THURSDAY, JANUARY 29, 1903.

SCIENCE AND THE NAVY.

THE Board of Admiralty are to be entirely congratulated upon their new scheme of entry, education and training of officers, which has recently been printed *in extenso* in the *Times*, and already given rise to much comment on the part both of naval officers and schoolmasters.

The most important parts of it, from our point of view, are that it shows that, in the opinion of the Admiralty, for the naval service the education obtained by studying things instead of books is essential, and that the scheme set forth is sound and broad in its educational details. The mere existence of it for the purpose intended is certain in time, we believe, to have a profound effect, not only upon the entrance examinations to the Army and the Civil Service, but upon secondary and university education generally. We may go further and say that if the Council of Defence were anything more than a name, the naval scheme would have formed part of a more general one embracing the whole armed service of the country.

Let us see what improvements are proposed upon the present system. First of all, a battleship is to be made more of a fighting unit than it is at present by having all the officers, whether navigating, gunnery, torpedo, engineer, and those more numerous lieutenants whose duties are not specially devoted to any particular branch, but excepting medical officers and the accountant branch, educated alike up to a certain point. The Army is a non-scientific body with scientific corps; the Navy is to be a scientific body all round.

At present, the marine officers enter late after the often soul-destroying training of the ordinary schools which provide the officers of the Army. The engineer officers enter earlier at a special naval engineering establishment. The executive officers enter the *Britannia* at the age of 14½ to 15½ for four terms, and we believe the instruction given in the first three is something like this:—

Mathematics, including Navigation and Chart Work	30½	hours a	fortnight.
French	6	,,	,,
Steam	4	,,	,,
Mechanical Drawing	3½	,,	,,
Instruments	3	,,	,,
Physics	1	,,	,,
Naval History	1½	,,	,,
Seamanship	6½	,,	,,

In the fourth term, the cadets are sent for a cruise, and are further instructed in practical navigation, instruments and chart work, steam and seamanship.

It will readily be gathered, then, that on the present system, in the schools which furnish the cadets, not much attention need be paid to physical science and the mental training that it brings, if *one hour a fortnight* is all that is provided for it on the *Britannia*.

Under the new scheme, all the officers to whom reference has been made will enter the *Britannia* between the ages of twelve and thirteen, thus saving some two years of ordinary school training. As the age is so low, nomination and a limited competitive examination are preferred to an open examination. This, we consider, is justified, but some alterations seem desirable with regard to the nominations.

The scheme, in the first place, provides that these nominations are to be limited generally to the First Lord, with certain privileges, elaborately set out, conferred upon individual members of the Board, secretaries, flag officers, commodores and captains. This looks too much as if the Navy were looked upon as an Admiralty preserve. We can imagine, although Sir Michael Hicks-Beach has so far made no revelations with regard to the Navy, that the officers who have to look after promotions may think, as we think, that the nominations should be exclusively in the hands of the First Lord and of the Prime Minister, for it is a question of the whole country with all its interests. The principle of heredity may be pushed too far, for captains will be admirals when their nominees come up for promotion as commanders, and this fact is quite enough, human nature being what it is, to suggest how undesirable the so-called privileges are.

Then comes another point. The payment for each cadet entered is 75*l*. per annum, but the Lords of the Admiralty reserve the power of reducing this to 40*l*. in the case of sons of naval, army, or marine officers, or of the civilian staff at the Admiralty.

If the whole Navy and Army, why not the whole Civil Service? and, indeed, why limit the concession to the public services when good cause can be shown for an extension? The more rigid the limitation the less certain the capture of future Nelsons, and the more justification will be given to a possible outcry that the Navy is being made a close preserve for the well to do.

Were the limit extended, a natural sequel would be to enter originally for the *Britannia* a larger number of boys—say some 30 per cent.—than would be wanted for the service, admitting the required number of these to the service by strict open competition at the end of the *Britannia* period and rejecting the rest. In this way, some objections to the nomination system at entry will be met. If only a few are rejected as under the proposed scheme it would be a stigma, whereas if the number is larger it would only be considered a misfortune, and the rejected would have had the best education in England, one fitting them for any walk in life, as we shall show.

We can have nothing but praise for the subjects chosen for the examination for entrance to the *Britannia*, which are as follows:—

PART I.

(1) English (including writing from dictation, simple composition, and reproduction of the gist of a short passage twice read aloud to the candidates).
(2)—(*a*) History and (*b*) Geography—
  (*a*) History (simple questions in English History and growth of the British Empire).
  (*b*) Geography (simple questions, with special reference to the British Empire).
(3) French or German (importance will be attached to the oral examination).
(4)—(*a*) Arithmetic, and (*b*) Algebra—
  (*a*) Arithmetic (elementary, including vulgar and decimal fractions).
  (*b*) Algebra to simple equations, with easy problems.

(5) Geometry (to include the subject-matter of the first book of Euclid, or its equivalent in experimental geometry and mensuration. The use of instruments and of algebraical methods will be allowed).

PART II.

(One only to be taken.)

(6) Latin (easy passages for translation from Latin into English and from English into Latin, and simple grammatical questions).

(7) A second modern language (of which, if not French or German, notice must be previously given), or an advanced examination in the language selected under Part I.

(8) Experimental science (easy questions with the object of testing practical knowledge and powers of observation).

The cadets are to remain four years in the *Britannia*, the instruction comprising an extension of the present course there, and we rejoice at the promise that the present one hour a fortnight for physics is to be replaced by a "thorough elementary instruction in physics and marine engineering, including the use of tools and machines." This, of course, means that there are to be laboratories and practical work, for book-work alone in such subjects is next to useless. Part of this instruction is also to be carried out afloat.

Such a course as this must not only give the cadets a good grounding in the subjects necessary to their profession, but such a mental training as is sure to lead to that brain-power which lies at the root of all good organisation and administration.

After these four years, the cadets will go to sea and become midshipmen. We are told in Lord Selborne's memorandum,

"Special attention will then be paid to their instruction in mechanics and the other applied sciences and to marine engineering. The instruction of the midshipmen in seamanship will be given, as at present, by an executive officer deputed by the captain; otherwise it will, under the general responsibility of the captain, be supervised by the engineer, gunnery, marine, navigating and torpedo lieutenants of their respective ships; they will be examined annually as to their progress in seamanship, navigation and pilotage, gunnery, torpedo work and engineering, all set papers being, as at present, sent from the Admiralty."

At the end of three years, every midshipman who has passed the qualifying standard at the last annual examination and the final examination in seamanship will become an acting sub-lieutenant, and if abroad return to England and proceed to the College at Greenwich for a three months' course of mathematics, navigation and pilotage, followed by an examination, and afterwards to Portsmouth for a six months' course in gunnery, torpedo and engineering, at the close of which he will be examined, and on passing out be confirmed in the rank of sub-lieutenant.

How the cadets are to be sent to sea is not yet settled. Either they will serve for the whole three years as midshipmen to battleships and cruisers, ordinarily commissioned, or the first part of this period will be passed in specially commissioned training ships. It is quite decided that at whatever period they are posted to ordinarily commissioned battleships and cruisers, compulsory school on board these ships shall cease.

The young officers who will pass out of the college at Portsmouth between the ages of nineteen and twenty will all have received exactly the same scientific training, and will have had opportunities of displaying their powers of organisation and of dealing with men.

We are not yet told what the common training is to be at Greenwich or at Portsmouth. We believe the present course for sub-lieutenants is somewhat as follows:—

PART I.

Length of course	... ...	8 weeks.
Subjects.		
Mathematics ...	Trigonometry, Mechanics, Navigation, Instruments.	21 hours a week.
Steam		2 ,,
French		2 ,,
Surveying		3 ,,
Physics		3 ,,
		31

PART II.

Length of course	... ...	11 weeks.
Mathematics	Advanced Pure Maths., Statics, Hydrostatics, Dynamics, Navigation.	27 hours a week.
Physics		1 hour lecture. 3 ,, practical.
		31

PILOTAGE.

Length of course	... ...	6 weeks.
		28 hours a week.

Now the differentiation begins. It seems to be as follows:—

Executive officers { Special navigation, ,, gunnery, ,, torpedo, Unspecialised,
Engineer officers,
Royal Marine officers,

and the object to be kept in view is stated to be to make them fit to perform those specialised duties which are the product of modern science; nothing is said about those officers who have no specialised duties.

The Executive Branch.

On this differentiation, all officers ranking as sub-lieutenants will go to sea for two years.

The next phase is that after two years at sea all the executive sub-lieutenants will be promoted to the rank of lieutenant on gaining the same qualifying watch-keeping certificate as at present. All those who have passed their examinations exceptionally well will, as now, receive accelerated promotion. Then comes a selection by the Admiralty of those among them who are to be trained as specialists in gunnery, torpedo work or navigation; these will go to the Royal Naval College at Greenwich for special courses. We presume that this "selection" for training as specialists represents a promotion for those so selected.

After five years' seniority in the rank of lieutenant, all officers will have to pass an examination for promotion to the rank of commander in certain technical subjects.

These are :—

Court-martial procedure,
International law,
Knowledge of British and foreign warships, guns, torpedoes, &c.,
Naval history,
Signals,
Strategy,
Tactics and battle formation.

This examination as it exists at present in the scheme is to be undergone alike by those who are engaged in the specialised scientific duties in the ship, with all their responsibilities, and those—under existing practice a much larger number—who have under the scheme no specialised scientific duties. Now it is obvious that these latter will be under much better conditions for preparing for an examination, and that the former will have no opportunity of letting their specialised duties tell in the examination, so that the effect of it will be to favour the promotion of those who were not selected to perform specialised duties.

The Engineer Branch.

On this differentiation, the engineer officers, sub-lieutenants about the age of nineteen, instead of going to sea for two years like the executive officers, will go to the college at Keyham for a professional course, the exact duration of which will be subsequently determined. At the expiration of this course, a proportion will be selected to go to Greenwich for a further course, while the remainder go to sea. They will then, if found qualified, all be promoted to be lieutenants under the same conditions as the executives. The nature and duration of the special course at Greenwich will be very carefully determined, and an opportunity will be afforded to those officers selected for it to make themselves acquainted with the latest developments of engineering science, not only at Greenwich, but at the great civil engineering establishments and institutions which are to be found in the country.

The engineers are now to be put on an equality with the executive officers, the ranks and uniform being assimilated, but with a difference, for while the executive officers specially trained for navigation (N), gunnery (G) and torpedo (T) lose these letters when promoted to be captains, the engineers are to retain the special (E) to the rank of Rear-Admiral (E), and as a solatium for not being allowed to command a ship are to receive higher pay and are promised "high appointments." Whether this arrangement will be carried out when the time comes, some twenty years hence, the future will show. In all the discussions on the complexity of the machinery of the modern man-of-war, the as great or greater complexity of the old sailing three-decker seems to have been entirely lost sight of.

The Royal Marines.

With regard to the sub-lieutenants drafted to the Royal Marines, we read as follows :—

"After his final examination as sub-lieutenant along with the future executive and engineer officer, the young Royal Marine officer will receive his special military training during the next two years partly at the college at Greenwich and partly at the headquarters of divisions or the depôt ; the training of all these officers will be extended so as to correspond more closely to the training now received by the young officers of the Royal Marine Artillery ; and after this two years' training, the young Marine officer will receive the rank and pay of lieutenant of marines so as to put him financially on an equality with the executive sub-lieutenant. As in the case of the executive lieutenants, specially good officers will qualify as gunnery and torpedo lieutenants, provided that they have kept watch at sea for one year, have passed the test examination for qualifying for gunnery and torpedo lieutenants, and have been specially selected and recommended. . . . The future Royal Marine officer will thus become available for keeping watch at sea and for general executive duties on board ship up to and including the rank of captain of marines."

Such is a short abstract of a scheme which we believe will be of the utmost value to the Naval Service. Educationally and scientifically, it has so much to recommend it that its authors, and chief among them, Lord Rosebery tells us we must hold Sir John Fisher, are to be warmly congratulated.

Only one conclusion can be drawn from the scheme as a whole ; many of the anticipated difficulties will have vanished before it comes into full operation some ten years hence, and the effect of the practical work in pure science now to be generally introduced for the first time, and the opportunities the officers will have of becoming acquainted and being responsible for every class of duty, both scientific and administrative, will weld them into a homogeneous body each member of which should have had his brain-power so thoroughly developed that the greatest scientific skill will generally be combined with the highest powers of organisation. At present, it would seem, the very opposite is the case, for otherwise the present Admiralty system of promotions cannot be defended. Nor is the difference in the treatment of the various branches limited to the promotions. Certain lieutenants are at present selected for certain specially scientific duties ; this leaves a large residuum not so selected. Special allowances are given to the navigating, gunnery and torpedo lieutenants in a ship, but the first lieutenant, who may be taken as the representative of the large body of non-specialists, not only gets a smaller allowance, but has to spend money in eking out the Admiralty's meagre supply of paint.

The allowance paid to the navigating officer is the highest, and it might be assumed, therefore, that his duties are considered important ; but what happens to him ? We are informed that of 187 commanders promoted captains between June, 1892, and June, 1902, only 16, that is 1 in 11, have specially studied navigation and all that navigation means, and had the real handling of battleships in tactical exercises. Further, that these 16 have been promoted so late that none of them, in ordinary circumstances, can become admirals on the active list.

Recent sad experiences both with flag-ships and smaller craft—100 "accidents" to torpedo boats and t.b.d.'s in two years—have taught us that the best admiral and the best commander even of a torpedo boat will be he who knows most about what ships can do in various circumstances and how to make them do it. The most instructed navigator will always be the safest tactician. Leading a great fleet into action and drilling men in the

duties performed in a single ship are vastly different affairs.

The present system, however, as we have seen, bars the promotion of a navigating officer to the higher ranks. So that all the admirals, the future leaders of our battle fleets, eventually to be selected from among the 187 captains to whom we have referred, will be the least instructed and least practised in navigation and all that navigation means in the way of handling ships.

We are told that information with regard to the promotion of gunnery and torpedo officers is much more difficult to obtain, but this is of little importance, as their functions are necessarily limited to single ships and can have no bearing on tactics or the leading of fleets into action.

To the plain man, this result seems curious. Other reasons than that we have suggested have been given, but whatever the reason may be—we are not concerned either to attack or defend the Admiralty—we may hope that under the new system the apparent paradox will disappear, and it seems a pity to wait until then.

There is one part of the scheme of instruction which calls for criticism in a scientific journal. We read of special schools of gunnery, engineering and torpedo work, but no school of navigation is referred to.

It is a question whether an officer who has been generally trained and has been six years at sea will derive any benefit from going to a land college to learn navigation. What is really wanted to complete the scheme on true scientific lines is a navigation school afloat at this period of the officer's career where each member of the batch could take charge, under proper supervision of course, not only in tideways and strong currents, among traffic and in entering and leaving harbours, but in the open Atlantic.

This condition might be utilised by sending Marconi ethergrams, which would not only enable the Meteorological Office vastly to improve its service, but would give the young officers an interest in meteorology, a science which is still important to those who go to sea, though we find no reference to it in the memorandum.

Another important point that would be gained by this method of procedure would be to teach the officer that the roll of his ship will depend to some extent upon its presentation to the sea running at the time, so that there will be courses on which the fighting platform can be made more stable than on others. With homogeneous fleets, this may replace the "getting to windward" of old days preparatory to a naval engagement.

A PSYCHOLOGIST ON EVOLUTION.

Development and Evolution; *including Psychophysical Evolution, Evolution by Orthoplasy, and the Theory of Genetic Modes.* By James Mark Baldwin, Ph.D. Princeton, Hon. D.Sc. Oxon., LL.D. Glasgow, Stuart Professor in Princeton University. Pp. xvi + 392. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1902.) Price 10*s.* 6*d.* net.

THE theory of evolutionary method to which the name of "Organic Selection" has been generally applied was independently originated by Profs. Baldwin, Osborn and Lloyd Morgan. It has been accepted in its main features by many leading biologists, who see in it a probable interpretation of numerous facts which have hitherto been felt as difficulties in the way of the Darwinian explanation of evolutionary processes. It has even been considered to afford a prospect of reconciliation between the Neo-Lamarckians and the impugners of the hereditary transmission of acquired characters, though there can be no doubt that for the former party its adoption would mean nothing less than the surrender of the central citadel of their position.

In the present volume, Prof. Baldwin has not only given a detailed account of the theory in all its bearings, but has also brought together in the form of appendices the original statements of the same principle by Osborn and Lloyd Morgan, besides valuable comments by other authorities, including Prof. Poulton, Prof. Conn and Mr. Headley. The reader of "Development and Evolution" is thus furnished with ample material for forming a judgment on the significance of the views summed up under the general headings of "Organic Selection" and "Orthoplasy."

The relation of these views to the theories that may be roughly grouped as "preformist" on the one hand and "Lamarckian" on the other is stated by Prof. Baldwin with admirable clearness as follows:—

"If we give up altogether the principle of modification by use and disuse, and the possibility of new adjustments in a creature's lifetime, we must go back to the strictest preformism. But to say that such new adjustments influence phylogenetic evolution only in case they are inherited is to go over to the theory of Lamarckism. Now the position is that these individual adjustments are real (*versus* preformism), that they are not inherited (*versus* Lamarckism), and yet that they influence evolution. These adjustments keep certain creatures alive, so put a premium on the variations which they represent, so 'determine' the direction of variation and give the phylum time to perfect as congenital the same functions which were thus at first only private accommodations. Thus the same result may have come about in many cases as if the Lamarckian view of heredity were true. The general principle, therefore, *that new adjustments effected by the individual may set the direction of evolution without the inheritance of acquired characters* is what was considered new and was called organic selection." (Italics Prof. Baldwin's.)

In claiming elsewhere that the "broader principle of organic selection from certain points of view is new," the author is careful to allow that it was not only in some degree foreshadowed by Darwin, but that in the special instance of "social heredity" (better called "social transmission") its importance has been emphasised by Wallace and other writers. "Of course, to us all," as Prof. Baldwin says, "'newness' is nothing compared with 'trueness'"; nevertheless, the credit undoubtedly belongs to him of having independently discerned the real significance in evolution of individual adjustments, and of having been perhaps the first to put the relation between ontogeny and phylogeny, and between organic and social evolution, on a basis that should be satisfactory at once to the biologist and the philosopher.

It must not be forgotten that Prof. Baldwin is primarily a psychologist, and is apt to consider evolutionary questions largely from the psychological standpoint. In expounding his idea of the "psychophysical unit"; in his

revision (to our mind abundantly justified) of Herbert Spencer and Bain's theory of "overproduced movements" in mental ontogeny; and especially, perhaps, in the tracing of his own theory of knowledge to its outcome in the doctrine of "genetic modes," he often uses a notation which to biologists as such may seem somewhat unfamiliar. No one, however, who is at the pains to follow him through his chains of argument, often intricate, but with few exceptions consistent and intelligible, will be inclined to deny the great service he has done in submitting the problem of organic development to philosophical analysis.

It will be satisfactory to those biologists who still regard Darwin and Wallace as the true founders of a rational theory of evolution that the author, in demonstrating the inadequacy and improbability of use-inheritance, and in rightly laying stress on the importance of individual adjustment and of social transmission, does most explicitly assert the dominance of natural selection. "The value of accommodation," he allows, "is implicit in the theory of natural selection," and in more than one place (as in chapter xii., with its comprehensive table of the various kinds of "selection") he expresses his concurrence with Prof. Poulton's statements to the same effect. There is thus no room to doubt of his attitude towards the general question; but it is somewhat surprising, and, we think, regrettable, that in the case of the "highest and most specialised form of accommodation," viz., the intelligence, Prof. Baldwin speaks of the resulting "emancipation from the operation of natural selection and from dependence upon variations" in a way that seems open to misconstruction. There can be no such emancipation in the long run. *Naturam expelles furcâ, tamen usque recurret.* Whatever allowance we make for individual adjustment to environment, whether it be intelligent or not, there will be no reason to say that "the struggle for existence is in some degree done away with" unless we limit our outlook to variations other than variations in plasticity. It is true that the struggle is transferred "in some degree" to the sphere of the latter, but the "direct action of natural selection" is not thereby evaded. All individuals but a few (comparatively) are still eliminated in virtue of the same failure of correspondence with the environment; only this failure is, or may be, in the individual's power of accommodation, not in his invariable or fixed endowment. If, on the other hand, we were to hold, as Prof. Osborn seems to do, that this plasticity is an inherent power or function of protoplasm undirected and uncontrolled by natural selection, we should, of course, find ample reason for Prof. Baldwin's expressions. But he makes it elsewhere perfectly clear that he differs on this point from Prof. Osborn, and we therefore think that he would do well on a future occasion to avoid the appearance of putting plasticity, in its relation to selection, on a footing distinct from that of other qualities. It would be hard to show that any characteristic property of protoplasm did not take its share in the "fundamental endowment of life" and was not "part of its final mystery." Where, then, is the justification for claiming an exemption for one property which is not claimed for all?

We should have much more to say, did space permit, in commendation of this excellent and stimulating book. Many of the points raised are enticing subjects for discussion, but those features that call for adverse criticism are few in number and of little importance. The plan of the work, several chapters of which have already appeared under other conditions, necessarily involves a certain want of system and concentration; nor must the reader expect to find all that deals with one part of the subject gathered into one place. On the other hand, the author is enabled to enforce his arguments by repetition, and, as a sentence in his preface reminds us, "to the psychologist, at least, repetition has its pedagogical justification."

F. A. D.

A HISTORY OF AËRONAUTICS.

Travels in Space. By E. Seton Valentine and F. L. Tomlinson. With an Introduction by Sir Hiram S. Maxim. Pp. 328; with about sixty illustrations. (London: Hurst and Blackett, 1902.)

IT appears to be a growing practice in this country to publish books with a preface by some man of distinction, whose name figures prominently on the cover. It is a pity that publishers cannot agree to discountenance this practice. Either a book is worth reading without the recommendation or it is not worth reading even with it. Not but what the introduction in this case is worth reading.

The task which Messrs. Valentine and Tomlinson have had before them has been no easy one. They have no doubt derived considerable help from the French "Histoire des Ballons" and other books of a similar character, but even with that help they must have had to wade through a large mass of literature and then to sum up the principal points in a very short compass, all of which takes much time. The authors are greatly to be congratulated on the success with which they have completed their undertaking. The designs of Leonardo da Vinci, the fantastic project of Lourenco, the abortive attempts at flight by Besnier and De Bacqueville, the balloon ascents of Montgolfier, Pilatre de Rozier, Blanchard, Nadar, the impossible air-ships of Pétin and De Landelle, the actual glides of Lilienthal, Pilcher, Chanute, Santos Dumont rounding the Eiffel Tower, the *Pax* disaster, all these give a very inadequate idea of the large number of designs, projects, ascents, descents, successes, failures and fatalities described in these pages. There are few people so well versed in the history of aërial navigation that they would not learn something new and interesting on reading the present volume.

The authors confine themselves to the task of chronicling and describing, and do not indulge in lengthy speculations as to the future of the flight-problem. Seeing how uncertain that future is, they have acted wisely. At the same time, Sir Hiram Maxim points out that the book may have a useful purpose in the near future in preventing others from repeating experiments that have previously been tried and failed. The list of aëronauts who have met their death as the result of their aërial experiences since 1783 should be a warning to future experimenters or would-be experimenters. Theoretical considerations, numerical calculations and mathematical formulæ lie outside the scope of this book.

A reviewer usually likes to point out omissions, but the only one as yet noticed is that of the very recent experiences of Wilbur Wright and his brother. And evidently there are two accounts of Degen's attempts, of which the more improbable one is here given. According to the other, his machine would not rise until he attached it to a balloon.

The illustrations are excellent, but it may be as well to warn the reader that when he sees a picture of an aëronaut sailing over houses, trees, mountains, rivers and even pyramids in an extraordinary looking machine, it is not to be supposed that the journey depicted was ever performed, or even that the machine was necessarily constructed in the forms shown. Readers of the "Histoire des Ballons" will remember the fantastic figures of flying men in that book and will not be surprised to find a few of the types reproduced here, but now that experiments have been successfully made in directed navigation through the air, it would be well if some indication could be given on illustrations in future books showing at a glance whether the flight which they depict is a real flight or a mere flight of the imagination.

G. H. BRYAN.

TERRESTRIAL MAGNETISM.

United States Magnetic Declination Tables and Isogonic Charts for 1902. By L. A. Bauer. Pp. 405. (Washington: Government Printing Office, 1902.)

THE activity of the United States Coast and Geodetic Survey Department in carrying out a magnetic survey of the States and outlying territories has long been a subject of interest to magneticians, and in this book we have the first complete information on the results of that survey up to January 1, 1902, as regards the one element magnetic declination.

Tables, giving every observation made, occupy 142 pages, including positions, date of observation, values observed and values reduced to 1902, followed by the name of the observer or authority. The succeeding 138 pages are devoted to descriptions of the magnetic stations occupied by the Survey between 1881 and July, 1902.

The accompanying chart of "Lines of Equal Magnetic Declination" is based on the results plotted at about 5000 points, embodying all the latest declination data of known value. The lines are true isogonals, drawn with considerable sinuosities, representing the results of actual observation and showing disturbances from normal values, but as these latter have not yet been calculated, the amount of disturbance and the centres of disturbance have not been ascertained. The chart for Alaska gives normal lines of the magnetic declination calculated from all available observations, there being too few of the latter from which to draw true isogonals.

A welcome addition to the tables and charts will be found in the opening chapter under the heading "Principal Facts relating to the Earth's Magnetism," showing our present state of knowledge of terrestrial magnetism and the vast field open to future observers and students of that branch of science.

In this chapter, the evolution of the compass is treated boldly and agreeably with the evidence of the best authorities, and one rather looks for the date and the name of the first person who applied that very important addition to the mariner's compass—its suspension in gimbal rings. It is clear that the use of this suspension was implied by Pedro de Medina in his "Arte de Navigacion" of 1545, and was accurately described as part of a compass by Martin Cortés in his "Arte de Navigacion" of 1556, but they leave the inventor's name in obscurity.

Turning to the subject of Gilbert's work, "De Magnete," the author remarks on the "intolerance and lack of appreciation of the work of his predecessors" shown by Gilbert. When, however, one reads the account given by the latter of the mass of ignorance and superstition he had to battle with and relinquish to "the moths and worms"—such as the medicinal properties of the lodestone and its uses as a detector of immorality and many other "vanities"—we can hardly wonder at their begetting a spirit of intolerance in him. Even "the Onyon and Garlick myth" which he so denounced was revived in 1885 by an inventor who proposed the use of the juice of the common Dutch red onion as a magnetic screen. Possibly some readers of the present work will think the author has not quite done full justice to Gilbert.

On p. 60, the authority of the late Prof. Eschenhagen is given for the statement that the effects of earthquakes on the magnetic needle are "entirely mechanical." As the more recent investigations of Prof. Milne point to an opposite conclusion, there is evidently room for further inquiry as to how far the disturbances observed are due to magnetic causes or not.

In the article on magnetic observatories, some useful details are given of the structure of the magnetic observatory at Cheltenham, Maryland, where, although it is built entirely above ground, the diurnal change of temperature has been reduced to a few tenths of a degree, and further reduction is looked for.

In conclusion, it may be remarked that some of the illustrations are taken from rare prints, and their reproduction cannot fail to be of great interest to many who may not have the means of seeing the originals. Pleased as the investigator may be with the valuable results contained in this book, he will look forward with enhanced interest to a similar publication relating to the magnetic inclination and force, both of which have been so extensively observed in the United States.

OUR BOOK SHELF.

Letters on Reasoning. By J. M. Robertson. Pp. xxviii +248. (London: Watts and Co., 1902.)

THIS book is in the form of letters addressed to the author's children, and is lucidly and fluently written. Mr. Robertson's counsels upon the duty and importance of clear thought and scrupulous candour in reasoning are excellent, and it is to be hoped the children to whom the letters are addressed will profit by them. It is a pity Mr. Robertson does not always follow his own good advice. In the constant polemic against theism, to which he recurs in chapter after chapter, he often unconsciously misrepresents the case against which he is

arguing, and his own reasoning is not unfrequently vicious. Thus it is hardly fair to the advocates even of the crudest form of the "design" hypothesis to meet Paley's argument about the traveller who finds the watch in the desert with the retort that the argument assumes the desert at least to be "undesigned." All that is assumed is that the desert, whether "designed" or not, does not, like the watch, exhibit design of a specific kind recognisable by the traveller. And Mr. Robertson's own chief argument against theistic design, that an infinite series, such as the "totality of events," cannot have any specific predicates beyond the one predicate of "infinity," is surely very doubtful. If I can make predications about the infinite series of the natural numbers (such as, *e.g.*, that every member of it has a next term, that every member is commensurable with every other), why not of the infinite series of "events?" Similarly, the argument used in discussing psychological determinism, that no one predicate, such as, *e.g.*, "free," can be applied to all volitions, since they are an infinite series belonging to no wider species, is really fallacious. For in psychology the very need of a precise definition of a volition compels us to distinguish volitions from other psychical states, such as impulses, cravings, resolutions, and volitions thus come to be an infinite series, no doubt, but an infinite series of which the law of formation is known. The infinity of such a series in no way excludes specific predication about it. Mr. Robertson presumably thinks that the "totality of events" is a series of which we do not know the formative law. But this is just what he has to *prove* against the theist. He is not entitled to assume the point at issue as if it were a self-evident axiom of thought.

It is much to be regretted that the author allows himself to exhibit a zeal which too often degenerates into partisan rancour against his "religious" opponents. A man is not necessarily either dishonest or stupid because he holds opinions on these subjects other than those of Mr. Robertson, and Mr. Robertson does not strengthen his case by writing as if he were so. A. E. T.

Electro-plating and Electro-refining. By A. Watt and A. Philip. Pp. xxiv + 680. (London: Crosby Lockwood and Co., 1902.) Price 12*s.* 6*d.* net.

THE late Alexander Watt's book on electro-deposition was well known as a standard work on the subject, but for some time it has been out of date both in subject-matter and in method of treatment. Mr. Arnold Philip, in editing and largely rewriting a new edition, has performed a service which was much required, but it is to be regretted that he has not been sufficiently thorough in his work of revision. Perhaps this is due to a desire on his part to retain as far as possible the form of the original book, but there can be little question but that by entirely recasting it and putting the vast amount of useful information it contains in a form more suited to modern ideas and developments he would have been performing a more valuable service. It is, for example, rather out of date to give instructions for carrying out different operations in terms of Wollaston, Smee, Daniell or other batteries. We hope that the number of electro-platers using such sources of electricity is at the present day small, but even if it is considerable it is eminently desirable that a book such as this should make use of scientific units. To take one other example, we were surprised to find that the section devoted to nickeling bicycles described the operations to be performed in taking to pieces an old-fashioned "ordinary" and entirely disregarded the existence of the modern safety or pneumatic tyres. Such a fault as this, possibly not of much importance in itself, has the grave defect of destroying the reader's confidence in the rest of the work; how is the student to feel sure that the numerous recipes and instructions are not as much things of the past as the solid-tyred ordinary?

Mr. Philip has, however, done much to improve Watt's book, especially in the chapters which he has added. Chapters ii. and iii. of the second part, dealing with the cost of electrolytic copper refining and with the many important details of that industry, are particularly to be commended. Taken altogether, this new edition is, like the older ones, a good and valuable book, and our only cause of complaint against Mr. Philip is that he has somewhat missed the opportunity of bringing it properly up to date. M. S.

The Teaching of Chemistry and Physics in the Secondary School. By Alexander Smith, B.Sc., Ph.D., and Edwin H. Hall, Ph.D. Pp. xiii + 377. (London: Longmans, Green and Co., 1902) Price 6*s.* net.

THIS book, which belongs to the American Teachers Series, is well worthy of the attention of those who are engaged in the teaching of chemistry and physics, whether in schools or universities. It contains an able and temperate discussion of nearly every important question of method that arises in connection with the teaching of chemistry and physics, and it has the great merit of being neither wordy nor pedantic. It will be a surprise to many English teachers to see how thoroughly this subject is being handled in America.

It is, unfortunately, not possible in the limits set to this notice to give illustrations of the treatment of the subject by the two American professors. If the book is read in this country as it deserves to be, it will tend to induce a more philosophical attitude towards the extremely difficult and important question of teaching physical science in the earlier stages. A. SMITHELLS.

Index Zoologicus. By C. O. Waterhouse. Edited by D. Sharp. Pp. xii + 421. (London: Zoological Society, 1902.)

FOR the last twenty years, the "Zoological Record" has contained an appendix of the new generic and subgeneric names recorded annually in its pages. These lists have been combined, with the addition of such names of earlier date as were omitted from Dr. Scudder's "Nomenclator Zoologicus," published in 1882, and the result is the present volume, which includes the period from 1880 to 1900. The value of such a compilation to working zoologists cannot be overestimated, and the author and editor, as well as those gentlemen by whom they were assisted, by the completion of their laborious task have earned a debt of gratitude beyond the power of thanks to repay. The present volume includes about 40,000 names, of which some 6000 belong to the period before 1800; an idea may therefore be formed of the enormous rate at which new names are growing. Many of these, like those in earlier lists, are, of course, synonyms, but the editor is of opinion that some 80,000 generic and subgeneric names are actually used in zoology. A glance at almost any page in the volume before us will show that much still remains to be done in purging the list on account of the same name being used for two or more groups, but this did not come within the province of the compilers.

How near the list approaches completeness must depend to a great degree on the thoroughness, or otherwise, with which the various contributors to the "Zoological Record" have done their work. Personally, the writer feels responsible for at least one omission—the genus Dinocynops, proposed by Ameghino in 1898—and probably he is not the only offender. Such omissions detract, however, in no way from the careful and painstaking manner in which the compilers have executed their task, and we can but repeat our sense of the obligation under which they have placed all working naturalists. R. L.

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.*]

Genius and the Struggle for Existence.

WILL you allow me to supplement the excellent reply of Sir Oliver Lodge to your correspondent Mr. G. W. Bulman by a few remarks dealing more specifically with that gentleman's difficulty, which is one very widely felt, but is, I believe, founded on a misconception?

The words "useful" and "advantage" have two distinct meanings, the one referring to material the other to intellectual and moral results; and it is in the former sense only that they can be properly used in relation to natural selection or survival of the fittest. In that relation, physical results only are of value—those that tend to the preservation of life on occasions of stress and danger. In deciding whether any quality, physical or mental, is of *value* in this sense, Lloyd Morgan's admirable test should be applied—"Is it of survival-value?" If not, then it is *not* useful in the struggle for existence either to the individual or the race, unless it happens to be combined with other qualities which are, in an exceptional degree, of survival value. Now genius in all its varying manifestations is a quality which has hardly any relation to survival except an adverse one, and only in exceptional cases is of any *material* advantage to the race. The genius of the poet, of the writer, of the artist, even of the inventor, only occasionally benefits the race in its material struggle with other races, while it very rarely gives long life and an ample progeny to the possessor. Its *use* to him is solely the enjoyment of the exercise of his faculty of creating. Too frequently it is of no material use whatever to him, and he dies in poverty and neglect. The two races that have exhibited the highest manifestations of genius were the ancient Greeks and the Jews. But this genius did not advantage their respective races in the struggle for existence. Both of them became permanently subject races, and that they have survived at all is not due to their genius, but to their exceptionally fine physical qualities, their courage and their endurance.

As a matter of fact, the law of the survival of the fittest has almost entirely ceased to apply to civilised man, and the more civilised he is the less it applies. I [have already shown (in the chapter on "Human Selection" in my "Studies"), how, under a higher civilisation and a truer social system, it will be superseded by another law, which may be termed "the perpetuation of the fittest," and which will operate as automatically and as beneficially in improving the human race as natural selection has acted in improving the lower animals. At present, as Darwin himself fully recognised, it is not the best or the highest that survive, but a comparatively low type morally and intellectually, though in relation to our present very imperfect civilisation they may be held to be the fittest. It is, however, fitness to "succeed in life," as it is termed, not necessarily to survive; and this is indicated by the comparatively short lives of millionaires and of the inhabitants of cities, who are continually replaced by the sons of the less successful but more virile inhabitants of the rural districts. ALFRED R. WALLACE.

The Holy Shroud.

PROF. MELDOLA'S notice from a truly scientific standpoint of Dr. Vignon's book, entitled "The Shroud of Christ," is not less interesting than valuable, but I think two difficulties which hardly fell within the scope of his article may also be raised. One struck me at once in examining the facsimile of the photographic negative plate of the Holy Shroud (facing p. 17). The body had been lying, of course, face upwards. I presume that if a corpse were thus placed on a stone slab, within a very few hours of death, the nates would be slightly flattened by pressure, but their normal roundness—as in a nude standing figure—caught my eye at once when examining the plate.

But a still more serious difficulty awaits Dr. Vignon. The shroud in shape has a general resemblance to an elongated bath-towel; on one half, smoothed out, the body was laid, and the other was neatly doubled over the head and brought down so as completely to cover the feet. This mode of burial, so far as I know, was not usual among the Jews at that date (the corpse being more or less wrapped up, as described in the raising of Lazarus). But passing over this point, for Dr. Vignon pleads that the arrangement was a temporary one (though, by the way, it would make the preservative myrrh and aloes much less effective), we find the authors of the four Gospels all use language which excludes any such arrangement of the so-called shroud. Matthew and Luke both write ἐνετύλιξεν αὐτὸ ἐν σινδόνι; Mark in a nearly identical sentence substitutes the verb ἐνείλησεν. But both these words mean to wrap or to roll up, not to lay a sheet over (and under). John, in a rather more minute description, says, ἔδησαν αὐτὸ ἐν ὀθονίοις μετὰ τῶν ἀρωμάτων, adding "as is the custom of the Jews in burial." He also mentions bandages or body-cloths a second time, and a napkin bound about the head—which would have interfered with the photographic process. Dr. Vignon endeavours to elude the plain meaning of these passages, but, as it seems to me, he can only prove the genuineness of the shroud by rejecting the four principal witnesses to the facts of which it is supposed to be a record, a process which has a suspicious resemblance to sawing off the branch on which you are sitting. T. G. BONNEY.

The Herbarium of Ferrante Imperato at Naples.

IN a recent issue of NATURE (vol. lxvii. p. 181), there is an account of a paper by Prof. B. Schorler on a history of systematic botany prior to Linnæus. In the list given of the most ancient existing herbaria, no mention is made of that of Ferrante Imperato, which is among the oldest extant. This ancient herbarium, the remains of which are preserved in the National Library of Naples, is also overlooked in the interesting paper, now in course of publication, in the *Magyar Botanikai Lapok* (Budapest, 1902), by Alföldi Flatt Károly, "Zur Geschichte der Herbare."

An incidental notice of the herbarium of Ferrante Imperato was published by me in NATURE (vol. lxiii., November, 1900) in an article on Domenico Cirillo and the chemical action of light, in connection with vegetable irritability.

Ferrante Imperato, a Neapolitan *simplicista*, born in 1550, lived in Naples, where he died in 1625. In those days, museums of natural history began to be formed in Italy, the most famous being those of Aldovrandi in Bologna, the museum of Pisa, where Andrea Cesalpino (1519–1603) taught, and the museum of Ferrante Imperato in Naples. In Ferrante's book, "Dell' Historia Naturale, Libri XXVIII.," edited by his son, Francesco Imperato, in 1599, is given a picture of the museum at Naples. This museum, as the author says, contained "Natural plants artificially preserved, attached to the pages of special books, and besides, terrestrial, aquatic and flying animals: moreover, gems, marbles and divers stones, earths, minerals and metals, and preserved seeds and rare leaves, and extracts of divers earths and plants."

At the end of the sixteenth century, a Genoese nobleman, Giovanni Vincenzo Pinelli, formed in Naples a botanical garden or "Orto dei Semplici," in which many rare plants were collected under the care of Bartolomeo Maranta, of Venosa (who died in 1570), Ferrante Imperato and Fabio Colonna (1567–1650), an active correspondence and exchange of materials being kept up with other collectors. As Imperato puts it in his book, "human sciences grow by communion among men; this do I say and confess because our studies and the matters of which we write have developed by the help of friends who have concurred in procuring for us things from divers parts of the world, or have been companions and fellow-labourers." Besides G. V. Pinelli, the chief helper in collecting foreign objects, and Maranta and Fabio Colonna, who lived in Naples, Imperato records among his correspondents Pietro Andrea Mattioli, of Siena (1500–1577), Melchiorre Guilandini, of Padua (1520–1589), Jacopo Cortuso, also of Padua (1513–1603), Ulisse Aldovrandi, of Bologna (1522–1605), Carlo Clusio, Kaspar Bauhin, of Bâle (1560–1624), and Colantonio Stelliola, "Professor of Recondite Sciences, to whom I have communicated the greater part of the discoveries made by me." One does not understand why some authors attribute the work of Imperato to this Stelliola.

The herbarium was perhaps the more important part of this Neapolitan museum, being contained in eighty volumes. The museum of Imperato got dispersed during the great plague of Naples in 1656, and only nine out of the eighty volumes of the

herbarium were saved, passing into the hands of Nicola Cirillo (1671–1734), a physician and botanist who possessed a private botanical garden and was a Fellow of the Royal Society of London, for which Society he collected data on the climate of Naples, and wrote a treatise on the application of cold in the treatment of fevers. Remaining in the Cirillo family, the herbarium was finally bequeathed to the celebrated botanist Domenico Cirillo, who preserved these volumes as the most precious treasure in his collections. In 1783, Martin Vahl, a friend of Linnæus, saw Imperato's herbarium in Cirillo's house, and it is said that he fell on his knees in reverence before the ancient relic. In 1799, when the royalist mob sacked Cirillo's house and Cirillo himself was hanged, all his collections were dispersed, including the herbarium of Imperato. Of the nine volumes only one was saved, and finally came into the hands of Camillo Minieri-Riccio, who in 1863 published a short account of this botanical relic (C. Minieri-Riccio: "Breve notizia dell' Erbario di Ferrante Imperato," *Rendiconti dell' Accademia Pontaniana*, xi., 1863). Minieri says that Imperato's name is written in the volume.

The collections of Minieri-Riccio were finally sold to the National Library at Naples, where the volume of Imperato's herbarium may now be seen.

The volume, of 268 pages, is bound in parchment and is labelled "Collectio Plantarum Naturalium." It contains 440 plants, glued to the paper, each with one or more names. There is an alphabetical index, probably written by Imperato himself.

The authorities in the Naples library do not seem aware of the importance of the relic they possess, for the herbarium is kept as an ordinary book and the plants are exposed to inevitable damage and decay. Several of the specimens have already been eaten up by insects. ITALO GIGLIOLI.

R. Stazione Agraria Sperimentale, Rome, January 8.

A Curious Projectile Force.

I AM able to corroborate B.A. Oxon.'s letter (p. 247). In my case, the screw stopper of the bottle (inverted) rested at an angle against some books on a table. When the pressure of the gas was sufficient to force out the stopper, the bottle sprang three or four feet into the air and fell some distance off on the floor of the room. NORMAN LOCKYER.

The Principle of Least Action. Lagrange's Equations.

WHETHER good mathematicians, when they die, go to Cambridge, I do not know. But it is well known that a large number of men go there when they are young for the purpose of being converted into senior wranglers and Smith's prizemen. Now at Cambridge, or somewhere else, there is a golden or brazen idol called the Principle of Least Action. Its exact locality is kept secret, but numerous copies have been made and distributed amongst the mathematical tutors and lecturers at Cambridge, who make the young men fall down and worship the idol.

I have nothing to say against the Principle. But I think a great deal may be said against the practice of the Principle. Truly, I have never practised it myself (except with pots and pans), but I have had many opportunities of seeing how the practice is done. It is usually employed by dynamicians to investigate the properties of mediums transmitting waves, the elastic solid for example, or generalisations or modifications of the same. It is used to find equations of motion from energetic data. I observe that this is done, not by investigating the actual motion, but by investigating departures from it. Now it is very unnatural to vary the time integral of the excess of the total kinetic over the total potential energy to obtain the equations of the real motion. Then again, it requires an integration over all space, and a transformation of the integral before what is wanted is reached. This, too, is very unnatural (though defensible if it were labour-saving), for the equation of motion at a given place in an elastic medium depends only upon its structure there, and is quite independent of the rest of the medium, which may be varied anyhow. Lastly, I observe that the process is complicated and obscure, so much so as to easily lead to error.

Why, then, is the P. of L. A. employed? Is not Newton's dynamics good enough? Or do not the Least-Actionists know that Newton's dynamics, viz. his admirable Force = Counter-force and the connected Activity Principle, can be directly applied to construct the equations of motion in such cases as above referred to, without any of the *hocus pocus* of departing from the real motion, or the time integration, or integration over all space, and with avoidance of much of the complicated work. It would seem not, for the claim is made for the P. of L. A. that it is a commanding general process, whereas the principle of energy is insufficient to determine the motion. This is wrong. But the P. of L. A. may perhaps be particularly suitable in special cases. It is against its misuse that I write.

Practical ways of working will naturally depend upon the data given. We may, for example, build up an equation of motion by hard thinking about the structure. This way is followed by Kelvin, and is good, if the data are sufficient and not too complicated. Or we may, in an elastic medium, assume a general form for the stress and investigate its special properties. Of course, the force is derivable from the stress. But the data of the Least-Actionists are expressions for the kinetic and potential energy, and the P. of L. A. is applied to them.

But the Principle of Activity, as understood by Newton, furnishes the answer on the spot. To illustrate this simply, let it be only small motions of a medium like Green's or the same generalised that are in question. Then the equation of activity is

$$\text{div. } \mathbf{q}\mathrm{P} = \dot{\mathrm{U}} + \dot{\mathrm{T}}; \qquad (1)$$

that is, the rate of increase of the stored energy is the convergence of the flux of energy, which is $-\mathbf{q}\mathrm{P}$, if $\mathbf{q}$ is the velocity and P the stress operator, such that

$$\mathrm{P}\mathbf{i} = \mathbf{P}_1 = \mathbf{i}\mathrm{P}_{11} + \mathbf{j}\mathrm{P}_{12} + \mathbf{k}\mathrm{P}_{13} \qquad (2)$$

is the stress on the $\mathbf{i}$ plane. Here $\mathbf{q}\mathrm{P}$ is the conjugate of $\mathrm{P}\mathbf{q}$.

By carrying out the divergence operation, (1) splits into two, thus

$$\mathbf{F}\mathbf{q} = \dot{\mathrm{T}}, \qquad \mathbf{G}\mathbf{q} = \dot{\mathrm{U}}. \qquad (3)$$

Here $\mathbf{F}$ is a real vector, being the force, whilst $\mathbf{G}$ is a vector force operator. Both have the same structure, viz. $\mathrm{P}\nabla$, but in $\mathbf{F}$ the differentiators in ∇ act on P, whereas in $\mathbf{G}$ they are free and act on $\mathbf{q}$, if they act at all.

Now when U is given, $\dot{\mathrm{U}}$ becomes known. It contains $\mathbf{q}$ as an operand. Knock it out; then $\mathbf{G}$ is known; and therefore $\mathbf{F}$; and therefore the equation of motion is known, viz.

$$\mathbf{F} = \frac{d}{dt}(m\mathbf{q}),$$

where m is the density, or the same generalised eolotropically, or in various other ways which will be readily understood by electricians who are acquainted with resistance operators.

Of course, P becomes known also. So the form of U specifies the stress, the translational force and the force operator of the potential energy. To turn $\mathbf{G}$ to $\mathbf{F}$ is the same as turning $\mathrm{A}\dfrac{d}{dx}$ to $\dfrac{d\mathrm{A}}{dx}$.

If, for example, the displacement is $\mathbf{D}$, the potential energy is a quadratic function of the nine differentiants $d\mathrm{D}_1/dx$, &c., of the components. Calling these r_{11}, r_{12}, &c.;

$$\mathrm{U} = \tfrac{1}{2}r_{11}\frac{d\mathrm{U}}{dr_{11}} + \tfrac{1}{2}r_{12}\frac{d\mathrm{U}}{dr_{12}} + \ldots, \qquad (4)$$

by the homogeneous property. Therefore, since $\dot{r}_{12} = a q_1/dy = \mathbf{i}\,d\mathbf{q}/dy$,

$$\dot{\mathrm{U}} = \left(\frac{d\mathrm{U}}{dr_{11}}\,\mathbf{i}\,\frac{d}{dx} + \frac{d\mathrm{U}}{dr_{12}}\,\mathbf{i}\,\frac{d}{dy} + \ldots\right)\mathbf{q} = \mathbf{G}\mathbf{q}; \qquad (5)$$

therefore, writing P_{21} for $d\mathrm{U}/dr_{12}$,

$$\mathbf{F} = \mathbf{i}\left(\frac{d\,\mathrm{P}_{11}}{dx} + \frac{d\,\mathrm{P}_{21}}{dy} + \frac{d\,\mathrm{P}_{31}}{dz}\right) + \ldots \qquad (6)$$

$$= \frac{d\mathbf{P}_1}{dx} + \frac{d\mathbf{P}_2}{dy} + \frac{d\mathbf{P}_3}{dz}. \qquad (7)$$

It is clear that the differentiants in (4) (which involve the large number 45 of coefficients of elasticity in the general case of eolotropy) are the nine components of the conjugate of the stress operator. Of course, vector analysis, dealing with the natural vectors concerned, is the most suitable working agent, but the same work may be done without it by taking the terms involving q_1, q_2, q_3 separately.

Another expression for U is $\mathrm{U} = \tfrac{1}{2}\mathbf{G}\mathbf{D}$, which shows how to find $\mathbf{F}$ from U directly.

Another claim made for the P. of L. A. is that it leads to Lagrange's equations of motion. That is not remarkable, seeing that both are founded upon Newtonian ideas. I suppose Lagrange's equations can be made to lead to the P. of L. A. But the practical way of proving Lagrange's form is to derive it immediately from Newton's Principle of Activity. Thus, when there are n independent coordinates x, with velocities v, the kinetic energy T is a homogeneous quadratic function of the v's, with coefficients which are functions of the x's. This makes

$$2\mathrm{T} = v_1 \frac{d\,\mathrm{T}}{dv_1} + v_2 \frac{d\,\mathrm{T}}{dv_2} + \ldots ; \qquad (8)$$

therefore

$$2\dot{\mathrm{T}} = \frac{d}{dt}\frac{d\,\mathrm{T}}{dv_1} v_1 + \frac{d\,\mathrm{T}}{dv_1}\dot{v}_1 + \ldots . \qquad (9)$$

But also by the structure of T,

$$\dot{\mathrm{T}} = \frac{d\,\mathrm{T}}{dx_1} v_1 + \frac{d\,\mathrm{T}}{dv_1}\dot{v}_1 + \ldots . \qquad (10)$$

So, by subtraction of (10) from (9)

$$\dot{\mathrm{T}} = \left(\frac{d}{dt}\frac{d\,\mathrm{T}}{dv_1} - \frac{d\,\mathrm{T}}{dx_1}\right) v_1 + \ldots ; \qquad (11)$$

and therefore, by Newton, the force on x_1 is the coefficient of v_1, and similarly for the rest.

Some people who had worshipped the idol did not altogether see that the above contained the really essential part of the establishment of Lagrange's form, and that the use of the activity principle to establish the equation of motion is proper, instead of *vice versâ*. To all such the advice can be given, Go back to Newton. There is nothing in the P. of L. A., or the P. of L. Curvature either, to compare with Newton for comprehensive intelligibility and straight correspondence with dynamics as seen in Nature. It must, however, be said that Newton's third law is sometimes astonishingly misconceived and misapplied, perhaps because it is badly taught.

OLIVER HEAVISIDE.

Leonids of 1902, and Quadrantids of 1903.

CLOUDS and full moonlight seem to have impeded observations of the Leonids to a considerable extent in November, 1902. The night of November 14 was fine here, but as there seemed little probability of a display on that date—as is fully confirmed by the negative results of other observers—no extended watch was maintained. The night of November 15 turned out very unfavourable. It seemed unusually bright here about 6h. 30m. on the morning of November 16. No observations were possible in the circumstances. Even if the sky had been clear, very probably nothing unusual in the way of a meteor display would have been visible, owing to the presence of the full moon, then shining with almost maximum brilliancy. M. D. Eginitis, with three assistants, observing at Athens during the night of November 15, did not see more meteors—in fact, they counted one less—than on that of November 14, 1901, on which night the American maximum took place. Both those nights were clear, but possibly the observations may not have been equally extensive. The maximum of 1902 probably took place in America, but in the absence of reports of clear observations at a few stations on the other side of the Atlantic, it is difficult to gauge with certainty the character of the display.

The Quadrantid meteors, on the other hand, were well seen here, considering the broken character of the weather. Anticipating that the display of 1903 would occur early on the night of January 3—the maximum had been determined as due at 8h. 55m.—a watch was begun at 8h. 45m., and during the next hour or so some very fine meteors were observed. The following are the times of their appearance, and their approximate flights:—

d.	h.	m.	
Jan. 3	8	53,	from 2° west of Gemini to Orion, = 1st magnitude.
,, 3	8	56,	,, 1° east of the "Guards" to Pole Star, = 1–2 magnitude.
,, 3	9	20,	,, between Castor and Pollux to Orion, = 1st magnitude.
,, 3	9	47,	,, between the "Guards" half-way to Pole Star, = 2nd magnitude.
,, 3	9	59½,	,, 20° west of "Guards" to 10° higher up, = rich streak.
,, 3	10	0,	,, 20° west of "Guards" to Cassiopeia, = Capella.

Shortly after 10 o'clock, clouds came up from the horizon and by 10h. 15m. the whole north-eastern sky up to Gemini was covered. At 10h. 35m., that part of the sky had again cleared, and, between 10h. 40m. and 10h. 55m., eight meteors, varying from about 1st to 2nd magnitudes, were observed. They were all long-pathed, but generally not so much so as the early part of the display, nor did they seem to move in beaten tracks, as it were, like the first meteors. The direction of their flight resembled, on the whole, that of the former, but one of them (= Sirius) shot downwards for about 30° in a direction parallel to the tail stars of Ursa Major. It started from a point about 20° east of that constellation. The latter part of the display between 10h. 40m. and 10h. 55m. was the richest I have ever observed. I observed no meteors, except one or two between 9 and 10 o'clock, that could not be traced. They began to come so rapidly at 10h. 40m. that when making a note of the course of one, another would put in an appearance, and so prevent the completion of the first observation, their paths not being near any well-known stars. An interval of quiescence for a few minutes would then follow, when the phenomenon would be again repeated as before. At 11 o'clock, the sky became again clouded and a heavy shower of rain terminated open-air observation. Between 12h. and 12h. 20m., two more were seen through a window, of about the 3rd magnitude, one on either side of the tail stars of Ursa Major; then clouds once more intervened.

JOHN R. HENRY.

Dublin.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE fifty-second annual meeting of the American Association was held at Washington, December 29 to January 3, and was in many respects the most successful meeting ever held in the fifty odd years of the existence of the Association. As pointed out in the article in NATURE of July 24, 1902, in the account of the Pittsburg meeting of last June, this is practically the first time in which the Association has met during the winter since the close of the Civil War, and in this meeting culminated the prolonged efforts of a special committee of the Association, of which Dr. Charles Sedgwick Minot was chairman, to bring about an agreement among the scientific and other learned societies and the leading universities and other institutions of learning in the United States to set apart the week in which the first of January falls as a "Convocation Week," and in this week to bring together at one place as many as possible of the scientific societies. This culmination of the efforts of Dr. Minot's committee was eminently satisfactory. The meeting was a great success, and the institution of Convocation Week has apparently been established under the most favourable auspices.

Dr. Ira Remsen, president of Johns Hopkins University, presided over the Washington meeting, and the retiring president, the noted astronomer, Prof. Asaph Hall, U.S.N., delivered his address on the opening night of the session. His subject was "The Science of Astronomy," and it was published in full in our last week's issue.

The local arrangements for the meeting were complete, and the President of the United States acted as honorary president of the local committee, the active chairman being Dr. C. D. Walcott, Director U.S. Geological Survey, and the local secretary Dr. Marcus Benjamin, U.S. National Museum.

The addresses of the vice-presidents of the different sections were given in the afternoon of Monday, December 29, as follows:—

Prof. G. W. Hough before the Section of Mathematics and Astronomy, on "The Physical Constitution of the Planet Jupiter." Prof. Franklin before the Section of Physics, on "Limitations of Quantitative Physics." Prof. Weber before the Section of Chemistry, on "Incomplete Observations." Prof. Culin before the

Section of Anthropology, on "New World Contributions to Old World Culture." Prof. Welch before the Section of Physiology and Experimental Medicine. Prof. J. J. Flather before the Section of Mechanical Science and Engineering, on "Modern Tendencies in the Utilisation of Power." Prof. C. C. Nutting before the Section of Zoology, on "Some of the Perplexities of a Systematist." Prof. D. H. Campbell before the Section of Botany, on "The Origin of Terrestrial Plants." Prof. Wright before the Section of Social and Economic Science, on "The Psychology of the Labour Question."

Many important scientific bodies met in affiliation with the Association. Among these were:—The American Anthropological Association, the American Chemical Society, the American Folk-lore Society, the American Microscopical Society, the American Morphological Society, the American Philosophical Association, the American Physical Society, the American Physiological Society, the American Psychological Association, the American Society of Naturalists, the Association of American Anatomists, the Association of Economic Entomologists, the Astronomical and Astrophysical Society of America, the Botanical Society of America, the Botanists of the Central and Western States, the Geological Society of America, the National Geographic Society, the Naturalists of the Central States, the Society of American Bacteriologists, the Society for Plant Morphology and Physiology, the Society for the Promotion of Agricultural Science, the Zoologists of the Central and Western States.

The approximate register of scientific men and women in attendance at this series of meetings was fifteen hundred, of whom about one thousand registered for the American Association. The week was thus a very crowded one, the days being occupied with the meetings of the sections and the affiliated societies, and the general functions being as follows:—

On Monday evening, the annual address of the retiring president, Prof. Hall. Monday afternoon, the addresses of the retiring vice-presidents. On Tuesday evening, the address of the retiring president of the American Chemical Society, Dr. Remsen, and the public lecture of the American Society of Naturalists, delivered by Dr. C. Hart Merriam, on the subject "Protective and Directive Coloration of Animals, with especial Reference to Birds and Mammals." On the same evening, the Botanical Society of Washington gave a reception to visiting botanists. On Wednesday afternoon, the annual discussion of the American Society of Naturalists was held; the subject was "How can Endowments be Used most Effectively for Scientific Research?" On the same afternoon, a public lecture, complimentary to the citizens of Washington, was given by Prof. I. C. Russell, of the University of Michigan, on "The Volcanoes of the West Indies." On Wednesday evening, the annual dinners of the American Society of Naturalists and the Geological Society of America, and the annual smoker of the American Chemical Society, were held.

On Thursday evening, the secretary of the Smithsonian Institution, Prof. Langley, held a reception in the National Museum.

On Friday afternoon, a lecture, complimentary to the citizens of Washington, was given by John Hays Hammond, on "Rhodesia, the Site of the Mines of King Solomon." Friday evening, the local committee, with the trustees of the Corcoran Art Gallery, gave a reception to the visiting members of the Association and the affiliated societies at the Art Gallery.

On Saturday morning, President Roosevelt received all visiting members at the White House.

Several important changes in the constitution of the Association went into effect at this meeting, all tending toward the improvement of the stability of the council and the sectional committees. Hereafter, the sectional committees will hold office for five years; the secretaries of sections will also hold office for five years, and the council will elect annually three members at large to serve for three years. National scientific societies adopting permanent affiliation with the Association are now represented upon the council of the Association, and this body probably at the present time includes a larger number of the active leading scientific men of America than any other organisation, not excepting the National Academy of Sciences.

Many notable papers were presented during the session, and the character of the proceedings, as will appear from the published reports in the journal *Science*, the organ of the Association, will undoubtedly show a very general improvement over the papers of previous meetings.

The general committee decided upon St. Louis as the next place of meeting, the time to be during Convocation Week of 1903–4, and recommended to the next general committee that Philadelphia be the following place of meeting during the Convocation Week of 1904–5.

The officers elected for the St. Louis meeting are as follows:—

President, Carroll D. Wright, Washington.

Vice-presidents:—Section A, Mathematics and Astronomy, O. H. Tittmann, Washington; B, Physics, E. H. Hall, Harvard University; C, Chemistry, W. D. Bancroft, Cornell University; D, Mechanical Science and Engineering, C. M. Woodward, Washington University; E, Geology and Geography, I. C. Russell, University of Michigan; F, Zoology, E. L. Mark, Harvard University; G, Botany, T. H. Macbride, University of Iowa; H, Anthropology, M. H. Saville, American Museum of Natural History; I, Social and Economic Science, S. E. Baldwin, New Haven; K, Physiology and Experimental Medicine, H. P. Bowditch, Harvard University.

General Secretary, C. H. Wardell Stiles, U.S. Revenue Marine Hospital and Public Health Service.

Secretary of the Council, Charles S. Howe, Case School.

Secretaries of the Sections:—Section A, Mathematics and Astronomy, L. G. Weld, University of Iowa; B, Physics, D. C. Miller, Case School; C, Chemistry, A. H. Gill, Massachusetts Institute of Technology; D, Mechanical Science and Engineering (no election); E, Geology, G. B. Shattuck, Baltimore; F, Zoology, C. Judson Herrick, Denison University; G, Botany, F. E. Lloyd, Teachers' College, Columbia University; H, Anthropology, R. B. Dixon, Harvard University; I, Social and Economic Science, J. F. Crowell, Washington; K, Physiology and Experimental Medicine, F. S. Lee, Columbia University.

The treasurer, Prof. R. S. Woodward, of Columbia University, and the permanent secretary, Dr. L. O. Howard, of the U.S. Department of Agriculture, remain unchanged.

BUBONIC PLAGUE AT HOME AND ABROAD.

A VOLUME of reports and papers on bubonic plague has recently been issued by the Local Government Board,[1] in continuation of the series originally commenced by the late Mr. Netten Radcliffe and since carried on by Dr. Bruce Low. In the preceding volume, Dr. Bruce Low carried the history of the distribution of plague throughout the world to the middle of 1898, while the present report comprises the period from the middle of 1898 to the middle of 1901.

Dr. Low follows the occurrence and progress of bubonic plague chronologically and topographically by

[1] "Reports and Papers on Bubonic Plague." By Dr. R. Bruce Low. With an Introduction by the Medical Officer of the Local Government Board. Pp. xi + 446. (London: Eyre and Spottiswoode, 1902.) Price 4s. 1d.

the aid of a host of official documents, and partly from numerous other publications. To procure, sift, digest and arrange this enormous mass of polyglot literature is a task as complex as it is difficult, and, looking through the present volume, the reader will agree that Dr. Low has done a difficult piece of work in an exhaustive manner. The usefulness of such a work to the sanitarians of the world must be obvious. Dr. Low, in a clear and systematic and at the same time objective manner, describes the progress and general character of plague as it appeared in and as it affected the various countries during the period stated (middle of 1898—middle of 1901); to this are added the official regulations and procedures in use in the different countries in dealing with plague.

As might be expected, the first place is given to England, Wales and Scotland; there being no case of plague recorded in Ireland, Dr. Low passes on to other European countries in which cases of plague have occurred, and then takes his readers into Turkey, the Levant, Arabia, South and Central Africa, India, the Far East, Australia and New Zealand, and finally America. As to the cases of plague that had been imported into England and Wales, it is satisfactory to learn from Dr. Low's account that the vigilance of, and procedures adopted by, our port sanitary officers were on the whole unremitting and thoroughly efficient; that whenever the case required it, the Local Government Board by its medical inspectors promptly and energetically assisted the port sanitary and local authorities in devising and carrying out the necessary protective and prophylactic measures. As a matter of fact, practically all the cases of plague that reached our shores were promptly intercepted and dealt with, and no further spread of the disease occurred.

Of no mean interest and importance are the facts collected by Dr. Low as to the relation of plague in the rat to plague in the human subject, and we cannot do better than quote here the concise summary on the subject by the Medical Officer of the Local Government Board (p. x).

"The records to which Dr. Low has had access, though they go to confirm belief that as regards plague man and the rat are reciprocally infective, fail completely in affording sufficient data for determining the degree to which man is in danger through the rat. So far as plague ashore is concerned, it would appear that in particular localities man and the rat suffered from plague coincidently; that in other localities man suffered before the rat; and that in others again the rat suffered antecedently to man. Further, it would appear that when in a particular district the one (man or the rat) has suffered plague antecedently to the other, the interval between invasion of the first and of the second species has been often a long one—extending sometimes over weeks and months. Finally, it would appear that plague may prevail largely among men without rats becoming conspicuously affected; and conversely that the disease may cause large mortality among rats of a locality while neglecting to attack its human inhabitants. As regards plague on shipboard, very similar facts were forthcoming. The disease does not, under conditions of sea transit, appear to be at all readily conveyed from the rat to man or from man to the rat. On the one hand, ships plague-invaded for several weeks in the persons of crew or passengers have come into port with the rats on board them seemingly altogether exempt from disease; and on the other hand, ships infected with plague-smitten rats have, after voyages of considerable duration, arrived at their destinations wholly free from plague as regards crew and passengers."

There is, then, no cause for the extreme views which some alarmists have put forward, *i.e.* those who would wish us to prevent any ship coming from an infected country from landing or discharging cargo unless previously all rats on board were destroyed, even in cases where no disease occurred amongst the crew or passengers. Such a procedure would, in the face of Dr. Low's array of facts, be quite unnecessary, and would inflict on shipping in general hardships which experience has shown would be scarcely justified even in the case of ships which on their voyage had actually been infected with plague.

(From the detailed account by Dr. Tidswell of the characters, origin and progress of the plague in Sydney,[1] it appears that the outbreak in man was preceded by great mortality amongst rats from plague, and, further, that the progress of the epidemic amongst human beings in different parts of the town was consistent with the dissemination of the contagion by rats.)

There is one further important point to be noted in the account by Dr. Low, and that is the comparatively simple and comprehensive manner in which plague-stricken or plague-suspected vessels arriving on our shores are dealt with, and the complete success which so far has attended the procedures both as to passengers and crew and cargo. These procedures contrast in a most favourable way with some of the doings in similar circumstances of the authorities in some other countries, in which countries machinery is put in action the chief object of which appears to be the most vexatious treatment of harmless passengers (*vide* s.s. *Niger*, Marseilles, p. 117).

The description of the epidemic of plague in Oporto in 1899 is very instructive reading, and throws into strong relief the broad fact, observed also in Glasgow (1900), in Alexandria, Bombay, the Cape and other places, how difficult, nay, impossible, it is to trace in these epidemics the origin of the outbreaks, the manner and channels in which the contagium had found entrance, and the lapse of considerable and most valuable periods before the disease as such is actually recognised. In these respects, England and Wales have so far been most fortunate in the Local Government Board having everywhere, in our seaports as well as inland, the attention of Medical Officers of Health early, and especially, directed to the danger of importation and to the best means to lessen it and to deal with any case should such occur. It is a fact that, in a good many instances, Medical Officers of Health have with laudable promptitude carefully taken account even of cases which from their clinical and epidemiological characters were not considered as cases of plague, but because they bore in one respect or another a resemblance to plague were notified and subjected to further examination. As was to be expected, these cases were proved not to have been cases of bubonic plague. On the other hand, the necessity for noting all such cases lies in this, that there are atypical cases of real plague which in clinical respects have only a distant resemblance to that disease; such atypical cases of plague could, under less strict supervision, easily escape detection and be the starting point for dissemination of the disease.

A point of extreme interest to western countries is the comparison between the epidemics in the oriental, from which the present pandemic of plague started (1894), and the occidental countries into which it was imported and disseminated. The result of this comparison is highly gratifying, since it shows the very much lesser virulence of the disease in the occidental than in the oriental countries. The Medical Officer thus summarises these important facts (p. viii):—

"There can be no question at all as to plague having very especially affected certain Oriental populations; outside the Asiatic continent, the disease has manifested small ability to become seriously epidemic. For instance, in India, plague, while year after year producing a heavy

[1] "Some Practical Aspects of the Plague at Sydney," by Dr. Frank Tidswell (*Journal* of the Sanitary Institute, vol. xxi. part iv.).

rate of mortality, has at the same time proved exceptionally virulent, as shown by a high ratio of deaths to attacks; and this notwithstanding strenuous efforts on the part of well equipped sanitary bodies to obtain and to maintain control of the disease; whereas in many other countries in various quarters of the world, not a few of them greatly inferior to India as regards administrative preparedness to resist imported disease, plague has failed, when introduced, to cause any but insignificant mortality, has not tended to recur from year to year, and has proved infinitely less virulent case for case than in better ordered India."

A detailed account of the regulations, orders, &c., employed in all the affected countries, with ten carefully arranged coloured maps, form a valuable addition.

E. KLEIN.

THE ARCHIVES OF PHONOGRAPHIC RECORDS.

THE Imperial Academy of Sciences of Vienna has recently appointed a commission to inquire into the possibilities of the application of the phonograph to scientific purposes. It would appear that this instrument has as yet been used mainly as a means of domestic recreation or as an adjunct to the penny showman, but it is quite clear that the instrument provides a means of preserving actual spoken specimens of languages, especially of those which are in a state of gradual development and growth or in a condition of decay. Moreover, by bringing the spoken speech or dialect of distant lands and out-of-the-way districts to those to whom they would be otherwise inaccessible, a most valuable means of scientific research is made available. Recognising the latent possibilities of the phonograph in this direction, the Vienna Academy appointed the above-mentioned commission, the special task of which was the establishment, if possible, of central archives where phonographic records could be kept, duplicated and made accessible to the general scientific world.

The commission has recently issued its second report, dated July 11, 1902, in which the position of affairs at that date is recorded.

The preliminary work undertaken was chiefly mechanical in nature and was concerned in the production of a standard instrument (Archiv-phonograph), and in working out the method of preservation and duplication of the records. It is, of course, self-evident that the wax record is unsuitable for preservation, and in order that this may be most conveniently copied in metal, the Archiv-phonograph has a flat wax plate instead of a cylindrical one. The instrument is shown in Fig. 1. The "cast" wax plate is fixed on the round metal plate (24), which is caused to revolve round its centre by means of the gear shown, the driving force being a wound-up spring contained in the bottom case. The speed of rotation can be adjusted by means of the screw (32) and is indicated by a pointer in (33). The Edison recorder is contained in (7) and is caused to travel radially over the plate (24) so that the record is in the form of a spiral on the same; the distance between each line is $\frac{1}{4}$ mm. It can be seen that the instrument is of very solid construction, and as such would be of more likely use for the laboratory than for purposes requiring its transport from place to place. The wax recommended is that used by Edison, and a plate is capable of taking a speech of two minutes' duration. The metallic negative is prepared as follows. The wax is removed from the instrument and peppered and brushed all over with very fine graphite, the current connection being made by a ring of copper wire stuck into the middle of the plate. Alcohol is then poured over the graphited plate, and it is at once placed in the electrolytic bath and copper deposited thereon. The so-formed negative is sprung from the wax, cleaned and polished, and flashed over with a very thin layer of nickel in a nickel bath. These metal "phonotypes" are used as patterns for casting the "Archiv" plates in wax which are used in the phonograph for the reproduction of the acoustic record. The metal negatives are, of course, durable and are kept, and as many "Archiv" plates can be cast off them from time to time as may be desired.

In order to put the ideas underlying the appointment of the commission to practical test, three scientific expeditions recently sent out by the Vienna Academy were each provided with an Archiv-phonograph, and the reports furnished by the leaders of these expeditions are given. The expeditions were two philological ones to Kroatia and Slavonia and Lesbos respectively, and a geological one to Brazil. It is evident from the reports that the, it is true, interesting and valuable records obtained were only got by dint of much trouble and perseverance, as the apparatus for such purposes is most unsuitable, the whole outfit weighing, as it does, 120 kilogrammes. Such an apparatus may be compared to a photographic artist's studio camera, while what is required is something more of the nature of a hand camera. It was found impossible to remove the phonograph any distance from the railway, so that very

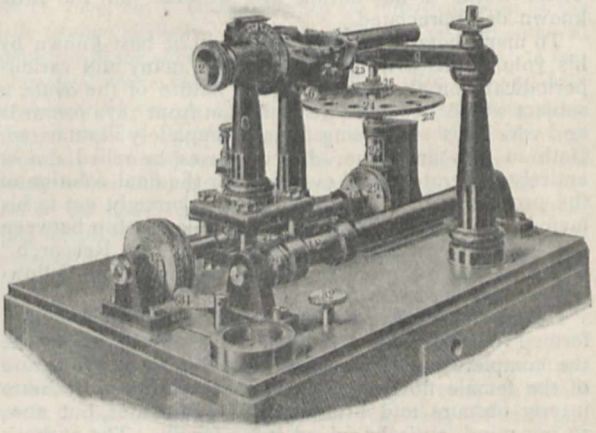

FIG. 1.

interesting records of dialects, &c., which could otherwise have been obtained were not possible to be got. However, there is no reason why, with proper design, an instrument may not be worked out which will fulfil the practical and mechanical conditions required; the main thing to be settled by the present experiments was if the records obtained and preserved are of real scientific value. The records brought back were, therefore, treated in the above-delineated manner, and the "Archiv" plates obtained submitted to the leaders of the expeditions and to other authorities, who reported that they gave, as a rule, a good reproduction of the original speech and words, from which it may be concluded that the method adopted is a success and capable of much use in the future. Of course, certain limitations, such as the differentiation of similar consonants, &c., have to be recognised, and whether the phonograph is capable of such improvement that it will get over these remains to be seen; at any rate, if the establishment of the phonographic archives is a success, it is likely that our descendants one or two thousand years hence will not find themselves in the same predicament as to our present pronunciation as we are as to that of our Latin and Greek, not to mention other dead languages, and that besides this advantage to our posterity, valuable service to science of the present day will result. C. C. G.

PROF. LADISLAV CELAKOVSKÝ.

AFTER a long and painful illness, due to a serious internal malady of many years' standing, Prof. Čelakovský, the well-known and brilliant botanist, passed away at Prague on November 24, at the age of sixty-seven.

It was with the morphological department of botanical science that Celakovský chiefly identified himself.

His papers dealing with evolutionary problems appear to date from the year 1868 with the memoir "On the General Evolution of the Vegetable Kingdom." The theses "On the Different Forms and the Meaning of the Alternation of Generations in Plants" (1874) and "On the Threefold Alternation of Generations in the Vegetable Kingdom" (1877) appear to us to afford so adequate a solution of this great subject as to cause wonder that botanists should still vex their minds by discussion of it. Two treatises which must long keep his memory green, while helping to establish the supremacy of his genius, are those on "The Law of Reduction in Flowers" (1894) and on "The Evolution of the Flower," in two parts (1896 and 1900); at the latter end of the second part, an interesting discussion and, in our view, a probable solution of the of late much-debated phenomenon of "double-fertilisation" in Angiosperms is introduced. These works of our author are, we fear, far too little known or appreciated.

To many botanists, Čelakovský will be best known by his voluminous writings, published in many and various periodicals, on the morphological nature of the ovule, a subject which occupied his attention from 1874 onwards and which his surpassing talent completely illuminated. Both in this and other difficult cases, he relied almost entirely on teratological evidence for the final solution of the problem. It is this position, well brought out in his memoir in *Lotos* of 1874, "On the Relationship between the Different Methods of Morphological Research," which caused so much opposition to him from fellow-workers in the same fields.

During the latter part of his career, Čelakovský performed the enormous service of what we consider to be the complete unravelling and elucidation of the nature of the female flower in Coniferæ, a subject hitherto utterly obscure and bristling with difficulties, but now, to our mind, entirely solved once for all. The author's views are contained chiefly in "Die Gymnospermen" (1890) and "Nachtrag zu meiner Schrift über die Gymnospermen" (1897).

Another important field of botanical research yielded scope for the display of his great powers, viz., that connected with the building-up of the stem and its members. Three of the principal papers treating of this subject are "On Terminal Members" (1876), "On Cases of Branching Underlying the Phytostatic Law" (*Pringsheim's Jahrbücher*, vol. xxxii.) and "The Segmentation of the Stem" (1901). The latter is an elaboration and wide expansion of the bare principles laid down long ago by Gaudichaud, and revolutionises all modern conceptions of the subject.

Many memoirs have, of necessity, been left unnoticed in this brief sketch; suffice to add that what appears to have been the last paper published by him, at least in German, was that on "The Cortication of the Stem by Leaf-bases," which appeared in 1902.

W. C. W.

NOTES.

WE published last week the wireless telegram sent by President Roosevelt to the King and also His Majesty's reply thereto. This latter message was not sent by wireless telegraphy, the reason being that at the time it was dispatched the nearest telegraph office to Poldhu was closed, and so it was impossible to get the message to Poldhu, though its transmission from there to America could have been easily effected. The *Times* of Monday deals with this difficulty in a leader, and points out that the Post Office as a public institution ought immediately to afford the facilities of connection between Mullion and Poldhu for which the Marconi Company asks. It is only a matter of erecting a couple of miles of telegraph line and providing for a continuous service, and this should certainly be done without any delay. The Post Office is said to be "considering the matter," but in the interests of the public and in fairness to the Marconi Company, the "consideration" ought to be cut short and the necessary connection made at once. As the *Times* rightly says, any questions of the ultimate trustworthiness and utility of the wireless system or of our telegraphic relations with the cable companies or other States have nothing to do with the Post Office, at any rate at the present time. All they are asked to do is to provide facilities for telegraphing to a customer likely to make large use of them. It is sincerely to be hoped that the Post Office will realise that it owes it as a duty to the public to remove immediately this purely artificial hindrance to the development of what may possibly be a great commercial enterprise. Such action would be impossible in any other country.

AN influential committee has been formed in Rome to take measures to honour the memory of Father A. Secchi, S.J., the distinguished astronomer and meteorologist, on the occasion of the twenty-fifth anniversary of his death, which occurred on February 26, 1878. The president of the committee, Father G. Lais, S.J., vice-director of the Vatican Observatory (address, Via Torre Argentina, 76, Rome), will be glad to add the names of scientific men and institutions to the list of those interested in this celebration. Father Secchi was for many years director of the observatory of the Collegio Romano, now occupied by the Italian Central Meteorological Office, and his well-known meteorograph was erected there in 1858. It was in connection with this observatory that almost all Secchi's work was done in solar and terrestrial physics. He published several volumes of the *Memorie dell' Osservatorio del Collegio Romano*, 1852–1863, and began, in the year 1862, the *Bolletino meteorologico*, of which seventeen volumes appeared, and contained many valuable discussions by himself and others. The Italian Spectroscopic Society owes its foundation to his energy. He was the author of numerous papers and also of books on the sun, the stars and the unity of physical forces.

PROF. E. B. POULTON, F.R.S., has been elected president of the Entomological Society for the session 1903–1904. Prof. Poulton has nominated as vice-presidents the Rev. Dr. Fowler, Prof. Meldola, F.R.S., and Dr. D. Sharp, F.R.S.

AT a general meeting of the Linnean Society on January 15, it was resolved to take the necessary steps to obtain a supplementary charter embodying certain alterations in the constitution of the Society. A motion was carried in favour of adding the words "without distinction of sex" to the existing paragraph of the charter referring to the admission of fellows, so that when the supplementary charter has been obtained, women will be eligible for election into the Society.

ON Saturday, January 24, a cone 800 feet in height is reported to have been blown off Mont Pelée by a volcanic eruption.

A TELEGRAM, through Reuter's Agency, received at New York from Kingstown, St. Vincent, states that an eruption of the Soufrière occurred at noon on January 22. A whirling, incandescent cloud was seen to shoot from the volcano clear into the sky, followed by a black cloud, which rapidly ascended to a great height and was visible throughout the island. Sand fell at Château Belair.

THE Central News Agency states that the severest earthquake shock experienced at Charleston since the disaster of 1886 visited this city during the night of January 23. A number of other cities in South Carolina and Georgia were similarly affected.

REFERENCE has already been made to the proposal to form a society of persons interested in electrochemistry. We are glad now to announce that, as the result of the support and encouragement received in response to the circulars recently issued, it has been resolved to hold a general meeting of the supporters of the movement to inaugurate the work of the society and elect a president and council. The meeting will be held at the rooms of the Faraday Club, St. Ermin's Hotel, Westminster, on Wednesday, February 4, at 5 p.m. Dr. J. W. Swan, F.R.S., has consented to be nominated as president, and the following have accepted nomination as vice-presidents:—Prof. A. Crum-Brown, F.R.S., Sir Oliver T. Lodge, F.R.S., Dr. Ludwig Mond, F.R.S., Lord Rayleigh, F.R.S., Mr. Alexander Siemens and Mr. J. Swinburne.

THE twenty-first congress and exhibition of the Sanitary Institute will be held at Bradford, commencing on July 7.

AS the work of the Photographic Record Association is attracting much attention, it is of interest to note that at the meeting of the Essex Field Club on Saturday next, Mr. A. E. Briscoe will bring forward a proposal for a photographic and pictorial survey of Essex, to be carried on in connection with the county Museum of Natural History. Anyone wishing to attend should apply to the secretaries, Buckhurst Hill, Essex.

THE Eleventh International Congress of Hygiene and Demography will be held in Brussels on September 2–8 under the patronage of H.M. the King of the Belgians. The secretary-general of the congress is Prof. F. Putzeys. All information and programmes can be obtained from Dr. Paul F. Moline, 42 Walton Street, Chelsea, S.W., the hon. secretary of the British committee.

A REUTER message from St. Petersburg states that two members of Baron Toll's polar expedition, Lieutenant Matissen, commander of the yacht *Zaria*, and Lieutenant Kolchak, have just arrived in St. Petersburg with nine men of the *Zaria's* crew, after an absence of two and a half years.

IT is announced that Dr. Jean Charcot will leave in mid-May for a tour of Arctic exploration in a yacht built in cast steel, and fitted up and manned at his own expense. Dr. Charcot, the *Daily News* Paris correspondent says, is paying great attention to the laboratory fittings and apparatus. His scientific staff will include a zoologist, an expert in oceanography, a bacteriologist, a geologist and a botanist. Provisions for eighteen months will be taken on board, though the expedition is to last but six months.

REFERRING to the recent death of Joseph Chavanne, the Austrian geographer and meteorologist, the *Athenaeum* states that in 1875 he was at work at Vienna in the Imperial Meteorological Institute, and in the same year became editor of the Austrian *Mitteilungen der Geographischen Gesellschaft*. In 1884, he was commissioned by the Brussels Geographical Institute to undertake a topographical survey of the district between the Congo and the Kuilu-Niadi on one side, and between the mouth of the Congo and the Equator station on the other side.

WE learn from *La Nature* that M. H. Poincaré has been promoted to be Commander of the Legion d'Honneur. M. Mascart succeeds M. Berthelot, who has resigned, as the representative of the Collège de France on the Superior Council of Public Instruction. M. Gautier has been elected president of the Bureau des Longitudes; M. Lippmann is the new vice-president and M. Radau the new secretary.

IN addition to the sums which the German Government proposes to allocate for the prevention of typhoid fever and the collection of sickness and mortality statistics, the Imperial budget for the coming year provides, we learn from the *British Medical Journal*, a sum of 3250*l.* for the carrying out of experimental researches directed to the further elucidation of the relation between human tuberculosis and the *Perlsucht* of cattle. The problem of protective inoculation of cattle against tuberculosis falls within the scope of these researches.

ON Thursday next, February 5, at 5 o'clock, Sir Clements Markham will deliver the first of a course of three lectures at the Royal Institution on "Arctic and Antarctic Exploration." Mr. G. R. M. Murray being unable, owing to illness, to deliver his course of lectures beginning on Thursday, February 26, Prof. L. C. Miall will instead deliver three lectures on "Insect Contrivances." The Friday evening discourse on February 6 will be delivered by the Right Hon. Sir Herbert Maxwell, on "George Romney and his Works"; on February 13 by Prof. S. Delépine, on "Health Dangers in Food"; and on February 20 by Principal E. H. Griffiths, on the "Measurement of Energy."

AT a meeting of the Vienna Academy of Sciences on December 11, 1902, Dr. J. Hann presented an important paper on the daily rotation of the mean wind direction and on a semi-diurnal oscillation of the atmosphere on mountain peaks of two to four kilometres above sea level. The author has deduced from anemometrical records the wind components according to the four rectangular directions and has calculated the daily range by means of trigonometrical series. The differences of the hourly values from the daily means obtained in this way exhibit the daily variation both of direction and force, freed from the prevalent wind direction and depending only on the influence of the sun. He has shown in this way that the wind daily rotates regularly with the sun, being easterly in the morning, southerly at noon, westerly and north-westerly in the afternoon and northerly at night. The author has next investigated the daily changes of the wind components and has exhibited their harmonic constituents. The most important result is that in all four components, especially the north and south, a large semi-diurnal period exists, which equals or even exceeds that of the whole-day period in magnitude. The regularity of the phase periods and the magnitude of the semi-diurnal period make it appear probable that this regular daily oscillation of the atmosphere at a height of two to four kilometres is connected with the regular daily oscillation of the barometer. The daily range of mean wind force was also found to follow the same rule on the mountain peaks as on the earth's surface, at all directions attaining its maximum force at nearly the same time, the maximum, however, occurring at nighttime instead of soon after noon.

WE have received vol. vi. of the *Pubblicazioni della Specola Vaticana* (Roma: Tipografia Vaticana, 1902). The first 326 pages are devoted to the meteorological observations made during the years 1895–1901. The observations are printed in full detail, the values for each hour of observation for barometer, aspect of sky, direction and velocity of wind, thermometers, vapour tension, relative humidity, evaporation, &c., being given. Then follow another set of meteorological observations made daily at 9 o'clock during the year 1901. The velocity of the wind and description of the sky are next given for three observations every day during the year 1895. At the end of the volume is given a series of plates, which illustrates graphically the variations of the principal meteorological elements from day to day during each year. More than one hundred pages contain details of the observations of meteors made during the months of

August and November for the years 1896–1901. From a statistical point of view, the volume will prove useful, but it seems a pity that observations should be kept so long before they are published.

THE paper on electric automobiles read by Mr. H. F. Joel before the Institution of Civil Engineers on January 13 is one of great interest. The desirability of the automobile replacing horse traction from a sanitary point of view is probably admitted by everyone, and certainly the electric car would afford the best solution. Mr. Joel is of opinion that there is a great future before the electric automobile, which has already proved itself capable of running 100 miles on one charge and of performing much longer tours. This shows that even the storage battery of to-day is sufficiently good to give very satisfactory results; the author in his paper goes carefully into the results of the battery tests made by the Automobile Club of France, and into the question of the ratio of weight of vehicle to weight of battery. Many valuable curves showing the relations between ton-mileage, total weight, useful load, &c., are given, and the paper is, on the whole, a valuable contribution on the subject.

A SERIES of papers by Dr. Quirino Majorana in the *Atti dei Lincei* of last summer are devoted to the phenomena of magnetic double refraction and the so-called "bimagnetic rotation" of the plane of polarisation. The phenomena were observed by fixing a column of liquid 7 cm. long between the poles of a Weiss electromagnet, the solutions best suited for the purpose being chloride of iron and still better "dialysed iron." The bi-refraction is proportional to the thickness of the liquid column, which is normal to the lines of force and also to the degree of concentration of the solution. For different colours, it varies inversely as the square of the wave-length. Experiments conducted with the view of ascertaining the rapidity with which the phenomena are produced tend to show that, like rotatory polarisation and Kerr's phenomenon, it takes place instantaneously. Dr. Majorana's phenomenon of "bimagnetic rotation," which has already been noticed in these columns, is discussed in conjunction with Voigt's highly probable explanation that it owes its origin to the unequal absorption of the light-components polarised along and perpendicular to the lines of force. It is obvious that in a ray polarised on entrance in a direction making an angle of, say, 45° with the lines of force, the effect of such an unequal absorption would be to deflect the plane of polarisation towards the direction in which the absorption is least. The phenomenon is observed in certain impure solutions of ferric chloride; it is approximately proportional to the thickness of the liquid traversed, at any rate when the deviation is small. As the intensity of the field increases, the deviation at first increases rapidly and then tends to a constant limit. From theoretical grounds, it follows that if the planes of polarisation on incidence and emergence make angles α and β with the lines of force, the ratio of tan α to tan β is constant, and hence sin $(\alpha-\beta)$ is proportional to sin $(\alpha+\beta)$, so that the deviation $(\alpha-\beta)$, being small, is proportional to sin $(\alpha+\beta)$, and hence is a maximum when the angles are nearly 45°, agreeing with the results of experiment.

THE U.S. Department of Agriculture has issued two reports, one by Dr. W. O. Atwater and Dr. F. G. Benedict, on the metabolism of matter and energy in the human body, and the other by Prof. Charles E. Wait, drawn up under the immediate supervision of Prof. Atwater, dealing with the effect of muscular work on the metabolism of nitrogen and the digestibility of food. These reports form a part of the nutrition investigations for which a special committee has been appointed by the Department. The first report deals with thirteen experiments, forming part of a series which are in progress at Middletown, Conn., and which have for their ultimate object the study of the laws of nutrition. The Atwater-Rosa respiration calorimeter used in the experiments is shown to be a satisfactory instrument of precision, and the conclusions, besides affording information as to the demands of the body for nutriment, and the effect of muscular work on digestion and metabolism, afford evidence little short of definite demonstration that the principle of conservation of energy holds good in living organisms.

THE first part of an illustrated paper, by Dr. H. von Buttel-Reepen, on the phylogenetic relationship of bees' nests, and the biology of solitary and social bees, appears in the *Biologisches Centralblatt* for January.

WE have received a copy of the *Transactions* of the Yorkshire Naturalists' Union for 1900, containing reports on the Lepidoptera and also on the botany and meteorology of the county.

IN part i. of the third volume of *Annals* of the South African Museum, Dr. W. F. Purcell describes new genera and species of the arachnoid family Solpugidæ and also certain typical Arachnida.

THE *Zoologist* for January contains an account, by Mr. W. F. Raunsley, of a South American quaker-parrot (*Myiopsittacus monachus*)—said to be the only nest-building species of its tribe—building in the open in the New Forest, near Lyndhurst. The nest, which was of large size, was constructed in the angle of the roof of a house. It is not the first time that birds of this species have nested in the open.

WE have received two fasciculi o. the *Proceedings* or the U.S. Museum (Nos. 1311 and 1312). In the former, Mr. J. E. Benedict describes as new one genus and forty-six species of the crustacean family Galatheidæ, with a list of all the known marine representatives of the group. In the latter, Mr. W. H. Dall gives a synopsis of the molluscan family Veneridæ, with a list of the existing North American species, among which many are new.

THE *Fishing Gazette* or January 17 relates a curious incident which occurred at the fish-breeding establishment at Helmsbach, Germany, on July 3, 1899. In one of the buildings were some tanks containing a number of live trout about to be dispatched to Berlin. During a thunderstorm, a heavy flash of lightning appeared to strike the building, and on examination it was found that all the fish in the tank next an open window were dead. Although the wire-netting covering the tank was not damaged and the fish themselves showed no special signs of having been struck, there seems every probability that the deaths of the latter were caused by the lightning. A similar experience was recorded in Germany in 1901, and some years ago, after a severe thunderstorm, a number of large trout were found dead in a pool in our own Lea.

THE *Quarterly Review* for January contains three articles connected with biological science. In the first, Mr. Lydekker discusses the origin of the present and past vertebrate faunas of South America, devoting special attention to the fossil mammals and birds of the pampean formation of the Argentine and the Santa Cruz beds of Patagonia. It is shown that at the epoch of the deposition of the latter, South America was insulated and inhabited mainly by a fauna of edentates, peculiar ungulates, rodents, monkeys, marsupials and giant birds. A subsequent connection with North America permitted the immigration of northern types, while, conversely, a certain number of southern forms effected an entrance into North America. As to the origin of the primitive South American fauna, there is still much uncertainty and speculation, but it is considered probable that a contingent was furnished from Africa by means of a land-bridge. Some remarkable evidence is cited in regard to the

possible survival of one of the ground-sloths to modern times. The article is illustrated by figures of the remains of some of the extinct forms.

IN the second article—"A Conspectus of Science"—Sir Michael Foster tells the history of the founding of the "International Catalogue of Scientific Literature," three parts of the first volume of which had been issued at the date of going to press. The immense value of the Royal Society's "Catalogue of Scientific Papers" is fully acknowledged; but the absence of a "subject-index" and the omission of all literature other than periodical render this publication—even if it could be continued—inadequate to present requirements. Finally, a brief reference is made to the portions of the "International Catalogue" for 1901 already published, and the hope is expressed that when the staff has got into full swing, the annual volumes will be produced in a shorter space of time.

THE third article in the January number of the *Quarterly* contains a review of a dozen works, for the most part on sport and travel, but including President Roosevelt's volume on deer in the "American Sportsman's Library." The latter work, together with Mr. J. G. Millais's volume on wild-fowl shooting in Scotland, has been already noticed in NATURE. The list also includes Prince Demidoff's two volumes on big-game shooting in the Caucasus and the Altai and Mongolia, Mr. Powell-Cotton's account of his recent Abyssinian expedition and Mr. W. P. Church's "Chinese Turkestan with Caravan and Rifle." The reviewer directs special attention to three features connected with modern sport—the comparative ease with which regions long thought practically inaccessible can be reached, the destruction of game all over the world and the means which should be taken for its preservation, and the advantage of rifles firing small projectiles at great velocity over weapons of larger calibre.

THE evolution of the northern part of the lowlands of south-eastern Missouri, by Prof. C. F. Marbut ("University of Missouri Studies," vol. i. No. 3, 1902), forms the subject of an essay on river development. The author endeavours to show how the Mississippi has abandoned two valleys and now occupies a third. It has, in his opinion, been twice captured by the smaller Ohio river.

REFERRING to our report of Prof. J. B. Farmer's remarks at the Chelsea conference (NATURE, January 15, p. 260), in which mention is made of the conditions under which larch grows, Mr. Hawie Brown gives some particulars of his own experience in the cultivation of this kind of tree. He says, "the best and healthiest and oldest Scottish larch grows on hill-slopes facing the north, where there is not a great depth of soil, but often a thin soil resting on a shaly bed." Prof. Farmer has kindly supplemented our brief reference to his instance of the frequent lack of conscious and common-sense appreciation of the relations existing between cause and effect in the cultivation of crops which has led to the planting of a tree like larch in localities and under conditions obviously unsuitable for it. He adds, "of course the larch is a mountain tree, and the whole point of the illustration lies in the fact that in this particular instance the shallow soil overlying the rock was of a 'sour' and poor character, as indicated by the indigenous weed vegetation. It is generally accepted that the larch is a tree making considerable demands on the soil, both as regards fertility and depth—or, at least, of openness."

OBSERVATIONS on fluctuations in the level and in the alkaline character of the ground water have been made by Mr. W. P. Headden at the Agricultural Experiment Station, Fort Collins, Colorado (*Bulletin* 72, Agricultural College of Colorado, August, 1902). The total salts held in solution in the well waters were less than in the water in the soil. As the water-plane falls, it leaves much saline matter in the soil, but the total solids in the ground water varied greatly in the different wells and also from time to time in each well. Reference is made to the salts that occur at different depths in the soil, to the abundant formation of nitric acid in the upper layers and to the effects of irrigation.

AN ecological memoir possessing more than ordinary merit is the report on a botanical survey of the Dismal Swamp region, compiled by Mr. T. H. Kearney and published by the U.S. Department of Agriculture. The interest lies, not only in the nature of the associated formations, but is also due to the descriptions accompanied by very admirable and well-chosen illustrations. The region surveyed lies between Chesapeake Bay and Albemarle Sound, and is marked by a series of inlets extending into or towards the inundated swamp area. A peculiar feature of these marshy inlets is the Baccharis-Hibiscus formation on the inner edge. Here *Baccharis halimifolia* is conspicuous with a snow-white pappus, and colour is added by *Hibiscus moscheutos* and *Kosteletzkya virginica*, another malvaceous plant. From the coast, a series of dunes leads up to

FIG. 1.—Incursion of the sand on inland vegetation near Cape Henry, Virginia.

the forest. A remarkable plant found on the outer dunes is the aromatic composite *Iva imbricata*. The dunes are encroaching upon the inland vegetation, though not so rapidly as might be expected. Where the dunes are exposed, there the sand is piled up in hillocks, higher even than the neighbouring forest. The illustration which is reproduced shows how the banked-up sand, with a steep inner slope which may approach an angle of 45°, is pouring down on the trees growing in the swampy ground, the desert as it is called, while on the slope some old cypress trees still bearing a few leaves are gradually being overwhelmed in the drift. On the western side is situated Lake Drummond, a small patch in the extensive swamp, where the water has varied from 6 to 15 feet. A weird appearance more especially near the shore is presented by the stumps of old cypress trees, and still more fantastic are the aërating processes, the knees of the bald cypress, *Taxodium distichum*, and the arching roots of the same plant and of the black gum *Nyssa biflora*.

THE *Proceedings* of the Liverpool Geological Society for the session 1901–1902 (vol. ix. part ii., 1902) contain an interesting

address, by Mr. Charles C. Moore, on the volume composition of rocks. He deals with the porosity of various rocks and observes that in many cases the appearance of the specimen does not give the slightest clue to its actual porosity. Comparisons are made between various rocks of similar chemical or mineralogical composition. The effect of pressure in the faulting of a sandstone has been used to calculate the amount of displacement. The structural changes that would occur from the conversion of a bed of limonite into hæmatite are pointed out. The subject is one of considerable practical importance. Among other papers is one by Prof Bonney, on fragmental rocks as records of the past.

MR. HUGH J. L. BEADNELL has given an account of the Cretaceous region of Abu Roash, near the pyramids of Giza (Geological Survey Department, Egypt, 1902). The area lies near the edge of the Libyan Desert, some distance west of Cairo, and it is composed of an isolated massif of Cretaceous rocks in the midst of an unconformable and overlapping tract of Eocene strata. These structural relations have not hitherto been determined. Owing to the highly disturbed nature of the beds, due, as the author explains, to pre-Eocene folding and faulting, it has been a difficult matter to work out the complete succession in the Cretaceous rocks; but this has now been done, and Cenomanian, Turonian, Senonian and Danian subdivisions have been determined. Particulars of these and their fossils are given, together with illustrative sections and excellent photographic views of scenery, and there are brief descriptions of the Eocene and newer deposits. The author observes that the effects of the action of wind-borne sand in the denudation of rocks are perhaps more beautifully displayed at Abu Roash than in most other localities in the western desert—a fact due in great measure to the abundance of hard cherty and crystalline limestones, which so well exhibit the effects. Illustrations of these are given.

A THIRD edition of "Modern Microscopy," by Mr. M. I. Cross and Mr. Martin J. Cole, has been published by Messrs. Baillière, Tindall and Cox. The book has been completely revised, and now contains, in addition to the two parts into which the last edition was divided, a third section on the choice and use of microtomes, prepared by Mr. G. West.

MESSRS. WATTS AND CO. have issued, for the Rationalist Press Association, Ltd., a sixpenny edition, in paper covers, of Mr. Herbert Spencer's "Education: Intellectual, Moral and Physical." These essays are all well known to teachers throughout the world, and it is to be hoped that this cheap reissue will serve to encourage parents everywhere to become familiar with sound principles of education.

THE "Handbook of the Federated Malay States" (Stanford, 2*s*. 6*d*.), compiled by Mr. H. Conway Belfield, British Resident of Selangor, contains trustworthy information brought together at the request of the Government for the use of persons interested in the Malay States. Direct guidance is offered to different classes who propose to emigrate to this part of the world. The handbook is well illustrated and plentifully supplied with maps and statistics.

A COPY of the thirty-third of the thirty-six parts of "Living London," being issued by Messrs. Cassell and Co., Ltd., under the editorship of Mr. G. R. Sims, has been received. It contains a section, by Mr. John Munro, on scientific London, profusely illustrated by pictures showing audiences at the Royal Institution, the Royal Geographical Society and the Society of Arts. A full-page illustration depicts the ladies' night at the Royal Society.

AN almanac for 1903, compiled at the offices of the Survey Department of the Public Works Ministry and published at Cairo, has been received. Much of the miscellaneous information contained in the almanac will be of use to persons in this country personally interested in Egyptian affairs, for example, the conversion tables giving the Egyptian equivalents of English and French money, measures of length and weight. The facts provided deal with every department of administrative activity in the country.

THE eighteenth issue of "Hazell's Annual," that for 1903, has reached us. It is well described by its subtitle as a cyclopædic record of men and topics of the day. Its abundance of information is arranged alphabetically and includes, amongst other matters of interest to men of science, summaries of the work accomplished during 1902 in the chief branches of natural knowledge. Particulars are also given concerning the important scientific societies and of the scientific institutions of a national character, such as the Royal Observatory, the National Physical Laboratory and Kew Observatory.

PROF. LLOYD MORGAN, F.R.S., contributes to the current number of the *International Quarterly* an article on the beginnings of mind. He discusses in the first place the questions, Is mind a product of evolution? second, Is mind a factor in the evolutionary process, and if so, under what limiting conditions? Towards the conclusion of his essay, Prof. Morgan says:—"From the physiological point of view, the conditions of the beginnings of mind would seem to be the differentiation of a control system with conscious concomitants. From the standpoint of behaviour, conscious accommodation through control as the result of individual experience. And what from the psychological point of view? . . . One may surmise that there is, in some dim form of expectation, at least the germ of that looking before and after to which consciousness eventually attains with more and more clearness." Another article in the same magazine deals with ethnology and the science of religion, and Prof. C. Lombroso endeavours to explain why criminals of genius have no type.

THE additions to the Zoological Society's Gardens during the past week include an American Grass Snake (*Contia vernalis*) from Mexico, presented by Miss Green; two Smooth-headed Capuchins (*Cebus monachus*) from South-east Brazil, two Derbian Wallabys (*Macropus derbianus*), three Brush Turkeys (*Talegalla lathami*) from Australia, a Blue-fronted Amazon (*Chrysotis oestiva*), a Common Boa (*Boa constrictor*) from South America, deposited; nine Regent Birds (*Sericulus melinus*) from Australia, purchased.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 2. 7h. 11m. Minimum of Algol (β Persei).
6. 9h. 45m. to 10h. 30m. Moon occults δ^2 Tauri (mag. 4·7).
9. 3h. 56m. to 4h. 49m. Moon occults λ Geminorum (mag. 3·6).
9. 11h. 21m. to 12h. 25m. Moon occults 68 Geminorum (mag. 5·0).
11. 16h. 47m. to 17h. 45m. Moon occults ν Leonis (mag. 4·5).
11. Ceres in opposition to the sun (Ceres mag. 7·4).
14. Venus. Illuminated portion of disc = 0·951, of Mars = 0·942.
15. 11h. 0m. Mars in conjunction with Moon (Mars 3° 22′ N.).
19. 4h. 0m. Jupiter in conjunction with the sun.
19. 12h. 5m. Minimum of Algol (β Persei).
22. 8h. 54m. Minimum of Algol (β Persei).
22. Perrine's comet (1902 *b*) 2½° E. of Sirius.
25. 5h. 43m. Minimum of Algol (β Persei).
27. 11h. 0m. Mercury at greatest elongation (26° 58′ W.).
27. Perrine's comet (1902 *b*) 3½° N. of Sirius.
28. Giacobini's comet (1902 *d*) 2½° S.S.W. of ϵ Geminorum (mag. 3·2).

COMET 1902 *d* (GIACOBINI).—A daily ephemeris of this comet is given by M. G. Fayet in No. 3840 of the *Astronomische Nachrichten*. The following is an extract therefrom :—

12*h*. *M.T. Paris.*

Date.	α	δ	log *r*.	log Δ.	Brightness.
	h. m. s.	° ′			
Jan. 29 ...	6 43 16	+12 53·2	0·4524	0·2871	1·48
Feb. 2 ...	6 41 15	+14 12·7	0·4513	0·2911	1·46
,, 6 ...	6 39 33	+15 31·2	0·4502	0·2961	1·43
,, 10 ...	6 38 13	+16 48·3	0·4493	0·3019	1·40
,, 14 ...	6 37 17	+18 3·5	0·4484	0·3085	1·36
,, 18 ...	6 36 45	+19 16·4	0·4476	0·3158	1·32
,, 22 ...	6 36 38	+20 26·7	0·4469	0·3237	1·28
,, 26 ...	6 36 58	+21 34·3	0·4463	0·3321	1·24
Mar. 2 ...	6 37 44	+22 39·0	0·4458	0·3408	1·19

Brightness at time of discovery = 1·0.

COMET 1903 *a* (GIACOBINI).—The following ephemeris has been calculated by Herr M. Ebell and Prof. H. Kreutz (*Kiel Circular*, No. 57).

Ephemeris for 12*h*. *M.T. Berlin.*

Date.	α	δ	log. Δ	Brightness.
	h. m. s.	° ′		
Jan. 31 ...	23 11 57 ...	+5 24·9 ...	0·2043 ..	1·9
Feb. 4 ...	23 17 25 ...	+6 35·6 ...	0·1909 ...	2·4
8 ...	23 23 17 ...	+7 51·3 ...	0·1753 ...	3·0
12 ...	23 29 35 ...	+9 13·1 ...	0·1573 ...	3·8

Brightness at time of discovery = 1·0.

SEARCH-EPHEMERIS FOR THE COMET TEMPEL$_3$-SWIFT.—In No. 3840 of the *Astronomische Nachrichten*, M. J. Bossert gives a daily ephemeris for the search of this comet from which the following is an abstract :—

12*h*. *M.T. Paris.*

Date	α	δ	log *r*	log Δ
	h. m. s.	° ′		
Jan. 29 ...	0 8 43 ...	+ 5 17·4 ...	0·062	0·141
Feb. 1 ...	0 20 24 ...	+ 6 25·4		
3 ...	0 28 15 ...	+ 7 10 5 ...	0·064	0·142
6 ...	0 40 9 ...	+ 8 17·7		
8 ...	0 48 9 ...	+ 9 2 0 ...	0 067	0·144
11 ..	1 0 14 ...	+10 7·6		
13 ...	1 8 21 ...	+10 50·7 ...	0·072	0·148

A BRIGHT METEOR.—Mr. C. J. Lacy, writing to the *Times* from Fleet, Hants, says that on January 25, at 7.57 p.m., he observed a very bright meteor. "It first attracted my attention near the zenith, and must have come within our range a few degrees to the south of Capella, which star, being directly in its path, was possibly even occulted. It sailed slowly and majestically in a N.N.W. direction, passing about two degrees north of Cassiopea and finally disappearing near the star Alderámin in Cepheus." The head was remarkably brilliant and the tail was about ten or eleven degrees in length.

THE PLANET MARS.—In the January *Bulletin de la Société astronomique de France*, M. E. Touchet gives some details respecting the coming opposition of Mars, and directs special attention to the fact that between February 27 and August 20 of this year, observers will have the opportunity of observing the phenomena attending the Martian summer in the northern hemisphere. The disappearance of the snow-cap will be the main feature, and is easily seen with small instruments.

Two excellent coloured drawings of this planet, as observed with the 9½-inch equatorial at Juvisy by MM. Flammarion and Antoniadi during the last opposition, accompany the article.

REPORT OF THE HARVARD COLLEGE OBSERVATORY.—The fifty-seventh annual report of this observatory deals with the work done during the year which ended on September 30, 1902.

A recent anonymous gift of twenty thousand dollars has enabled the authorities to erect a new fireproof wing in which to store the immense library of negatives which they now possess, and also to contract with Messrs. Alvan Clark and Sons for a new 2-foot reflector, which will be used, first at Cambridge (Mass.) and then at Arequipa, for obtaining photographs of faint objects in all parts of the sky.

Seventeen thousand photometric light comparisons, observed with the East equatorial, 66,932 settings of the 12-inch meridian photometer and 10,784 measures with the smaller meridian photometer have been made during the year by Profs. Wendell, E. C. Pickering and Bailey respectively.

The "Henry Draper Memorial" photographs now show the spectrum of every star in the sky which is permanently greater than the ninth or tenth magnitude, besides many more which are fainter.

Prof. Bailey has been to Arequipa, taking the meridian photometer with him, in order to obtain measures of comparison stars for the observation of Eros at its next opposition, when it will be too far south for the European and United States observatories to observe it.

The Blue Hill Meteorological Observatory, carried on at the expense and under the direction of Mr. Rotch, has made several special series of observations during 1902, amongst which the determination of the meteorological conditions of the upper atmosphere by means of kites has been very successful. It is now proposed to explore the atmosphere above the tropics and the equator by this means.

The time service is now working under a new system, devised by Mr. Gerrish, in which an electric light, which acts as the signal, is made to pulsate in response to the signals from the standard clock.

A RECORD OF THE TOTAL SOLAR ECLIPSE OF 1898.

THIS interesting report[1] has been considerably delayed for the reason given in the preface that the director, Prof. Naegamvala, has been engaged in securing solar and stellar spectra which might assist in discussing the chromosphere spectrum, which he considers was first adequately secured at this eclipse.

The report gives the usual details as to the selection of a site, ultimately fixed at Jeur, and gives a full description of the instruments used and of the work of the observers. It is liberally furnished with maps and photographs, and we must express our admiration of the excellent manner in which these records have been reproduced.

The report itself is interesting reading and appeals to a larger audience than professional astronomers; any intelligent reader casually taking it up will find much to attract his attention.

The pictures of the corona are particularly fine; maps showing the alterations in its shape at maximum and minimum sun-spot periods, compiled from various sources, are appended and may be useful for handy reference.

The spectrum of the lower chromosphere appears to have been the part of the subject which had the most attraction for Prof. Naegamvala, and he has devoted a large part of the report to this question. Some authorities regard it as a mere reversal of the Fraunhofer spectrum, while others, Sir Norman Lockyer in particular, consider that the reversals take place, not in one thin layer, but at various levels of the solar atmosphere. So far as this point is concerned, Prof. Naegamvala comes to the conclusion that there "can be no question that Lockyer has fully established his contention." With regard to the true explanation of the chromospheric lines in relation to the Fraunhofer spectrum generally, he considers the question to be still *sub judice*. The very important point of the intensities of the lines of the chromospheric spectrum as compared with those of the Fraunhofer spectrum has, however, not been included in the discussion.

It is unfortunate that, as Prof. Naegamvala states, the six-inch prismatic camera with which the so-called "flash" spectrum was taken was somewhat out of focus, owing to the brief time at the observer's disposal for its adjustment, and from the reproduction of the plate the arcs are apparently not sufficiently sharp for accurate measurement. For this purpose, they are distinctly inferior to the spectrum obtained by Mr. Shackleton at Novaya Zemlya in 1896, which, from a remark in the preface, Prof. Naegamvala thinks he has improved on. On this point, we are afraid we cannot agree with him.

The wave-length of the celebrated "green line" is found by the Poona measurements to be λ 5301·195, which is rather less than that found by other observers.

Although we do not think that the many questions connected with eclipses are advanced beyond the point reached by other observers and whose reports were published long ago, we can heartily congratulate Prof. Naegamvala and his eclipse observers on having produced so interesting and readable a volume.

H. P.

[1] Report on the total solar eclipse of January, 1898, by Kavaoji Dadabhai Naegamvala, director of the Observatory at Poona. (Bombay: Government Central Press.)

CHARACTERISTICS OF RECENT VOLCANIC ERUPTIONS.[1]

THERE is a remarkable similarity between the islands of St. Vincent and Martinique. Both are roughly oval in form, with the long axis almost north and south. The north-west portion of each is occupied by a volcano, the Soufrière and Mont Pelée, which have many points in common. Both volcanoes show a single or practically single vent, and a remarkable absence of parasitic cones and a scarcity of dykes. In both a transverse valley exists to the south of the volcanoes, and the main discharge of ejecta during the recent eruptions, which have often been nearly synchronous, has been into this depression, and especially into its westerly portion. In both islands, the recent eruptions have been characterised by paroxysmal discharges of incandescent ashes, with comparatively few larger fragments and a complete absence of lava.

There are, however, a few points of difference. The eruptions of St. Vincent have been altogether on a much larger scale than those in Martinique. The area devastated was considerably larger, the amount of ashes ejected probably ten times as great, and if the loss of life was not so large, this is accounted for by the absence of a populous city at the foot of the mountain. While both volcanoes show practically a single vent, this is much more marked by the case of St. Vincent, where, excepting the new crater, which is practically part of the old or main one, there is not a single parasitic cone. We saw no fumaroles, no hot springs, or any trace of radial cracks and fissures.

On Mont Pelée, it is true, the main activity is confined to a restricted area about the summit of the mountain, and the top of the great fissure which extends or extended from this down in the direction of the Riviere Blanche; and there are no parasitic cones comparable, for instance, to those which are so numerous on Etna; but there are many fumaroles, which Prof. Lacroix and his colleagues speak of as emitting gases hot enough to melt lead and even copper wire. A telegraph cable has been three times broken at about the same place, and the broken ends on one occasion, at any rate, showed marks of fusion. There are also several hot springs. Judging from these and other indications, it is most probable that radial cracks entered deeply through the substance of the mountain, and penetrated even the submarine portion of its cone.

The local distribution of erupted material in Martinique is accounted for by the great fissure at the top of the valley of the Riviere Blanche, which communicated with the main pipe of the volcano, and out of which the eruptions took place. This fissure, which was mentioned as existing in the eruption of 1851, pointed almost directly towards St. Pierre, and as the erupted material flowed out almost like a fluid, it was directed straight down on the doomed city. The lowest portion of the lip of the crater of the Soufrière was much broader and more even, so the incandescent avalanche which descended from it was spread much more widely.

The latest accounts from Prof. Lacroix indicate that the recent small eruption of Mont Pelée has filled up the highest parts of the fissure and formed a cone, the foot of which covers up the former crater ring. In any further eruption, therefore, the avalanche of incandescent sand will not be confined to the district of the Riviere Blanche, but may descend on any side of the mountain.

The accompanying photograph of Mont Pelée in eruption was obtained from a ten-ton sloop in a sea way and is therefore not quite sharp. Attention was directed to the eruption by a peculiar black cloud which appeared over the volcano and then rolled down the side of the mountain to the sea. The cloud was formed of surging, rolling, expanding masses, in shape much like those of the previous cauliflowers, but quite black, and full of lightning-flashes and scintillations, while small flashes constantly struck from its lower surface on to the sea. The upper slopes of the mountain cleared somewhat, and some big red-hot stones were thrown out; then the triangular crack became red, and out of it poured a surging mass of incandescent material, reminding us of nothing so much as a big snow-avalanche in the Alps, but at a vastly different temperature. It was perfectly well defined, did not at all tend to rise like the previous cauliflowers, but flowed rapidly down the valley in the side of the mountain which had clearly been the track of previous eruptions, until in certainly less than two minutes it reached the sea, and was there lost to view behind the remains of the first black cloud, with which it appeared to coalesce. There and on the slopes of the mountain were doubtless deposited the greater part of the incandescent ash, while the steam and gases, with a certain portion of still entangled stones and ash, came forward in our direction as a black cloud, but with much greater rapidity than before. The cloud got nearer and nearer; it was well defined, black and opaque, formed of surging masses of the cauliflower type, each lobe rolling forward, but not all with one uniform rotation; bright scintillations appeared, some in the cloud itself and some like little flashes of light vertically between the cloud and the sea on which it rested. This was clearly the phenomena described by the survivors in the St. Vincent eruption as "fire on the sea," occurring in the black cloud which overwhelmed the windward side of that island. We examined them carefully, and are quite clear that they were electric discharges. The scintillations in the body of the cloud became less numerous and more defined, and gradually took the form of vivid flashes of forked lightning darting from one part of the cloud to another. When the cloud had got within perhaps half a mile or a mile of us—for it is difficult to estimate distances at sea and in a bad light—we could see small material falling out of it in sheets and festoons into the sea, while the onward motion seemed to be chiefly confined to the upper part, which then came over our heads and spread out in advance and around us, but left a layer of clear air in our immediate neighbourhood. It was ablaze all the time with electric discharges.

FIG. 1.—Photograph of an eruption of Mont Pelée.

As soon as it got overhead, stones began to fall on deck, some as big as a walnut, and we were relieved to find that they had parted with their heat and were quite cold. Then came small ashes and some little rain. The cloud was also noticed at Fort de France. It was described as like those in the previous eruptions, but was the only one in which electric scintillations had been noticed. Two unbiased observers, who had seen it and that of May, declared this was the larger of the two.

As to the mechanism of the hot blast and the source of the power which propelled it, both Dr. Flett and I are convinced of the inadequacy of previous explanations, such as electricity, vortices, or explosions in passages pointing laterally and downwards, or explosions confined and directed down by the weight of the air above. Such passages into the mountain, which, to be effective, would require to be closed above, do not exist in the case of the Soufrière, and we are not aware that they have been observed in Mont Pelée; and as to the weight of the air, this did not prevent the explosions in the pipe of the Soufrière from projecting sand and ashes right through the whole thickness of the trade-winds until they were caught by the anti-trade current above and carried to Barbados. Moreover, the black cloud, as we saw it emerge from Mont Pelée, seemed to balance itself at the top of the mountain, start slowly to descend and gather speed in its course, and the second incandescent dis-

[1] From a discourse delivered by Dr. Tempest Anderson at the Royal Institution on January 23.

charge followed the same rule. We believe that the motive power for the descent was gravity, as in the case of any ordinary avalanche.

The accepted mechanism of a volcanic eruption is that a molten magma rises in the volcano chimney. It consists of fusible silicates and other more or less refractory minerals, sometimes already partly crystallised, and the whole highly charged with water and gases, which are kept in a liquid state by the immense pressure to which they are subjected. When the mass rises nearer the surface and the pressure is diminished, the water and gases expand into vapour and blow a certain portion of the heavier and less fusible materials to powder, or, short of this, form pumice stone, which is really solidified froth, and they are violently discharged from the crater. When the greater part of the steam and gases have been discharged, the lava, still rising, gets vent either over the lip of the crater or often through a lateral fissure, and flows quietly down the side of the mountain.

It is quite recognised that these phenomena may occur in various relative proportions. We believe that in these Pelean eruptions, the lava which rises in the chimney is charged with steam and gases, which explode as usual, but some of the explosions happen to have only just sufficient force to blow the mass to atoms and lift the greater part of it over the lip of the crater without distributing the whole widely in the air. The mixture of solid particles and incandescent gas behaves like a heavy liquid, and before the solid particles have time to subside, the whole rolls down the side of the mountain under the influence of gravity, and consequently gathers speed and momentum as it goes. The heavy solid particles are gradually deposited, and the remaining steam and gases, thus relieved of their burden, are free to ascend.

The effect of avalanches in compressing the air before them and setting up a powerful blast, the effects of which extend beyond the area covered by the fallen material, has long been recognised. A group of large trees was overthrown by the blast of the great avalanche from the Attels on the Gemmi pass in 1895; all lay prostrate in directions radiating away from the place where the avalanche came down.

THE ZOOLOGICAL SOCIETY'S MEETING.

THE monthly meeting of the Zoological Society of London, at their house in Hanover Square, held on January 22, was well attended, it being expected that some account of the operations of the committee of reorganisation recently appointed by the council, on the occasion of the change in the secretaryship, would be given. The chair was taken by His Grace the Duke of Bedford, K.G., the president, at 4 p.m., and the new secretary, Mr. W. L. Sclater (lately director of the South African Museum, Cape Town), was present for the first time. After the election of new fellows and other routine business, the report of the council was read by the secretary. It stated that thirty additions had been made to the Society's menagerie during the month of December last, amongst which was a very fine pair of the one-wattled cassowary (*Casuarius uniappendiculatus*), deposited by the Hon. Walter Rothschild, M.P. The report also stated that the total income of the Society in 1902 had been 29,077*l.*, being, in spite of the bad weather that had prevailed during the summer, only 273*l.* less than the receipts of the previous year, and being the sixth largest annual income ever received by the Society. The report of the reorganisation committee was then read to the meeting by Sir Harry Johnston, K.C.B., the hon. secretary of the committee. It was divided into numerous heads relating to every branch of the Society's affairs, and containing recommendations thereon. Many of these were of a technical character, but important changes were advised under the heads of the gardens and menagerie, the prosectorium, the staff at Hanover Square and the secretaryship. The charge of the Society's gardens and menagerie was proposed to be entrusted to a member of the council, Mr. W. E. de Winton. Mr. de Winton would thus, for the present, take the place of Mr. Clarence Bartlett, who has retired on account of bad health on a pension. This appointment being for a year only would give time for the selection of a new superintendent, who must possess special qualifications such as were not easily to be found. Various buildings, such as the giraffe house, the small mammals' house and the bears' dens, were pointed out as specially requiring reconstruction, and there should be a new seals' pond and better accommodation for the polar bears. Alterations were also recommended at the monkey and antelope houses and in other buildings. A foreman keeper should be appointed to make periodical tours of inspection in the gardens during the day, and the keepers should be forbidden to accept gratuities, to trade in living animals or to keep them without the sanction of the authorities. The prosectorium should be carried on by the present officer in charge (Mr. F. E. Beddard, F.R.S.), but on lines to be laid down by a scientific committee, so that the work should have a more definite object. The prosector should also have a veterinary assistant, who would help in the *post-mortems* and look after the health of the animals in the menagerie. The salary of the new secretary would begin at 600*l.* a year, and his work would be under the supervision of various committees, of all of which the president would be an *ex officio* member. These committees were to be directly responsible to the council. The garden-guide, which the council had formerly granted to the secretary as part of his emolument, had now reverted to the Society, and would be improved and carried on for their benefit.

After the report had been read, the recommendations based upon it and adopted by the council were read from the chair by the president, and it was agreed that they should be printed and sent to the fellows. Notice of a motion was then given by Mr. A. G. Ross that copies of the testimonials tendered to the council by Mr. W. L. Sclater, the newly elected secretary, and by Dr. Chalmers Mitchell (one of the unsuccessful candidates) should be printed and sent to all the fellows. This motion was ordered to be discussed at the next general meeting on February 19.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AT Bedford College on Thursday, February 5, a lecture on "Electricity and Matter" will be given by Sir Oliver Lodge.

THE first two scholarships at Oxford granted under the terms of Mr. Rhodes's will have just been awarded by the Government of Rhodesia to two students of the Jesuit College in Bulawayo.

THE award of valuable scholarships by private institutions deserves encouragement. We are glad, therefore, to notice that as a result of the recent scholarship examinations, the board of control of the Electrical Standardising, Testing and Training Institution has made the following awards:—To W. H. C. Prideaux, of Shrewsbury School, a Faraday scholarship, value eighty guineas, tenable for two years; to N. S. Smith, of Wellingborough School, an exhibition, value thirty guineas, tenable for two years; to W. d'Arcy Madden, of Haileybury College, and to Frederick Smith, of Aldenham College, special prizes of ten guineas each.

IT is understood that the Carnegie Trust will shortly take active steps to encourage post-graduate research. The present idea is that with the assistance of the Trust, students, after graduating, will be enabled to prosecute thoroughly their particular branches of study. Mr. Carnegie is reported not to consider suitable the post-graduate organisation of Oxford and Cambridge. His scheme will provide no substantial livings. The amount of fellowships, while ample for adequate study, will not be so large as to induce the possessors to cling to them for a livelihood, and, moreover, the fellows will be selected and not ascertained by competition. The fellowships will be directed mainly into the channels of scientific research. Graduates desiring to become fellows will be required to state the class of research they wish to pursue.

THE annual meeting of the Mathematical Association was held on January 24, Prof. A. Lodge in the chair. The report of the committee appointed by the Association to consider the subject of the teaching of elementary mathematics, to which reference has already been made in these columns, was referred to in the council's report for the past year. Prof. Forsyth was elected president for the forthcoming year, and Mr. A. W. Siddons submitted the report of the committee on the teaching of elementary mathematics, which, he said, had been criticised as very conservative. The most immediate need was that the preparatory schools should move in the matter, and they should get the head-masters of such schools to adopt a more modern treatment of mathematics. It would not be done in the public schools unless the boys were taught from the beginning.

In a short discussion which followed, Prof. Forsyth said it was desirable that they should not hurry changes. It did not lie with the public schools or the preparatory schools to make changes. There was a vast body of teachers in the small schools, but the great difficulty was to get at such teachers and induce them to adopt new methods. The report was adopted.

AMONG the many interesting papers read at the conference of the Froebel Society and the Child-Study Association on Saturday was one by Dr. W. B. Drummond, of Edinburgh, who dwelt upon the preparation for child-study as a piece of proper scientific investigation carried on according to modern methods. He laid down that a course of training in biology, that is to say, in the practical study of plants and animals, was the first essential to success. His reason was that the observations made on children are in reality part of biology. Next a course of psychology should follow, and then one in methods of education, for many of these have been based upon an intimate acquaintance with the ways and needs of children. He pointed out how advantage was taken of the peculiarities of the child mind in the Bible, and instanced the setting up of the twelve stones from Jordan so that when they had aroused the curiosity of the children, and this had been satisfied, the monument would always be a reminder to them of the crossing of Jordan as on dry land. The educational results of many celebrations, customs and games which we are ourselves familiar with were touched upon, though it was pointed out that these were not always intentional at the beginning. The danger was pointed out of asking children ill-considered questions which might excite their imagination in a way detrimental to them, or which by suggesting an answer or confusing the young persons might defeat the object of the experiment. During the course of the paper, the characteristics of primeval man were touched upon, as indeed they had been previously during the conference, and in the concluding discussion, Mr. Lewis Paton, head-master of University College School, expressed the opinion that much light could be thrown upon the ways of boys by a study of savages. Another and possibly more serious point was that he found by the time his pupils had reached the age of nine and came to him, their characters were formed or more often deformed, and this is a very strong argument for the advancement of child-study.

AN article by Sir William Ramsay, in the January number of *East and West*, deals with the recent Report of the Indian Universities Commission, and contains several suggestions which ought to be read by all who are interested in the aims and character of university education. The commissioners had not the courage of their convictions, for after forming an accurate conception of the function of a university, they refused to act upon it and accepted old ideals as offering the path of least resistance for the universities of India to follow. As regards the government of the universities, Sir William Ramsay shows that the commissioners could have found abundant precedent for a recommendation that a small number of persons, not exceeding ten, should have been given control of the funds of the university, leaving to the teachers—that is, heads of departments—the entire management of academical affairs. The large number of colleges—many of them really secondary schools—in so-called affiliation with Indian universities presents a difficulty, but the suggestion is put forward that it could be overcome by making the B.A. and B.Sc. degrees, or the former only, equivalent to a leaving examination for secondary schools. Students who wished to pursue their studies would do so at the universities. There would thus be a separation of the college from the university, as in the United States, where numerous colleges give the degrees of A.B. and S.B., and the students afterwards proceed to such places of post-graduate study as the Johns Hopkins University or the university side of Harvard. Some American universities have both college and university sides, but the students in the latter are those proceeding to higher degrees. As to the objection that unless external examiners are called in the examination for degrees by colleges could not be contemplated, Sir William Ramsay urges that the teacher ought to be trusted to gauge the capacity of his students, though it would be advisable for him to act in conjunction with an external examiner for all the colleges to secure uniformity of standard. Finally, he remarks:—"The true prosperity and success of colleges and of universities in training men for their later careers, and in creating and disseminating knowledge, depend on the observance of two fundamental maxims:—First, choose for professors men who have made some reputation and are engaged in active prosecution of research; second, give such men a wide liberty in dealing with their subjects and with their students. Where these maxims have been acted on, university education has been a conspicuous success, and the creation and progress of knowledge have been maintained. May India see fit to adopt and practise these maxims."

SCIENTIFIC SERIALS.

American Journal of Science, January.—The morphogenesis of Platystrophia. A study of the evolution of a Palæozoic brachiopod, by E. R. Cumings.—On ruling concave gratings, by W. Rollins. It has been shown that the Rowland concave gratings give false spectral lines so sharp and clear that there is probability and some evidence that they have been mistaken for real lines. The cause of this is examined, and suggestions are made for a new design of ruling machine in which these defects are overcome. The machine has not yet been constructed.—The variations of potential along a wire transmitting electric waves, by C. A. Chant.—Rickardite, a new mineral, by W. E. Ford. The mineral occurs in the Good Hope mine at Vulcan, Colorado, and consists of a nearly pure copper telluride, Cu_4Te_3.—On the occurrence of free phosphorus in the Saline Township meteorite, by Oliver C. Farrington. The phosphorus was noticed on drilling a hole into the meteorite for the purpose of breaking off a piece, and was proved to exist in the free state by its smell, luminosity, action on silver nitrate and conversion into ammonium phosphomolybdate.

Bulletin of the American Mathematical Society (2), ix., No. 3 (December, 1902).—W. B. Fite, commutator subgroups of groups whose orders are powers of primes.—L. I. Hewes, note on irregular determinants.—G. O. James, on the projections of the absolute accelerations in relative motion.—E. P. Eisenhart, on infinitesimal deformation of the skew helicoid.—S. Epoteen, on integrability by quadratures.—E. B. Wilson, account of the Abel centenary.—Reviews: English and French translations of Hilbert's "Grundlagen der Geometrie" (E. R. Hedrick); Dickson's "Linear Groups" (G. A. Miller); Buckingham's "Thermodynamics" (E. H. Hall).—No. 4 (January, 1903).—F. Cajori, on series whose product is absolutely convergent.—L. E. Dickson, on the abstract simple groups of orders 504 and 660.—C. M. Mason, account of the Carlsbad meeting of the Deutsche Mathematiker-Vereinigung.

SOCIETIES AND ACADEMIES.

LONDON.

Anthropological Institute, January 13.—Dr. A. C. Haddon, F.R.S., in the chair.—Dr. C. S. **Myers** read a paper on the future of anthropometry. He suggested that the work in which anthropometry had hitherto been concerned, viz. the determination of the average metric differences between the various peoples of the world, must ultimately yield before improved methods and new problems. The frequency-distribution of any one character in a series of individuals must be studied with greater accuracy. The mean of the deviations of individuals from the mean of the whole series and the form of the binomial frequency-curve require to be determined both for relatively pure and mixed peoples. Frequency-curves will almost invariably show more than one point of maximal frequency. But before the usual inference is drawn that these several peaks represent heterogeneous elements in the series, care must be taken that the irregularities of distribution are not the result of examining an insufficient number of individuals. The future will see the precise investigation of the degree of correlation of various characters, the mode of inheritance of characters, the fertility and characters of cross-breds, and the effect of migration and evolution on mankind. Mr. Francis Galton, Prof. Karl Pearson and others have already made a start. Anthropometry has first to look for aid to the infant science of biometry, which can employ experimental and therefore simpler conditions. The whole study of natural history is passing from the descriptive to the quantitative aspect. In this, physical anthropology must join.

Royal Meteorological Society, January 21.—Mr. W. H. Dines, president, in the chair.—The **President** delivered an address on the method of kite-flying from a steam vessel and meteorological observations obtained thereby off the west coast of Scotland. In the spring of 1901, the Royal Meteorological Society appointed a committee for the purpose of making an investigation as to the temperature and moisture of the upper air, and the British Association, at the Glasgow meeting, also appointed a committee to cooperate in the work. At the request of the joint committee, Mr. Dines undertook to carry on the inquiry during the summer of 1902, and in this address he gave an interesting account of all that he had done. After describing the apparatus, which included kites (of a modified Blue Hill pattern), eight miles of wire in one piece, winding-in apparatus, steam engine and meteorograph, he proceeded to give an account of his work and observations at a fixed station, and also from a steam tug, in the neighbourhood of Crinan off the west coast of Scotland. A considerable amount of information concerning meteorological phenomena was obtained, seventy-one observations of temperature at an average height of 4140 feet and thirty-eight charts from the self-recording instruments with an average of more than 6000 feet having been secured. The greatest height attained was 15,000 feet, by means of four kites on the wire. The temperature gradient over the sea was considerably less than its average value over the land, being about 1° for every 300 feet of height. The upper currents were found to differ in direction from those below much less than was expected. As a general rule, the humidity increased up to a level of about a mile and then decreased. Mr. Dines illustrated his address with a number of interesting lantern slides.—Captain D. Wilson-Barker was elected president for the ensuing year.

Entomological Society, Annual Meeting, January 21.—The Rev. Canon Fowler, president, in the chair.—Canon **Fowler**, the retiring president, in the first part of his address dealt chiefly with the many facts that have been recently brought forward with regard to cryptic coloration and mimicry, more especially as affecting the order Coleoptera; the facts are indisputable, but the hypotheses founded upon them are, perhaps, sometimes pressed too far. In the second part, the question of the origin of the Coleoptera was discussed; there is no satisfactory evidence of the appearance of the order in the Palæozoic period, but the leading families are found in the Lias, as completely differentiated as at the present time; in fact, many of the genera and even the species are almost identical with those now living; the Coleoptera, that is to say, have altered but little from the time at which they existed side by side with the gigantic extinct saurians and the pterodactyles; the whole question of the origin and history of the insects generally is of the first importance in the history of evolution.

PARIS.

Academy of Sciences, January 19.—M. Albert **Gaudry** in the chair.—Notice on the work of the late M. Sirodot, by M. **Bornet**.—Researches on the chinchona alkaloids, by MM. **Berthelot** and **Gaudechon**. A thermochemical paper, giving the heats of combustion and formation of quinine and quinidine, together with the heats of solution of several salts of these alkaloids. Attention was paid to the influence of the physical condition of the quinine, the value obtained with quinine which had been recently precipitated being slightly different from that given by quinine which had been precipitated for some days. The isomer quinidine proved to have the same function, the same heats of formation and of neutralisation.—On some formulæ of kinematics useful in the general theory of elasticity, by M. P. **Duhem**.—The coloured drawings on the walls of the cave of La Mouthe, forming true decorative panels, by M. Emi **Riviere**. The antiquity of the numerous drawings and paintings on the walls of this cave has been verified by the anthropologists of the Congress of the French Association for the Advancement of Science. The drawings have been identified as certainly dating from the Quaternary epoch. They are contemporary with the *Tarandus rangifer*, *Ursus spelaeus* and *Hyaena spelaea*. The extreme freshness of some of the drawings threw some doubt on their authenticity, but it has been shown that these are covered with the same clay as the others. A detailed account of the drawings uncovered up to the present is given, and the work is being continued.—On a colouring matter from the figures in the cave of La Mouthe, by M. Henri **Moissan**. The black colouring matter, freed from particles of silica and chalk, proved to consist entirely of an oxide of manganese. It is similar to that discovered by MM. Capitan and Breuil in the cave of Font de Gaume.—On the reducibility of differential equations, by M. R. **Liouville**.—On the universal functions of the plane and surfaces of Riemann, by M. A. **Korn**.—On the surfaces which correspond with parallelism of the tangent planes and conservation of areas, by M. C. **Guichard**.—The proof of a rotating electromagnetic field produced by a helicoidal modification of stratifications in a tube of rarefied air, by M. Th. **Tommasina**. The facts described correspond with the view of the anodic origin of these phenomena and the part played by reflection in the anode modification. It is pointed out that if the charges are transmitted along the helicoidal bundle, this should behave as a solenoid carrying a current. In this case, the bundle which would be the deviable bundle should turn under the action of the other part of the current which passes along the non-deviable bundle, precisely like a movable solenoid turning round a fixed linear current.—On the so-called electrolytic reduction of potassium chlorate, by M. André **Brochet**. A criticism of a paper by Bancroft and Burrows. The author is in general agreement with the experimental part of this work, but arrives at quite different conclusions regarding the true explanation of the phenomenon. The reduction he regards as being produced by a secondary and purely chemical reaction, and hence concludes that the reduction is not electrolytic properly so called.—On a mode of formation of phenols, by M. F. **Bodroux**. Phenyl magnesium bromide and the corresponding derivatives of other aromatic hydrocarbons are slowly acted upon by dry air, and from the product of this reaction, after acidifying with hydrochloric acid, phenols can be extracted. Working in this way, phenol has been obtained from bromobenzene, and ortho- and para-bromotoluene have been transformed into the corresponding cresols. From monobromaniscl, the monomethylether and hydroquinone were obtained, parabromophenetol behaving similarly. The yields are small, varying from 5 to 10 per cent. of the theoretical.—On ethyl dinitroacetate, by MM. L. **Bouveault** and A. **Wahl**. This compound has been obtained by the action of ordinary fuming nitric acid upon the acid ethyl ester of malonic acid. carbon dioxide being given off. The physical and chemical properties of the nitro-compound are given, and the preparation of the ammonium salt described.—The influence of the nature of the external medium on the state of hydration of the plant, by MM. Eug. **Charabot** and A. **Hebert**. The effect of the addition of a salt of a mineral acid to the soil is to accelerate the diminution of the proportion of water in the plant. The nitrates have the most powerful effect in causing the loss of water, then follow sulphates, chlorides and finally sodium phosphate.—Observations on the theory of cell division, by M. P. A. **Dangeard**. The primitive laws of cell division are found to be modified by the appearance of a membrane or an inextensible envelope; the laws of Hertwig and Pflueger only give expression to this modification interposed in the cellular structure in the course of development.—The existence of the lower Cretacean in Argolide, Greece, by M. L. **Cayeux**.—On the presence of a kinase in some Basidiomycetes, by MM. C. **Delezenne** and H. **Mouton**. The powdered fungus is extracted with saline water (0·8 per cent.) in presence of toluol, and the liquid filtered either through paper or a Berkefeld filter, the extract from *Amanita muscaria* giving the best results. This extract, which is inactive towards albumen, when mixed with a pancreatic juice also inactive by itself, is capable of rapidly digesting albumen. The effects are produced by a soluble ferment analogous to enterokinase.—The influence of the stereochemical configuration of glucosides on the activity of the hydrolytic diastases, by M. Henri **Pottevin**. An examination of some apparent exceptions to the law of Fischer.—Acetaldehyde in the ageing and alterations of wine, by M. A. **Trillat**. Acetaldehyde appears to play an important part in the various modifications undergone by wine. The ageing corresponds to a normal oxidation of the alcohol of the wine, resulting in the formation of aldehydes, their transformation into acetals and esters. Under the influence of certain diseases, the proportion of aldehydes increases; according to the conditions, these aldehydes may either form an insoluble compound with the colouring matter or may be resinified by the action of the mineral salts of the wine.—The comparative bactericidal power of the electric arc between poles of ordinary carbon or of carbon containing iron,

by MM. Alfred **Chatin** and S. **Nicolau.** The arc with iron has always a greater bactericidal power than the arc between ordinary carbon poles, the effect being most marked with the staphylococcus aureus and least with the anthrax bacillus, but even in the latter case the ratio of the times required for sterilisation was as 5 : 1 in favour of the poles containing iron.—Researches on the toxic power of *Ksopo* or *Tanghin de Menabe*, by M. Lucien **Camus.**—The origin of pearls in *Mytilus gallo-provincialis*, by M. Raphaël **Dubois.**

NEW SOUTH WALES.

Royal Society, November 5, 1902.—Prof. Warren, president, in the chair.—New South Wales Meteorites, by Prof. **Liversidge**, F.R.S. *Barratta Meteorites*, Nos. 2 and 3. The first meteorite from this locality was examined by the author in 1872; the later ones were received in 1889. No. 2 weighed 31½ lb. and No. 3 48 lb.; they both very closely resemble the first one found in appearance, specific gravity, &c. No. 2 has, on analysis, been found to resemble No. 1 also in chemical composition; it is essentially a mixture of enstatite, olivine, &c., with about 6 per cent. of nickeliferous iron. No. 3 has not yet been analysed. *Gilgoin Meteorites*, Nos. 1 and 2. The weight of No. 1 was 67½ lb. and its sp. gr. 3·857. They are both much fissured and weathered. No 2 weighed 74 lb. and has a sp. gr. of 3·757. No. 1 has been found on analysis to resemble the Barratta meteorites, but to contain more lime and alumina, and less iron and magnesia and about 14 per cent. of nickeliferous iron. No. 2 has not yet been analysed. *Boogaldi* (*Bugoldi*) *Meteorite.* An account of this meteorite was given by Mr. R. T. Baker about two years ago; it has since been analysed; the principal constituents are iron 91·135, nickel 8·636, cobalt 0·065 and phosphorus 0·17.—Forests considered in their relation to rainfall and the conservation of moisture, by Mr. J. H. **Maiden.** A descriptive statement of the relation between forests and water supply. Some uses of forests are, (*a*) to temper floods; (*b*) to conserve springs and to aid in the more even distribution of terrestrial waters; (*c*) to prevent evaporation of water; (*d*) to give shelter to stock, crops, &c.; (*e*) the leaves of forest trees, &c., afford manure and mulch.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 29.

ROYAL SOCIETY, at 4.30.—The Relation between Solar Prominences and Terrestrial Magnetism: Sir Norman Lockyer, F.R.S., and Dr. W. J. S. Lockyer.—The Bending of Electric Waves round a Conducting Obstacle: H. M. Macdonald, F.R.S.—On Skew Refraction through a Lens; and on the Hollow Pencil given by an Annulus of a very Obliquely Placed Lens: Prof. J. D. Everett, F.R.S.—On the Decline of the Injury Current in Mammalian Nerve, and its Modification by Changes of Temperature: Miss S. C. M. Sowton and J. S. Macdonald.

ROYAL INSTITUTION, at 5.—Pre-Phœnician Writing in Crete and its Bearings on the History of the Alphabet: Dr. A. J. Evans.

FRIDAY, JANUARY 30.

ROYAL INSTITUTION, at 9.—Vibration Problems in Engineering Science: Prof. W. E. Dalby.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design of the Electrical Equipment of a Light Railway: J. R. MacIntosh.

SATURDAY, JANUARY 31.

ESSEX FIELD CLUB (Essex Museum of Natural History, Stratford), at 6.30.—Proposals for a Photographic and Pictorial Survey of Essex: A. E. Briscoe.

MONDAY, FEBRUARY 2.

SOCIETY OF ARTS, at 8.—Paper Manufacture: Julius Hübner.

VICTORIA INSTITUTE, at 4.30.—On the Unseen Life of our World, and of Living Growth; Design, Human and Divine: Prof. Lionel S. Beale, F.R.S.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Statistics of British and German Chemical Trades for 1901, with Suggestions for Improving the Official Tables: F. Evershed.—The Standardisation of Analytical Methods: H. Droop Richmond.

TUESDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 5.—The Physiology of Digestion: Prof. Allan Macfadyen.

SOCIETY OF ARTS, at 8.—Technical Education in Connection with the Book-Producing Trades: Douglas Cockerell.

MINERALOGICAL SOCIETY, at 8.—(1) On a Meteoric Stone seen to fall on August 22, 1902, at Caratash, Smyrna; (2) Note on the History of the Mass of Meteoric Iron found in the Neighbourhood of Caperr, Patagonia: L. Fletcher, F.R.S.—On the Crystalline Forms of Carbides and Silicides of Iron and Manganese: L. J. Spencer.—The Refractive Indices of Pyromorphite: H. L. Bowman.—Note on Quartz Crystals from De Aar: T. V. Barker.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion of papers on* The Nile Reservoir, Assuan: M. Fitzmaurice, C.M.G.—Sluices and Lock-Gates of the Nile Reservoir, Assuan: F. W. S. Stokes.

ZOOLOGICAL SOCIETY, at 8.30.—On the Hair-slope of four Typical Animals: Dr. W. Kidd.—A Prodromus of the Snakes hitherto recorded from China, Japan and the Loochoo Islands: Capt. F. Wall.—On the Variation of the Elk: H. J. Elwes, F.R.S.—Note on the Wild Sheep of the Kopet Dagh: R. Lydekker, F.R.S.

WEDNESDAY, FEBRUARY 4.

SOCIETY OF ELECTRO-CHEMISTS AND METALLURGISTS (Faraday Club, St. Ermin's Hotel, Westminster), at 5.—General Meeting to inaugurate the work of the Society and elect a President and Council.

SOCIETY OF ARTS, at 8.—Methods of Mosaic Construction: W. L. H. Hamilton.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Annual General Meeting.—At 8.30.—The Determination of Glycerine in crude Glycerines: Dr. Julius Lewkowitsch.—(1) A Plea for the more Extended Consideration of Physics in Analytical Methods; (2) Note on the Determination of Casein precipitated by Rennet: H. Droop Richmond.

ENTOMOLOGICAL SOCIETY, at 8.—An Account of a Collection of Rhopalocera made on the Anambara Creek in Nigeria, West Africa: Percy I. Lathy; On the Hypsid Genus Deilemera, Hübner: Colonel C. Swinhoe.

GEOLOGICAL SOCIETY, at 8.—(1) The Granite and Greisen of Cligga Head (West Cornwall); (2) Notes on the Geology of Patagonia: J. B. Scrivenor.

THURSDAY, FEBRUARY 5.

ROYAL SOCIETY, at 4.30.—*Probable Papers:*—The Brain of the Archæoceti: Prof. Elliot Smith.—On the Negative Variation in the Nerves of Warm-Blooded Animals: Dr. N. H. Alcock.—Primitive Knot and Early Gastrulation Cavity coexisting with Independent Primitive Streak in Ornithorhynchus: Prof. J. T. Wilson and J. P. Hill.

ROYAL INSTITUTION, at 5.—Arctic and Antarctic Exploration: Sir Clements Markham, K.C.B.

CHEMICAL SOCIETY, at 8.—(1) A New Vapour-Density Apparatus; (2) A New Principle for the Construction of a Pyrometer: J. S. Lumsden.

LINNEAN SOCIETY, at 8.—Stephanospermum, Brongniart, a Genus of Fossil Gymnospermous Seeds: Prof. F. W. Oliver

RÖNTGEN SOCIETY, at 8.30.—Discussion on Some Points suggested by the Presidential Address of November, 1902, opened by J. H. Gardiner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Adjourned Discussion on the Metric System.

CONTENTS.