THURSDAY, DECEMBER 29, 1904.

THE FUTURE OF THE HUMAN RACE.

(1) *Mankind in the Making.* Pp. viii+429. Price 7*s.* 6*d.* (2) *Anticipations.* Pp. 122. Price 6*d.* (London: Chapman and Hall, Ltd., 1903.) (3) *The Food of the Gods.* Pp. 317. (London: Macmillan and Co., Ltd., 1904.) Price 6*s.* By H. G. Wells.

MR. WELLS is a man of imagination, and he has let his imaginative faculty play about the great problems that obtrude themselves when we contemplate the new conditions under which civilised man is now living, conditions which must inevitably undergo further change as science advances. Three books of his more especially claim to forecast the future of our race, and to lay down the lines on which education should proceed. These three are "Anticipations," a very bold attempt to peer into the future; "The Food of the Gods," a lively romance full of humour that does not pall from beginning to end of the book; and "Mankind in the Making," a series of essays dealing mainly with education, and advocating radical changes in our methods.

As to style, Mr. Wells is a hard hitter. He pounds at all classes or professions or trades which fall below his standard of efficiency, or who represent, as he thinks, mouldering ideas and systems. He cannot talk patiently of bishops, schoolmasters, army men or plumbers. His philosophy has had its origin in the theory of evolution. He looks at the race of men in the past, the present, and the future, and he sees a long series of births. The individual is trustee for the race of the principle of life. The idea of this trusteeship is to Mr. Wells a great and ennobling one. A man must not look upon his individual life as the all-important thing, but must find his true happiness in the propagation and education of offspring. Nevertheless, we find in "Anticipations" that this ideal will be shared only by a limited number of people. In the world he pictures are many childless *ménages*, and Mr. Wells himself is prepared to tolerate relaxation of the marriage law and even "sterile gratification." But in this new world there will be also many men of strenuous earnestness and of religious purpose, though not professing a definitely Christian faith, who will be the leading spirits. As a rule they will be fathers of families, for the childless *ménages* will not fit in with their theory of things.

These men of energy—men of science, engineers, doctors, and so forth—will shape policy and administration. The result will be marvellous efficiency, such as is rarely if ever seen now. There will be no king. Monarchy will have given place to the New Republic. Royalty is connected with all things out of date, with aristocratic privileges, ridiculous costumes and decorations. Therefore it must go. In the New Republic, though so efficiently managed, there will be many idlers. There will be an enormous development of irresponsible wealth, great numbers of people living on invested money, having no cares of management and no duties in connection with their property. It is among this class mainly that will be found the childless *ménages*. The class that supplies unskilled labour, the old servile class, will tend to disappear. The invention of machines capable of performing more cheaply all the work that has hitherto fallen to the unskilled will make such men unnecessary. Peasant proprietors and all small land-holders must pass away. They represent stagnation, and there is room only for go-ahead, adaptable people. Those who fail to adapt themselves will fall into the abyss, the great sink in which wallow all those who are unfitted for the new conditions. The people of the abyss are to be encouraged to extinguish themselves, to practise what would commonly be called vice without offspring resulting.

Mr. Wells is quite alive to the need of an antiseptic in a wealthy society such as he foresees. To keep down excessive accumulations of wealth he proposes heavy death duties, and heavy graduated duties upon irresponsible incomes, "with, perhaps, in addition, a system of terminable liability for borrowers." But besides this there will be at work for many years to come "that most stern and educational of all masters—war." In its methods war will be very unlike anything of which we have as yet had experience. There will be marksmen few in number, but possessed of skill altogether beyond that of the marksmen of to-day. The army will no longer be officered by men too stupid and indifferent to use properly the inventions of science. No masses of raw, unskilled lads will be driven on to the slaughter.

Some greater synthesis will emerge. Mr. Wells reviews the various large groups of peoples which make up the greater part of the population of the earth. There is the Russian group, the German, Latin, and English groups, and there are the Yellow Races. Mr. Wells does not think the Russian or the German likely to predominate. In the French he has a great belief, though they do not "breed like rabbits." The richness and power of their literature make him think their language will extend itself far. He laments the comparative poverty and meagreness of our literature. Still, he inclines to the belief that a great dominant synthesis of the English-speaking peoples may be formed. Germany will be cowed by the combined English and American Navies, and Anglo-Saxonism will eventually triumph.

There remain the Yellow Races. Their star, too, will pale before that of the Anglo-Saxons. But all syntheses, however great, will eventually fuse into one. There will be a World State, and rival nationalities will be a thing of the past. "Against these old isolations, these obsolescent particularisms, the forces of mechanical and scientific development fight and fight irresistibly."

All these speculations are very interesting reading, but we cannot help regretting that Mr. Wells did not study and reflect a little longer before writing. His imagination, unclogged by knowledge, is apt to run away with him. Though he expresses the greatest reverence for Darwin and his successors, he does not show a very thorough grip of the principles of evolution. To begin with, he seems unaware of the part in the national life that is played by the lower stratum

of society, the "stagnant" masses as he would call them. From this stratum emerge the men of energy so dear to Mr. Wells's heart. Occasionally the son of a poor man, say in Scotland or Yorkshire, rises to eminence. Far more often it takes more than one generation to climb the ladder. But this does not alter the fact that this substratum is an absolute necessity. For the upper strata do not keep up their numbers, and society has been truly described as an organism that is perpetually renewing itself from its base. But Mr. Wells knows only of the abyss into which tumble all the failures of modern life. Such a valuable national asset as peasant land-holders he despises and wishes to abolish. Yet from such "stagnant" classes spring the families that work upward and produce the men of energy that do the highest work of the nation. The downward movement of which Mr. Wells talks so much is comparatively but a puny stream. No doubt there is an abyss, no doubt there are in our big towns not a few degraded families which are tending to die out. Yet even the most degraded produce here and there a man of grit, a man, for instance, who enlists and rises to be a non-commissioned officer. The pick of the slum-bred men make fine fighters.

Mr. Wells wishes all citizens to be energetic and up to date. The unadaptable masses must be got rid of. They must be instructed so that the indulgence of their sexual instincts may not lead to their having offspring. Reckless parentage must be in every way discouraged. And yet Mr. Wells declares that he cannot devise any system of selection by which it would be possible to breed good citizens; the qualities demanded are too diverse. So we are to get rid of the reckless classes and depend solely on the careful classes. We are to introduce careful parentage, that is, put a stop to natural selection; but there is to be no scientific selection to take its place. The result would indeed be disastrous. As it is, our national physique may be poor, but what there is in the nation of physical vigour is due to the great amount of elimination, probably not far short of 50 per cent., that still goes on.

Here is another strange forecast. War is "the most educational of all masters," and yet after many years a great world state will arise and there will be a kind of millennium. If war the great educator, the great antiseptic, is no more, surely the world is likely to be the worse for its absence. What is to make the world better? No doubt Mr. Wells would say, "The advance of science." Science is his sheet anchor. It is to ennoble the national life so that even the idle holders of irresponsible wealth will be powerless to degrade it. But will this be so? No doubt the inventor is ennobled by his brain labour, by his striving to make his dream a reality. And the men of energy who find practical applications of his discoveries are doing work of a kind that often, though not always, elevates the character. But what of the people who merely make use of the discoveries and inventions of others? The man who invents a locomotive engine is likely, at the lowest, to be above the pettiest meannesses. But the mere travelling in railway trains leaves men morally no better and no worse. The striving after knowledge is the ennobling thing, and not the knowledge itself, the making of discoveries, not the enjoyment of them.

This being so, there is a fallacy running all through that very humorous romance "The Food of the Gods"; in the story those who are fed on this food in their infancy and youth grow to a height of some forty feet. The inventors do not add to their inches. In its application this is not true. The mass of mankind remain small in brain and character—they grow, but do not grow much, when their youth is nurtured on the clearest and noblest ideas. The few thinkers, discoverers, inventors are the giants. As to education, Mr. Wells has much to say that is worth pondering. He wishes boys to make a real study of the English language and literature. On our success in teaching English and producing good literature depends the answer to the question: Will English retreat before the tongue of some rival synthesis, or will it become the language of the world? For educational purposes, the dead languages, as we might expect, are tried and found wanting. Those who teach them are "fumbling with the keys at the door of a room that was ransacked long ago." F. W. H.

BRITISH FRESHWATER ALGÆ.

A Treatise on the British Freshwater Algae. By Prof. G. S. West. Pp. xv+372. (Cambridge: At the University Press, 1904.) Price 10*s.* 6*d.* net.

A Monograph of the British Desmidiaceae. Vol. i. By W. West and Prof. G. S. West. Pp. xxxvi+224. (London: Printed for the Ray Society, 1904.) Price 25*s.* net.

WHOEVER has sought to gain a practical knowledge of the British freshwater Algæ has in the past been often checked by the impossibility of determining, by the aid of English works, many of the forms met with. During the twenty years that have elapsed since the issue of the latest large English work on the group (Cooke's "British Freshwater Algæ") very great progress has been made in most countries of Europe, in North America, and to some extent in other countries also, in the study of these plants. Very many species previously unknown have been detected, and much light has been thrown on obscure life-histories, on the effects of environment, and on the relationships of the various Algæ to one another, and to other organisms of simple structure. But while so much new knowledge has been gained, it is dispersed in various languages and in numerous volumes; and there has been, in English, no trustworthy guide even to the published results of these years dealing with the British freshwater Algæ. Thus it has become more and more difficult to pursue the study with success, and the need of adequate presentation of the subject has been felt to be very urgent. The works just issued by the Messrs. West are most welcome, and mark a very great advance on earlier books in English dealing with these Algæ. The authors possess a unique knowledge of the species and of their distribution in Britain, the result of personal investigations carried on unweariedly in many and varied districts of the British Islands. They have

added largely to previous records in species new to science, in others new to British lists, and in the fuller knowledge of the life-histories of species already known. The task was no easy one, but none more competent could have undertaken it, and it has been accomplished in a way to deserve the gratitude of all interested in the freshwater Algæ of Great Britain and Ireland.

The "Treatise" is one of the well known and excellent Cambridge Biological Series. Its aim is stated as "to give the student a concise account of the structure, habits and life-histories of Freshwater Algæ, and also to enable him to place within the prescribed limits of a genus any Alga he may find in the freshwaters of the British Islands." To do this within the limits of an octavo volume of less than 400 pages, in which are numerous illustrations, is a task possible of accomplishment only by one very familiar with the subject and skilled in concise expression; but that it has been successfully done will, we think, be the verdict after testing the book thoroughly. The views and labours of others receive due attention, and footnotes direct the student to the original publications; but Prof. West is no mere follower of the views of others, and much of the excellence of his book is due to his personal researches and to the conclusions he has drawn from them. In the preface we read that "there is no single book, or accessible set of books, by means of which a student can hope to accurately identify one-third of the freshwater Algæ he may find in a single day's ramble through a reasonably productive part of the country." With the aid of this guide he may hope to determine the genus of all save the more critical forms, and even the species in some of the genera. But the book is much more than a guide to the identification of genera and species. The introduction gives a very readable and interesting general account of freshwater Algæ in respect of their habitats, distribution, relations to and associations with certain other plants, and even with the lower animals, some of these correlations being of very curious kinds. Their relations to temperature (some thriving on ice and snow, while others can live around hot springs at 94°·5 C.), to surface conditions and exposure, and to geological strata are discussed; and the author's wide experience in field work gives much interest to the discussion. Mountainous districts are the richer, especially in Myxophyceæ and Conjugatæ, of which latter the desmids and Mougeotia are peculiarly numerous in species in these regions. The older Palæozoic and Igneous regions are preeminent in this respect, and the richest localities in Britain, "and perhaps in the whole of Europe," are tarns and peat-bogs in hollows of the Lewisian gneiss of north-west Scotland, while the fen district of eastern England is the poorest in Britain in freshwater species of Algæ.

The methods of collection, of cultivation (so important as a means of study), and of preservation for future use are described. The structure, cell-contents, nutrition and growth of the cells and plant-bodies, the methods of multiplication by division and of reproduction (asexual and sexual), the alternation of generations, the range of polymorphism observed in some species, and alleged to occur in others, are considered, and the belief is stated that the higher types have originated by gradual evolution from the more lowly types, but that the latter still persist, and must not be confounded with stages in the life-histories of the higher forms, as the author believes has been done by some. The phylogeny and scheme of classification take full note of the discoveries and views of Blackman, Bohlin, Borzi, Chodat, Wille and others, combined with the author's own discoveries.

Six great classes are recognised, of which four (Rhodophyceæ, Phæophyceæ, Bacillariaceæ or diatoms, and Myxophyceæ) are of the usual compass, the two former including few species in fresh waters. The Heterokontæ, a group proposed a few years ago by Luther for a few families characterised by yellowish-green chromatophores and the production of oil as a reserve of food, are separated off from the other green Algæ; but all the remaining green types are included in the class Chlorophyceæ, the methods of reproduction not being accepted as justifying their separation into different classes. Chlamydomonas is regarded as nearest to the origin from which all have sprung, scarcely different from the Flagellata, and the divergent lines of increasing complexity are traced, three chief tendencies, as pointed out by Blackman, showing themselves, and resulting in three types of structure, viz. the motile cœnobium, the multinucleate unicellular cœnocyte, and the multicellular aggregate, the cells of which become more and more intimately related and specialised to form the definite organism. This last type has resulted in the most complex structures among Algæ, and is regarded as having given origin through them to the archegoniate plants.

All grades of classification of the British freshwater Algæ down to genera are defined in this "Treatise," and each genus is well illustrated by drawings from the plants themselves, with few exceptions original. The number of British species is stated under each genus, and information is often added regarding the more representative species. For each genus also the synonymy is given, along with references to the literature.

Prof. West's treatment of his subject is instructive and stimulating, and the book will do much to extend the study of these plants. But it also excites the hope that he will supplement this work by giving us one descriptive of all the species and varieties of these Algæ that have been found in Britain, with, if practicable, indications of those likely to be added to the flora. He has pointed out the need of such a guide, and has proved that it could be attempted by none more fit to make it a success.

The volume on "British Desmidiaceæ" also illustrates the extraordinary advance in the study of British freshwater Algæ in recent years, due to the researches of but a few workers, among whom the authors are in the front rank. In this monograph will be brought together not only much information that, though published, was often scarcely accessible, but also much acquired through researches in many regions, from Shetland to Cornwall, in Wales and Ireland, and not yet published. Nearly 700 species and 450 varieties are now known from the British Islands (being rather more than one-third of all named species). Of these

many have been discovered and made known by the authors. Cooke's "British Desmids," issued in 1886–7 as a compilation of all the forms then known, included less than 300 species and less than 50 varieties. In this first volume rather more than one-fifth of the British species and varieties are included, so that the "Monograph" will probably extend to five volumes.

Each form is described, with references to its synonyms and its bibliography; and its distribution in the British Islands is detailed, the authority for each locality being stated. The figures are original, except where it was not possible to procure specimens. When borrowed the sources are always acknowledged. A very full list of books and papers on desmids adds to the value of the work.

The "Monograph of British Desmidiaceæ" is worthy of a place among the numerous valuable works issued by the Ray Society, and will be indispensable in the study of these plants.

THEORY OF RAPID MOTION IN A COMPRESSIBLE FLUID.

Leçons sur la Propagation des Ondes et les Équations de l'Hydrodynamique. By Jacques Hadamard. Pp. xiii+375. (Paris: Hermann, 1903.) Price 18 francs.

THE theory of fluid motion, as ordinarily worked out, presents several *lacunae*. One notable omission is the absence of any detailed discussion of the effects of compression and rarefaction of air owing to the rapid motion of bodies through it. An artillerist, seeking by the aid of the theory for principles that would help him to understand the resistance of the air to the motion of projectiles, would be likely to be disappointed. He would find an explanation of the effect of rifling in keeping the points of projectiles forward; but, while he might admire the ingenuity displayed in the development of the theory, he would feel that, with this exception, it shed but little light upon his business. The present book represents the outcome of efforts made in recent years by some French mathematicians, and especially by Hugoniot and P. Duhem, to widen the scope of the traditional hydrodynamics so as to include rapid motions in compressible fluids.

Our hypothetical artillerist would need to exercise much patience in order to get on with the book. He would probably soon give it up as too intensely mathematical. The first chapter is devoted to an account of an existence theorem in the theory of potential. It is to be proved that, provided a certain condition is satisfied, there exists a function which is harmonic in a given region and has a given normal rate of variation at the boundary of the region, in other words, that irrotational motion of incompressible fluid is possible within a closed surface which changes its form in a prescribed manner without changing its volume. The author gives a proof which is very interesting from the point of view of analysis. He also expresses the required function by means of a subsidiary function which he calls "Fonction de Franz Neumann," and of another which he calls "Fonction de Klein." The latter is the velocity potential due to a source and a sink within the given surface, and the former also can be interpreted physically, but the interpretations are not recorded. In the case of a spherical boundary, which is worked out, the results are attributed to Bjerknes and Beltrami. It would seem that these writers, therefore, virtually anticipated Hicks's discovery of the image of a source with respect to a sphere. One misses the interpretation in terms of images. The mathematics is there, but the author does not tell us what it means. Nevertheless the mathematics is excellent.

In chapters ii. and iii. we have so much of the ordinary theory as is requisite for the purpose of setting out the equations and conditions which govern the motions of fluids, and we have also an extension to discontinuous motions. The fact that was emphasised by Hugoniot is that the motion is not necessarily continuous. He paid especial attention to the case in which the velocity is everywhere continuous, but the differential coefficients of the components of velocity are discontinuous at a moving surface. The discontinuities at such a surface are not arbitrary, but are subject to three sorts of conditions. The surface moves through the fluid like a wave. One set of conditions connects the discontinuities with the direction of the normal to the surface. A second set connects them with the velocity of propagation. These two sets of conditions are kinematical. To determine the velocity of propagation the dynamical equations must be introduced. The kinematical conditions are called "conditions d'identité" and "conditions de compatibilité," and they are expressed by means of some elegant geometry. The necessity for such conditions has been recognised by other writers in the case of discontinuities that affect the velocity. The latter are here called "waves of the first order." The origin of Hugoniot's discontinuities, called "waves of the second order," is found in an analytical paradox. If the pressure is a function of the density, the equations of motion determine the acceleration of every particle; but, if the motion of a boundary is prescribed, the normal component of the acceleration of the particles that are in contact with the boundary is prescribed also. The two values thus obtained for this acceleration are in general different. Waves of the second order originate at the boundary, and are propagated through the fluid.

Chapter iv. deals with rectilinear motion in a gas, and is mainly occupied with the problem, first attacked by Riemann, of discontinuities that affect the velocity. Riemann's theory was condemned by Lord Rayleigh on the ground that it violated the principle of energy, and the problem remained in an unsatisfactory state for many years. It was taken up again by Hugoniot in 1887 without knowledge of Riemann's work. Hugoniot introduced expressly the condition that the increment of energy—kinetic and internal—of the portion of fluid which undergoes a sudden change of state is equal to the work done upon it by the pressures of neighbouring portions, and he concluded that the law connecting pressure and density ($p=k\rho^{\gamma}$) cannot be maintained during the passage of the dis-

continuity. This conclusion is opposed to Riemann's theory. H. Weber, in his recent edition of Riemann's "Vorlesungen über die partiellen Differentialgleichungen der mathematischen Physik," has contended that a complete calculation of the energy supports Riemann's theory against Lord Rayleigh's objection, but he did not refer to Hugoniot. In the book under review no mention is made of Lord Rayleigh's objection or of H. Weber's contention, but Riemann's theory and Hugoniot's are developed side by side, and the results are compared both with each other and with the results of certain experiments by Vieille. Much of the analysis is worked out and interpreted by the aid of geometrical constructions, but the reader wishes often for a more physical interpretation.

Chapters v. and vi. contain extensions of the theories of the preceding chapters to motion in three dimensions and to waves in elastic solid media. The physical value of a theory of rapid motions, accompanied by strains that are not "small," in an elastic solid, supposed to have a strain-energy function, is extremely doubtful; but no exception can be taken to the analytical methods by which the theory is developed. Chapter vii. brings the theory of waves that do not involve discontinuities of velocity or strain into relation with the theory of characteristics of partial differential equations. The discovery of the relations between these two theories has attracted a good deal of attention recently, and we may be grateful to M. Hadamard for his masterly exposition of the subject. A few notes are appended to the volume. Of these the most interesting is the one in which it is shown that discontinuities of the first order may give rise to vortex motion, even when the pressure and density in the undisturbed state are uniform throughout the fluid.

It is a sign of the healthy state of mathematics in France that the ablest analysts are bringing their powerful methods to bear upon recondite physical questions. The book under notice is a very valuable contribution to a most important and, at the same time, a most difficult subject. It breaks fresh ground, and it cannot fail to stimulate inquiry. It may be expected to conduce to the further advance of our knowledge of aërodynamics A. E. H. L.

THE GREAT ST. BERNARD PASS.

Across the Great St. Bernard. The Modes of Nature and the Manners of Man. By A. R. Sennett. Pp. xvi+444 and 111; illustrated. (London: Bemrose and Sons, 1904.)

A FLUENT but not too accurate pen, and a general knowledge of the more frequented districts of the Alps appear to be Mr. A. R. Sennett's chief qualifications for writing this book. It has a comprehensive title, and needs it, for the St. Bernard Pass is hardly more than a thread to connect, if possible, quotations in prose and verse, scraps of science and history, descriptions of scenery, and moralisings on things in general. The author has nothing new to tell us about the St. Bernard, which is not surprising, for the pass has been often described, and a carriage road now goes the whole way from Martigny to Aosta. Mr. Sennett, however, informs us that Hannibal crossed it "with his vast army," of which he proceeds to describe the sufferings. Notwithstanding what has been written by Law, Ellis, Freshfield and others, we are well aware that it is not easy to determine what route Hannibal did follow, but thought that the Great St. Bernard was no longer advocated by anyone who had studied the question.

Other statements are disputable. We are told the soldanella flower protrudes through the edge of the *névé* (which does not mean the winter snow); that the edelweiss dwells "in snow, owning a habitat where no other flowering plant may survive," and as "its haunt is far removed from all verdant vegetation and in the most craggy and inaccessible positions," we cannot expect to see it growing at the botanical station in Bourg St. Pierre, and so forth. This village is rather more than 5300 feet above sea-level, and the plant is often found between this and 6000 feet; indeed, it can be cultivated in England. As for the craggy and inaccessible positions, we had thought newspaper correspondents now enjoyed a monopoly of this fiction. Like any other Alpine plant, it may grow in a break-neck place, but its favourite habitat is a rough slope of grass and stone. It used to grow profusely on a place of this kind, where it could be gathered in perfect safety, on a mountain ridge about a thousand feet above San Bernardino.

But Mr. Sennett, though prone to discuss scientific questions, does not always win our confidence. The "Tertiary period of the London Clay" is an odd phrase, and adamantine an inappropriate epithet for the *firn* or upper basin of a glacier; and in what respect the Lago di Garda resembles a diadem we fail to perceive. To his vision of a Europe the glacier fields of which only just failed in reaching the Alps we are perhaps accustomed, but think that most geologists at the present day would speak less confidently of glaciers having scooped out the Alpine lake basins, or having "cut out gorges for themselves through the solid mountain, divided enormous peaks in twain, planed down and levelled great asperities." The Märjelen See does not lie in a lake basin, but simply at the head of a glen, blocked by the great Aletsch Glacier, and after seeing it one day full and the next empty, we utterly disbelieve Mr. Sennett's explanation that it is emptied on the principle of a syphon. The name Mörjelen, which he prefers, may be patois, but the other form is more usual; so also is Gondo for Gonda, Guttannen for Guttenen, Meiringen for Meyrengen, and, notwithstanding Baedeker, Penninus for Pœninus (the title of the Alpine Jupiter). The science is discursive and commonplace, where not enriched by extracts from Tyndall or Ruskin, or yet more ornamental writing. Mr. Sennett may think in English, but is so prone to translate into journalese that we suspect he was trained in a certain Fleet Street haunt of young lions. We cannot welcome the verb "resurrect," the adjective "riverian" (of or belonging to a river), or "lithic" (a favourite one) when plain folks would say stony or rocky. The book, however, contains numerous illustrations, often pretty, but it is tiresome to have them (except in the appendix) only

numbered, and to be obliged to consult a list to see what they are, especially when we are sometimes greeted with fanciful titles instead of place-names. "Dame Nature's Painters" does not much enlighten us, but it looks very like a view down the lower part of the Via Mala. But the author has tried the dangerous experiment of mingling poetry and science, and we cannot honestly congratulate him on his success.

T. G. B.

TRACHOMA.

Trachoma. By Dr. J. Boldt. Translated by J. Herbert Parsons, D.Sc., F.R.C.S., and Thomas Snowball, M.B., C.M. With an introductory chapter by E. Treacher Collins, F.R.C.S. Pp. lii+232. (London: Hodder and Stoughton, 1904.)

DR. BOLDT'S monograph on "Trachoma," published at the end of last year, deals with a subject presenting many problems to which no satisfactory solutions can at present be offered. It is therefore a matter for congratulation that an English translation of such an excellent *résumé* of the subject has been prepared. Dr. Boldt has been working for many years in one of the trachoma infested centres of Germany, and has been constantly faced during that time with these unsolved problems, and in the book before us he clears the ground of all the lumber which gathers round any subject of discussion, and states clearly the present condition of our knowledge and the lines on which future investigation must go.

The first and most important difficulty met in dealing with trachoma is that at present the ætiological factor is unknown. The discussion of this question in chapter iv. particularly, and incidentally in chapters iii. and v., will be, to ophthalmic surgeons, the most interesting part of the book. The author distinctly inclines to the view that there is a specific organism, the primary cause of trachoma, as yet undiscovered, but that also an individual predisposition and a number of subsidiary causes, such as climate, soil and race, overcrowding, uncleanliness, and other social evils, are also contributing causes.

Many workers at the present time are inclining to lay much greater stress on the importance of the individual predisposition and to hold the view that the disease may be set up by any bacterium which is pathogenic for the conjunctiva. The large number of cases in which some scrofulous taint can be traced is distinctly in favour of this view. It has been frequently shown that in such people any infection will give rise to a lymphoid hypertrophy, and the essential pathology of trachoma is primarily a hypertrophy of lymphoid follicles with subsequent degeneration of the lymphoid tissue and formation of scar tissue. Dr. Boldt, with absolute fairness, gives both hypotheses and the arguments which have been advanced by various writers in support of them.

It would be of undoubted benefit to the community if this book were to get into the hands of two classes in particular, the men who are concerned in the administration of the Poor Laws of the country, and those concerned in the medical and sanitary administration of the Army. The excellent introductory chapter by Mr. Treacher Collins gives details of the most useful work which is being carried on at Swanley, and of the influence that proper hygienic measures have had generally in checking the disease. Dr. Boldt gives similar details of the progress and subsequent checking of trachoma throughout the various countries of Europe. It would indeed be well if the last chapter were separately printed and distributed as a pamphlet to the various boards of guardians and health officers throughout the Empire.

We have nothing but praise for the way in which the translators have carried out their work. We could nowhere detect a trace of German origin in the style.

OUR BOOK SHELF.

The Cyclones of the Far East. By Rev. José Algué, S.J. Second (Revised) Edition. Pp. 283. (Manila: Bureau of Public Printing, 1904.)

IN the present edition the author has extended the area dealt with in the earlier editions, and as abundant additional data have been collected, not only from the Philippines themselves, but also from the surrounding coasts, this information has now been embodied. The author says that, "owing to the opening up of the Far East in recent years, an endeavour has been made to extend the usefulness of the work by giving a greater compass to the study of the phenomena which cause, accompany, and follow the atmospheric perturbances which are experienced in the various seas of the Far East." The title of the revised edition is changed from "Cyclones of the Philippines" to "The Cyclones of the Far East." The present edition appears in English, and is freed from the formidable list of errors found in the English version of an earlier edition. Among the many additions contained in this new edition may be mentioned some practical rules for navigating in case of encountering a typhoon, and a list and description of the ports of refuge during storms in the Far East, especially in the Philippine Archipelago.

Commendation should certainly be given of the careful arrangement and division of the whole work, which aid much the general study and grip of the valuable material, whilst numerous illustrations add much to the elucidation of the subject. Father Algué must be credited with what is only too commonly overlooked. At the conclusion of each chapter reference is given to the works which may be consulted in connection with the branch of the subject dealt with. The references appear to have been chosen with the greatest impartiality and with the sole desire to render the work as complete as possible. This example may commend itself to authors of other branches of scientific work.

The principal cause which influences the progressive movement of typhoons is said to be the general movement of the atmosphere in which they take place, not of that part only which overlies the land and sea over which they pass, but especially of that portion of the atmosphere which moves at higher altitudes, as we are to look there for the seat of the greater part of the energy and power which nourish and sustain the atmospheric whirls. This opinion is endorsed by all who discuss the nature and law of storms, but, unfortunately, too little light can be thrown on the movement of the upper air, although praiseworthy efforts are being made in this direction.

The storms which visit the Philippine Archipelago vary greatly in frequency according to season, the months with the greatest number being July, August, and September, whilst the months with the least frequency are January, February, and March. Much good work is done in the classification of cyclones, and diagrams are given showing the paths of eleven different types. Considerable attention is paid to the precursory signs of cyclones, and naturally much importance in this direction is attached to the form and movement of clouds.

The whole treatise is suggestive of further scientific inquiry, and Father Algué has done much by this work to advance our knowledge of the law of storms.

C. H.

The Animals of New Zealand: an Account of the Colony's Air-breathing Vertebrates. By F. W. Hutton and J. Drummond. Pp. xiv+381; illustrated. (Christchurch and London: Whitcombe and Tombs, Ltd., 1904.)

SOME months ago, when noticing Captain Hutton's valuable "Index" of the New Zealand fauna, we had occasion to refer to the impending issue of the present volume; now that it is before us, we are happy to be able to state that it fully realises our expectations, and forms a most valuable history of the air-breathing vertebrates of the colony, written in a pleasant style which cannot fail to make it acceptable to a large circle of readers. At starting, the authors refer to their indebtedness to the late Mr. T. H. Potts, who did such good work in describing a fast vanishing fauna before it was too late. The melancholy story of the waning of this curious and interesting fauna forms, indeed, the key-note of the introduction of the volume. From the time that Captain Cook, in 1773, turned down pigs in Queen Charlotte's Sound, the native fauna has had to contend with competitors from Europe of a stronger and more aggressive type, the natural result being that many forms, like the tuatera lizard, have already disappeared from the mainland, although in some instances surviving in the adjacent islets, and many more are destined to go ere long. Among the latter (if, indeed, it be not already extinct) is the short-tailed bat, the sole representative of the genus Mystacops, its rarity, or extermination, being attributed to the destruction of insect life caused by the introduction of European birds.

From a purely commercial standpoint the authors do not, however, by any means condemn the introduction of many of the foreign species, having even a good word to say for the much abused sparrow. "Without the sparrow, or some other bird equally common," they write, "residents in the colony would be over-run with the insects again, and life would be insupportable." The phrase concerning insects, it may be explained, refers to the "plagues" of various species which occurred when European food-crops were first introduced into the colony. On the other hand, the introduction of certain species, such as the greenfinch and, above all, the rabbit, is most strongly condemned. The acclimatisation of several kinds of deer is considered to be of considerable advantage to the general prosperity of the islands, as it leads to the visits of European sportsmen.

Among the species which have suffered most severely from foreign competition may be mentioned the two bats, the kiwis, the weka rail, and the tuatera. The moas appear to have been completely and the Notornis all but exterminated by the Maories before the European advent.

Limitations of space alone prevent further commendation of a very excellent, interesting, and beautifully illustrated work.

Zellenmechanik und Zellenleben. By Prof. Dr. Rhumbler. Pp. 43. (Leipzig: J. A. Barth, 1904.) Price 1 mark.

THIS little work represents a sketch of the author's views on the causes and means of manifestation of cellular activity. The point of view adopted is a materialistic one. It is considered that the whole subject should be dealt with from the physical or the physico-chemical aspect, even when this fails to present a complete solution of all the difficulties that may arise. It is becoming more and more recognised that many of the acts which used to be regarded as specially the outcome of vital activity find their parallel in inorganic nature. An amœba when ingesting a filament of oscillatoria much longer than itself is able completely to enclose it because the algal thread becomes coiled up within the protoplasmic body of the protozoan. But an exactly similar state of things is produced if a drop of chloroform is placed in water and a filament of shellac be then presented to it. The filament is drawn into the chloroform, and coiled up much as the alga in the amœba; and if a short glass thread be coated with shellac, it is also "ingested," but as the lac becomes dissolved the glass thread is gradually extruded. The whole question here resolves itself into one of surface tension, and perhaps the processes of ingestion and excretion may ultimately prove to be essentially similar in nature.

Again, the remarkable uniformity in the details of nuclear divisions (karyokinesis), from whatever source the cells may originate, strongly suggests that a comprehensive physical explanation of the process will one day be forthcoming.

But although the physical aspects of cellular activity will certainly become more clear and definite, this is only the first step on to the threshold of the temple in which the secret of life is guarded. Behind the proximate physical phenomena lies a vast complex of changing chemical conditions, and it will be long before we are likely to be able exhaustively to analyse them. The more successfully we do so, however, the more nearly shall we be able to grapple with the physical problems of movement and the like. Rhumbler regards changes of surface tension, and the reactions that affect it, as constituting one of the most profitable of the many possible lines of cytological investigation.

Studies in Astronomy. By J. Ellard Gore, F.R.A.S., M.R.I.A. Pp. xi+336. (London: Chatto and Windus, 1904.) Price 6*s*.

IN this book the reader is presented with a series of disconnected essays on a variety of astronomical subjects, many of which include interesting and suggestive results of calculations made by the author. The subjects range from "giant telescopes" to the "construction of the visible universe," but Jupiter is the only planet to which any detailed reference is made, and the sun is only dealt with from the point of view of its stellar magnitude and its motion in space. The chapter on "Messier's nebulæ," bringing together all the recent information with regard to these objects, will be of considerable value to those who possess telescopes, and the notes comprising "recent advances in stellar astronomy" give a useful summary of the state of our knowledge of the subjects dealt with at the beginning of the present year.

Most of the papers have already appeared as magazine articles, and, notwithstanding the revision which has been made for the present purpose, there is necessarily a considerable amount of repetition. Apart from this, however, the book provides a very acceptable course of not too difficult reading for those who have a general elementary acquaintance with the subject.

Salts and their Reactions. By Dr. L. Dobbie and H. Marshall. Pp. 198. (Edinburgh: James Thin, 1904.) Price 3*s.* 6*d.* net.

THIS book is intended to serve as an introduction to the study of practical chemistry, and has for its basis a series of notes intended for use in the Edinburgh classes. In an interesting preface Prof. Crum Brown states his belief in the possibility of devising a course that would be "something better than a mechanical training to enable students to pass a mechanical examination consisting in the detection of simple salts in solution." Notwithstanding this assurance, one finds that about half the book consists of descriptions of the ordinary tests and schemes of analysis common to most books treating of elementary practical chemistry.

The first part of the work consists of a short and very clear account of the general physical properties of salts and salt solutions. An outline is given of the ionisation hypothesis and of its applications, some of which are practically illustrated at a later stage. After a short account of the nature and use of indicators, a chapter is devoted to alkalimetry and acidimetry. The experimental part of the book, excluding the sections on qualitative analysis, is only represented by about twenty-five pages, and although the selection of experiments has evidently been carefully made, it seems a pity that the practical illustration of a really excellent theoretical introduction should be so meagre.

The remainder of the book is taken up with a description of the reactions of metallic and salt radicals, and with schemes for analysis. In several small particulars a departure from the conventional methods has been made with distinct advantage. Dry-way reactions, which so few chemists appear to appreciate, are relegated to an appendix, which also contains the inevitable and perfectly useless description of the reactions of the so-called rare elements. Teachers who have the management of large practical classes should find the volume of value.

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.*]

Radiation Pressure.

ON p. 515 of your issue of September 22 I stated that there is a retarding force on the earth as it moves along its orbit amounting in all to about 20 kgm. The calculation was made on the supposition that the earth is a full radiator of uniform temperature. I have found on revising the calculation that there was an error in the arithmetic, and that the force is considerably greater, though still too small to have an effect worth considering. The following is a simple method of obtaining its value. It assumes that the earth may be treated as a black sphere exposed to sunlight, radiating as much as it receives, and with all its surface at one temperature.

If the stream of solar energy falling normally on 1 sq. cm. is S per second, a black sphere, radius a, receives πa^2S per second. If it radiates R per second per sq. cm. its total radiation is $4\pi a^2$R, and the assumption of equal receipt and expenditure gives R=S/4. The total repulsive force exerted by the sun's radiation is $S\pi a^2/U$, where U is the velocity of light. The total retarding force due to velocity u in the orbit is $4/3\ Ru/U^2.\pi a^2$. This is the Doppler effect due to crowding of energy in front and opening out behind (*Phil. Trans.*, A, ccii. p. 546, corrected by final note). Hence we have

$$\frac{\text{Retarding force}}{\text{Solar repulsion}} = \frac{u}{3U}.$$

At the earth's distance u/U is about 10^{-4}, so that the retarding force is about 1/30,000 of the solar repulsion.

If we take S/U as $5{\cdot}8\times10^{-5}$ dyne/sq. cm. (*Phil. Trans.*, *loc. cit.*, p. 539), and the radius of the earth as $6{\cdot}37\times10^{8}$ cm., the total solar repulsion is about 75×10^{6} kgm., say 75,000 tons, and the retarding force is about 2500 kgm.

But another effect comes in which will more than counterbalance this. The hemisphere of the earth which is advancing in the orbit is on the whole colder than that which is retreating, owing to the lag in the warming of the surface exposed to the sun. I find that if one hemisphere is at 301° A. and the other at 300° A., the greater radiation from the warmer side gives a net push directed from that side to the colder of about 165,000 kgm. Of course this hemispherical distribution of temperature is only a rough approximation to the real condition, and even if the force be as large as 165,000 kgm. only a component of it acts along the orbit tending to accelerate the motion. Still, that component must almost certainly be much greater than the retarding force due to the Doppler effect, and on the whole, therefore, there is probably a small acceleration in the orbit. A force of 2500 kgm. would destroy about $4/10^{18}$ of the earth's momentum in one year. Even if the accelerating force were twenty-five times as great as this it would only generate $1/10^{16}$ of the present momentum in one year. This illustrates the insignificance of radiation pressure on the larger bodies in the solar system.

I take this opportunity of correcting another error in the address in NATURE of September 22, which has been pointed out to me by Mr. C. T. Whitmell. It arose from some very faulty arithmetic on p. 541 of the paper in the *Philosophical Transactions* already referred to. Apparently in the formula giving the radius of each of two equal spheres the mutual radiation-repulsion of which balances their gravitative attraction, a square root of 10 was omitted, and the value of that radius should be $a=0{\cdot}69\theta^2/10^4\rho$. A wrong value was also assigned to the density of the sun. Mr. Whitmell has very kindly re-calculated the results depending on this formula, and I have worked them out independently. We now find that two equal spheres will have equal radiation-repulsion, and gravitative attraction with radii as given below:—

Temperature absolute		Density		Radius in centimetres
6200	...	1·375	...	1930
300	...	1	...	6·1
300	...	11	...	0·5645
300	...	5·5	...	1·13

The last was given previously as 3·4 cm.

The effect of radiation pressure on terrestrial dust is worthy of consideration, for it may be quite appreciable when the particles are small and are among surroundings at different temperatures. For simplicity of calculation, let us suppose a very small dust particle, of density ρ, to be cylindrical with radius a and length a, and let its flat ends be black and let its curved surface be perfectly reflecting. Let it be situated between two indefinitely extended parallel vertical walls, one at a temperature θ_1° A., the other at a lower temperature θ_2° A., and let its ends be parallel to the walls. The two faces of the dust particle will, if it is small enough, be at very nearly the same temperature, so that we may leave out of account the pressures due to the emitted radiation and consider only those due to that received from the walls. If σ is the radiation constant $5{\cdot}32\times10^{-5}$, and if U is the velocity of light, the difference of pressure on the two sides will be $2\sigma(\theta_1^4-\theta_2^4)/3U$, and the acceleration due to this on area πa^2 and mass $\rho\pi a^3$ is $2\sigma(\theta_1^4-\theta_2^4)/3U\rho a$. When $\rho=1$, $a=10^{-3}$, $\theta_1=400°$ A., $\theta_2=300°$ A., this acceleration is 0·02 cm./sec.^{2}.

If the law of radiation pressure can be taken as still holding when the radius is reduced to $a = 10^{-5}$, the acceleration is 2 cm./sec.^{2}. This implies that such a particle of dust, in a vacuum, and between vertical walls respectively at 27° C. and 127° C. would not fall vertically, but would deviate about 2 mm. per metre towards the colder wall.

The effect found by Prof. Osborne Reynolds (*Phil. Trans.*, ii., 1879, p. 770) on a silk fibre exposed to radiation from a hot body, and assigned by him to "radiometer" action, is far larger than this. The radius of the fibre was 0·000625 cm., and its length was probably about 15 cm. When it was hung up in a test tube containing hydrogen at atmospheric pressure, and was exposed to radiation from a neighbouring jar filled with boiling water, the lower end of the fibre moved through 0·01 cm. This would imply an acceleration of about 0·7 cm./sec.^{2}, about sixty times the acceleration on a dust particle of the same radius under the conditions assumed above. The action detected by Reynolds increased, too, very rapidly as the pressure fell, being ten times as great when the pressure was reduced to 1 inch of mercury.

J. H. POYNTING.

The University, Birmingham, December 15.

The Date of Easter in 1905.

ALREADY queries have been addressed to me on the subject of the date of Easter in 1905, owing to the fact that, according to the almanacs, the moon is full at 4h. 56m. Greenwich mean time on the morning of March 21 next, and that therefore, according to the Prayer Book rule, it would appear that Easter Day should be the Sunday following March 21, viz. March 26. As the misunderstanding on the subject seems widely spread, perhaps you will allow me to explain that the "moon" referred to in the ecclesiastical calendar is not the actual moon in the sky, which is full at a definite instant of time, but a fictitious moon, the times of the phases of which are so arranged as not to differ much from those of the actual moon. These phases are held to occur, vaguely, on certain days, and therefore hold good for all longitudes, and so avoid a practical inconvenience that would arise from the use of the actual moon. Thus, in the instance before us, in which the actual moon is full at 4h. 56m. a.m. Greenwich mean time, the same moon is full at 11h. 48m. p.m. (*on the preceding day*) Washington mean time. The people adopting Greenwich time would, therefore, in the supposed circumstances, keep Easter Day on March 26, whilst those adopting Washington time would keep it on April 23.

Perhaps the simplest expression for the date of the Paschal full moon is March (44 − epact), which gives the date directly when the epact is less than 24. When the epact is equal to or greater than 24, this expression gives the date of the preceding full moon, and the Paschal full moon is found by adding 29 to this date.

Thus in 1905 the epact is 24, therefore the calendar moon is full on March 20, and again on April 18. The latter is, by the rule, the Paschal full moon, and Easter Day is the following Sunday, viz. April 23.

A. M. W. DOWNING.

H.M. Nautical Almanac Office.

Lepidocarpon and the Gymnosperms.

THE concluding sentence in your note on Mr. H. E. H. Smedley's admirable models of the fructifications of Palæozoic plants (NATURE, December 22, p. 183) may possibly be misleading to some of your readers. As the models of Lepidocarpon shown in your figure were prepared from my instructions, I may be supposed to share the responsibility for the hypothesis of an affinity between the lycopodiaceous cones and the Gymnosperms, stated to have been urged by "the author," especially as the points of agreement mentioned are quoted, with some slight abridgment, from my paper on the seed-like fructification of Lepidocarpon in the *Philosophical Transactions*.[1] Such an affinity has never appeared to me to be probable. The characters cited—the presence of an integument and micropyle, the single functional megaspore, and the detachment of the indehiscent, seed-like organ as a whole—are important points of analogy with true seeds, but in Lepidocarpon "these organs differ too much in detail from the seeds of Gymnosperms to afford any evidence of affinity."[1] I doubt whether my friend Mr. Smedley really intended to suggest anything more than an analogy.

As regards the Gymnosperms, evidence has been accumulating for some time past indicating their connection with the fern-phylum rather than with the Lycopods. Some account of this evidence will be found in my discourse at the Royal Institution on the origin of seed-bearing plants (1903),[2] while a more recent summary is given in Mr. Arber's article on Palæozoic seed-plants in NATURE for November 17, p. 68.

The seed-like organs of some Palæozoic Lycopods, such as Lepidocarpon and Miadesmia,[3] seem to be cases of homoplastic modification, and not to be indicative of any affinity with those groups of seed-plants which have come down to our own day.

D. H. SCOTT.

Jodrell Laboratory, Kew.

[1] *Phil. Trans.* R.S., Series B, vol. cxciv., 1901, p. 320. See also NATURE, vol. lxiii., 1900–1901, pp. 122 and 506.

Fishing at Night.

THE notice in your Journal of the "Sea Fishing Industry," written by Mr. Aflalo, suggests to me that he or some other of your readers may inform me why sea fishing takes place for the most part at night. I have heard the subject discussed all my life, and the answers have been of the most opposite and unsatisfactory character, such as to obtain a supply of fish for the morning markets, and because fish come nearer to the surface in the dark. Everyone must be familiar with the sight of our fishing boats preparing to take their departure as the evening approaches in the different harbours on our coasts. Some of the masters, unfortunately, like the Apostle Peter, have toiled all night and caught nothing.

S. W.

December 20.

A New British Bird!

A FINE example, a male, of the Pacific eider-duck, *Somateria v-nigrum*, was killed at Scarborough on December 16. This is the first recorded instance of the occurrence of this bird on our shores. Closely resembling the common eider, *Somateria molissima*, it may yet be readily distinguished therefrom by the bright orange colour of the bill, and the sharply defined, black V-shaped mark on the throat—hence the specific name *v-nigrum*.

The Pacific eider occurs in abundance along the coasts of north-western America and north-eastern Asia.

W. P. PYCRAFT.

Natural History Museum, South Kensington.

Intelligence of Animals.

IN reference to the question of intelligence in animals, it may be of interest to mention a case of distinct reasoning power in a cat which for nine or ten years associated himself with our family; he would have scorned the suggestion that he belonged to it. When he found himself on the wrong side of a closed door—a very constant occurrence—he stood up and, catching the handle in his fore paws, *rattled* it. I do not think he tried to *turn* the handle, but he certainly knew that it played an essential part in the opening of the door. He is now no more, and *de mortuis nil nisi bonum* bars any further reference to his career, for he was a dissipated old scoundrel; but it is a pleasure to me to pay, with your permission, the above little tribute to his memory.

Greenock, December 17. T. S. PATTERSON.

[1] *Phil. Trans.*, *loc. cit*, p. 324.

[2] NATURE, vol. lxviii., p. 377.

[3] Miss M. Benson, "A New Lycopodiaceous Seed-like Organ," *New Phytologist*, vol. i., 1902, p. 58.

FAUNA OF THE HIGHLANDS.[1]

THIS handsome new addition to Mr. Harvie-Brown's "Vertebrate Fauna of Scotland" maintains the high standard of excellence which has marked the preceding volumes. It is punctiliously accurate and at the same time picturesque and full of interest. One of the authors, the Rev. H. A. MacPherson, sacrificed himself too whole-heartedly to an enthusiasm for ornithology, and died in 1901 at the age of forty-three, and Mr. Harvie-Brown has also to deplore the loss of another collaborator, Mr. T. E. Buckley, who died in 1902. Of both these naturalists there are appropriate *in memoriam* sketches.

This volume deals specially with the western parts of the counties of Sutherland and Cromarty—west of the great "watershed"—and with similar portions of Ross-shire and Inverness-shire down to the boundary of "Argyll." In the introductory matter we find terse physiographical accounts of Skye, the Ascrib Islands, Handa, Priest Island, and the coast of the mainland, designed to illustrate the most outstanding faunal feature of the area, namely, its isolation. Mr. Lionel W. Hinxman contributes a brief account of the geology of the north-west Highlands, and there is another interesting section dealing with climatic and other changes, including those due to the hand of man. Few of these can be said to do man's intelligence much credit.

Mr. Harvie-Brown confesses that the chief interest of the area in question is the comparative poverty of its fauna. "The true faunal value lies in its isolation by sea and mountain ranges." "It appears to me to be almost the poorest and least favoured of our Scottish Faunal Areas, both as regards species and in its paucity of individuals of many of them." But it includes some old frequented haunts of some of our now rarer birds, it illustrates faunistic changes traceable to climatic changes, and it gives evidence of a keen struggle for existence amid which some species are still advancing. What Mr. Harvie-Brown particularly seeks to show is that the hemmed-in nature of the area is a main reason for its faunal poverty; thus some of the more prominent land-features of the country, such as the long tongue of land of Ardnamurchan, act as deterrents to the advance of land birds from south to north. The nature of the soil, the vegetation, the distribution and character of wooded areas, and the climatic conditions have also to be borne in mind, but Mr. Harvie-Brown has not done justice to himself or to his theme in his treatment of this aspect of the problem. Of course it is not given to everyone to be a Humboldt, but without attaining to his compre-

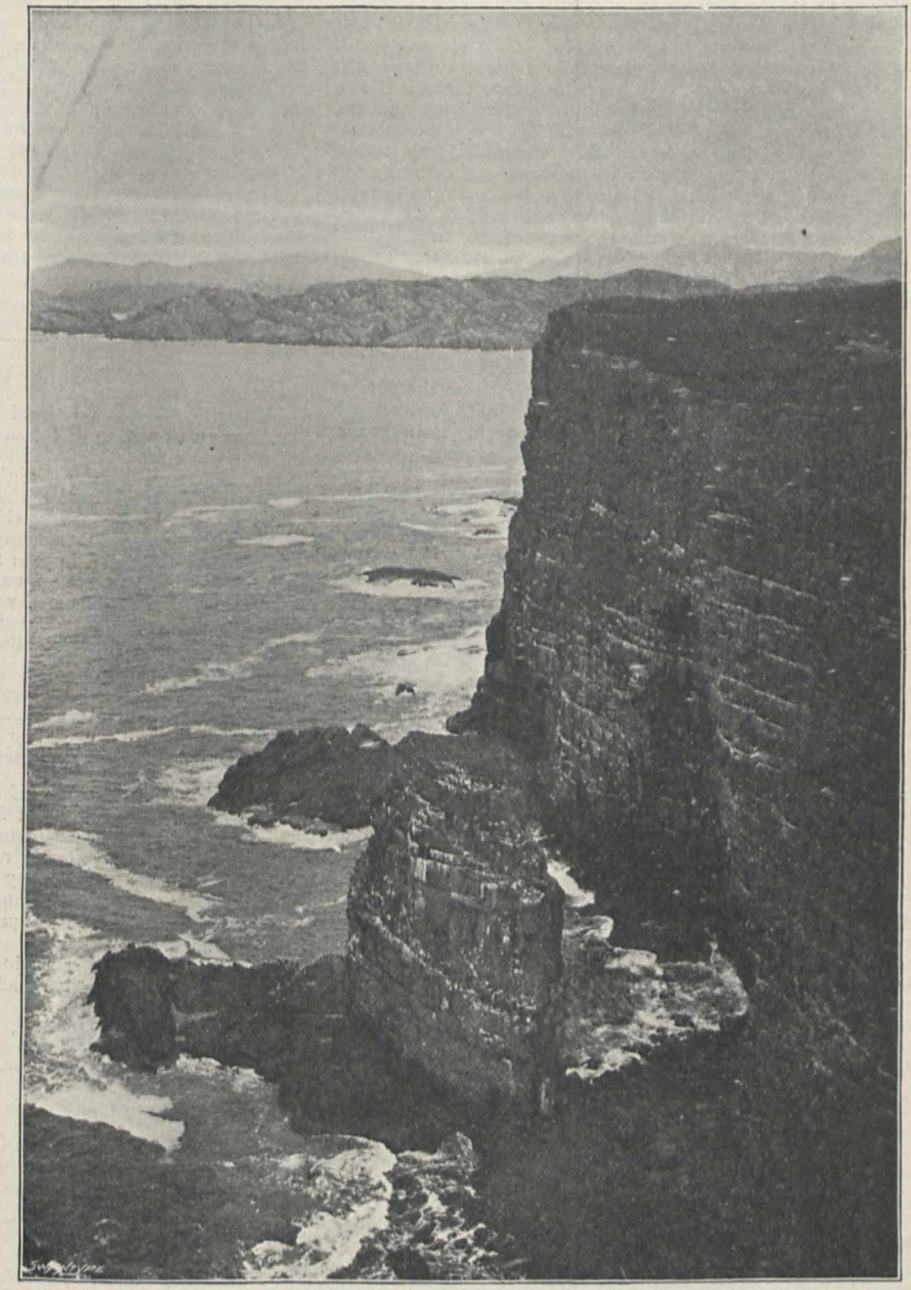

FIG. 1.—Fulmar's first nesting-place on Handa (at small white ×). From "A Fauna of the North-West Highlands and Skye."

[1] "A Fauna of the North-West Highlands and Skye." By J. A. Harvie Brown and H. A. MacPherson. Pp. civ+378; illustrated. (Edinburgh: David Douglas.) Price 30*s*.

hensiveness of outlook it would not have been difficult to improve the chapter on the "Faunal Position" of the area in question; and even in regard to the particular factors which Mr. Harvie-Brown emphasises in his interpretation of the faunistic peculiarities of the areas, his "argument," as he calls it, appears to us too jerky and elliptical to win conviction. But he gives some references to papers dealing with the physiographical conditions in some detail.

Turning to the list of mammals—which is somewhat mournful—we find that there is only one bat, the pipistrelle; the hedgehog, the lesser shrew, and the water-shrew are rare; the true wild cat still lingers; foxes, once *very* numerous, are now scarce; the marten, once abundant, is trembling in the balance between rarity and extinction; the polecat has become decidedly rare; a colony of badgers still persists; the rabbit, introduced about 1850, is in many places taking a rapid—lamentably rapid—hold of newly afforested grounds; and so on. The chief value of such information lies in the precision with which it records increase or decrease, *e.g.* of squirrel and polecat, within a term of years, and thus illustrates evolutionary processes going on around us.

We need hardly refer to the records of adder, lizard, and slow worm, of frog and toad, and two newts; but we may be allowed to note, without being captious, that the title on the back of the book and on the beautiful frontispiece, "A Fauna of the North-West Highlands and Skye," is somewhat too big for the volume, which deals with mammals, birds, reptiles, and amphibians, and no more.

The most entertaining part of the book is that which deals with the birds, in regard to which the authors speak from rich experience and with infectious enthusiasm. There is naturally enough a dominant *note personnel*, but it is always pleasant, even when the information given does not seem very important. Among the rare visitors we may mention the lesser whitethroat, the barred warbler, the nuthatch, the golden oriole, the great grey shrike, the waxwing, the rose-coloured pastor, the roller, the hoopoe, the osprey, the bittern, Pallas's sand-grouse, the red-necked phalarope, the great crested grebe, and the fulmar. Among the most interesting residents are the chough, the raven, the hen-harrier, the sea-eagle, the rock dove, and the ptarmigan. This section is rich in historical material, *e.g.* in regard to the starling, the golden eagle, the sea-eagle, the osprey, the grey lag goose, and the fulmar. Apart from their historical interest, the notes on the birds are full of interesting observations, and some of the descriptions by the late Mr. MacPherson are fine pieces of picturesque writing. Mr. Harvie-Brown gives here and there an inkling of his strong views on bird protection; thus, "the Bird Acts require steady and relentless revision and change. The idea of saving trouble at Westminster and County Council and Sheriff Courts, by dividing Great Scotland into two divisions—north and south—for all species mentioned in these Acts, is absurd, and appears to me to be eminently calculated to defeat all useful purposes of the Acts."

The book is beautifully got up and illustrated, and though, unfortunately, somewhat of a luxury, is sure to be welcomed by those who are interested in the wild life of Scotland. Its mood is one that will foster interest in open-air natural history, and the thoroughness of its lists should help to lessen the ruthless killing of supposed rarities. J. A. T.

A NATURALIST IN SARAWAK.[1]

NEARLY forty years ago Dr. Beccari, the well known traveller-naturalist, made extensive journeys in Sarawak, but not until now has he published an account of his experiences; indeed, for this volume we have to thank the Ranee, H.H. Lady Brooke, who wisely urged Dr. Beccari to give the public the benefit of his knowledge, for, as she justly stated, the conditions have practically remained unchanged from times unknown.

FIG. 1.—Adult Male Mayas Tjaping. From "Wanderings in the Great Forests of Borneo."

Dr. Beccari collected in the land of the Land Dyaks, of the Sea Dyaks, and of the Kayans, not to mention less numerous peoples, and he gives a first-hand account of the people, their houses, dress, weapons, and ways. All this is very interesting reading, but there is little, if anything, that has not been recorded in Ling Roth's great compilation "The Natives of Sarawak and British North Borneo," or in the writings of more recent travellers. Indeed, it is the great fault of this book that the numerous contributions that have of late years been made to the natural history and

[1] "Wanderings in the Great Forests of Borneo: Travels and Researches of a Naturalist in Sarawak." By O. Beccari. Translated by Dr. E. H Giglioli, and revised and edited by F. H. H. Guillemard. Pp. xxiv+424 illustrated. (London: A. Constable and Co., 1904.) Price 16s. net

ethnology of Sarawak are one and all ignored. A few references are given to older publications or the *Sarawak Gazette*, and to some of the papers based on the collections sent home by Dr. Beccari. The reader must consequently bear in mind that there is a considerable amount of information about the animals and people of Sarawak which, to say the least of it, supplements Dr. Beccari's book. To the ethnologist the chief value of the book lies in the identification of animals, and especially of plants, employed by the natives, as the author not only gives their uses, but their native and scientific names.

The general naturalist will find the book packed with interesting information. Dr. Beccari is an enthusiastic and keen witted field naturalist. The intending traveller will pick up many valuable suggestions, and the stay-at-home naturalist will gain an extremely good idea of the conditions of life in the jungles of Borneo. The author not only describes what he saw, but he seeks to trace the interdependence of organisms upon one another and their relations to the environment. As Dr. Beccari is a professional botanist, the botany of a tropical forest is dealt with more fully and with greater knowledge than is usual in similar books, and those botanists who are interested in ecology will find much that will be of service to them.

FIG. 2.—Rafflesia Tuan-Mudæ, Becc. (flower 22 inches in diameter). From "Wanderings in the Great Forests of Borneo."

The most important zoological observations are those on the orang-utan. The Dyaks recognise several varieties of orang, the two more important being the "Mayas kassa" and the "Mayas tjaping," with a laminar lateral expansion of naked skin in front of each ear. (In a foot-note we read that *tjaping*, in Malay, is the term applied to a small, nearly triangular piece of silver which is hung in front of baby girls as a fig-leaf.) Wallace and others have expressed the opinion that at least two species of orang-utan exist in Borneo. Dr. Beccari has come to the following conclusions:—There is no well authenticated case of a female with lateral face-expansions, though there is some evidence that such do occur; but there are young orangs with milk dentition which have them well developed, and adult male individuals are found with the expansions rudimentary. Not associated with the above character is the frequent absence of the terminal phalange of the hallux with the total or partial suppression of the nail. Evidently there is great variability in the orang, but Dr. Beccari holds that there is only one species of *Simia satyrus* with two main varieties, "tjaping" with lateral adipose cheek-expansions and highly developed cranial crests, and "kassa" with no lateral cheek-expansions and its skull devoid of strongly pronounced crests. Nevertheless, he suggests "that in a remote past the Mayas tjaping and the Mayas kassa were two quite distinct species, perhaps having their origin in separate regions, and only later coming into contact on the same area . . . at present it seems hardly likely that the two races should remain distinct." Dr. Beccari brought home a large number of skins, skeletons, and heads of these animals, and he confesses to have killed and wounded others which he could not take away. He adds practically nothing to our knowledge of their habits.

Dr. Beccari does not hesitate to throw out a number of hypotheses, many of which will by no means be implicitly accepted by biologists; for example, he suggests (p. 32) that the prominent nose with narrow nostrils directed downwards of the Semitic people is associated with living in an open country, "whilst Negroes and Malays, for the most part dwellers in the forest, have snub noses with wide nostrils turned upwards, such as characterise most monkeys." Again,

he says, "I have always thought that there must have been a formative epoch, in which every creature had the power of special adaptation to its own needs—nay even to its own wishes or caprice. In this epoch of 'plasmation' when the so-called force of heredity—which tends to reproduction according to the type of the progenitor—had but little power, the world being still young, the organism must have been far more susceptible of modification by external forces (p. 36). . . . The actual power of adaptation in organisms is at the present day well nigh non-existent as compared with what they must have possessed in the past (p. 211). . . . The varied forms assumed by those groups of individuals called by naturalists species, would be merely the result of a plasmative force exerted by surrounding conditions on primitive beings (p. 208). . . . May it not be that the Rafflesia, and a host of other aberrant species, both animals and plants, are examples of the autocreation of organisms (derived from exceptional circumstances of the environment) and suddenly appeared *à l'improviste*, as it were, in that primitive epoch during which organic matter was easily plasmated, so as to adapt itself with facility even to extraordinary conditions of existence? (p. 389). . . . Therefore, contrary to the present prevailing tendency to attribute a powerful action to variability during the existing period, and to consider every species as inconstant, I hold the opposite opinion, namely, that at the present time species do not vary in Nature, returning thus to the old idea of the nearly absolute fixity of existing species (p. 210)." It is interesting to compare these views with those arrived at by Alfred Wallace, who wandered in the same jungles; and, as Dr. Guillemard, the English editor, rightly observes, "Whether the scientific reader does or does not admit the validity of all Dr. Beccari's theories concerning species-formation, he cannot call in question his abundant experience of the country, or his knowledge of the subjects of which he treats." A. C. H.

OILS FOR MOTOR-CARS.

POSSIBLY this article may be of interest to readers of NATURE who are not chemists, and therefore no apology need be made for treating certain parts of the subject in an elementary manner. The commercial names for motor-oils are numerous and confusing, and the automobilist may well be puzzled to discriminate between them, even if his chemistry has by no means become a mere schoolboy reminiscence.

The various liquids in use at the present time as fuels for motors are derived from three sources, namely, crude petroleum, coal tar, and alcohols. By far the largest quantity is furnished by the petroleum. Coal-tar "spirit" is scarcely beyond the experimental stage. Alcohol is somewhat largely used abroad, but at present is almost out of the question in this country.

Products from Crude Petroleum.—These, so far as motor fuel is concerned, are two: a *light oil* and a heavier or *"burning" oil*. The light oil, in one grade or another, is variously known as gasoline, petroleum spirit, petrol, petrol spirit, motor spirit, mineral spirit, motol, moto-essence, naphtha, petroleum-benzine, and benzoline. Of these, gasoline has the lowest density, benzoline the highest. The oil is obtained in the distillation of American crude petroleum, and may be said generally to be the portion of the distillate passing through the still between the temperature-limits of 60° C. and 150° C., and having a specific gravity ranging from 0·68 to 0·74. The limits, however, vary somewhat with the different refineries. To obtain a good motor "spirit" this fraction of the distillate is purified with sulphuric acid and with soda, and rectified by re-distillation. Such a spirit is clear, has no strong odour, and leaves no residue when evaporated from the hand. Two or three years ago the best English petrol had a specific gravity of 0·680; but, for reasons to be mentioned later, the density has been gradually raised, and is now generally about 0·720 or more.

Chemically, light oil or petrol is a mixture of several members of the homologous series of paraffin hydrocarbons, C_nH_{2n+2}. It is generally assumed to be mainly heptane, C_7H_{16}, and octane, C_8H_{18}, but both lower and higher members are usually present, and some analyses indicate that the range may commonly be from hexane, C_6H_{14}, to undecane, $C_{11}H_{24}$. A point to notice is that whilst petrol as a whole is a light, volatile oil, it is by no means a homogeneous liquid. The different hydrocarbons composing it have not the same volatility as one another, and they require different quantities of air for their complete combustion.

The heavier oil obtained from crude petroleum corresponds to what is ordinarily known as kerosene, petroleum oil, or paraffin. It is obtained by refining the fraction which distils between 150° and 200°, and has a density of about 0·78 to 0·81. This product contains higher members of the paraffin series than those of petrol. It is consequently less volatile, and has a higher flash-point.

Kerosene is not only cheaper than petrol, but safer in the handling. Why, then, is petrol used so largely as a motor fuel instead of kerosene? And why are some kinds of petrol better than others? To answer these questions we have to remember that, to form the proper explosive mixture for the engine, it is necessary to have the vapour of the liquid mixed with a particular proportion of air. With too little air the mixture burns too gently; with too much there is a diluent effect, and liability to failure of ignition. The ready volatility of petrol allows of the requisite mixture being made more easily, more certainly, and with a simpler form of carburetter than when kerosene is used. Failure to ignite is less frequent, and the combustion is cleaner.

Nevertheless, since the supply of petrol is not limitless, attempts are being made, with some success, to utilise kerosene as a source of motor energy. The principle employed is that of heating up the vapour of the kerosene, or the liquid itself, in order to allow of a readier admixture with the air in the carburetter. This is effected either by the heat of the exhaust or by some other special contrivance. A "smokeless petroleum engine" has recently been described which is said to run without smoke or smell, and without "sooting" the cylinder. It will not, however, start with the cold kerosene. Petrol is used for the first revolutions in order to heat the vaporiser and raise the kerosene to the necessary temperature.

As regards differences of quality met with in motor spirits (petrol), the first thing to notice is that the higher the density of the liquid the nearer does it approach to the character of kerosene and to the possession of the disadvantages peculiar to the latter. To meet the growing demand, makers have been more and more inclined to eke out their supply of petrol by including a portion of the heavier fractions that were formerly rejected. Hence many of the present oils are to that extent of inferior quality. Next, the density alone is not an infallible criterion, because a spirit having a density of, let us say, 0·700, may be made up in different ways. Ideally, it might consist of a single hydrocarbon having the density in question. On the other hand, it might be compounded of two hydrocarbons having widely different densities, such as 0·660 and 0·740 respectively. In the first case it would distil completely at one uniform temperature, in the second there would be a difference of perhaps a hundred

degrees between the initial and the final boiling points. With homologous hydrocarbons the lower-boiling member vaporises more readily than the higher; consequently, in practice, the vapour from the second spirit would in the early stages of a run contain an excessive proportion of the more volatile constituent, and in the later stages too much of that which is less volatile. For satisfactory combustion these two constituents require very different proportions of air; hence if the carburetter was initially arranged to give the proper quantity it would not do so in the later stages. The practical bearing is that, to avoid waste of fuel or loss of heat, more attention must be paid to the carburetter when the petrol has a wide range of boiling points than when it is more nearly homogeneous.

As already mentioned, the petrols in actual use consist of several hydrocarbons; there is none containing only one, or even only two. But the foregoing examples typify the better and the inferior qualities respectively.

Products from Coal-tar.—These are known commercially as benzol or benzole, benzine, and coal-tar spirit, all of which terms mean nearly the same thing, and toluol, which is a very similar liquid of lower density. (Benzol or benzine should be distinguished from benzoline, the petroleum product previously referred to.) In the first group the aromatic hydrocarbon benzene, C_6H_6, is the chief constituent, but toluene, C_7H_8, and xylenes, C_8H_{10}, also accompany it. Benzol is commercial benzene, *i.e.* benzene with some impurities and homologues; benzine is a cruder variety; these differ only in the proportions of the admixtures, and are often indistinguishable the one from the other. Coal-tar spirit is a general term for either. In America and in France, as well as sometimes in this country, the term "benzine" refers to the petroleum naphtha, not to the coal-tar product.

Benzol has a greater density than petrol (about 0·883 at 15°·5 C.), and a higher boiling point, viz. about 90° C. Nevertheless, it has the advantage of distilling, as a whole, within much narrower limits than most varieties of petrol do. Thus, while there may be a difference of more than 100° C. between the initial and final boiling points of petrol, a good sample of "90's benzol" will distil completely within a range of about 55° C. or less, *i.e.* between 90° and 145°. Benzol is consequently more like the ideal homogeneous fuel than petrol is, and this, together with the necessity of supplementing the supply of petrol by some other fuel, has led to its frequent employment abroad and to experimental trials in this country. Deutz benzol locomotives have been used for some time in Germany, and the tram-cars of the Saalgau-Herbertingen-Riedlingen line are worked by a 14 h.p. benzol motor, whilst a mixture of benzol and alcohol is used in some of the French racing cars. So far as the German experience has gone, the results are said to indicate that the benzol motor is about 10 per cent. cheaper in working than the alcohol engine. The British trials seem to show that benzol works more uniformly than petrol, and is generally satisfactory, except that with too great a compression in the cylinders there is a liability to pre-ignition.

One disadvantage of benzol is the presence in it of sulphur compounds, chiefly carbon disulphide and thiophene. These not only give an evil-smelling exhaust, but may conceivably corrode the metal of the cylinder through the formation of acid vapours in the combustion. Probably at a cost of about a penny per gallon the benzol could be sufficiently freed from sulphur, and it is thought that, with a good demand, the purified liquid might be supplied at a price of about 7*d.* a gallon, or less. Unfortunately, however, the supply of benzol is even more limited than that of petrol; the yield from coal-tar is only some 0·6 per cent., and much of what could be produced is already absorbed by the chemical and dye industries. It seems, therefore, very unlikely that benzol will ever largely supplant petrol, though it may usefully supplement this fuel.

Toluol (crude toluene), of lower density but higher boiling point than benzol, has also been recently tried, though not on a sufficiently extended scale to give much practical information. Benzol is essentially a mixture of pure benzene and toluol, and in one respect the mixture is better than pure benzene, because the latter freezes at 0° C., and this is prevented by the presence of toluol.

Alcohols as Fuels.—The industrial side of the question has encouraged the use of alcohol in France and Germany, since, other things being equal, it is better to support home agriculture than foreign oil-fields. Strong alcohol can be bought in Germany at a cost of 8½*d.* to 10*d.* per gallon, and at this price its use is said to be economical compared with petrol. Pure alcohol, of course, is heavily taxed—in this country the duty amounts to 17*s.* per gallon of 90 per cent. alcohol—and that used for motor purposes is "denatured" by the addition of foreign substances. In England the denatured product is methylated spirit, obtained by mixing "spirits of wine" with not less than one-ninth of its bulk of wood-naphtha, and when intended for retailing, with 0·38 per cent. of mineral naphtha or petroleum oil in addition. In France the denaturant is a mixture of heavy "benzine" and malachite green. Ordinary methylated spirit, in some experiments made a short time ago, was said to give an exhaust with an odour so vile as would preclude its general use; this is attributed to the denaturant, and to obviate it one suggestion is that alcohol intended for motor-fuel should be denatured with petrol. There are, however, some fiscal difficulties in the way.

Alcohol is a substance already partly oxidised; it contains rather less hydrogen than does petrol, and only about one-half as much carbon, the difference being made up of oxygen. Consequently its available heat-energy, viz. the heat developed by the complete oxidation of its carbon and hydrogen, is not much more than one-half that of good petrol. Nevertheless, it has some compensations. It is of nearly uniform composition, and distils within much narrower limits than petrol; in fact, strong alcohol, not denatured, is an almost homogeneous body, which boils away completely at a practically constant temperature. Moreover, it is claimed that the alcohol engine has a much greater efficiency than the petrol motor. To get the best results, however, it has been found necessary to use a higher compression than that given by the ordinary petrol engine. In some cases both petrol and alcohol are employed, with two carburetters; the petrol is used for starting, and is automatically cut off by a governor when the motor is sufficiently hot. The net result of the alcohol trials at present seems to be that, for equal volumes, petrol is appreciably more efficient than denatured alcohol; but the difference is not considerable, and fluctuations in price may yet make alcohol a serious competitor with petrol where the fiscal difficulties can be overcome.

The cheaper higher alcohols of fusel oil (chiefly amyl and butyl alcohols) have also been proposed for use as motor-fuels. But practical trials are lacking, and in any case the supply of fusel oil is only a limited one. For the principal motor-fuel of the future it is probably to kerosene that we must look.

C. SIMMONDS.

ADMIRAL SIR ERASMUS OMMANNEY, K.C.B., F.R.S.

A WELL-KNOWN figure has been lost to scientific circles by the death of Admiral Sir Erasmus Ommanney, K.C.B., F.R.S., which occurred on December 21, at ninety years of age.

Erasmus Ommanney was born in London so long ago as the year 1814, and entered the Navy in 1826. He became Lieutenant Ommanney in 1835, and at once volunteered to serve under Sir James Ross in the voyage for the relief of a number of missing whalers reported to be caught by the ice of Baffin's Bay, and on the coasts of Greenland and Labrador. The objects of the expedition were successfully carried out, notwithstanding the extreme danger of the navigation during the winter months.

In 1850 he was appointed second in command under Captain Horatio Austin on the Arctic expedition in search of Sir John Franklin; and in August of that year was the actual discoverer of the first winter quarters of Franklin's ships. He also directed an extensive system of sledge journeys, by which the coast of Prince of Wales Land was laid down. After his return from the Arctic he was elected a Fellow of the Royal Society for his services to science.

After his retirement in 1877, he threw himself with zeal into the work of numerous learned societies, of which he was an energetic member. He was a Fellow of the Royal Geographical Society, and had been a member of the council. He was also a Fellow of the Royal Astronomical Society. An active member of the British Association, he had served upon its council, and went with it to Canada in 1884 as treasurer, receiving on that occasion the honorary degree of LL.D. from the McGill University, Montreal.

The funeral took place at Mortlake Cemetery on Tuesday afternoon. Among the wreaths placed upon the coffin was one from the president and members of the Royal Geographical Society.

NOTES.

IT is proposed to establish in the University of Liverpool a memorial to Mr. R. W. H. T. Hudson, late lecturer in mathematics, whose brilliant career was so tragically cut short at the end of last September. The memorial will probably take the form of an annual prize in mathematics, to be awarded for distinction in geometry, the subject in which Mr. Hudson's work chiefly lay. For this purpose a sum of 100*l.* would be required. Contributions to the fund should be sent to Mr. Alexander Mair, the University, Liverpool.

DR. J. MACINTOSH BELL, a nephew of Dr. Robert Bell, F.R.S., has just been appointed Government geologist of New Zealand. Dr. MacIntosh Bell has seen much active service on the Canadian Geological Survey, having worked during four seasons under his uncle, the director. In the spring of 1899 he went with Dr. Robert Bell to Great Slave Lake, where he spent the following winter, and in 1900 he was sent to Great Bear Lake, several hundred miles further north. On his return he was employed in 1901 and 1902 as geologist by the Lake Superior Commercial Co., and in 1903 by the Ontario Bureau of Mines.

REPLYING to a vote of thanks, after laying the foundation-stone of the Chelmsford Free Library, School of Art, and Museum on December 21, Lord Rayleigh said that the visit to Stockholm from which he had just returned was of great interest. His colleagues and he received almost a royal welcome, and at the banquet which formed part of the proceedings it was very much impressed upon them that what Nobel had in view in providing his prizes was to bring scientific men of the various countries together not merely for the advancement of science, but to promote good feeling and the cause of peace between the nations of the world. Lady Rayleigh afterwards distributed the prizes to the students of the local science and art classes.

LORD KELVIN has accepted the nomination of the council for the presidency of the Faraday Society, in succession to Sir Joseph Swan, F.R.S.

THE death is announced of the Rev. J. M. Bacon at the age of fifty-eight. Mr. Bacon had made a number of balloon ascents for scientific purposes, and some of the results of his studies are described in his works "The Dominion of the Air" and "By Land and Sky."

ACCORDING to the *Patria*, negotiations have been entered upon by the Italian Minister of Posts and Telegraphs and the British Postmaster-General with a view to establish wireless telegraphic communication between the stations of Poldhu and Bari.

WE are informed that the constitutional amendment exempting the California Academy of Sciences from further taxation was carried at the election, November 8, by a majority of nearly 11,000.

THE bog-slide reported in several newspapers as having occurred on December 7 between Frenchpark and Castlerea, in the north part of the county of Roscommon, appears now to have come to rest, after invading a village and covering a large area of agricultural land. Local information reaches us to the effect that clefts still remain visible in the bog, but that the hollow formed at the origin of the slide is gradually closing in. The flow is attributed to heavy rain, with which existing means of drainage were unable to cope. Lord de Freyne is erecting huts for the dislodged tenantry, and about twenty men were still engaged at Christmas in clearing the main road from its peaty covering.

ON December 22 the airship *Lebaudy II.* made its thirtieth experiment in aërial direction at Moisson, near Mantes. In these voyages the *Lebaudy II.*, the volume of which has been brought up to 2063 metres, returned each time to the shed which shelters it, after having gone away to distances so great as ten miles. The length of the balloon is 64 metres, and its regular crew consists of three people. Several times, however, it has taken passengers, as many as six persons having ascended at one time. The speed attained by its own propulsion, measured with a registering anemometer, may be estimated at 40 kilometres per hour. The airship has been taken out in wind blowing at 5 or 6 kilometres, and in rain. It has risen to the altitude of 500 metres. The ascent of December 22 was the last of the autumn campaign, eighteen ascents having been made during the months of November and December. During this season experiments were made to decide whether an astronomer aboard an airship can know the precise geographical position of the balloon when he makes his observation. An ascent was made between 1 and 2 a.m. on a foggy morning. In the car had been taken an acetylene searchlight equalling 100,000 lamps of ten candles each, like those at the Exposition of the Grand Palais. The balloon was invisible to persons on the earth, and the earth itself could not be seen by the aëronauts. But the light could easily be distinguished, and its movements

followed. Next year new voyages to considerable distances will be undertaken, like that from Moisson to Paris, or to the Crystal Palace from London. In its last trial the *Lebaudy II.* remained inflated for sixty-four days.

WITH Mr. C. G. Barrett, whose death was announced last week, has disappeared one of the last of the old school of British lepidopterists, contemporary with Doubleday and Newman. The first mention we can find of Mr. Barrett's name is in the list of entomologists in the "Entomologist's Annual" for 1857, but from that time onwards he became a frequent contributor to the *Entomologist's Weekly Intelligencer*, and afterwards to its successor, the *Entomologist's Monthly Magazine*, the first number of which appeared in June, 1864, so that the fortieth year of this periodical has been marked by the demise of two out of the seven editors whose names appear on the early numbers of 1904, Robert McLachlan, the last of the original staff who still continued to act, and C. G. Barrett, who joined the staff of that magazine in 1880, and became a member of the Entomological Society of London in 1884. Mr. Barrett was an enthusiastic and very successful collector of British Lepidoptera, and as he held a position in the Excise which involved his being moved from one station to another, he had great facilities for investigating the insects of widely separated localities. Perhaps the most important of his captures was the extremely interesting moth which he obtained on the Hill of Howth, near Dublin, and was named *Dianthoecia Barrettii* after him. Mr. Barrett's contributions to entomology, with one notable exception, were published almost exclusively in magazines, but in 1892 he commenced his great work, "The Lepidoptera of the British Isles," in serial parts, and he had completed the Macro-Lepidoptera at the time of his death. Mr. Barrett's last paper, a description of the larva of *Doryphora palustrella*, Douglas (one of the Tineina), appeared in the *Entomologist's Monthly Magazine* for the present month, so that he may be said to have died in harness.

THE *Standard's* correspondent states (December 26) that the Vienna Veterinary Institute has just opened a laboratory for the study of the diseases of fish, which will be in charge of Prof. Fiebinger.

THE Paris correspondent of the *British Medical Journal* details some of the conclusions of the committee appointed to investigate Dr. Doyen's claims respecting the cause and treatment of cancer (December 24, p. 1720). M. Metschnikoff, one of the committee, states (1) that in culture tubes inoculated by Dr. Doyen with cancerous material in his presence the *Micrococcus neoformans* developed; (2) that the characters of the microbe so obtained agreed with those described by Dr. Doyen as characteristic of the *M. neoformans*; (3) it is not yet possible to report on the specificity or pathogenic characters of the microbe; (4) it is not possible yet to state whether Dr. Doyen's serum has a curative action or no. It will be seen that this report is a very guarded one, and very different from the details published in the daily Press.

WE learn from the *Times* (December 21) that a considerable number of beautifully worked flints have recently been discovered at Culmore, which is said to be in the south of Scotland, but we have been unable to find the locality on maps. The spot where the flints were found has the appearance of having been surrounded by marshy ground, and it is possible that the flint-tools may have belonged to lake-dwellers. Arrow-heads, scrapers, anvil and hammer stones, are abundant among the worked flints. The collection has been acquired by Mr. Ludovic Mann, and will be exhibited for a few weeks in the People's Palace, Glasgow.

THE annual conversazione of the Royal College of Science and Royal School of Mines was held at the college as we went to press last week, and was attended by about five hundred guests. The company included Sir Norman Lockyer, Sir Arthur Rücker, Mr. Morant, Prof. Judd (the dean), Prof. Tilden, Prof. Perry, Prof. Callendar, Prof. Gowland, and Mr. G. W. C. Kaye (secretary). There were many interesting exhibits in the various departments in chemistry, physics, astrophysics, mechanics, metallurgy, mining, geology, and biology, under the direction of their respective professors. The Solar Physics Observatory was open by permission of Sir Norman Lockyer, and a kinematograph exhibition was given, while the college company of the Corps of Electrical Engineers showed a searchlight. Dr. W. Watson, F.R.S., delivered a lecture during the evening on radium and twentieth century alchemy.

Spolia Zeylanica for October contains the description by Mr. Boulenger of a new snake of the genus Aspidura, and an illustrated account by Mr. J. L. Hancock of the Cingalese representatives of the grasshoppers of the family Tettigidæ.

THE October number of the *American Naturalist* is entirely devoted to botanical subjects, even the usual pages of notes being omitted. In the first article Prof. Penhallow completes his account of the anatomy of conifers, in the second Dr. B. M. Davis contributes the fourth instalment of his studies of the plant-cell, while in the third Prof. D. H. Campbell discusses the affinities of the ferns of the groups Ophioglossaceæ and Marsilaceæ.

AT the meeting of the Zoological Society held on December 13 Mr. Rothschild exhibited a wonderful series of mounted skins and skulls of gorillas and chimpanzees, most of which had been set up by Rowland Ward, Ltd. A long paper was also read on this unique collection, in the course of which the author stated that he recognised four different forms of gorilla, two of which constituted species. Unfortunately, in our opinion, he advocated the transference of the name *Simia satyrus*, so long applied to the orang-utan, to the chimpanzee. Surely a title to a name ought to become valid after such a long period of unchallenged use.

TWO articles from the twentieth volume of the *Journal* of the Imperial University of Tokyo were received by last mail. In the first Mr. T. Fujita discusses the mode of formation of the germinal layers in gastropod molluscs. More general interest attaches, however, to the second, in which Mr. H. Yabe describes a number of cephalopod remains from the Cretaceous rocks of Japan, this being his second contribution to the subject. Most of the species belong to European genera, and the large size of some of the specimens of turrilites is very noticeable. We have also received article 8 from vol. xviii. of the same serial, in which Mr. B. Hayata gives a list of the plants of the order Compositæ found in Formosa.

IN the December number of *Bird Notes and News* the Royal Society for the Protection of Birds records its efforts in regard to the late osprey case in Surrey. It may, however, be asked whether it would not be well to admit that the preservation of such stragglers is a practical impossibility, and that ospreys and motors are incompatible. Similarly, in view of recent letters in the *Field*, the question

as to whether birds are or are not harmful requires discussion on a business footing, altogether apart from sentiment. If they are proved harmful, we can decide whether we will put up with the damage for the sake of the attraction they add to the landscape; but let us abandon attempts to gloss over charges of damage and to defend birds at all costs. The society urges the advisability of establishing a "bird and tree day" throughout the country; possibly an excellent way of developing interest in nature—but this time will show.

WE have received four zoological papers from American serials. The first (from the *Proceedings* of the Boston Natural History Society) contains a list of molluscs from Frenchman's Bay, Maine, by Mr. D. Blaney, while in the second (from the same journal) Mr. W. R. Coe discusses the terrestrial nemertean worms of the genus Geonemertes from Bermuda. These worms, it may be remembered, were first discovered, dwelling in company with ordinary earthworms, during the *Challenger* cruise, but the specimens were lost, and no others were ever collected until 1898 and 1901. In the third paper (from the *Proceedings* of the U.S. National Museum) Mr. P. Schmidt re-determines a Japanese fish, while in the fourth (from the *Proceedings* of the American Academy) Messrs. Parker and Starratt record some interesting experiments with regard to the effect of heat on the colour-changes of the American chamæleon-iguana (*Anolis carolinensis*).

MESSRS. Jordan, Russell, and Zeit publish details of experiments on the longevity of the typhoid bacillus in water (*Journ. of Infectious Diseases*, i., No. 4, p. 641), from which it appears that under conditions probably closely simulating those in nature the vast majority of typhoid bacilli introduced into a water perish within three or four days. This is rather opposed to the views now generally prevailing, and needs confirmation before it can be absolutely accepted.

AT a meeting of the Institute of Mining and Metallurgy held on December 15 Messrs. Thomas and Macqueen read a paper on methods of dealing with dust in the air and gases from explosives in a Cornish mine (Dalcoath). Miners' phthisis is especially due to inhalation of stone dust, and it is found that the use of a water-jet with machine drills entirely prevents dust if used from the commencement of operations and properly directed, a coarse spray being more efficient than a fine one, but is difficult to apply when the drill-holes become deeper than about two feet. James's water blast was found particularly effective for laying the dust caused by shovelling and blasting.

AN interim report has been issued by a committee appointed by the British Association to inquire into ankylostomiasis in Britain. The Ankylostoma is an intestinal parasite producing serious and sometimes fatal effects. The report states that there are many channels by which the Ankylostoma might be introduced into British coal mines (it has been introduced into the Westphalian coal fields and into the Dalcoath tin mine in Cornwall, as already recorded in these columns). The conditions existing in our mines are such that it would probably flourish and become firmly established. Once introduced it is doubtful if it could ever be eradicated, and therefore it is recommended that proper sanitary regulations should without delay be formulated and enforced to prevent infection of the pits.

A REPORT by Drs. Haldane and Wade has been issued by the Local Government Board on the destruction of rats and disinfection on shipboard, with special reference to plague. For destroying rats the burning of sulphur, the use of liquid sulphurous acid, carbonic oxide, carbonic acid, and the Clayton process are discussed. Carbonic oxide, while very fatal to rats, has no effect on insect vermin and no disinfecting action, and having no odour may be dangerous to man, and may form an explosive mixture with air. Carbonic acid, while fatal to rats, is similarly without lethal effect on vermin, has no disinfecting action, and a large quantity is required, which makes it expensive, but it is less dangerous to man than carbonic oxide. Burning sulphur is tedious and only applicable in empty cabins and holds, but is cheap and fairly effective. Much the same may be said of liquid sulphurous acid, but it is quicker though more costly. The Clayton process consists in burning sulphur in a furnace, the fumes from which are pumped into the holds, &c., and is probably the best of the methods discussed. Properly carried out it is fatal to rats and all vermin, has considerable disinfecting and penetrative power, is not likely to cause accident as its odour is so marked, but it damages certain articles, especially if damp, and does not diffuse well in a closely packed hold.

THE area planted with cotton this season in the West Indies is estimated in the *Agricultural News*, November 19, at from eight to ten thousand acres, excluding Carriacou, where four thousand acres were planted mostly with Marie Galante cotton. Of this amount Barbados and St. Vincent each have sixteen hundred acres under cotton, and in St. Kitts the acreage exceeds two thousand acres. The crops generally are much healthier than in the previous year, and an output of about 5000 bales may be expected.

THE *Quarterly Record* of the Royal Botanic Society of London for the second quarter of this year contains an account of the horticultural exhibition held in June, and most of the papers read at the conferences have been published. The educational section attracted a number of speakers and visitors when nature-study and horticulture formed the subjects of addresses by Sir George Kekewich, Mr. F. Verney, and others. At the forestry conference Prof. W. R. Fisher delivered the address, in the course of which he discussed the selection of seeds of forest trees, and advocated the formation of experimental stations in order to study the suitability of different trees for particular districts and soils.

THE morphological nature of the ovary in the genus Cannabis has engaged the attention of many botanists, including Payer, C. B. Clarke, and Briosi and Tognini; finally, Dr. Prain, having been deputed by the Government of India to report upon the cultivation of *gánjá*, has upon the evidence of certain abnormal forms contributed a new explanation in No. 12 of the Indian *Scientific Memoirs*. Previously the views had been expressed that the pistil consists either of a single carpel, or of two carpels of which the anterior alone is developed, and bears an ovule; the bicarpellary nature of the ovary is, in Dr. Prain's opinion, fully borne out by specimens showing phyllody of the gynœcium, but it is the posterior carpel which is fertile. With respect to the character of the diclinism of the flower, this is shown to be primitive and not vestigial.

WE have received from the Rev. J. de Moidrey, S.J., of the Zi-ka-wei Observatory, an interesting and useful memoir on the climate of Shanghai, based upon observations made between 1873 and 1902. The coldest weather occurs about the beginning of February, and the warmest about August 1, nearly forty days after the solstices. The mean temperature for thirty years at Zi-ka-wei was 59°·2 F., and the mean range 43°·2. The extreme readings were:—maximum 102°·9, minimum 10°·2. A variation of the

climate is not apparent. The average monthly relative humidity is 78 per cent.; the annual variation is insignificant, averaging only 4 per cent. The average yearly rainfall is 43·6 inches; June is preeminently the rainy month, both for frequency and amount, while December is the driest month. The paper contains useful remarks upon the cyclones experienced over the China seas.

WE have received a copy of "Meteorology in Mysore" for 1903, being the results of observations at Bangalore, Mysore, Hassan, and Chitaldrug; these observing stations lie at the corners of a quadrilateral comprised between 12° 18′ and 14° 14′ N. latitude and 76° 10′ and 77° 36′ E. longitude, Bangalore being 190 miles west of and 3000 feet higher than Madras. The results, including the means for eleven years, 1893–1903, have been very carefully worked out by the director, Mr. John Cook, and contain some interesting features. The highest reading for eleven years of air temperature in shade was 103° at Chitaldrug in April 1901 and 1903, and the lowest 42°·7 at Hassan in December, 1895. The mean relative humidity varied from 57 per cent. to 62 per cent., but extreme dryness was occasionally experienced, the humidity varying between 4 per cent. and 6 per cent. Rainfall is fairly uniform throughout the province, varying from 26¼ to 37¾ inches per annum. The value of the report would be enhanced by a key-map of Mysore and surrounding districts.

IN the *Sitzungsberichte* of the Vienna Academy, cxiii., 3 and 4, Dr. Fritz Hasenöhrl discusses the laws of reflection and refraction of light as applied to a body which is moving relative to the ether, in connection with the thermodynamical aspects of the principle of reciprocity, and also the variations in the dimensions of matter due to motion through the ether.

IN No. 86 of the *Communications* from the Leyden Physical Laboratory Dr. H. Kamerlingh Onnes and Dr. H. Happel discuss the application of Gibbs's volume-energy-entropy model to the representation of the continuity of the liquid and gaseous states on the one hand, and the various solid aggregations on the other. For this purpose models have been constructed for an ideal substance, showing the continuity of the solid and liquid as well as of the liquid and gaseous states.

A SERIES of experiments on the influence of abnormal position upon the motor impulse is described in the *Psychological Review* for November 1 by Mr. Charles Theodore Barnett. Without going into the theoretical aspect of these investigations, we notice that the author refers to the well known puzzle of drawing a rectangle and its diagonals in front of a looking-glass, and the difficulty of playing the piano with crossed hands, as Beethoven so often requires in his sonatas, is another illustration which suggests itself.

PART i. of vol. xlviii. of the *Transactions* of the Institution of Engineers and Shipbuilders of Scotland contains a paper by Mr. F. J. Rowan on the smoke problem, which is of especial interest on account of the recent inquiry by Sir John Ure Primrose at the sanitary congress in Glasgow into the connection of smoke with the production of rain and fogs in large cities. It is pointed out that although domestic fires are principally responsible for atmospheric pollution in a large town, only the smoke issuing from factory chimneys is subject to municipal control, and that many kinds of industrial furnaces, other than those used for raising steam, are employed in operations of such a nature that they cannot but necessarily produce large volumes of smoke. In dealing with the question of the prevention of smoke from furnaces used in connection with steam boilers, the employment of smoke-consumers, smoke-washers, and similar appliances is condemned, and a system of gas firing is advocated. Mr. Fyfe, the sanitary inspector of Glasgow, in the course of the discussion of the paper, stated that although the Public Health Act empowered prosecution in the case of "any chimney (not being the chimney of a private dwelling house) sending forth smoke in such quantity as to be a nuisance," it was customary in Scotland, under the Burgh Police Act, not to proceed against other kinds of furnaces than those used for heating boilers. His own experience had convinced him that gas firing was not absolutely necessary in such cases, but that by means of a suitable and inexpensive smoke-consumer, consisting of ignited jets of producer gas, all the smoke could be got rid of, and an additional supply of heat given to the boiler.

SAMPLES of an improved form of crucible lid have been sent to us by Messrs. J. J. Griffin and Sons. It is made slightly convex towards the crucible, and has been designed to obviate the loss of substance which so readily occurs in simple gravimetric experiments, such as the conversion of copper into copper oxide by means of nitric acid, when the ordinary form of crucible lid is employed.

ACCORDING to a paper by M. Bertrand in the *Comptes rendus* (No. 20, p. 802) mountain ash berries not only contain the alcohol sorbitol, but an isomeric alcohol, sorbierite, is also present. To obtain it the sorbitol is completely converted into sorbose by the action of the sorbose bacterium, and the sorbose is removed by crystallisation. Sorbierite has been obtained from the mother liquor in the form of deliquescent crystals. That the new alcohol is hexahydric has been established by the cryoscopic determination of its molecular weight, and by the preparation and analysis of the di- and tri-benzoic acetals.

A VERY interesting paper dealing with the primary formation of optically active substances in nature is contributed by Dr. A. Byk to the *Zeitschrift für physikalische Chemie* (vol. xlix. p. 641). It is shown in an indirect experimental manner that it is possible to effect the resolution of racemic substances by a purely physical agent—circularly polarised light. The reflection of the plane polarised rays of sunlight from the surface of water under the influence of the earth's magnetism is supposed to give rise to a predominating quantity of one form of circularly polarised light, and this is the cause which determines the production of optically active substances in the photochemical processes taking place in animal and plant life.

WE have received Williams and Norgate's "International Book Circular." An article on some contemporary foreign chemists, illustrated by twenty portraits, is contributed by Dr. M. O. Forster.

PROF. M. W. TRAVERS'S work on the experimental study of gases has been translated into German by Dr. T. Estreicher, and the translation has been published by Messrs. F. Vieweg and Son, Brunswick.

AN authorised translation, into German, of Prof. J. J. Thomson's lectures on "Electricity and Matter," reviewed in NATURE of May 26 (vol. lxx. p. 73), has been made by Herr G. Siebert, and published by the house of F. Vieweg and Son, Brunswick. The work forms the third volume of a series of monographs issued under the general title "Die Wissenschaft."

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY, 1905.

Jan. 2–3. Epoch of January meteors (Radiant 230°+53°).
6. 4h. 52m. to 7h. 5m. Transit of Iupiter's Sat. III. (Ganymede).
8. 2h. Saturn in conjunction with Moon (Saturn 3° 3′ S.).
9. 3h. Venus in conjunction with Moon (Venus 2° 13′ S.).
,, 11h. Juno in conjunction with Moon (Juno 0° 11′ S.).
10. 5h. 9m. to 6h. 23m. Moon occults ϕ Aquarii (Mag. 4·4).
11. Perihelion Passage of Encke's Comet.
13. 8h. 52m. to 11h. 6m. Transit of Jupiter's Sat. III. (Ganymede).
,, 10h. 36m. Minimum of Algol (β Persei).
15. Venus. Illuminated portion of disc=0·650, of Mars=0·903.
16. 7h. 25m. Minimum of Algol (β Persei).
24. 12h. 43m. to 13h. 40m. Moon occults β Virginis (Mag. 3·8).
27. 10h. Mars in conjunction with Moon (Mars 2° 45′ S.).
28. 15h. 7m. to 16h. 11m. Moon occults γ Libræ (Mag. 4·1).

ELEMENTS AND EPHEMERIS OF COMET 1904 *d*.—*Circular* No. 69 from the Kiel Centralstelle contains a set of elements, calculated by Herr M. Ebell from the observations made on December 17, 18, 19, and a short ephemeris, for comet 1904 *d*, recently discovered by M. Giacobini at Nice. They are as follows:—

Elements.

$T = 1905$ Jan. $3{\cdot}2814$ Berlin.
$\Omega = 75^\circ\ 9'{\cdot}8$
$\mathfrak{S} = 225^\circ\ 1'{\cdot}2$ } 1904·0
$i = 103^\circ\ 27'{\cdot}3$
$\log q = 0{\cdot}27173$

Ephemeris 12h. (M.T. Berlin).

1904–5	α h. m. s.	δ ° ′	log Δ	Brightness
Dec. 26	16 37 56	+31 45	0·3328	1·12
,, 30	16 49 48	+33 53	0·3234	1·17
Jan. 3	17 2 37	+36 8	0·3146	1·22

Brightness at time of discovery=1·0.

From the above it will be seen that both the northern declination and the brightness of the comet are increasing, but at the same time its right ascension is approximating more closely to that of the sun, thereby rendering observations increasingly difficult, and only possible during the few minutes preceding dawn.

OBSERVATIONS OF BRIGHT METEORS.—During a sea voyage undertaken in 1903–4, Dr. J. Möller, of Elsfleth, observed a large number of meteors, and in No. 3984 of the *Astronomische Nachrichten* he records the essential data regarding the observations of the sixteen brightest objects seen during November–December, 1903, and March, 1904. Of these, two were as bright as Jupiter, and five were brighter than Saturn. The latitude and longitude of the place of observation are given in each case, so that in the event of duplicate observations having been made the real paths may be computed.

The same observer recorded in No. 3971 of the same journal an authenticated naked-eye observation of Jupiter's third satellite on November 1, 1903.

THE GREAT RED SPOT ON JUPITER.—In a note to No. 3983 of the *Astronomische Nachrichten* Mr. Denning gives the results of his own and the Rev. T. E. Phillips's observations of the Great Red Spot since the last conjunction of Jupiter. They show that for the seven months prior to last September the motion of the spot indicated a rotation period, for the zone wherein it is located, of 9h. 55m. 38·6s., a shorter period than any observed since 1883, when it was 9h. 55m. 38·2s.

In the same publication Mr. Stanley Williams gives the results of his observations of this phenomenon, and shows that from his eye-estimates of the times of transit, during the period August, 1903, to January, 1904, the average time of rotation was 9h. 55m. 41·52s.

He points out that this is a remarkable increase on the rotation period (viz. 9h. 55m. 39·66s.) of the preceding year.

REPORT OF THE UNITED STATES NAVAL OBSERVATORY.—Rear-Admiral Chester's report of the work done at the United States Naval Observatory during the fiscal year ending June 30, 1904, shows that the observatory and the staff are still maintaining their reputation as regards the number and excellence of the observations made. In all 15,287 observations were made, including photographs of the sun taken on 210 days which show an increase of 93 days on which spots and faculæ were recorded on the solar disc. A new photo-visual triple objective with an aperture of 7·5 inch and a focal length of 65 feet, giving a 7-inch image, is to be obtained for the photoheliograph, and will also be used on future eclipse expeditions for photographing the corona. In regard to next year's eclipse the superintendent asks for a special grant of 1200*l*. and recommends the employment of a man-of-war and its crew to assist in the observations, which he suggests should be made at two widely separated stations in Spain.

The report also contains individual reports from the assistant in charge of each department, and records the personnel, the routine work performed with each instrument, and the publications issued during the period with which it deals.

The branch observatory at Tutuila, Samoa, has now been established, and placed under the supervision of assistants from Washington.

MATHEMATICAL DRAWING.[1]

THE appearance of a useful little book by Prof. Gibson may be made the occasion of emphasising the importance of drawing in mathematics, whether pure or applied, especially as the University of London has recently made a paper on drawing compulsory for all mathematical candidates for the B.Sc. degree. It was not without due consideration of the attendant difficulties that this step was taken. For the last two years the paper on drawing was left optional for the candidates in order that teachers as well as students should have time to obtain some definite notion of what is required; but even now, in the absence of well established text-books, a considerable amount of uncertainty exists as to the nature and scope of the subject. Time will, no doubt, set this right, and we welcome Prof. Gibson's text-book as assisting towards the desired object.

There are three prominent conceptions of mathematical drawing which may be noticed. These are:—(1) plotting, which means the construction of curves by taking a set of successive values of an abscissa and from them calculating (by a book of tables or otherwise) the values of the corresponding ordinate, and finally marking the positions of the points on squared paper; (2) the construction of curves—usually conic sections—from certain geometrical data; (3) what is generally called "geometrical drawing," embodying the principles and processes of projective geometry, and including problems in three dimensions. This is, perhaps, a rough division, but it will suffice.

Plotting may be a very humble process—"mere" plotting, as it is sometimes contemptuously called—or it may be what has long been known as curve tracing, and is to be found in treatises on the differential calculus. But even in this latter and higher character it is not (at least as usually employed by students) a system of accurate drawing. The construction of circles, and conics generally, from assigned data is certainly not a pure exercise in drawing, because it involves a very large knowledge of theorems on the part of the student. An exercise in this subject is apt to be, in reality, a severe examination in Euclid or in the theory of conic sections, and it cannot be what was intended by the advocates of a paper on drawing. With regard to projective geometry the case is somewhat different; the principles involved are not very numerous, and it cannot be said that a

[1] "An Elementary Treatise on Graphs." By George A. Gibson, M.A., F.R.S.E., Professor of Mathematics in the Glasgow and West of Scotland Technical College. Pp. x + 183. (London: Macmillan and Co., Ltd.) Price 3*s*. 6*d*.

knowledge of a large assortment of theorems is necessary; but the practical value of the study to students who are neither engineers nor architects is another matter.

There is, however, another kind of mathematical drawing which does not fall under any of these heads, and which consists in the invention of graphic solutions of equations which can be solved with great difficulty, if at all, by the stock processes of accurate mathematics. This branch is at once the most useful and the most vague; it is impossible to lay down its principles in systematic order—it must be learnt by abundant exemplification.

The ordinary academic problems of statics and hydrostatics furnish many examples of this subject, but only a few of these can be noticed here.

If AB and BC are two ladders freely jointed together at B, of different weights and lengths, placed with the ends A and C resting on a rough horizontal plane, A being prevented from moving while C is drawn out along the plane, the inclinations, θ, ϕ, of AB and BC to the ground when the limiting position is reached are determined from two equations of the forms

$$a \sin \theta - b \sin \phi = 0; \; m \tan \theta + n \tan \phi = k,$$

where a, b, m, n, k are all given quantities. The graphic solution of these equations is effected with great ease thus:—draw a line OH equal to m, and produce OH to O′ so that HO′ $= n$; at H draw HC perpendicular to OO′ and equal to k; through O draw any line OQ meeting HC in Q; take a point R in CH such that CR $=$ HQ, and draw O′R; then the point, P, of intersection of OQ and O′R is a point on the locus represented by the second of the above equations, the angles θ, ϕ being POO′ and PO′O. These points, P, are therefore constructed with great ease and rapidity. Also the locus represented by the first equation is a circle having for diameter the line joining the points which divide OO′ internally and externally in the ratio $a : b$, and the points of intersection of these two loci give the required values of θ and ϕ.

The following problem leads to precisely the same equations as the above:—rays of light emanate from a fixed point P in one medium separated by a plane surface from a second medium; find the ray proceeding from P which will be refracted to a given point, Q, in the second medium.

Again, the fact that when a uniform chain hangs with free extremities over two fixed supports of equal heights there are either two figures of equilibrium or none results from the solution of an equation of the form $xe^{a/x} = k$, which is effected by drawing the curve $y = e^x$ and the right line $y = kx/a$, and then it is at once seen that there are either two points of intersection or none.

When a heavy wire rope has its ends fixed at two points in the same horizontal line, and a load is suspended from the lowest point of the rope, the rope forms parts of two distinct catenaries, and the determination of these curves leads to an equation of the form

$$e^{k/x} = [(x^2 + a^2)^{\frac{1}{2}} + a]/[(x^2 + b^2)^{\frac{1}{2}} + b],$$

in which x alone is unknown. The tracing of the curve obtained by putting y equal to the right-hand side of this equation is quickly effected by means of two fixed circles and the drawing of right lines.

The figure of equilibrium of a revolving self-attracting liquid spheroid gives an equation which is a particular case of $x(a + bx^2)/(c + x^2) = \tan^{-1} x$, and this is best solved by the tracing of two curves. If we put y equal to the left-hand side we have a curve of the third degree the geometrical construction of which is exceedingly simple, and requires only a fixed circle and right lines.

Whenever a problem involves two unknown angles in two equations one of which is of the form $m \cos \theta + n \cos \phi = c$, where m, n, c are given, all angles satisfying this equation can be represented as the base angles of a triangle the base of which, AB, is fixed, and the vertex of which describes what may be called a quasi-magnetic curve, the geometrical construction of which is this: take any two fixed points, A, B; about A as centre, with radius m.AB/c describe a circle; about B describe a circle with radius n.AB/c; draw any line perpendicular to AB meeting these circles in Q and R respectively; then the lines AQ and BR intersect in a point on the required curve. When $m = n$ we have the common magnetic curve the construction of which is not nearly so well known as it should be.

The solutions of the above examples have all been of a purely geometrical kind, and have not involved the plotting of points by coordinates arithmetically calculated. There are other problems of a slightly different kind, still independent of plotting, but involving *trial*; the value of a certain unknown quantity which has to satisfy a certain geometrical condition is found by trial to do so very nearly if not completely. In all such cases Taylor's theorem furnishes a still closer value than the observed one, and completes the solution with all desirable accuracy.

For example, many problems lead to the equation $a \sin 2(\theta - \alpha) = b \sin \theta$ for an unknown angle θ, the other quantities being all given. This can be solved by two circles thus:—draw a line AB equal to b, and on it as diameter describe a circle the centre of which is C; draw AD making the angle BAD $= \alpha$ and cutting the circle in D; draw CD and produce it to E so that CE $= a$, and on CE as diameter describe a circle. Now find on the circumference of the first circle a point P such that if CP meets the second circle in Q we have BP $=$ EQ. This is done with great accuracy by the eye, and Taylor's theorem will improve the solution.

An equation which can be solved also very easily by trial is $a \sin^2 \theta = b \cot \theta$, which may be taken in the form $a \sin^3 \theta = b \cos \theta$, and a graphic solution suitable to each form is easily found.

Finally, we may notice equations of the form

$$\tan x = ax/(c - x^2),$$

which we obtain from Bessel functions in certain problems relating to vibrations. Such an equation is easily solved by the intersections of the curve $y = \cot x$ with the hyperbola $y = (c - x^2)/ax$, and the construction of the hyperbola belongs to the most simple case of this curve, viz. given one point on the curve and the asymptotes. As compared with the graphic solution of equations given by physical problems, the graphic solution of algebraic equations is unimportant, though not devoid of interest, because Horner is always available for numerical cases.

Prof. Gibson gives many examples of the solutions of quadratics and of cubics by graphic methods; but as regards quadratics it must be confessed that there is no utility in the process, and too much space is usually devoted to it. For cubics in general he gives a graphic solution and an interesting discussion. In a second edition of his book he might treat the biquadratic similarly, because its graphic solution can be easily effected by means of a circle and a parabola, or by means of a right line and a curve easily derived from a parabola. Many curves occurring in physics are dealt with in the book—such as isothermals and adiabatics; there is also a useful discussion of Fourier's theorem, and a treatment of the curves belonging to vibrations, damped as well as undamped. The graphic method is also applied to the solution of some of the simpler mixed trigonometric and algebraic equations, and the book concludes with a chapter on the properties of conic sections.

GEORGE M. MINCHIN.

CENTRAL AMERICAN MAMMALS.[1]

THREE years ago the author of these volumes published, in the same serial, a valuable synopsis of the mammals of North America and the adjacent seas. In the present larger work he has taken in hand the mammals of the tract generally known in this country as Central America, but on the other side of the Atlantic termed, at any rate by zoologists, Middle America, together with those of the West Indian islands. The greater bulk of the present work is accounted for, not so much by the greater number of species (690 against 606) as by the increased elaboration of the mode of treatment, the addition of diagnostic "keys" to the various genera, and by a fuller account of the habits of many species, the latter feature rendering these volumes proportionately more valuable to the naturalist, and at the same time of more general interest. The illustrations, too, are more numerous, comprising, besides crania, figures of the external form of a considerable number of species,

[1] "The Land and Sea Mammals of Middle America and the West Indies." By D. G. Elliot. *Field Columbian Museum Publications*, Zoological Series, vol. iv., parts i. and ii., pp. xxi+850, illustrated.

the addition of the latter likewise tending to popularise the work.

In his preface Dr. Elliot reiterates and emphasises the remarks made in the companion volume as to "the excessive and probably unwarranted multiplications of species and races (made easy by the too liberal application of the trinomial system)" of American mammals in general. Many of the forms, he adds, which have received separate names are separated on the evidence of comparative instead of distinctive characters. That is to say, their differences from other types are so slight as to be incapable of definition except by comparison with the latter, often, indeed, involving the necessity of placing specimens of each side by side. Consequently, in many instances specimens cannot be referred to their respective species or races without access to museums.

Perhaps it is rather unfortunate that the author did not see his way to go one stage further, and mention what species and races are entitled, in his opinion, to recognition. A step would then have been made towards the elimination of the forms named on insufficient distinctive characters. Nowadays it is the fashion to assign a distinct name to every recognisable form, however slight may be its points of difference; but some limit in this direction will apparently have to be imposed before long, unless zoology is to become an impossible science. In our opinion, one way of mitigating the difficulty is by using specific terms in a comparatively wide sense, thus leaving the subspecies, or races, to be recognised or not according to the discretion of the individual student.

Nomenclature is another point on which the author has a good deal to say, and he mentions that some of the names employed in the companion volume have been changed in the present work. He hopes, however, that as the result of such changes "a nomenclature that at least will approach stability may, in the distant future, be expected to be reached." Possibly it may—at the cost of rendering all the older standard works on zoology, palæontology, distribution, and scientific travel worse than useless—but a proposal like that of emending such a name as Odocoileus (in universal use among his naturalist countrymen) to Odontocœlus scarcely seems calculated to pave the way to such a happy millennium!

Among changes in nomenclature that we specially regret to see is the substitution of Agouti for Cœlogenys as the name of the paca, largely on the ground that the former is the popular title of a totally different group of rodents, for which reason we think its use in the scientific sense should be barred. It is also distressing to see the familiar

FIG. 1.—Lord Derby's Opossum and young. From Elliot's "Mammals of Middle America."

name Hapale, for the marmosets, banished in favour of Callithrix, so long used for the titi monkeys, which now figure as Saimiri. On a par with the latter is the substitution of Tayassu for Dicotyles, of Coendu for Cercolabes, and of Potos for Cercoleptes, which is like an invasion of zoological Goths and Vandals into the sacred precincts of classic Rome. One point in regard to the plan of the work—whether intentional or accidental it is not easy to say—strikes us as unsatisfactory. In the case of certain species, such as *Odontocoelus americanus* and *Ovis cervina* (pp. 69 and 84), for example, of which the typical form does not occur within the limits of the area under consideration,

FIG. 2.—Long-tailed Skunk. From Elliot's "Mammals of Middle America."

the species-name itself does not appear in the list at all, but only the subspecies, such forms consequently lacking a distinctive number, and thus rendering the census of specific types occurring within the area inaccurate.

Otherwise we have nothing but commendation to bestow on the general mode of treatment of the subject, and it may be safely affirmed that the author has earned the gratitude of all naturalists on this side of the Atlantic by putting in a convenient and easily accessible form such a vast amount of information with regard to the mammalian fauna of an extremely interesting region. The illustrations (two of which are reproduced), it may be added, are, for the most part, beyond praise. R. L.

THE FISHERIES OF SCOTLAND.

THE twenty-second annual report of the Fishery Board for Scotland, for the year 1903, is issued in three parts as usual, the first dealing with the sea fisheries, the second with the salmon fisheries, and the third being concerned with marine research.

With regard to sea fisheries, tables are given showing the results of the trawl fishing and the line fishing. The number of steam trawlers has been increasing steadily for the last seven years, and rose from 109 in 1896 to 280 in 1903. The average catch per vessel increased from 5030 cwt. to 5594 cwt., while the value of the catch per cwt. was practically the same in 1903 as it was in 1896.

In the line fishing the number of steam liners increased from 39 vessels in 1898 to 91 vessels in 1903, the number having varied somewhat in the intermediate years, 23 vessels having been added in 1903. The total number of boats was slightly less than in 1898, owing to a steady decrease in the number of sailing craft. The catch, since

1898, has steadily decreased from 1,050,000 cwt. to 602,600 cwt., and the value per cwt. has slightly decreased. The reason given for the reduction in value of line-caught fish is that the trawlers have been landing large quantities of cod. Thus, in spite of the large increase in the number of steam liners, which are, of course, independent of wind in getting to the fishing grounds, the catch per boat fell from about 182 cwt. to about 121 cwt.

It is interesting to note that for the herring fishing in the Buckie and Peterhead districts experiments have been made with sailing boats fitted with auxiliary steam power. The value of steam power is shown in another part of the report, where the catch of the Scotch boats (sailing craft) working from English ports during October and November is compared with that of the English boats, a large number of which are steamers. The Scotch boats caught more than 65½ per cent. of the total catch, but only got 46⅝ per cent. of the total value, the steamers always being able to make the market first.

The west coast mackerel fishing has shown great improvement, the catch in 1903 being 57 per cent. better than in 1902. The trade apparently only requires development, as "shoals of mackerel almost every year visit the coast."

In the report on salmon fisheries we learn that during the year Mr. Calderwood, Inspector of Salmon Fisheries for Scotland, made inquiries as to the views of the various fishery boards with regard to the limitation of netting in narrow waters, this move being an outcome of the report of the Royal Commission on Salmon Fisheries.

Some of the boards have already taken steps to reduce the netting in their rivers. In the Annan all nets have been removed, while in the Spey only about three miles of water is now netted. In the Aberdeenshire Dee an association has, for about thirty years, annually bought off the nets on some sixteen miles of water, and now both upper and lower proprietors are seeking to secure the permanent removal of these nets.

While eleven of the boards consulted passed resolutions in favour of reducing the netting, six were unable to express an opinion, and only one, the North Esk Board, passed a resolution against any such reduction. In Mr. Calderwood's words:—"The resolution was prepared and agreed to by the lower proprietors—who are in the majority—before the meeting took place, and was based upon the argument, supported by good evidence, that the present amount of netting in the district—which netting has been constant for a great number of years—has not produced a decline in the stock of fish. The question of improving the general interest of their *whole* district is complicated by other considerations which need not be referred to here."

One of the most important papers in this report is Mr. Calderwood's contribution to the life-history of the salmon as observed by means of marking adult fish, the first part of which appeared in the report for 1901. Since then 62 additional re-captures of marked fish have been made, which, with those previously caught, gives a total of 252 re-captured fish. From this material, and also from other results obtained in Scotland, Ireland, and Norway, Mr. Calderwood has been able to draw some important conclusions. We now have evidence bearing out the commonly accepted view that the great majority of salmon after visiting the sea return to the river they left.

The marking experiments seem to show that grilse spend less time in fresh water than salmon, running up and down from the redds more quickly than the latter.

Another very interesting fact brought out is that a grilse kelt after running down to the sea may return within a few months as a summer salmon of about 10 lb., or may remain in the sea until the following year, returning to the river as a spring salmon. This partly upsets the belief that spring salmon are old fish, for, although there is no doubt that old fish do run up in the spring, we now know that a fish of 18 or 20 lb. may only be five years old, according to Mr. Calderwood, and on its second return from the sea.

There is evidence showing that some fish spawn in two successive seasons, and one case, No. 7298, seems to suggest that the fish was spawning for the third year in succession.

There is a diagram, in which fish of various weights are considered as being of various ages, which shows the interesting facts observed as to the "dual migration" which exists, perhaps, in all stages of the salmon's life-history.

We know that all the fish of one hatching do not migrate to the sea at the same time. Some migrate at one year old, the great majority at two years, and some again at three years.

For the smolt to grilse stage Mr. Calderwood mentions three cases in which the smolts returned after a year and some months as grilse of 3½, 3½, and 6½ lb. respectively, and says "we have no data to show any other seasonal migrations which may occur at this stage." We do not know whether the authority for the cases is untrustworthy, but we recollect records of smolts marked and released being re-caught after a few months as grilse up to 8 lb. weight. Such cases are mentioned by Fraser ("On the Salmon, &c.," 1833, pp. 15, 16) and by Brown ("Stormontfield Experiments," p. 92), who says "the experiments here have shown . . . that all the smolts of one year do not return the same year as grilse, the one half returning next spring and summer as small salmon."

Mr. Calderwood shows that what he considers five-year-old fish do not increase in weight in the way that four-year-olds and six-year-olds do, and he suggests that this may represent the period in the life of the adult salmon when the reproductive function is at its best, and thus asserts itself at the expense of the body-growth.

Surely this classing of fish into ages by size can only be roughly correct at best. We do not yet know to what extent fish spawn annually or biennially, or whether a fish may rest several seasons after spawning. Yet if Mr. Calderwood's suggestion that the activity of the reproductive organs checks growth is sound, surely a fish spawning three years in succession—as No. 7298 suggests may happen—would be considerably smaller than a fish of the same age which spawned in alternate years or less often.

There are several other interesting papers in this part, but space precludes us from referring to them.

Part iii., scientific investigations, contains eight papers on various subjects connected with marine fisheries. Dr. T. Wemyss Fulton, the superintendent, gives an account of the trawling investigations, and in another paper continues the report of his investigations on the rate of growth of fishes. He also reports upon the operations of the Nigg Marine Hatchery, and has another paper entitled "Ichthyological Notes" on the various interesting species taken during the year.

An important paper is that by Dr. Williamson on the life-histories of the edible crab and other decapod Crustacea. Dr. Williamson has discovered that the ova of the crab are not attached by mucilage to the long hairs of the spinnerets as was supposed, but that the eggs are actually pierced by the hairs, and are thus spitted in rows, the eggs not being attached to one another.

Dr. Thomas Scott contributes a paper on some rare and interesting marine Crustacea, and another upon some fish parasites new to the Scottish marine fauna.

The report is published at His Majesty's Stationery Office, and can be obtained through any bookseller.

FRANK BALFOUR BROWNE.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES.

AT the annual meeting of the Academy of Sciences the list of prizes awarded for the year 1904 was announced as follows:—

Geometry.—The Bordin prize to M. Servant, for his memoir on the determination of surfaces applicable to the paraboloid of revolution which pass through a given contour; the Vaillant prize, divided between M. Émile Borel (3000 francs) and M. Bricard (1000 francs); the Francœur prize to M. Émile Lemoine; and the Poncelet prize to M. Désiré André.

Mechanics.—A Montyon prize to M. Gustave Richard.

Navigation.—The extraordinary prize, of 6000 francs, divided in equal parts between M. Jacob (for his theoretical researches on the transmission of submarine explosions), M. Gayde (for a study of the resistance of hulls to submarine explosion), and M. La Porte (for hydrographic work on the coast of Brittany); the Plumey prize to M. Lucien Mottez, for important services to submarine navigation.

Astronomy.—The Pierre Guzman prize is not awarded;

the Lalande prize to Mr. S. W. Burnham, for his work on double stars; the Valz prize to M. de Campos Rodrigues, for work done at the Lisbon Observatory, with especial reference to the determination of the solar parallax by means of the planet Eros; the Janssen medal to M. Hansky.

Geography.—The Binoux prize, divided between M. Baratier (for his work in connection with Colonel Marchand's expedition in Central Africa), M. Bénard (for his work on Arctic exploration), and M. Alphonse Berget (for his book on the physics and meteorology of the globe); the Gay prize to Mr. Bell Dawson, for his hydrographic work in eastern Canada; the Tchihatchef prize to Lieut.-Colonel Lubanski, for his explorations in Indo-China; the Delalande-Guérineau prize to M. Auguste Pavie, for work in French China.

Physics.—The Hébert prize to M. Georges Claude, for his book on electricity for general readers; the Hughes prize to Lieut.-Colonel E. Ariès, for his publications on the theory of heat and chemical statics; the Kastner-Boursault prize to Captain Ferrié, for his work on wireless telegraphy.

Chemistry.—The Jecker prize, divided between MM. Freundler, Minguin, and Lespieau; the Cahour prize, divided between MM. Chavanne, Kling, and Binet du Jassoneix; a Montyon prize (unhealthy trades), divided between MM. Dupont and Détourbe.

Botany.—The Desmazières prize to M. Guilliermond, for his work on cryptogams, especially fungi; the Montagne prize to M. Camille Sauvageau, for his work on algæ; the de la Fons-Melicocq prize is not awarded.

Anatomy and Zoology.—The Savigny prize to M. Krempf; the Thore prize to M. d'Orbigny.

Medicine and Surgery.—A Montyon prize to M. Paul Reclus, for his memoir on the proper use of cocaine in surgery; to M. Kermogant, for his work on exotic pathology and hygiene; and to M. Cazalbou, for his researches on the trypanosomiases of the French Soudan. Mentions are also accorded to MM. P. Launois and Roy, for their biological studies on giants; MM. F. Bezançon and M. Labbé, for their treatise on hæmatology; and to M. Odier, for his work on the action of electricity and certain poisons on nerve cells. MM. F. Marceau, P. Briquel, J. Gagnière, and R. Voisin are accorded citations. The Barbier prize to MM. Prenant, Bouin and L. Maillard, for their book on histology, and a mention to M. Pierre Lesage; the Bréant prize (accumulated interest) to M. Frédéric Borel, for his memoir on cholera and plague in relation to Mahometan pilgrimages; the Godard prize to MM. J. Albarran and L. Imbert, for their memoir on tumours of the kidney; the Baron Larrey prize to M. Conor, for work on typhoid fever, M. E. Lafforgue receiving a mention; the Bellion prize to M. Jules Delobel, for his book on hygiene in schools, M. Gabriel Gauthier receiving a mention; the Mège prize to M. G. Delamare, for his experimental researches on morbid heredity.

Physiology.—A Montyon prize to M. J. Jolly, for his memoir entitled "Experimental Researches on the Indirect Division of the Red Blood Corpuscles," a very honourable mention being accorded to M. C. Fleig, for his work on the mode of action of chemical stimulants on the digestive glands; the Philipeaux prize to M. Cristiani, for his work on thyroid grafting, an honourable mention being accorded to M. Joseph Noé; the Lallemand prize, divided between M. Maurice de Fleury (for his works on the nervous system) and MM. J. Camus and P. Pagniez (for their memoir on psychotherapy); the Pourat prize to M. J. Tissot, for a study of the physical and chemical phenomena at high altitudes; the Martin-Damourette prize, divided between M. A. Frouin (1000 francs) and M. Manquat (400 francs).

Among the general prizes, the Lavoisier medal was awarded to Sir J. Dewar, for his work on the liquefaction of gases; the Berthelot medal to MM. Freundler, Minguin, Lespieau, Kling, Binet du Jassoneix, Dupont, and Paul Villard; the Jerome Ponti prize to M. Maurain; the Trémont prize to M. A. Guillemin; the Gegner prize to M. J. H. Fabre; the Lannelongue prize to Mme. Vve. Nepveu; the Leconte prize to M. René Blondlot, for his work taken as a whole; the Wilde prize to M. Paul Villard, for his work in physics; the Houllevigue prize to MM. Henri de la Vaulx and Henri Hervé, for their work in aëronautics; the Saintour prize to M. Charles Frémont, for his experimental researches on the elasticity of metals; a Montyon prize (statistics), divided between M. V. Lowenthal, for twelve memoirs relating to the depopulation of France, and M. Paul Razous, for his memoir on the mortality and liability to disease in dangerous professions, MM. Henry Guégo, E. Maury, and Ott receiving mentions; the Jean-Jacques Berger prize is divided between MM. J. Resal (6500 francs), A. Alby (3500 francs), Laurent (2000 francs), Grimaud (1500 francs), and Retraint (1500 francs).

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LIVERPOOL.—The arrangements for excavations to be made during the winter under the auspices of the university institute of archæology, in Upper Egypt, have been completed, and the work will be begun at Hierakonpolis before the New Year. The excavations have been placed as in previous years at Beni-Hasan, Negadeh, and elsewhere under the care of the university reader in Egyptian archæology.

DR. NORMAN MOORE has been appointed a member of the consultative committee *vice* Prof. Bertram C. A. Windle, F.R.S., who has resigned his membership upon appointment as president of Queen's College, Cork. Dr. Moore is chairman of the board of advanced medical studies of the University of London, and represents the Royal College of Physicians upon the General Medical Council.

THE annual meeting of the Geographical Association will be held at the Royal Colonial Institute, Northumberland Avenue, London, W.C., on Friday, January 6, at 4 p.m. The president, Mr. Douglas W. Freshfield, will be in the chair. A report on the eighth international geographical congress will be read by Mr. H. Yule Oldham, and there will be a discussion on practical geography in schools.

ON December 20 Lady Warwick distributed the prizes gained by the students of the evening classes and of the day secondary school of the Carpenters' Company at Stratford. In the course of some remarks upon the school, she said that England needed a better system of secondary education, and it was now acknowledged that the State should take the matter in hand. But in the meantime the city companies were doing a good work in bringing secondary education to the doors of the people.

THE annual conference of the Public Schools Science Masters' Association will be held at Westminster School on Saturday, January 14, 1905. The following are among the subjects to be discussed:—(1) the importance of including both Latin and natural science in a scheme of general education; (2) recent proposals for school leaving certificates; (3) the use and misuse of terms in science teaching; (4) the possibility of teaching "scientific method" to boys whose education is almost entirely literary and who have no time for a regular course in chemistry and physics. Sir Michael Foster, K.C.B., is the president of the association for the year.

NEW buildings of the Willesden Polytechnic, erected at a cost of about 10,000*l.*, were formally declared open by Sir W. Anson on December 21. After distributing prizes to the successful students, Sir W. Anson remarked that polytechnics marked what he hoped was becoming the modern view of education, that it did not consist of independent sets of studies, but was a composite whole, no part of which did not rest upon or form a foundation for another part. It should be borne in mind that a polytechnic did not merely train a student in a handicraft. The object of such an institution was to combine theory and practice, to teach the student not only how to do a thing, but why it was done in a particular way, so that he became not only skilful in the craft upon which he was engaged, but got to understand the scientific principles underlying his work.

MR. L. L. PRICE read a paper at the meeting of the Royal Statistical Society on December 20 entitled "Accounts of the Colleges of Oxford, 1893–1903, with Special Reference

to their Agricultural Revenues." The paper is based on the accounts, published annually, of the colleges (and the university) of Oxford, and is a continuation of one read in 1895. The gross external receipts of the colleges (and the university) in 1903 exhibited an increase on 1893 of 29,797*l*., and on 1883 of 16,343*l*. The net external receipts of the colleges alone showed an increase of 16,566*l*. on 1893, and a decrease of 10,311*l*. from 1883. Later in his paper Mr. Price states that it hardly seems extravagant to affirm that during a quarter of a century the colleges (and the university) have lost between a third and a fourth of their agricultural revenues. Had it not been for an increase in revenues derived from other sources, they would have been crippled yet more seriously. The most noticeable feature is the large increase in the receipts from houses and sites of houses. Between 1883 and 1903 these receipts were doubled, and between 1893 and 1903 they increased from 56,877*l*. to 91,388*l*. On the whole this gross increase has more than balanced the gross diminution in the receipts from lands and tithe. The internal receipts of the colleges increased by 5814*l*. between 1883 and 1893, and by 11,428*l*. between 1893 and 1903.

THE annual conference of headmasters of public schools was held this year at Christ's Hospital, West Horsham, on Thursday and Friday last, December 22 and 23. Among the subjects discussed on Thursday were the recommendations of the consultative committee of the Board of Education for the establishment of school certificates, and the policy of the Board of Education in encouraging the sending of intending elementary school teachers to secondary schools in lieu of pupil teacher centres. The following resolutions were adopted:—"That the question of school certificates be referred to the committee of the conference with a view to immediate action, and that it be an instruction of the committee to obtain in writing the opinion of every member of the conference on the various points involved in the scheme of the consultative committee." "That this conference pledges itself to support the education authority in its policy of providing that candidates for pupil teacherships in public elementary schools shall receive a substantial portion of their education in a public secondary school, and considers it desirable that as many recruits as possible for teacherships in public elementary schools should be obtained from the ranks of ordinary pupils of secondary schools." On Friday a discussion took place on the subject of Greek, with special reference to the proposals of the Cambridge Syndicate, and the following resolution was carried by twenty-one votes to eight:—"That, without committing itself to details, the conference generally disapproves of the Cambridge Syndicate with regard to Greek in the Previous Examination." The conference also expressed itself against some of the reforms of the new Army entrance examinations, and carried the following resolution unanimously:—"That this conference hopes that the scheme for qualifying certificates in the examination for Woolwich and Sandhurst will be so amended as to encourage the study of Latin." A strong representation is to be made to the War Office on this subject. It was also agreed that the committee of the conference should consider the syllabus issued by the Board of Education on the teaching of English literature, and should include their recommendations in the annual report.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, December 21.—Capt. D. Wilson-Barker, president, in the chair.—Decrease of fog in London during recent years: F. J. **Brodie** (*Discussion*).—The study of the minor fluctuations of atmospheric pressure: Dr. W. N. **Shaw**, F.R.S., and W. H. **Dines**. The authors described an apparatus called the "microbarograph," which they have designed to magnify the minor fluctuations, and at the same time to disentangle them from the general barometric surges. They also showed some records from three of these instruments. The authors wish to obtain information as to the nature of the disturbances and the causes to which they may be assigned. Among the causes which suggest themselves as likely to produce temporary fluctuations of the barometric curves are stated by the authors to be (1) atmospheric billows passing along surfaces where there is discontinuity of density in a manner somewhat similar to ocean waves; (2) the passage of minute whirls or cyclonic depressions of small scale; (3) variations of pressure due to the attraction or repulsion produced by electric stress as masses of air at different potential pass over; (4) the mechanical effects of wind; and (5) the mechanical effects of rapid condensation of aqueous vapour.

DIARY OF SOCIETIES.

MONDAY, JANUARY 2.

VICTORIA INSTITUTE, at 4.30.—Confucianism: Rev. A. Elwin.

WEDNESDAY, JANUARY 4.

GEOLOGICAL SOCIETY, at 8.—The Marine Beds in the Coal Measures of North Staffordshire: J. T. Stobbs.—The Palæontology of the Marine Bands in the North Staffordshire Coalfield: Dr. Wheelton Hind.—The Geology of Cyprus: C. V. Bellamy, with Contributions by A. J. Jukes-Browne.

THURSDAY, JANUARY 5.

RÖNTGEN SOCIETY, at 8.15.—Description of an Automatic Vacuum Pump: C. E. S. Phillips. (The apparatus will be shown at work.)—Exhibition of a Method by which Strongly Adherent Films of Aluminium may be applied to Glass.—A Note on the Coloration of Glass by Radium Radiation.

FRIDAY, JANUARY 6.

GEOLOGISTS' ASSOCIATION, at 8.—The Third Issue of the British Association Geological Photographs: Dr. C. G. Cullis.

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