-going cold current is shown to the north-westward and westward of Ireland; there is a persistent southerly (S.E. to S.W.) movement of water in the eastern half of the Atlantic.

Mr. Dickson's charts show the existence of Gulf Stream water to the northward and westward of the limits given above for several months, notably on the January chart, and the explanation doubtless is that the value of the current being small, it has been inappreciable in navigation.

There exists, during the greater part of the year, a movement of water eastward, which divides, at a varying distance to the westward of the English Channel. One arm branches towards the Bay of Biscay, the other northward (Rennell's Current). The latter is well known to the captains of the large

[1] *Phil. Trans.* of the Royal Society:—"The Circulation of the Surface Waters of the North Atlantic Ocean." By H. N. Dickson.

Transatlantic liners, who are accustomed to make allowance for it when shaping their course to sight the Fastnet. This current is well shown on the author's temperature charts for several months.

In dealing with the question of causation, the author summarises as follows: "The general circulation of the North Atlantic is therefore the result of a large number of factors, each of which is subject to wide variation. From a consideration of the mean results in its relation to the mean atmospheric circulation, it appears that the oceanic circulation is directly controlled by the winds, the form, position and intensity of the whole Atlantic anticyclone and of the cyclonic area to the north of it being taken into account. The movements of water set up directly by these systems are modified by, firstly and chiefly, the configuration of the land, and, secondly, by the effects of melting ice." And again: "The key to the position seems to be the Atlantic anticyclone which controls the low-pressure areas, both directly and indirectly, by its far-reaching effect on the oceanic circulation; and it seems scarcely likely that the causes modifying this system are confined to the Atlantic, even if they are to be found at the surface at all."

It would be regrettable if this work, so ably and successfully inaugurated, should be dropped.

Mr. Dickson mentions that it can be efficiently carried on for the sum of 300*l.* annually, and we are of opinion that the cost might be even less, for on board of almost all large liners the temperature of the sea surface is recorded at intervals of four hours with regularity, and on many, observations for specific gravity also; the rough method by which the latter is obtained is, we admit, unsatisfactory, as the hydrometer is difficult to read when subject to the least movement, but these records are better than none. In the interests of navigation alone this investigation should be continued.

It is noteworthy that, at the present time, there are many navigators who, in some measure, utilise observations of sea-surface temperature, and the time is not, we hope, far distant when the sea-surface thermometer and hydrometer may be recognised generally, as aids in determining to some extent changes in the direction and strength of ocean currents, and as affording the seaman an additional safeguard against miscalculation when approaching land in thick weather.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Natural science scholarships are announced for competition at Balliol, Christchurch and Trinity on December 3, at Magdalen on December 10, at Jesus on January 14.

Dr. J. S. Haldane, lecturer in physiology, has been elected to a fellowship at New College.

Dr. G. C. Bourne has been re-appointed lecturer in comparative anatomy for a period of three years.

Mr. O. J. R. Howarth, of Christ Church, has been elected to the geographical scholarship.

The celebration of the tercentenary of Bodley's Library will take place in October, 1902, and a delegacy of twelve will shortly be appointed to undertake the necessary arrangements.

The 227th meeting of the Oxford University Junior Scientific Club was held (Wednesday, October 23) at the Museum. The principal business of the evening was a paper by H. S. Souttar, of Queen's College, entitled "The Atom, an Electromagnetic Theory of Matter." The principal officers of the Club for this term are:—president, A. C. le Rossignol, Exeter; treasurer, E. L. Kennaway, New College; chemical secretary, E. Walls, Corpus; biological secretary, E. Burstal, Trinity; Boyle Lecture treasurer, S. A. Ionides, Balliol; editor, H. D. Davis, Balliol; members of committee, J. G. Priestley, Christ Church; Rev. G. D. Allen, non-collegiate.

CAMBRIDGE:—Mr. H. Lamb, Trinity, Mr. J. Larmor, St. John's, Mr. H. W. Richmond, King's, and Mr. E. T. Whittaker, Trinity, have been appointed examiners for the Mathematical Tripos, part 2, to be held in 1902.

Mr. W. T. N. Spivey, of Trinity College, died on October 22 from septic pneumonia following a lamentable accident which happened to him in the University Chemical Laboratory a fortnight before. Mr. Spivey was engaged in research work and was shaking two volatile and explosive liquids in a flask when an explosion occurred and he was seriously cut and burned. The sad death of this promising young chemist is much regretted.

DR. R. THAXTER has been appointed professor of cryptogamic botany at Harvard University.

AT a meeting of the Royal University of Ireland held on Friday last, the degree of D.Sc. was conferred upon Prof. W. N. Hartley, F.R.S.

A NEW Hall of Natural History is to be erected in connection with Syracuse University at the expense of an anonymous donor.

MR. F. E. REES, lecturer in physics at the Storey Institute, Lancaster, has been appointed to the lectureship and demonstratorship of physics at the University College of North Wales, Bangor.

Science states that Milliken University, Decatur, Ill., will be opened next year with an endowment of more than a million dollars, half of which sum has been given by Mr. James Milliken. Prof. S. R. Taylor, late of the Kansas State Normal School, has been appointed the president.

ADDITIONAL examiners in mathematics, chemistry, zoology, materia medica and therapeutics, medicine and clinical medicine, surgery and clinical surgery will shortly be appointed by the University of Glasgow. Applications for the appointments must be lodged on or before December 3 next.

A CIRCULAR just issued by the Board of Education describes the principles which are being followed with regard to making grants to schools and classes conducted by School Boards under the provisions of the new Education Act. When the local Authority has given a general sanction to the work of an existing school, the school is eligible for grants upon subjects taught in the twelve months preceding the passing of the Act. Extensions of the curriculum, or of the work of a school by including pupils of an age or sex not previously admitted, will not be recognised unless the specific sanction of the Local Authority has been furnished to the Board of Education.

ACCORDING to *Science*, the attendance at Cornell University, including 850 new students, is about 250 in excess of that of last year. Inclusive of the medical school in New York and the summer school at Ithaca, the total registration for the year is between 3250 and 3500. The registration on the campus, of students in regular courses, promises to be about 2750. Sibley College has a total attendance of new students, in all classes and courses, of above 350, almost equal to the total of upper classmen returning to the college, making the probable total registration for 1901–2 about 750 in all grades. The College of Civil Engineering has inceased fifty per cent., and the other colleges and departments report large additions.

THE Hon. T. Jefferson Coolidge, of Boston, has given more than 50,000 dollars to the Jefferson Physical Laboratory of Harvard University to further physical research. In the terms of the gift he states that:—"The income of this fund shall be used primarily for laboratory expenses of original investigations by members of the laboratory staff. But the Director, at his discretion, may award therefrom an honorarium, of not more than five hundred dollars per annum, for the private use of any person who—although receiving no salary from the University—may wish to carry on original investigations under his directions at the Jefferson Laboratory. The results of such investigations shall appertain to the Laboratory, and the name of the Laboratory shall accompany the investigation; but no publication shall be made without the approval of the Director. The balance of this income is to be used only for meeting the legitimate expenditures of original investigations whether by professors or students."

IN introducing Mr. James Stuart, the Lord Rector of St. Andrews University, to the gathering held at Dundee on Friday, October 25, Lord Balfour of Burleigh, the newly-elected Chancellor of the University, remarked that it was said that trade was being taken away from the country, that German chemistry had deprived Britain of the indigo trade, that we had to go to other countries for our goods, and that, generally speaking, trade in this country was in a bad way. The British manufacturer depended upon old methods, while the German employed newer. It was their business to help the manufacturers of this country to put an end to this. What was wanted in Dundee was a greater

subdivision of subjects. They wanted a chair of geology and much more subdivision in the different branches of chemistry, and, first and foremost, a chair of the German language and literature. More teaching power was required and more space in which that power might exercise itself.

THE installation of Lord Balfour of Burleigh as Chancellor of the University of St. Andrews, in succession to the late Duke of Argyll, was made the occasion of a series of brilliant functions in the ancient city last week. The address delivered by Lord Balfour after his installation dealt with several important aspects of higher education, and his statement of the relationship between national progress and scientific research should be of value in showing that the work done in a progressive University is technical training of the highest kind. Referring to University studies, Lord Balfour remarked, "Besides the broad general treatment of any scientific course, the University should be enabled, as a sequel to that course, to specialise in the more advanced stages of scientific training and to encourage original research on particular lines. For this purpose the University must have full equipment and must be furnished with teachers of special attainments, who will direct and guide that original research. The students will pursue the subject as a University study, and with the view of enlarging and advancing the knowledge of their special subject. In this way only can a real advance in scientific knowledge be made; and from the students who pursue these courses—generally, I would say, post-graduate courses—we must look for the enlargement of scientific knowledge, and amongst them or as the products of their efforts we may find pioneers in the application of truly scientific method to our manufactures. A modern University must deal with the principles which lie at the root of our commercial relations, and upon which the development of manufactures must rest, just as much as it does with the principles of philology and mental philosophy. Our commercial, no less than our educational position, must be supported by a thorough training, by careful attention to principles and by imparting to young men who are to pursue commercial pursuits the power of grasping the wider aspects of the questions with which they will have to deal, and by taking care that while they obtain a training fitted to be of practical value to them in their after life, that training shall be such as will really awaken their intelligence and enable them to cultivate the inestimable qualities of judgment, of foresight and of enterprise." Upon this subject scientific and practical men are in agreement, and the demand will be met, as Lord Balfour remarked, not by curtailing the work of the Universities, or by lowering in any way their standard of scholarship or of pure science, but by enlarging their borders and extending their influence.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, October 25.—Prof. S. P. Thompson, president, in the chair.—A paper on the variation with temperature of the thermoelectromotive force and of the electric resistance of nickel, iron and copper between the temperatures of − 200° and + 1050° was read by Mr. E. P. Harrison. In this paper the changes with temperature of the thermoelectromotive force and the resistance of nickel and iron are traced over a wide range and the singularities present in the curves representing these changes are investigated. In all experiments the same specimens of metal were used. Previous work on this subject has been performed by Tait, Fleming and Dewar, Holborn and Day, and Stansfield. In the author's experiments on E.M.F. an ordinary potentiometer method was used, the potential difference due to the thermocouple being balanced against a portion of that due to two accumulators. Before each reading a standard cadmium cell was balanced on a definite resistance in the accumulator circuit. Readings of E.M.F. of copper-nickel couples were accurate to 1·8 microvolts, while those of copper-iron couples were accurate to less than one microvolt at moderate temperatures. The heating arrangement was designed to give a uniform temperature which was measured by a platinum thermometer and recorded automatically by Callendar's recorder. The cold junctions were placed in a large test-tube full of water, the test-tube being placed in a larger vessel also containing water. The temperature of the cold junctions varied with that of the room, and all observations were reduced to cold junction 0° C. Finally, in each case, observations were taken by placing the junctions in liquid air with the platinum thermometer beside them. To prevent oxidation of the metals forming the junctions at temperatures above 500° it was necessary to exhaust the porcelain tubes which contained them. The curves for variation of E.M.F. with temperature of copper-nickel and copper-iron couples are roughly a straight line and a parabola respectively. The differences between the actual curves and a selected straight line in the former case and a parabola in the latter case have been plotted against temperature. These difference curves show that the maximum variations occur, in the case of copper-iron, at 70°, 230°, and 370°. The temperature of inversion (cold junction 0° C.) is 536° C. and the neutral point is 262° C. In the case of copper-nickel, maximum variations occur at 70° and 340°, and there appears to be a small hysteresis effect at the latter point. The temperature of inversion does not occur within the limits of the experiments, and there is no neutral point. The E.M.F. curve for a nickel-iron couple up to 700° has been obtained from the two previous experimental curves by addition. Above this temperature direct observations have been taken. This curve is nearly linear up to 900°, at which point a decrease in E.M.F. occurs. Curves of thermoelectric power have been derived from the E.M.F. curves by drawing tangents, and these show that a considerable range of the copper-iron curve can be represented by straight lines, but that the remainder is approximately parabolic. The copper-nickel power curve can be represented by bits of straight lines. The Peltier-coefficient variation curve for iron-copper is at first parabolic and can then be made up of straight lines; for copper-nickel it can be made up of bits of parabolas. Considerable difficulty was experienced at high temperatures in getting concordant results owing to chemical changes and other effects. The experiments were therefore carried out under different conditions, and the results are discussed in the paper. In the resistance experiments a potentiometer method was employed, a manganin resistance coil immersed in an oil bath being used as a standard. The resistance of nickel increases with temperature almost parabolically up to 370°, when a change of slope occurs, and the resistance increases much less rapidly and almost linearly up to 1050°. In the case of iron, the resistance curve does not change its parabolic form till nearly 800°, when it becomes linear and remains so up to 1050°. The author concludes from his paper that the thermoelectric change in nickel-copper coincides approximately with the resistance change, but that no thermoelectric peculiarity exists for iron-copper at the temperature of the iron resistance change. Mr. A. Campbell said that with purer iron the change in thermoelectric properties might correspond with the change in resistance. Dr. Knott had performed experiments on nickel in 1886 and got results similar to those of the author. His results with thick wires were different to those with thin, probably because he did not exclude air and prevent oxidation. Mr. Campbell said that he had himself made experiments upon two samples of nickel differing in resistivity, and although their temperature coefficients were also different, the change in slope of the curve connecting resistance and temperature occurred at practically the same temperature in both specimens. Their thermoelectric powers were identical up to 300°, but above they differed slightly. Dr. D. K. Morris pointed out that the thermoelectric force, the resistance and the magnetic properties should be observed at the same time. In taking a thermoelectromotive force there must be a temperature gradient, and in the interesting parts of the curves differences of magnetic properties may arise and produce discrepancies. He drew attention to the caution which must be exercised in differentiating by drawing tangents except when the curves are smooth. Dr. Morris said the connection between resistance and magnetic qualities was interesting. The temperature coefficient of resistance of a magnetic body rises with temperature so long as the body is magnetic, but reverses when the body becomes non-magnetic. He asked for information on the subject. Prof. H. L. Callendar said he had followed the research with interest, and referred to the experimental difficulties, especially at high temperatures. He should like to have said something in reply to Dr. Morris, but he was afraid the subject was a large one and might well be discussed at some future meeting. There were several points to clear up, and the fact that the curves described cannot be represented by straight lines or parabolas showed that the subject was beyond the range of a simple theory. The chairman suggested that it might be well to re-examine more carefully

some of the curves which are accepted as straight lines and on which there is no complication due to magnetic properties. He hoped the author and others would continue working at this subject. Mr. E. P. Harrison, in reply to Dr. Morris, said he thought the number and accuracy of his observations justified him in drawing tangents to form his power and Peltier-effect curves.—A paper on asymmetry of the Zeeman effect, by Mr. G. W. Walker, was read by the secretary. Prof. Voigt predicted an asymmetry of the normal triplet, which has been verified by Zeeman. The author has considered the subject mathematically, and finds that asymmetry may arise as a second order term due to the magnetic field. The asymmetry would be more distinct the greater the field, which is opposed to the theory of Voigt. By giving numerical values to the symbols it is shown that the effect is extremely small. The author points out that his theory can provide an explanation of why a line may not be resolvable.

PARIS.

Academy of Sciences, October 21.—M. Bouquet de la Grye in the chair.—The junction of a closed network of triangulation, by M. P. Hatt.—Researches on the mummified fishes of ancient Egypt, by MM. Lortet and Hugounenq. A description and chemical analyses of mummified specimens of *Lates niloticus*. The ash consisted largely of common salt and silicates. The fish are in a wonderful state of preservation, they appear to have been enclosed in a mixture of clay and sand impregnated with a large proportion of alkaline salts, especially sodium chloride.—On a new layer of mammifers of the middle Eocene at Robiac, near Saint-Mamert, by MM. Ch. Déperet and G. Carrière. An account of the discovery of a rich deposit of Eocene vertebrates at Robiac. The species identified include *Lophiodon rhinocerodes* and *isselensis*, *Paloplotherium magnum* and *lugdunense*, *Pachynolophus Duvali*, *Anchilophus Desmaresti*, and *Hyopotamus Gresslyii*.—The limit of chemical reactions and that of the product PV in gases, by M. A Ponsot.—The diameters of Jupiter obtained with the Brunner Equatorial of the Observatory of Lyons. The influence of magnification, by M. J. Guillaume. The value obtained for the apparent diameters of this planet differed slightly according to the magnification employed. A comparison of measurements of these diameters taken at different times by various astronomers shows that this effect is general.—On secondary chains, by M. G. Kœnigs.—On groups of substitutions, by M. G. A. Miller.—On linear differential equations of the second order with algebraical coefficients of the second and third species, by M. Paul J. Suchar.—On two particular classes of congruences of Ribaucour, by M. A. Demoulin.—On the variations of magnetisation in a cubical crystal, by M. Wallerant.—Action of the pyridine bases upon the tetra-halogen quinones, by M. Henry Imbert. The action of the pyridine bases upon chloranil and bromanil has been previously described. It is now shown that the resulting compounds still possess the quinonic function, as on reducing with sulphurous acid, hydroquinones are undoubtedly produced. The isolation and properties of the pyridyl compound are described.—On the oxidation of the benzene hydrocarbons by means of manganese peroxide and sulphuric acid, by M. H. Fournier. Toluic aldehyde was obtained as the oxidation product of ortho-xylene with these reagents. One of the methyl groups in pseudocumene was similarly oxidised to the aldehyde grouping, paracymene behaving similarly. With ethylbenzene the chief product was acetophenone, a little benzaldehyde being also produced.—The action of ammonia on benzyl chloride and on the conditions of formation of benzylamine, by M. René Dhommée. A study of the conditions under which the best yield of benzylamine can be obtained.—On the amine derived from the supposed binaphthylene glycol, by M. R. Fosse.—The nitro-derivatives of arabite and rhamnite; the constitution of certain nitrous esters, by MM. Leo Vignon and F. Gerin. The penta-nitro-derivative of arabite and the penta-nitro-rhamnite both readily reduce an alkaline copper solution. The cause in the differences in reducing power of various nitro-derivatives is accounted for by the authors by supposing a difference in constitution.—On glycerophosphorous acid and the glycerophosphites, by MM. Auguste Lumière, Louis Lumière and F. Perrin. A study of the acids and salts resulting from the action of phosphorus trichloride upon glycerine.—On a new microsporidium, *Pleistophora mirandellae*, a parasite of the ovary of *Alburnus mirandella*, by MM. C. Vaney and A. Conte.—Seasonal histolysis, by M. G. Bohn.—On some ferns with heterospores, by M. B. Renault.—The development of the embryo in the ivy (*Hedera helix*), by M. L. Ducamp. In the formation of the radicular cone the central cylinder remains apart from the suspender.—Retinal inertia relative to the sense of form, by MM. Andre Broca and D. Sulzer.

DIARY OF SOCIETIES.

THURSDAY, OCTOBER 31.

ROYAL SOCIETY, at 4.30.—Special Joint Meeting with the Royal Astronomical Society, to receive Preliminary Reports on the Solar Eclipse of 1901.

CHEMICAL SOCIETY, at 8.30.—The Frankland Memorial Lecture: Prof. H. E. Armstrong, F.R.S.

FRIDAY, NOVEMBER 1.

GEOLOGISTS' ASSOCIATION, at 8.—A Conversazione in the Library of University College, Gower Street.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Adjourned Discussion on the Second Gas-Engine Research Report by Prof. F. W. Burstall.

MONDAY, NOVEMBER 4.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Rapid and Approximate Estimation of Free Oxygen in Sewage Effluents and Waters: Prof. W. Ramsay, F.R.S.—Phthalic Glyceride: Watson Smith.—Notes on the Manufacture of Varnish by the Pressure Process: A. J. Smith.

TUESDAY, NOVEMBER 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Address by Mr. Charles Hawksley, President, and Presentation of Medals and Prizes awarded by the Council.

WEDNESDAY, NOVEMBER 6.

GEOLOGICAL SOCIETY, at 8.—On an Altered Siliceous Sinter from Builth: Frank Rutley.—Note on a Submerged and Glaciated Rock-Valley recently exposed to view in Caermarthenshire: T. Codrington.—On the Clarke Collection of Fossil Plants from New South Wales: E. A. Newell Arber.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 7.

LINNEAN SOCIETY, at 8.—On the Life-history of the Black-currant Mite (*Phytoptus ribis*): Mr. Warburton and Miss Embleton.—Notes on the types of Species of *Carex* in Boott's Herbarium: C. B. Clarke, F.R.S.

RÖNTGEN SOCIETY, at 8.30.—Presidential Address: Herbert Jackson.

CHEMICAL SOCIETY, at 8.—Note on the Non-existence of a Higher Oxide of Hydrogen than the Di-oxide: Prof. W. Ramsay, F.R.S.—The Electrolytic Reduction of Nitrourea: G. W. F. Holroyd.—(1) The Constitution of Pilocarpine, III.; (2) A New Synthesis of α-Ethyl Tricarballylic Acid: H. A. D. Jowett.—The Action of Nitric Acid on Methyl Dimethylacetoacetate: Prof. W. H. Perkin, F.R.S.—(1) An Incrustation from the Stone Gallery of St. Paul's Cathedral; (2) Note on Asbestos: E. G. Clayton.—Liquid Nitrogen Peroxide as a Solvent: Prof. P. F. Frankland, F.R.S., and R. C. Farmer.

FRIDAY, NOVEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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