THURSDAY, JANUARY 1, 1903.

THE UNIVERSITY IN THE MODERN STATE.

AMONG the many documents prepared by Principal Sir Oliver Lodge in relation to the development of the University of Birmingham, there are more than one of which the interest is by no means merely local. Of these, the pamphlet entitled "Survey of the Sciences," which forms an appendix to a paper on University Development, is of especial importance at the present time, for we are glad to know that the belief that the weakness of our universities must lead to national weakness in several directions is growing with a rapidly accelerating pace.

It may be long in this slow-moving country before the influence of Brain-power on history is recognised as fully as the influence of Sea-power has been, thanks to Captain Mahan, but undoubtedly it will be bad for our future if much more time is lost.

While Sir Oliver Lodge has been investigating the "needs" of Birmingham, similar inquiries have been made elsewhere, and we have received from the Clarendon Press a statement of the "needs" of Oxford. We are glad to see that the *Times*, in a sympathetic article, goes to the root of the matter in stating that "if the pocket of the millionaire is closed, the pocket of the nation must be opened." Our eleven universities are competing with 134 State and privately endowed in the United States and twenty-two State endowed in Germany. English private endowment is much less than 10 per cent. of the American endowment, and the German State gives to one university more than the British Government allows to all the universities and university colleges in England, Ireland, Scotland and Wales put together. These are the conditions which regulate the production of brain-power in the United States, Germany and Britain respectively, so far as Universities are concerned, conditions which Sir Oliver Lodge proposes to face as manfully as he may. His paper on the "Survey of the Sciences" runs as follows:—

In a recent pamphlet I considered the question of the relation of the University of Birmingham to its central and suburban sites, with a view of determining what recommendation should be made to the Council concerning the Departments which ought to migrate and the Departments which ought to remain. I was able to arrive at some judgment on the matter except in connection with the Faculty of Science, and there the problem became so complicated that it was necessary to make a survey of the sciences in order to get the material on which to form an opinion. This survey is now printed, not only as an appendix to the former paper, but because it is hoped that it may be useful for other purposes; especially I hope that it may be of interest to those who are able to help financially in the forthcoming great educational development of the future, enabling them to realise the immensity of the area which we attempt to cover, and the largeness of the sum which could be properly invested in suitable buildings and equipment and in endowment of staff. Our position is such that if some man of power thought fit to exercise it by entrusting us with a sum of five millions for University development, it could be well and properly employed;[1] nor could such an investment fail to exercise an extraordinary influence on the progress of the country. Hitherto the ideas of this country in education and scientific research have been conceived on a wholly inadequate scale, and without proper appreciation of the vast extent of territory over which a modern University is called upon to preside.

Let us, therefore, now run over the pure sciences, and trace the collateral branches and practical applications with which they are most allied; taking them in alphabetical order, and enumerating only those sciences with which we ourselves at present in some degree attempt to deal.

ANATOMY:—is clearly so closely allied to professional medicine as practically to have drifted out of general culture; though it is to be remembered that it is in touch with Fine Art on the one side—and a course of lectures on Artistic Anatomy is annually given by our Professor or our Lecturer at the School of Art—and on another side it is in touch with the sciences of ANTHROPOLOGY and Ethnology. At the present time the course of lectures and practical instruction in the subject of Anthropology, laid down in the Calendar as an optional subject for Degrees in Science, is under the charge of the Professor of Anatomy, who has made a study of this subject and of Ethnology, particularly from the side of Prehistoric Archæology, and on two occasions has given courses of lectures on these subjects, though at the present time the plant possessed for their teaching is not large. He possesses a collection of lantern slides of an ethnological character, also a private collection of stone and metal implements, and the Summers-Freer collection is now displayed in his department; with it will shortly be exhibited—as a loan from the Geological Department to which it belongs—the Seton-Carr collection of early Egyptian stone implements; and there is, besides, a small collection of Palæolithic and Neolithic implements in the Geological Museum. A case of similar implements is in the City Museum, and there are a number of ethnological objects, some of considerable interest, in the Aston Hall Museum, which might, perhaps, become available some day for the purposes of the University.

On the practical side of colonial development modern Ethnology is a subject not altogether to be lost sight of.

ARCHÆOLOGY:—A study of the past from relics and monuments and excavated sites: skilled interpretation of which enables us to reconstruct the life of ancient times. Our present Lecturer in Greek has made a special study of Greek Archæology.

BOTANY:—Studied with us partly for its own sake as a department of Natural History, allied to Horticulture and Gardening generally, and also from the point of view of Vegetable Physiology. This science is the foundation of much of Agriculture, of Forestry, of Materia Medica, of Timber and Plant diseases, the Fermentation industries, and of many human diseases. It is allied on its morphological side with Palæontology. On its Physiological side it is largely dependent on Physics and Chemistry.

At the present time it is not now taught as a separate subject in the medical curriculum at Birmingham, but admittedly only because the course is so crowded that something had to give way.

CHEMISTRY:—This gigantic science branches out in every direction. Almost every manufacture is more or less directly concerned with it, and as a pure science it is a most important branch of Natural Philosophy in alliance with Physics.

In many places there is a Professor of its Inorganic and another of its Organic division: in Germany it is still further greatly subdivided, even from the point of view of the pure science. Flourishing departments of the new and growing science of Physical Chemistry exist at Leipzig and at other German and American Universities, in furtherance of pioneer work begun at Amsterdam and Stockholm.

As to the applications of Chemistry, they are almost too numerous to mention, and every one of them demands the full time and special knowledge of an expert. At present we have only attempted Brewing and Metallurgy.

A training in elementary chemistry, both inorganic and organic, is universally recognised as an essential ingredient in the training of a medical student.

And recently Chemistry has allied itself, on the fermentation side, with a branch of Biology, through the discoveries of the great chemist Pasteur—a subject in which our present Professor and his wife are eminent.

ECONOMIC SCIENCE:—is a branch of Sociology or the theory of Politics, of which we have recognised the commanding importance, on one of its many sides, by arranging that there shall be hereafter constituted a Faculty of Commerce. In the hands of our present Professor there is no fear lest either the term

[1] See "Concluding explanation."

Economics or the term Commerce shall be interpreted too narrowly: the two will be welded to some extent into one, and gradually it is to be hoped that the treatment of these subjects of national moment can be established on a sound and broad educational basis.

EDUCATION or Pædagogy.—The science of Education is coming to the front of practical politics in a most impressive manner just now. All that we attempt in this direction at present is the Training of a limited number of Primary Teachers, both men and women: a department which constitutes a successful and promising beginning of a most important work. But some part of the barrier between primary and secondary education is shortly to be broken down, and the Government is wisely going to insist on a training for Secondary Teachers also. It is important to remember that, for this work, teaching must be provided in all departments of ordinary knowledge, and by no means in the Arts subjects alone; though those no doubt constitute the backbone of the course. Also that methods of teaching the substance of Science (including Mathematics) and Modern Languages, in schools, are less developed and systematised than are the disciplinary methods for drilling in Ancient Languages, Euclid and Algebra. A Professorship is necessary if we are to enter into effective relations with and duly to influence secondary schools.

ENGINEERING.—This science is, even more than chemistry, overweighted with its own applications; so that there is a tendency to regard it solely as an applied science. But it has a large and most important pure-science aspect, *too; and on this side may be considered to consist of Applied Mechanics and Physics; meaning by that, such subjects as Thermodynamics, Elasticity, Strength of Materials, Theory of Mechanism, and much else; not to mention the enormous subject of Electrotechnics—the foundation of Electrical and Telegraphic Engineering; in fact, the ground to be covered is so large that but few Physicists are competent to treat the whole science adequately from an engineering point of view, and so a good deal falls to the province of the Professor of Engineering. At the same time a thorough knowledge of the groundwork of the pure Science of Physics and Mechanics is essential to the training of every engineer who aspires to rise to the higher ranks of his profession.

We have only to run over the aspects of Civil Engineering in its limited customary sense—Bridges and Tunnels, Reservoirs, Canals and Railways; and then to remember Marine Engineering and Military Engineering—to recognise that the whole subject is obviously gigantic. It alone could cover the whole site and employ a dozen professors.

GEOLOGY.—The great science of the earth's crust claims to deal with the constitution and history of the earth as a whole. It is in touch on the one hand with Astronomy—a science which at present we do not here attempt—with GEOGRAPHY, a science which has many aspects, both on the side of nature and on the side of the distribution of man, which are dealt with to a considerable extent by our present Professor of Geology—with MINERALOGY, which he also treats—with PALÆONTOLOGY, the Botany and Zoology of the ancient world, in parts of which he is a world-known authority—with Physics and with Chemistry, more especially perhaps with Physics, for many of the problems are the physics of the earth's crust. All this on the pure science side.

On the side of Applied Science it is in obviously close connection with Mining, with Civil Engineering, with Water Supply and with Agriculture.

HISTORY:—the science of humanity in the past, is closely allied with Sociology and Economics; it is often treated in a more literary manner than most sciences, and hence is sometimes taken for a time by a Professor of Literature; but never satisfactorily so. The whole range of ancient and modern history, of events and institutions and of constitutions, is large enough to demand the attention of several specialists, if the ground is to be adequately covered.

On its practical side it has close relation with Law and with Commerce.

MATHEMATICS:—the science of number and form, in its elementary stage, is an essential ingredient in all education, and hence is partly associated with the Faculty of Arts. In its higher stages it is essential to the Engineer, and is becoming necessary to the Chemist; and for these purposes a more immediately practical course, proceeding more quickly over the rudimentary portions, is desired. In still higher stages it is essential to the Physicist, the Astronomer, and the Natural Philosopher generally. And in its highest stages it constitutes a pure science of unexampled beauty and perfection.

The so-called Applied Mathematics, or Theoretical Mechanics, is closely allied with, and, indeed, trenches upon the mathematical side of Physics; and there is ample room for two or more professors of the different branches of Mathematics. Some day this statement will become practical politics.

MEDICINE:—is the only science which at present is adequately treated in England. A five years' course is devoted to its acquisition; and it is subdivided into a proper number of constituent parts, each dealt with by a special Lecturer.

Besides the three great sciences Anatomy, Physiology, Pathology, with which last at present the developing new science of Bacteriology is associated, there are the great practical Arts of Medicine and Surgery, together with the several branches called respectively Hygiene, Therapeutics, Materia Medica, Midwifery, Gynæcology, Forensic Medicine, Toxicology, Mental Diseases (the Pathological side of Psychology), Ophthalmology, each with a special Professor. Besides these we might have a Lecturer on Diseases of Children, another on the Ear and Throat; and we have seven Lecturers in Dentistry, a branch in which we give special degrees. There is also Pharmacy, including the training of Pharmaceutical Druggists, a branch of work we have not yet undertaken, but for which there is some demand.

Medicine therefore is a model according to which all the great sciences should be subdivided and conquered; and to some extent it is coming to be so in Germany. This country is ignorant of Science: and the administrative and commercial classes are not yet awake to its value.

PATHOLOGY.—This vitally important science used to consist wholly, and still consists largely, of post mortem operations and the study of fresh morbid specimens, with the object of throwing light upon the processes of disease; so that an essential appendage to the subject is its museum of morbid preparations; which indeed subserves also many practical branches of Medicine and Surgery.

A good *Pathological Museum* is one of the most valuable assets of a Medical School, and has been found to be a powerful factor in attracting students, as well as in maintaining the interest of medical practitioners, to whom it may be a considerable aid in difficult cases.

Nowadays the science has been illuminated and almost revolutionised by the discoveries of BACTERIOLOGY; and it bids fair to achieve for humanity the greatest service which on the terrestrial plane can be accomplished, viz., the earlier and surer recognition, the intelligent treatment, and ultimate removal, of many forms of disease.

The science is allied to Physiology, to Chemistry, to Zoology, and to Botany, and it is the root principle of Medicine and Surgery.

Its researches seem likely to open up the tropics to white habitation, thereby greatly enlarging the effective extent of the earth's surface; and, if it progresses as it has recently been doing, it is to be expected that the average duration of human life everywhere may be largely and efficiently prolonged.

PHYSIOLOGY.—This splendid science deals largely with the functions of the human body in health—indeed with organic or vital functions generally, save that those of the lower animals and of plants are generally relegated to the special sciences of Zoology and Botany. It is the Physics and Engineering and Chemistry of live machines. It is closely connected with Anatomy, which concerns itself with the discovery and enumeration of the structures themselves; and on the practical side it manifestly is closely related to Medicine. For a due understanding of the functions of the heart, the liver, the muscles, the lungs, the viscera, the nerves, the brain, the kidney, the stomach, the glands, the eye, the ear, and the other organs of the body, is essential to their proper treatment, whether by hygienic precautions or by remedial drugs; just as an exact anatomical knowledge of their position is the foundation of surgery.

The microscopic branch of Anatomy, called HISTOLOGY, the science of the minute structure of the tissues, is generally at present dealt with by the Physiologist, doubtless because these parts are intimately concerned with the business of secretion and with vital functions generally.

It has recently been customary to equip the Physiologist with a quantity of elaborate Physical instruments, chiefly for a special

study of the phenomena of nerves—in which of late years many discoveries have been made. The electrical concomitants of nervous action have been found very helpful in elucidating the processes and determining their true relations, even if they do not turn out to be themselves an essential part of the process; and accordingly the science demands extensive and expensive equipment.

From the side of the brain and nervous system it is related to the analysis of mental functions in Psychology.

PHYSICS.—Of the science of Physics I dare hardly trust myself to speak: suffice it to say that it is the chief part of Natural Philosophy, the science which covers everything except the treatment of life and mind, and it underlies every other science. It seeks to explain the phenomena of Chemistry and of Physiology, so far as can be done without trenching on the domain of Biology. It is closely allied to ASTRONOMY, it measures sizes and distances, and the chemical constituents of the heavenly bodies. It is concerned with all exact measurements, with weighings and gaugings and surveyings, all geodetic operations, and a great part of Navigation. It includes Meteorology, which is the physics of the atmosphere; it deals with Heat and Light, and Sound, including the theory of Music, with Magnetism and Electricity, with waves and vortices, with the flow of fluids, with the elasticity of solids, with the theory of gases; and it is the foundation of Engineering.

On its practical side it has blossomed in every direction: witness the pump, the barometer, the telescope, the microscope, the photographic camera, the steam engine, the telegraph, the electric motor, the electric light, the X-rays; less obviously in a multitude of other directions.

On its theoretical side it is the most advanced and extensive of the whole of the family of sciences; and a much larger staff is necessary if we are to occupy its territory in even a moderately respectable manner.

In the department of exact measurement and mathematical electrical theory our present Professor of Physics has made for himself a world-wide reputation; and the limits of discovery in a science like this are controlled more by the lack of time and of material equipment than by almost anything else.

PHILOLOGY:—the scientific treatment of language: a comprehensive subject which ranges from a competent understanding of the derivation of words to an interpretation of Hieroglyphics and of Cuneiform inscriptions, to Palæography—or the study of Ancient Manuscripts. It is thus allied on one side to History, Sociology and Folklore, on another side to Ethnology and Archæology. It welds languages into families, and traces their relationships, and on its practical side is a necessary element in the thorough study of any modern language. It is a subject in various departments of which our Professor of Classics and Lecturer in Latin are experts.

PSYCHOLOGY:—may be regarded as the highest of all the biological sciences, being the theory of mind and of mental operations in general; in another aspect it constitutes the fundamental substratum of knowledge, being the study of the processes by which we recognise the external world, and all the facts dealt with by other sciences: it is a study which on its practical side is closely allied with Education, which so far as it is scientifically based must rest upon it. In recent times experimental methods have been applied to the simpler mental operations, thus giving to the subject increasing definiteness and precision; and a large extension of knowledge is being foreshadowed in this direction by the labours of a few, as yet hardly recognised, pioneers.

Moral and Political Philosophy.—On the theoretic side Psychology lies at the base of any sound treatment of the phenomena of will and conduct, the relation of the individual to his social and political environment, the meaning and bearing upon human life of legal and State organisation. The treatment of these subjects has attracted the best minds at the highest stages of social development, both in ancient and modern times, from Plato and Aristotle to John Stuart Mill and Henry Sidgwick.

Logic and Metaphysics.—On still another side Psychology is an introduction to Logic, the science which seeks to analyse the processes followed by the reason alike in ordinary affairs and in the more familiar kinds of scientific investigation, and while offering a practical discipline in logical method and the conduct of the understanding leads in turn to METAPHYSICS or General Philosophy; which may be defined as the examination of the relation of the forms under which we know the world around us—matter, motion, life, intelligence, art, science, religion—to one another, to reality in general, and (under the name THEOLOGY) to the Divine Mind.

ZOOLOGY:—The study of animal life, from the lowest amœba to the highest mammal. On the practical side Zoologists are sent out by the Colonial Office to Ceylon to renovate the Oyster and Pearl Fishery there; by County Councils to study and improve the conditions of the sea-fishing industry round our coasts. The science has an important bearing on many of the operations of farmers, beekeepers, pigeon fanciers and veterinary surgeons; and in the United States a knowledge of many zoological facts, relating to sheep and cattle, as well as to blight, the Colorado beetle, potato-bug, and such like pests, is disseminated among farmers by a series of pamphlets issued by the United States Department of Agriculture. Zoologists are beginning to take their part also with the botanists and pathologists in the extermination of malarial and tropical disease, in which a knowledge of the life-history of the mosquito and such like insects is so important; and already it is coming to be more than suspected, especially in the light of South African enteric experience, that flies and other household insects are specifically dangerous, too.

A knowledge of Elementary Zoology, or at least of Comparative Anatomy and Physiology, is insisted on in every medical school.

The science of Zoology is sometimes sneered at as having to do with grubs, and butterflies, and snails; and so it has; but, though it has made no adequate beginning as yet, the greatest of problems lies before it—or before it and Physiology together—in the future, viz. the elaboration of a theory of the nature of life and death.

CONCLUDING EXPLANATION.

In venturing to name earlier in this pamphlet (see p. 193) such a sum as five millions, I have had in view certain considerations which it may be well to set forth.

First it has been found that the Carnegie donation to Scottish Universities is insufficient to attain its objects, and already it appears likely that it may have to be doubled.

Next it is well known, and indeed painfully familiar to all who have to do with administration, that every new department started, and every new building erected, means an increase of current expenditure and a drain upon resources. Expenditure is called for on behalf of rates, portering and cleaning, heating and lighting, maintenance, depreciation and supersession of equipment, and materials for experiments and processes. There are also annual grants to be made to the Library, to the various Laboratories and Museums, and to departmental Libraries. Then there is a large disbursement for salaries of demonstrators and curators and assistants and technical instructors. All these expenses come out of revenue, and are probably best provided for by the income derived from fees, and from the contemporary support of County and other bodies so as to preserve dependence on the interest of the living generation. But it is highly desirable to keep fees low—not by any means to abolish them, but to keep them low—so as to bring higher education within reach of all who are able to make use of it: a number which, with the improvement of schools, will probably be rapidly increasing. Hence it is probable that the above-mentioned items of annual expenditure will absorb the whole of the ordinary annual income and leave nothing for the payment of the chief Professors and Lecturers. Everywhere it has been found essential that chairs shall be endowed, so as to put them on a permanent and substantial basis; moreover, it is vitally important to be able to attract the best men, wherever they are to be found. At the present time it is not usually possible to compete with other places for the best men unless we can offer a sum comparable to 1000*l.* a year, and in some subjects more.

An invested million will therefore on the average relieve the annual income of the stipends for 30 principal chairs. There must be a large number of Lectureships, or subsidiary and supplemental chairs, and 60 of these at 500*l.* each could be provided with the second million.

The buildings already in progress on the new site are to cost more than a quarter of a million, and the remainder of what has been sketched out and actually contemplated will cost the other three-quarters. Another half million at least will be needed to equip them properly.

The older or central site will also need considerable enlargement, and fresh buildings should rise there. Half a million may be set aside for ultimate building and equipment on and near the Mason College site.

Four out of the five millions are thus accounted for; the fifth is intended for a real attempt at scientific research in all departments. A fund by which men could be sent to any part of the world: to study tropical diseases, or fisheries, or mining possibilities—to investigate either nascent industries or injured industries of any kind; a fund which could equip research laboratories at home, and could defray the expense of researches undertaken on a large or engineering scale, so as to bring in rapidly some practical results. At present there are men who perceive how many things could be reformed or improved, whether in purification of the atmosphere, or in novel modes of locomotion, or in many other ways; but they lack the means to demonstrate their plans or to try experiments. Manufacturers and Municipalities sometimes try experiment on a very extensive scale indeed—a really commercial scale—and in case of failure the resulting experience is over-dear. The endowment would not allow experiments on such a scale as that; considering the variety of subject, the amount available for each would permit of no extravagance. Some of the experiments undertaken would undoubtedly fail, yet the success of a few would far more than compensate for the failure of many, and the activity could not but conduce to progress.

The fund would have to provide, not only the necessary appliances and assistance, but it would endow fellowships for post graduate study, and would attract workers from many parts of the world, and certainly from the Colonies.

One Principal could not possibly supervise all the multifarious activities which we have thus supposed may some day be called into being. There would have to be a Research Principal (whatever he might be called), to organise and superintend the scientific and post graduate study; a Technical Director, in touch with all the technical departments; and an Educational or General Head, to supervise the general scheme of the College in all its various avenues to a degree, and to take a lead in whatever conduced to general culture.

If the scheme is lavish it represents lavishness in the right place. It is the kind of lavishness for which the nation is waiting—one of the few kinds of which hitherto it has been afraid.

> "There is that scattereth but yet increaseth:
> There is that withholdeth more than is meet, but it tendeth to poverty."

These lines refer not to individual wealth alone, but to National wealth also. We have failed to make the most hitherto of the brains and energy of our more able and specially-gifted youth, but have cramped them by the necessity of earning a living: a process wholesome enough for the individual, and right for 999 out of every thousand, but for the remaining one far less repaying to the Commonwealth than the special service which he could render, if set free and encouraged by suitable surroundings for a few years of research, following on a thorough educational preparation. Not all of these would justify their selection: nine-tenths of them even might do only moderately well; but the discoveries of the select tenth would be of incalculable value. The world has been wasteful of its genius hitherto. It thinks too facilely that people exceptionally endowed will struggle to the front somehow. A few do, but a number do not; the conditions are not favourable; and the struggle for existence, though doubtless a stimulating training for the hardier and sturdy virtues, is not the right atmosphere for the delicate plant called genius. Different kinds of treatment are suited to different characters, and the hot-house plant will not thrive in bracing arctic air.

From the Trust Deed with which Mr. Carnegie has endowed a research Institution at Washington with ten million dollars, I extract the following altogether admirable statement of "*aims*":—

"1.—To promote original research; paying great attention thereto, as one of the most important of all departments.

"2.—To discover the exceptional man in every department of study, whenever and wherever found, inside or outside of schools; and to enable him to make the work for which he seems specially designed his life work.

"6.—To ensure the prompt publication and distribution of the results of scientific investigation; a field considered highly important.

. . . "The chief purpose of the founder being to secure if possible for the United States of America leadership in the domain of discovery, and the utilisation of new forces for the benefit of man."

MUTUAL AID.

Mutual Aid, a Factor of Evolution. By P. Kropotkin. Pp. xix + 348. (London: Heinemann, 1902.)

THIS book is undeniably readable throughout. The author has a creed which he preaches with all the fervour of genuine conviction. He is anxious to make converts, but his zeal never leads him to forget fairness and courtesy. Those who disagree with him may learn much by studying the book.

The line of argument is, briefly, as follows. In the case of animals, there is very little evidence of any struggle for existence among members of the same species, though plants, beyond all doubt, jostle their own kin out of existence. Animals are, as a rule, banded together for mutual protection, and those that have the best organisation for mutual defence are those that thrive best. Such species are represented by large, often by countless, flocks. Those that are least sociable, such as the great carnivores, are far less vigorous, to judge by their small numbers, and barely hold their own. The term "struggle for existence" should not, therefore, be used in a literal sense, as if there were an unceasing internecine war between the members of the same species, a limited amount of food available and no individual able to dispel the cravings of hunger except by robbing his own kin and reducing them to starvation. So far from this, we see mutual aid almost everywhere. There is a struggle for existence, but only in a wide, a metaphorical, sense. There is at normal times plenty of food, and there is, therefore, no need for fighting among the members of a species. Rats are a painful exception, and the cries of distress that come from cellars tell of their fights and their cruelty.

Turning to men, we find that mutual aid is, or at any rate has been in the past, even more general than among animals. Among savages, mutual aid is the chief factor in evolution. The individual is never isolated, but is one of a clan. Among barbarians, we find the same tendency to sociability and cooperation, but historians, by dwelling exclusively on wars, have misrepresented the facts. When the clan broke up, men formed village communities. So unwilling were they to fight that they got soldiers to protect them, and in many cases became the slaves of their protectors. The risk of this led to the growth of the mediæval town; it was a union of several village communities for defence against marauders. Within the larger community of the town were smaller associations, the guilds. In these mediæval towns, the arts flourished to an extraordinary degree. Sometimes leagues of free cities were formed, and held their own against all enemies. But in time these little homes of freedom disappeared. The big centralised State arose and crushed out those smaller communities that existed for mutual help. Within the State has sprung up an individualistic civilisation, but even now there is an enormous amount of mutual help. There are benefit societies, cooperative associations, trades' unions.

Moreover, the poor have the habit of constantly helping one another in all their troubles.

In every line of the book you see the eagerness of the writer to make the lives of men happier. So zealous is he that he attributes to the lower animals a benevolence similar to his own. But has he correctly represented the struggle for existence? It is true that he partly succeeds in making good his first contention, that there is not much evidence of a fratricidal struggle between members of the same species. Still, there is a great deal more than he would have us imagine. Rats, he owns, are sad offenders. Can we be sure that the same spirit does not show itself among other animals when a crisis comes? And crises, though Prince Kropotkin does not allow it, are all-important from the point of view of natural selection. Do not cattle in time of drought trample each other to death in their efforts to get what water remains in a pool here and there? Do they not, even in normal times, prod with their horns and bully a weakly member of the herd? Mr. W. H. Hudson, a most unwilling witness, testifies to this. Even maternal affection is strictly subordinated to the needs of the species. I have recently heard of a well-authenticated instance of a kid which was being gored to death by its mother because it was weakly, and it was only saved by being removed from her. Pigeons are very affectionate towards their young, but as soon as the young are able to fend for themselves, the affection comes suddenly to an end, and is often succeeded by a strong tendency to tease and worry.

Prince Kropotkin tells of crabs that worked hard and long to put one of their kind, that had got overturned, right side uppermost. This is indeed a remarkable phenomenon, hard to parallel even among animals a great deal higher than crabs. Swans will drive their young away from their pond. Eagles will not tolerate rivals within a certain radius of their nest. Besides this, there is sexual selection, which often takes the form of selection by battle. I have read Prince Kropotkin's book from cover to cover, and find no mention of the habit, so common among males, of fighting for supremacy. In the index there is no reference to it. Yet sexual selection is an important form of natural selection; its total omission is extraordinary.

Prince Kropotkin certainly succeeds in showing that mutual aid is very frequent among members of the same species. Probably Darwin underrated the amount. But it is because they have formidable enemies that they assist one another. In fact, the struggle for existence is all the keener because they are formed into troops or armies. Mutual aid cannot "eliminate competition" (p. 74). True, it dignifies and ennobles it, but it makes it more intense. Whatever vigour any species possesses results from competition. If civilised men are stronger than barbarians, it is not because they suffer less from competition. The civilised races have gained their strength in the stress of the struggle for existence, and they retain much of it because there is still a struggle against cold, want and disease. The struggle against physical conditions is the only one that Prince Kropotkin recognises as normal and natural. As for lions and tigers, he deprecates their existence; in his eyes, they have no *raison d'être*. Yet they may claim the credit of having developed the habit of mutual aid among the ruminants. What need for mutual defence if there are no enemies? Birds of prey in the same way have fostered cooperation among the members of the species on which they make their raids.

As to the comparatively small numbers of the carnivorous animals, we need not attribute this, as our author does, to their want of cooperation. It is a question of food supply. Plants are more abundant than animals because they live on inorganic food, and that is plentiful. All animals require protoplasm that has been prepared for them by vegetables. This introduces a limitation of the food supply. The flesh-eaters must have it still further prepared by the vegetable feeders. Were there yet another class of animals that could subsist only on the flesh of carnivores, they would be still fewer in number than the class on which they preyed. Prince Kropotkin seems unaware of the influence of one species upon another. The keen eye of the falcon and his splendid swoop have necessitated counter developments in the species among which he seeks for his victims. Mere physical conditions, seldom changing, would never have brought about the evolution of the noblest forms of life. This could only be achieved through the interaction of competing species. The advance of one—the gain of keener sight, of greater speed or greater courage—has necessitated a corresponding advance in others.

Prince Kropotkin's failure to grasp this prevents him from understanding the growth of civilisation. His creed does not allow him to understand that the clan, the village community, the mediæval city, all derived their vitality from the fact that they had enemies to contend against. War necessitates loyalty and cooperation, as our author, at least in one passage, owns, and yet he will not allow that it has played any good part in evolution. The passive friendliness of all law-abiding citizens towards one another and the efficiency of the police prevent cooperation from being what it once was. It is only the largest cooperative association, the State, that can evoke enthusiastic loyalty and devotion, and this is, obviously, because nations have not yet done with war. If the law did not prevent active hostilities between trading associations, we should soon see institutions similar to the mediæval cities arising. Moreover, our philanthropic principles hinder us from bringing that pressure to bear upon the idle and corrupt which was essential to the successful working of the old guilds. Prince Kropotkin tells us that "the craft organisation required, of course, a close supervision of the craftsmen by the guild." An idle member might be ejected, and his fate would, probably, be far worse than that of the modern idler who tramps from workhouse to workhouse. It is not in benevolence we fail so much as in the sternness that is wanted for the proper treatment of the dregs of society. There are many persons whom society can only help by compelling them to help themselves. And such drastic measures Prince Kropotkin does not seem to recommend. He would abolish individualism. But how would he make the loafers, who will not work for themselves, bestir themselves on behalf of an association?

F. W. H.

THE FORESTS OF UPPER INDIA.

The Forests of Upper India and their Inhabitants. By Thomas W. Webber. Pp. xvi + 344; with 2 maps. (London: Edward Arnold, 1902.) Price 12*s.* 6*d.* net.

THE title of this interesting book is somewhat misleading. In the first place, the author deals with only a fraction of the forests of Upper India, namely those of the districts of Kumaon (with a visit to Thibet), Gorakhpur (with a dash into Nepal), Jansi, Bundelkund, and the northern part of the Central Provinces. In the second place, he gives far more information regarding the inhabitants, whether men or animals, than of the forests themselves. Indeed, the information regarding the latter is very sketchy and not up-to-date. What the author does say in this respect refers to a state of things existing some thirty-five to forty years ago, and we have now far more complete accounts than those contained in this volume. Nor is the information in this respect always very accurate. On p. 38, for instance, he gives the area of the Kumaon hill forests as 15,000 square miles, while the whole district in which they are situated is given as 150 miles long and 100 broad, which also comes to 15,000 square miles. At p. 184, on the other hand, the area of forests surveyed in Kumaon is said to amount to 1074 square miles. Again, at p. 41, it is stated that the silver fir grows on the northern slopes at an elevation of 12,000 feet, whereas that is practically the upper limit, the tree being usually found between 8000 and 12,000 feet. On p. 194, the author says that Sal is found in the Mysore hills and Tenasserim. This may have been believed fifty years ago, but it has long since been found that the southern tree is not Sal, but another Dipterocarp. Of Deodar, the most important tree of the Himalayas, we hear very little.

The information given of the forests serves, as a matter of fact, only as a frame, into which the author places the description of his travels, *shikar*, or sport, and enumeration of animals which he has met. This account will, we feel sure, interest many readers. The author despises ordinary shooting as now practised in these islands, but he loved stalking interesting animals, especially big game, in many of the out-of-the-way places which he visited between the years 1861 and 1871. He also gives an animated account of various wild or uncivilised tribes and their manners and customs. One of the most interesting parts of the book is, no doubt, that in which he tells us that, just inside Thibet, he came across the descendants of the famous Huns, which overran the greater part of Europe some 1500 years ago. Whether his surmise is correct or not, we shall not risk to say, but from the description which he gives of the present-day Huns, it is clear that these must have greatly degenerated since the sojourn of their ancestors in Europe.

The author's account of the animal life in the districts which he visited is very full and is told in an attractive manner. At the same time, we think that literary license and colouring have been employed in a somewhat excessive manner. It is quite wonderful to read of all the different kinds and numbers of quadrupeds and birds which our author has seen and, in many instances, shot. We cannot do better than give an extract from the chapter headed "The Bori Forest" (pp. 299-303):—

"The glory of the village was an immense banian-tree, standing alone and covering half an acre of level ground. . . . This great fig tree is in itself a whole aviary, affording both shade and figs, and insects and grubs, and safety from numerous enemies of the hawk tribe. There is the golden oriole (*Oriolus kundoo*), which makes a melodious whistle very like the ring of glass, short, single, and descending two octaves . . . Many little squirrels . . . came skipping and cocking high bottle-brush ringtails. . . . Among the thick, shiny leaves there is a sparkle of canary-yellow and bright scarlet; this is the female and male minivet or cardinal bird. There are many kinds of woodpeckers, which tap on the stems and screech. A dark-greenish bird sits in the shade—the koel. He makes the grove resound with his frantic cry, 'I've lost my shirt.' . . . The air is full of swifts and swallows, darting ever after insects. . . . At no time or place is there an interval in the wheeling of long-winged kites high overhead. . . . Towards evening . . . a little owl says 'Piu!' from the recesses of the many air-roots which hang overhead. Then . . . a hundred green paraquets screech all together. . . . There are flocks of the common large green paraquet, the smaller rose-collared *tota*, and many kinds of plum-headed paraquets, and slaty-headed and red-breasted parrots of all sizes. . . . There are notes of various owls . . . the purring also of the goatsucker. . . . Stag-beetles drone as they swing by, and cockchafers and the cicadas in the trees keep up a creaking which seems always in the air, and there is never silence."

Who would not like to see such a banian-tree and to sit under it and watch the variety of life here depicted by the author?

Men with a more practical turn of mind would perhaps fasten on another very short passage in this chapter (pp. 309-310), where it is said:—

"The complete exclusion of jungle fires, which had been successfully carried out for some years previously, certainly showed its effect, as fine saplings, grown from seed, of teak and other sorts were plentiful through the forest."

The author dismisses the subject with these few words, and yet this operation was of immense importance, as the protection from fire of the Bori Forest in the Central Provinces was the first thoroughly successful experiment of the kind, continued over some forty years. It was the beginning of a system of successful fire protection now carried on in all Indian provinces, a system which gives protection to some 30,000 square miles of the more valuable Indian forests. One of the greatest achievements of the Indian Forest Department is the success with which such extensive areas of valuable forests are now protected from the devastation formerly wrought in them by the annual forest fires. Whoever may have started the idea, so much is certain, that the officer who was the first to be thoroughly successful in this great work is Colonel Pearson, at that time Conservator of Forests in the Central Provinces.

In the appendix, the author gives us his ideas of "the scientific management of forests," and he winds up by reading a lecture to the Government on the neglect which forestry has met with in these islands. The author draws attention to the serious consequences which are likely to arise if something substantial is not done at once in augmenting the wooded area of Great Britain and

Ireland, as well as in introducing some rational system of management into the forests of the colonies. Let us hope that his words will fall on fruitful ground.

In conclusion, we cannot omit expressing our admiration for the cheerful way in which the author went through most fatiguing journeys and the healthy tone of his remarks on the love of nature. We feel sure that the attractive way in which the book is written will secure for it many readers.

THE ASCENT OF MIND.

Mind in Evolution. By L. T. Hobhouse. Pp. xiv + 415. (London: Macmillan and Co., Ltd., 1901.) Price 10*s.* net.

IN this able and thoughtful work, Mr. L. T. Hobhouse distinguishes five stages of correlation in the ascent of mind, from the first glimmerings of consciousness in some lowly organism of primeval times to the systematic thought of the man of science or the philosopher and the intuitive insight of the poet or artist. The first of these, placed in a category by itself, is the pre-intelligent stage, wherein there is an indirect correlation of experience, reaction and welfare before intelligence (which is defined as the capacity of the individual to learn from experience) comes into play. The behaviour of the organism is, at this stage, the outcome of inherited structure, and if any variation of structure secures a more suitable response, that is, one better adapted to preserve the organism or its offspring, such a structure would tend to be "selected," since the individual in which it occurred would have an advantage in the struggle for existence. In this way, inborn tendencies to a given method of response may be correlated with the past experiences of the race.

It will be noticed that the word "experience" is here used in a non-psychological sense. Instinctive reactions are the culminating products of this stage of pre-intelligent development. Above and beyond this comes the comprehensive category, the second of the two which Mr. Hobhouse distinguishes, wherein the correlation is based on individual (psychological) experience. This category comprises four stages; first, that of the unconscious readjustment, where the pleasure or pain consequent upon instinctive or random response to stimuli modifies subsequent reactions in a manner determined by the nature of the feeling; secondly, that of concrete experience and the practical judgment. Here behaviour becomes purposive, and the appearance at this stage of actions definitely directed to, and determined by, the ends which they serve, is regarded by Mr. Hobhouse as perhaps the most critical moment in the evolution of mind. In purposive action, so far as it is purposive, there is no fixed habit, but the response to the surroundings is determined by the effect which it will have in the particular case; that is to say, by the relation between act and consequence. Hence the organism at this stage does not respond uniformly to similar surroundings, but takes into account anything that, though outside the range of immediate perception, is relevant to the object to be attained. Within this stage are reached the limits of animal intelligence.

The connection between the perceived relation and the action based on it remains, however, unanalysed. The steps by which this bond of connection is analysed out as a distinct content of thought lead us to the third stage, that of conceptual thinking and will, and of the correlation it involves, language, both as cause and effect, is the central feature. In scope, the correlation that is now made possible is immeasurably widened. In the conceptions of this stage, thought first finds itself possessed of contents set free from the line of practical interests and also from strict conformity to the perceptual order. In this way a "world of ideas" is formed, going beyond as well as behind experience, and the conceptions which people this world form ideal schemes to which grouped experiences may be referred. Conduct is adjusted to meet the requirements of self or others as persons, of society as an abiding structure, or of morality as a system of universal rules. In fine, the correlation is now between the focussed results of connected bodies of experience and broad purposes of life or general standards of conduct.

The fourth and last stage—that of rational system—arises when the formation of a coherent, self-supporting, exact and exhaustive body of knowledge begins to be an explicit object of mental effort. The stage would be complete when such a system should embrace the conditions and possibilities of evolution, and should reach a complete synthesis of reality as a whole.

Such, stated for the most part in his own words, is a summary of the successive steps which Mr. Hobhouse traces in the ascent of mind. His work is characterised by breadth of view, logical development and fertility of illustration. It is an earnest attempt to grapple honestly and fairly with difficult problems in a spirit of serious investigation. Personally, I am of opinion that Mr. Hobhouse's psychological stages one and two—those of unconscious readjustment and of concrete experience—are much more closely related than is concrete experience to conceptual thinking, which again shades off into that of rational system. Dr. Stout's broader division into perceptual and ideational phases of mental development seems preferable. Within these might fall Mr. Hobhouse's subdivisions. The generic differences between the broader categories are not difficult to trace; but the specific differentiation of the subgroups is a less easy matter and one which leaves room for more difference of opinion.

A noteworthy feature of Mr. Hobhouse's work is the careful record of observations conducted under experimental conditions on cats, dogs, a rhesus, a chimpanzee, a seal and an elephant. His method seems preferable to that of Dr. Thorndike, since the conditions are less cramping to the intelligence; and though his interpretation is in some cases open to criticism, his honesty of purpose is unquestionable. If, making due allowance for differences in the usage of technical terms, for diversities of outlook, in a word, for the personal equation, we compare his results—for example in the study of monkeys—with those of Dr. Thorndike and of Mr. Kinnaman, we cannot but be struck by the large measure of agreement that may be found in views which, to some readers of their works (and perhaps still more to the writers themselves), may seem divergent. C. LLOYD MORGAN.

SCOTTISH GEOLOGY.

The Geology of Eastern Fife. By Sir Archibald Geikie, D.C.L., F.R.S. Memoirs of the Geological Survey, Scotland. Pp. xv + 421; with map, 12 plates and 71 figures in the text. (Glasgow, 1902.) Price 8*s*.

IT is not given to every author of a Geological Survey memoir to write an interesting as well as instructive volume. Too little attention has been paid to style and composition, while the necessity for recording many and often dry facts has had a tendency to obscure the philosophy of the subject in many of the official publications.

When, however, as in the present instance, the information is conveyed in a pleasant style and in well-chosen language, we feel that the science is placed on a higher level and that the task has been performed in no perfunctory spirit, but with the desire to make art a companion of science.

Sir Archibald Geikie has occupied much of his leisure time since he retired from the Geological Survey in writing a memoir on the geology of eastern Fife, which may be regarded as a sequel to his "Geology of Central and Western Fife and Kinross," published two years ago. He conducts us now eastwards into a region perhaps fuller of geologic interest. Composed mainly of Old Red Sandstone and Carboniferous rocks, it is diversified by the occurrence of contemporaneous eruptive rocks in both systems and by the further evidence of later igneous action, probably for the most part of Permian age, in numerous volcanic vents—necks or chimneys—filled with tuff or agglomerate, and in sills and dykes of dolerite and basalt. As the author points out, there is hardly any other region in Britain where lessons in practical geology could be better taught. On the coast, the rocks have been dissected and washed clean and bare by the tides, and they afford illustrations of stratification, jointing, curvature, intrusion and other characteristic structures of the earth's crust. Fossils in great variety are found in many of the strata. The Old Red Sandstone of Dura Den is a classic locality, one of the chief repositories of the fishes such as Bothriolepis, Phyllolepis and Holoptychius. In the Carboniferous rocks, there are banks of corals and crinoids in the marine limestones, shales with ostracods and bone-beds with fish-remains in the estuarine strata, and plant remains with erect and prostrate tree-trunks in the more distinctly terrestrial deposits. A general list of all the fossils has been drawn up by Mr. B. N. Peach, who acknowledges the help received from several specialists.

Workable coal has locally been found in the Calciferous Sandstone Series, but the chief development of this mineral is in the Carboniferous Limestone Series and in the Coal-measures. Full particulars of these strata are given.

The author's attention is naturally attracted to the eruptive rocks, and more especially to those which have invaded the Carboniferous strata. The sills form a remarkable group ranging from a few inches to masses more than 100 feet thick that form prominent ranges of hills. They are nearly all dolerites. The distinctive feature in the geology of eastern Fife is, however, the series of volcanic necks, of which about eighty have been observed; and, as the author remarks,

"they furnish an unrivalled body of material for the study of phenomena in the structure of volcanoes which are inaccessible at the active vents of to-day."

They

"mark the sites of former volcanic orifices by which egress was obtained to the surface for highly heated vapours, gases and other materials from the interior of the earth."

Notes on the petrography of the igneous rocks are contributed by Dr. J. S. Flett and Mr. H. J. Seymour.

Many other topics of interest are dealt with by the author, such as the glaciation, as evidenced by the ice-worn rock surfaces, the Boulder-clay and the Kames. The raised beaches and submerged forests likewise claim attention, and there is an instructive chapter on the latest geological changes in which the famous Links of St. Andrews and other places are duly described.

The work is illustrated by a clearly printed geological index map and numerous excellent pictorial views and sections.

ELEMENTARY MENSURATION.

Elementary Plane and Solid Mensuration, for use in Schools, Colleges and Technical Classes. By R. W. Edwards, M.A. Pp. xxx + 304. (London: Edward Arnold, 1902.) Price 3*s*. 6*d*.

THIS book begins with an explanation of the nature and use of logarithms, followed by that portion of trigonometry which deals with a single angle and the application thereto of logarithmic calculation. Then comes a short chapter on calculations relating to parallelograms, and this is followed by one on triangles, wherein there is such further development of trigonometry as is required for the solution of triangles from the usual data. After this, rectilinear figures are treated of in the order of simplicity—trapeziums, regular polygons, &c. We have then a very useful little chapter on similar figures of various kinds, illustrated by a considerable number of numerical examples, followed by one on irregular rectilinear figures in general. Next follow calculations relating to the circle, illustrated by nearly ninety examples. Modern demands for the employment of squared paper and graphic representation are satisfied by a short chapter on graphs, and this leads to an exposition and application of Simpson's rule. After this comes the treatment of solids in the order of simplicity, and all the well-known rules are proved and illustrated by numerous examples. No rule is given without the proof, the author saying in his preface that

"students of elementary mensuration are frequently obliged to be content with a mere statement of the rules employed and with working out examples on these rules."

This was, no doubt, true of treatises written thirty or forty years ago, but it has ceased to be a true criticism of recent works. The mensuration of solids concludes with a long chapter on the sphere which will be a help to the student in his study of spherical trigonometry.

It will thus be seen that this book contains all that is necessary for the ordinary work of the surveyor and the engineer, and that, as regards the amount of knowledge

of logarithms, algebra and trigonometry required as a preliminary, the work is self-contained.

The author says in the preface that he would "like to have added chapters on surfaces of revolution, centroids and radii of gyration"—subjects which are usually confined to treatises on the integral calculus. It is high time, however, to take them out of the exclusive control of the severe exponents of pure mathematics and to bring them more into contact with practical needs by means of arithmetic. More especially is this true with regard to what are called "moments of inertia"—a term so wide of the thing intended to be signified that it is a perpetual stumbling-block to perception in the mind of the average student. What can be the meaning of the "moment of inertia" of a mere *area* about an axis? Is not the notion of a *mean square of distance*, whether of a material body or of a mere area, from an axis something the nature of which is more readily grasped and firmly retained than the ordinary term *square of the radius of gyration?* The *square root of the mean square of distance* is what is universally called the "radius of gyration." No doubt, the expression sounds strange at first to the student, but the strangeness rapidly wears off; and the notion of a *mean square*, whether of distances or of velocities, is one which so often occurs in various branches of physics that benefit to the student would result if a "radius of gyration" were presented to him in this way. The notion is one which preeminently lends itself to arithmetical illustration and treatment; it is found, for example, to work admirably with certain engineering students, and we commend it to the consideration of Mr. Edwards when he prepares the second edition of his useful work.

OUR BOOK SHELF.

Traité encyclopédique de Photographie. Third supplement. By Charles Fabre. Pp. 423. (Paris: Gauthier-Villars, 1902.) Price 10 francs.

THIS supplement constitutes the seventh volume of Prof. Fabre's work, and covers the period from the date of the second supplement, 1897, to May of the present year. On turning over its pages, one cannot but be struck by the very large amount of space devoted to apparatus. More than 230 pages are so utilised, while negative making has but 54, direct printing methods 41, and photo-mechanical methods 11. It is needless to add that while lenses, cameras, shutters, &c., are dealt with in full detail, the progress of photography itself is inadequately treated. Some important matters, concerning which one would naturally turn to such a work as this, are omitted, and others are only referred to. This tendency to neglect photography for the sake of photographic apparatus is more or less general in the larger treatises on the subject; perhaps, therefore, this kind of manual best meets the general demand. But it is difficult to understand why the photographic student should desire a full technical description of every variety of objective and be satisfied with little more than a popular summary of work done in the science itself. We know of no treatise that gives any approach to a complete survey of the science of photography. And seeing that the present position of the science is so largely due to work done during the last ten, or at most about twenty, years, the need for a comprehensive treatise written from our present standpoint is obvious.

The character of Prof. Fabre's work is too well known and appreciated to call for detailed reference in connection with a supplement. The author might perhaps have been a little more up to date in some respects. He might, for example, have stated that the Royal Photographic Society has at last withdrawn its unit of *f*/4 for lens apertures and recognised that the natural unit is *f*/1. On the other hand, he could not have recorded the similar step taken by the International Congress of Paris, as their acceptance of the natural unit was not announced until after the first part of the supplement was published. The table at p. 43, showing the various series of empirical numbers that have been used for indicating apertures, is therefore now almost wholly a matter of history.

Astronomy Without a Telescope. By E. Walter Maunder, F.R.A.S. Pp. xii + 272. (London: *Knowledge* Office, 1902.) Price 5*s.* net.

BY collecting these papers on "Constellation Studies," "The Zodiacal Light," and other subjects for the amateur astronomer, Mr. Maunder has directed attention to many interesting observations which can be made without instrumental aid.

The book is divided into three sections, (1) constellation studies, (2) astronomical exercises without a telescope, and (3) astronomical observations without a telescope; and it is illustrated by 44 charts and photographs, and 12 excellent star maps. The object of the book is to encourage naked-eye observations, and this is kept in mind throughout, though for some parts of the subject an ordinary field-glass is allowed.

In "Constellation Studies," the reader is introduced to the constellations and their units, an intimate knowledge of which the author counts a *sine qua non* in the prosecution of the exercises and observations mentioned in sections ii. and iii. This instruction is given in a readable and interesting form, and seems to deal with all the objects which are of interest to a naked-eye astronomer. With the aid of frequent quotations from Aratus and some of the ancient rhymesters, the historical and mythological allusions to constellation and star names are explained in an instructive manner.

In sections ii. and iii., the observer is given assistance for the *scientific* observation of some ten different astronomical phenomena. For instance, in the chapter on "Meteors," a list of questions is given which observations of the meteor should answer, and, further, the unnecessary, but usual, complicated remarks are indicated. In the chapter on "Auroræ," also, there are hints on what to look for and what to note; whilst such suggestions as an apparent connection between the apex of the "Zodiacal Light" and the Pleiades will encourage amateur astronomers to make patient and persistent observation. The chapter on "New Stars" indicates another field of possible usefulness.

With the exception of the introduction of "Columbia" for "Columba" on map 12, the book seems to be free from typographical errors, but we would express a regret that the names of the letters of the Greek alphabet, when used to designate a star, were not printed in a different type from that used for the *proper* names of the stars, because, despite the explanation of the alphabet given as an appendix, this is likely, at first, to form a stumbling-block to readers who are not familiar with the names of the Greek characters.

Aids to the Analysis and Assay of Ores, Metals, Fuels, &c. By J. J. Morgan, F.I.C., F.C.S. Pp. viii + 105. Students' Aids Series. (London: Baillière, Tindall and Cox, 1902.) Price 2*s.* 6*d.*

THIS little book is intended for the use of students and others to whom the more expensive standard works on analysis and assaying are inaccessible. It is entirely devoted to quantitative estimations, and some two hundred methods are concisely described. It contain

the assay of the ores of gold, silver, copper, lead, tin, zinc, iron, manganese and chromium, and the estimation of the impurities usually met with in these metals. There are also sections devoted to the analysis of fluxes, refractory materials, slags, fuels, &c., and of white alloys, iron alloys and copper alloys. This enumeration is enough to show that an enormous amount of ground is covered, and in such a small book there is, of course, no room to explain the principles on which the directions are based. The directions themselves, however, are clear and generally accurate. Among the mistakes and omissions which have been noticed, the neglect to re-oxidise the lead reduced by the filter-paper in the ignition of lead sulphate and an erroneous method of calculating the gold contained in ores may be mentioned. The modern method of adding zinc acetate instead of soda and acetic acid in the iodide copper assay is not mentioned, and electrolytic methods generally are ignored. The book should be useful to students in polytechnics and other evening schools.

First Stage Mathematics. Edited by W. Briggs. Pp. vii+186. (London : Clive, 1902.)

THIS volume of "The Organised Science Series" deals with the geometry and algebra required for Stage i. Mathematics in the South Kensington examinations. In section i., the text of Euclid i. is strictly followed, with occasional notes and explanations. Useful summaries of the propositions are given, also several sets of easy exercises and a number of miscellaneous riders. A few additional propositions are proved, and hints are given on writing out proofs.

In section ii. (algebra), in one or two places the reasoning does not appear quite satisfactory. For example, on the sign of a product, on p. 21 :—"Suppose $+2\times-3$ or $-2\times+3$. Evidently the product will not be the same in either of these cases as in $+2\times+3$. Therefore we assume that $+2\times-3=-6$ and $-2\times+3=-6$. *Therefore, when one term has a plus sign and the other term has a minus sign the product is minus.* Again, suppose -2×-3. This is different from the last two cases, and we assume that $-2\times-3=+6$. Therefore, when two terms with minus signs are multiplied together the product is plus. From these results we can infer the rule of signs." A statement of this kind almost inevitably tends to fog the mind of a student.

The use of the word *sum* (as on p. 52) in any other than its exact algebraic meaning, in a text-book for beginners, is objectionable.

There are numerous easy exercises in algebra, also arithmetical questions from previous papers.

The book is well printed, and the figures in the geometry are clearly drawn.

Preparatory Lessons in Chemistry. By Henry W. Hill. Pp. v+122. (London : Allman and Son, Ltd.) Price 1*s.*

THE order of treatment in this little book represents the method of teaching chemistry more common twenty years ago than now. Before being set to examine for himself easy familiar chemical changes in a scientific manner, the beginner is expected by the author to be able to understand such subjects as atoms and molecules, formulæ and equations, and similar matters much more suitable for students at a later stage of work. Several better books for beginners in chemistry are available.

My Dog Frizzie and Others. By Lady Alicia Blackwood. Pp. 44. (London : Operative Jewish Converts' Institution). Price 4*d.*

THESE are simple, interesting stories concerning the habits and character of a pet dog. The tales may encourage children to study animals intelligently.

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.*]

Sound Waves and Electromagnetics. The Pan-potential.

THE photographs taken some years ago by Prof. Boys of flying bullets showed the existence of a mass of air pushed along in front of the bullet. Is there anything analogous to this in the electromagnetics of an electron? Suppose, for example, that an electron is jerked away from an atom so strongly that its speed exceeds that of light. Then it will slow down by reason of the resisting force to which I have shown it is subjected. So long as its speed is greater than that of light, it is accompanied in its motion by a conical wave. The question is whether there is any disturbance ahead of the electron, close to it, as in the case of a bullet moving through the air. It is a question of fact, not of theory. When Maxwell's theory shows that there is no disturbance in front of the electron, that is only because it is virtually assumed to be so at the beginning, by the assumption that the ether continues fixed when the electron traverses it.

Apart from this detail, the analogy between the conical sound wave and the conical electromagnetic wave is interesting in connection with C. A. Bjerknes's theory of pulsations in a liquid, as developed by V. Bjerknes in his "Vorlesungen über hydrodynamische Fernkräfte nach C. A. Bjerknes' Theorie." The liquid is incompressible, and is set into a pulsating state by pulsating sources, and the result shows remarkable analogies with electric and magnetic phenomena when they are static.

Now if the liquid is compressible, the results must be approximately the same provided the pulsations are not too quick. But if very rapid, and the compressibility be sufficient to lower the speed of propagation sufficiently, new phenomena will become visible with pulsating sources, like sound waves, and the question is how far they are analogous to electromagnetic phenomena?

Here, for example, is an interesting case. Let f be the density of the source, such that (if $q=d/d_t(vt)$),

$$(\nabla^2-q^2)\mathrm{V}=-f \qquad (1)$$

is the characteristic of the velocity potential V, so defined that $-\nabla\mathrm{V}$ is the velocity. Then f signifies the amount of fluid (unit density) generated per unit volume per second and diverging outward. Then, for a point source of strength Q, the V it produces is

$$\mathrm{V}=\frac{\epsilon^{-qr}}{4\pi r}\mathrm{Q}=\frac{\mathrm{Q}(t-r/v)}{4\pi r}, \qquad (2)$$

at distance r. This is equivalent to Rayleigh's account of Helmholtz's spherical waves from a centre ("Theory of Sound," vol. ii.), except in the interpretation of f or Q, which I do not altogether understand in that work.

Q is a fluctuating function of the time in the above in the acoustic application, though, of course, fluctuation is not necessary in the ideal theory. Now if the source Q moves through the air with velocity $\mathbf{u}$, the potential becomes

$$\mathrm{V}=\frac{\mathrm{Q}}{4\pi r\{1-(u/v)\cos\theta\}}, \qquad (3)$$

if θ is the angle at Q between $\mathbf{r}$ and $\mathbf{u}$ at the proper moment.

This equation therefore expresses the theory of a very small pulsating source moved through the air, and is so far very like that of an electric charge Q (which does not pulsate) moved through the ether. The analogy does not continue in details, when, for example, we compare velocity with electric displacement. The electromagnetic theory is more involved.

When u exceeds v, equation (3) is no longer the complete solution. If u is less than v, there is just one and only one position of Q at a given moment where it is, so to speak, in communication with P, the point where V is reckoned. But when $u>v$, there may be just one point, or two, or there may be any number. Thus, if the source Q starts at moment $t=0$ from a certain point, and then moves steadily in a straight line, the wave front is conical, with a spherical cap, or spherical, with a conical spike, Q being at the apex. If P is

inside the sphere, there is only one position for Q. But if P is inside the cone, there are two. The value of V at P is the same for both, given by (3) reckoned positive always. So the real V at P is double as much.

If the speed varies, the values of u will usually be not the same in the two positions, so the two partial V's must be separately reckoned. But the speed and path may vary in such a way that there are more than two positions of Q which are the centres of waves which all arrive at P at the same moment.

When there are any number of electrons moving about in given paths, the following will give a broad idea of the nature of the problem. To find V at a fixed point P at the moment t. Let at that moment a spherical surface expand from P at speed v, not forward in time, but backward. In expanding from radius 0 to ∞, it will cross the electrons one after another. Take note of the times of passage, t_1, t_2, &c. (less than t), of the charges and their velocities. Then

$$V=\Sigma\frac{Q}{4\pi R\{1-(u/v)\cos\theta\}}, \qquad (4)$$

where $R_n=v(t-t_n)$, and θ_n is the angle at Q_n between $\mathbf{R}_n$ and $\mathbf{u}_n$. Similarly as regards the vector potential.

When u is allowed to exceed v, the effect is to increase the number of crossings of electrons. An electron crossed twice counts as two electrons.

The value of i_n is $\{1-(u/v)\cos\theta_n\}^{-1}$. The vector $\mathbf{u}_n$ is the real velocity of Q_n at the moment t_n. Its apparent velocity, as viewed from P at the moment t, is $\mathbf{u}_n i_n$ or $-\dot{\mathbf{R}}_n$. It has no necessary resemblance to the real velocity, and may be positive or negative. The dot here signifies differentiation to t at P.

Talking of potentials, I am tempted to add a few words about their King, the Pan-potential. In equation (1) above, let q be not $d/d(vt)$, but any sort of complex time differentiator, for example, if $p=d/dt$,

$$q^2=(k+cp)(g+\mu p),$$

which is the special form for electromagnetic waves in a conductor. Then (2) is still the solution for a point source, and in general

$$V=\Sigma\frac{\epsilon^{-qr}f}{4\pi r}=\text{pan}\,f \qquad (5)$$

is the pan-potential due to the distributed source f. It is not the complete solution, because e^{qr} has not been counted; but that is not wanted when there is no barrier to reflect.

For instance, if $\mathbf{C}$ is *impressed* electric current, in a conductor, the characteristic of $\mathbf{H}$, magnetic force, is

$$(\nabla^2-q^2)\mathbf{H}=-\text{ curl }\mathbf{C}. \qquad (6)$$

It follows by the above that

$$\mathbf{H}=\text{pan curl }\mathbf{C}, \qquad (7)$$

that is, the magnetic force is the pan-potential of the curl of the impressed current. The operations pan and curl are interchangeable, so

$$\mathbf{H}=\text{curl pan }\mathbf{C}, \qquad (8)$$

i.e.,

$$\mathbf{H}=\text{curl }\mathbf{A}, \qquad \text{if} \qquad \mathbf{A}=\text{pan }\mathbf{C}.$$

(Similarly ∇ pan = pan ∇, and div pan = pan div.)

I worked out this problem for a fixed point source of impressed current some time ago ("Elec. Pa.," vol. ii. p. 432) without reference to the pan-potential. The operational solution there given, equation (258), represents either (7) or (8). The algebrisation was also done. There is no advantage in using the $\mathbf{A}$ function in this particular case; it is, in fact, more difficult to find $\mathbf{A}$ first and then derive $\mathbf{H}$ than to obtain $\mathbf{H}$ without $\mathbf{A}$. Similarly as regards $\mathbf{E}$, the electric force. The second circuital law derives it from the $\mathbf{H}$ equation, so that it is not required to introduce Φ to supplement $\mathbf{A}$.

If the point-source is in motion, the pan-potential requires Dopplerisation as well as the ordinary potential. But this does not require explicit representation for continuously distributed sources. For example, the electromagnetic circuital equations

$$\text{curl }(\mathbf{H}-\mathbf{h})=\mathbf{u}\text{ div }c\mathbf{E}+(k+cp)\mathbf{E}, \qquad (9)$$

$$\text{curl }(\mathbf{e}-\mathbf{E})=\mathbf{w}\text{ div }\mu\mathbf{H}+(g+\mu p)\mathbf{H}, \qquad (10)$$

where $\mathbf{u}$, $\mathbf{w}$, $\mathbf{e}$, $\mathbf{h}$ are functions of position and time, have the solutions

$$\mathbf{E}-\mathbf{e}=\text{pan }\mathbf{X}, \quad \mathbf{H}-\mathbf{h}=\text{pan }\mathbf{Y}. \qquad (11)$$

To prove this, and determine the nature of $\mathbf{X}$ and $\mathbf{Y}$, it suffices to put the characteristics of $\mathbf{E}-\mathbf{e}$ and $\mathbf{H}-\mathbf{h}$ in the form (1), q^2 having the more general later meaning. Now (9) and (10) lead to

$$(q^2-\nabla^2)(\mathbf{E}-\mathbf{e})=-\nabla\rho-\text{ curl }\mathbf{G}-(g+\mu p)\mathbf{C}, \qquad (12)$$

$$(q^2-\nabla^2)(\mathbf{H}-\mathbf{h})=-\nabla\sigma+\text{ curl }\mathbf{C}-(k+cp)\mathbf{G}, \qquad (13)$$

where

$$\rho=\text{div }(\mathbf{E}-\mathbf{e}), \quad \sigma=\text{div }(\mathbf{H}-\mathbf{h}), \qquad (14)$$

$$\mathbf{C}=\mathbf{u}\text{ div }c\mathbf{E}+(k+cp)\mathbf{e}, \qquad (15)$$

$$\mathbf{G}=\mathbf{w}\text{ div }\mu\mathbf{H}+(g+\mu p)\mathbf{h}. \qquad (16)$$

So $\mathbf{X}$ and $\mathbf{Y}$ are the right members of (12) and (13) as defined. $\mathbf{C}$ is the impressed electric current, $\mathbf{G}$ the impressed magnetic current. It will be seen that no separate determination of scalar potentials is required, because they are already included in $\mathbf{X}$ and $\mathbf{Y}$.

OLIVER HEAVISIDE.

Recent Dust Storms in Australia.

ON November 11, 12 and 13, 1902, New South Wales and Victoria experienced severe dust storms, apparently caused by a mild cyclone travelling from the west, as the dust reached here yesterday morning, the wind at the time being very light. The atmosphere was so loaded with fine dust that the sun looked dim and objects less than a mile away were quite indistinct, and all furniture, even with doors and windows closed, became coated with a fine grey deposit.

Reports from vessels coming along the coast say that the sea had a peculiar leaden colour; and a remarkable appearance was seen in Sydney Harbour yesterday morning. Crossing the harbour from the north to the south side, immediately on getting in sight of the sun the wavelets between the steamer and the sun showed streaks of brilliant light metallic blue colour. This was intensified when the boat entered the still glassy water of Sydney Cove, when the back of each ripple caused by the steamer on the sunny side showed a sheet of the same colour and that most brilliantly. The water where undisturbed was covered by a slight scum, which might either be settled dust or a layer of mineral oil, but appeared more like the former. The colour had not the iridescent appearance caused by oil, as it was a uniform pale blue and only showed on the back of the wavelets.

It seemed to me that this was an exaggerated example of the blue colour of water caused by finely-divided mineral matter seen in glacier waters and those of the hot lakes of New Zealand, where the water has silica in suspension.

WILL. A. DIXON.

97 Pitt Street, Sydney, November 14, 1902.

ABOUT half-past four o'clock on the afternoon of November 12, I noticed that the sky to the north and north-east, from the horizon half-way to the zenith, had assumed an extraordinary chocolate-brown tint, due to clouds of that colour which were moving towards us from the north-west. Under these clouds, and moving from the north-east, were ashy-grey patches of stratus, streaked with fantastic dark lines resembling bows and boomerangs. A few drops of rain which fell about five o'clock were charged with brown, earthy matter, and at six o'clock a paper which was held in the rain became spotted all over with brown blotches.

This fact, and the colour of the clouds, led me to the conclusion that a tornado had taken place in the interior of Australia, whirling the fine dust high into the upper regions of the atmosphere, in which position it was carried over the Straits and then descended with the rain.

At 6.20 p.m. the solid matter was still descending, but in less quantity; at 6.30 there was a marked diminution; and by ten minutes to seven the rain was all but free from it.

While the six o'clock shower was descending, one heard the remark on all sides that "it was raining mud"; those who were unfortunate enough to have their week's washing hanging out at the time were doomed to a second day at the wash-tub.

This remarkable occurrence recalls the events of Black Thursday, 1851, when Victoria was swept by tremendous bush-fires; leaves and portions of charred ferns were carried up to great heights by the currents of heated air, wafted across Bass' Straits and deposited upon our shores; the sky was so darkened by huge volumes of smoke that, although in the height of summer, lamps had to be lit early in the afternoon.

West Devonport, Tasmania, November 14, 1902. H. STUART DOVE.

A Sickle Leonid.

AT 2h. 17m. on Sunday morning, December 21, I witnessed the passage of a swift, streak-leaving meteor, magnitude 1, duration about 0·75 second. It proceeded from γ of Cancer and disappeared near to λ of Gemini. On tracing its path backward, I found its radiant to be in the well-known Sickle of Leo. G. MCKENZIE KNIGHT.

25 Holford Square, London, W.C.

THE BABYLONIAN AND ASSYRIAN LEGENDS OF THE CREATION.[1]

IT is now a little more than thirty years ago since the learned world was startled by the announcement that Assyriologists had discovered a remarkable version of the history of the Creation, which closely resembled the narrative of the first chapter of the Book of Genesis, and appeared to be based upon the archetype from which one of the earliest editors or writers of the Pentateuch drew many of his statements. The interest shown in the discovery of the Babylonian and Assyrian account of the Creation was widespread, and though it did not equal that displayed by the learned world in the story of the Deluge as unfolded from the cuneiform records by the late Mr. George Smith, it was sufficiently important to move Assyriologists to further exertions and to provide them with a public which has been ever ready to welcome the results of their labours with toleration and praise. The credit of the discovery of the cuneiform Creation records in the British Museum belongs, undoubtedly, to Sir Henry Rawlinson, and it must even be a subject for lament that his official occupations prevented him from laying his work before the world in a suitable manner many years before his assistant, Mr. George Smith, was able to do so. In the preface to the work before us, Mr. L. W. King, of the British Museum, has continued, and, we are glad to add, completed, as far as is possible at present, the work which was begun by Sir Henry Rawlinson, and he presents to us the whole of the available material in a form handy to use and easy to study.

The first volume of the "Seven Tablets of Creation" contains a useful preface, a good introduction, and transliterations into English letters of all the cuneiform texts, with clear translations arranged opposite them; five appendices, an index and a glossary complete the volume. In the second half of the work, we have the original cuneiform texts, and as they are written in a good, bold hand, the curious reader will find no difficulty in verifying any of Mr. King's statements. After sketching briefly the services which have been rendered by earlier editors of the Creation legends, Mr. King passes on to describe the new material which he has found as the result of several examinations of the collections of clay tablets from Kuyunjik now in the British Museum. In the thirteenth part of "Cuneiform Texts," published by the Trustees of the British Museum in 1901, Mr. King gave copies of a number of documents relating to the Creation, among them being several which, though used by previous workers, had not been published, and one which had been consulted by Mr. Smith in 1876, but had been apparently lost sight of. Great credit is due to Mr. King for identifying this last-mentioned important fragment, for, so far as we have been able to discover, it was not recognised by Dr. Bezold, who, in his "Catalogue of the Konyunjik Collection" (p. 998, K. 9267), describes it merely as "part of a mythological legend." Whilst, however, Mr. King was searching for fragments of other Babylonian legends, he discovered so many new portions of the Creation legends and duplicates that he decided to write a monograph on the subject, and as the result of his labours we are now able to form a connected idea of the whole of the Babylonian story of the Creation. Formerly, only twenty-one tablets and fragments inscribed with portions of the legend were known, but now no less than forty-nine separate tablets and fragments have been identified as containing portions of the cuneiform texts of the Creation series. In fact, Mr. King has identified twenty-eight new portions and duplicates of Creation texts, and the details of the great story can now be followed consecutively, a thing which, up to the present, has been impossible.

We now know that the great Babylonian poem of Creation was divided into seven sections, or tablets, and that the whole work was known by the title "Enuma Elish," which also forms the opening words of the text,

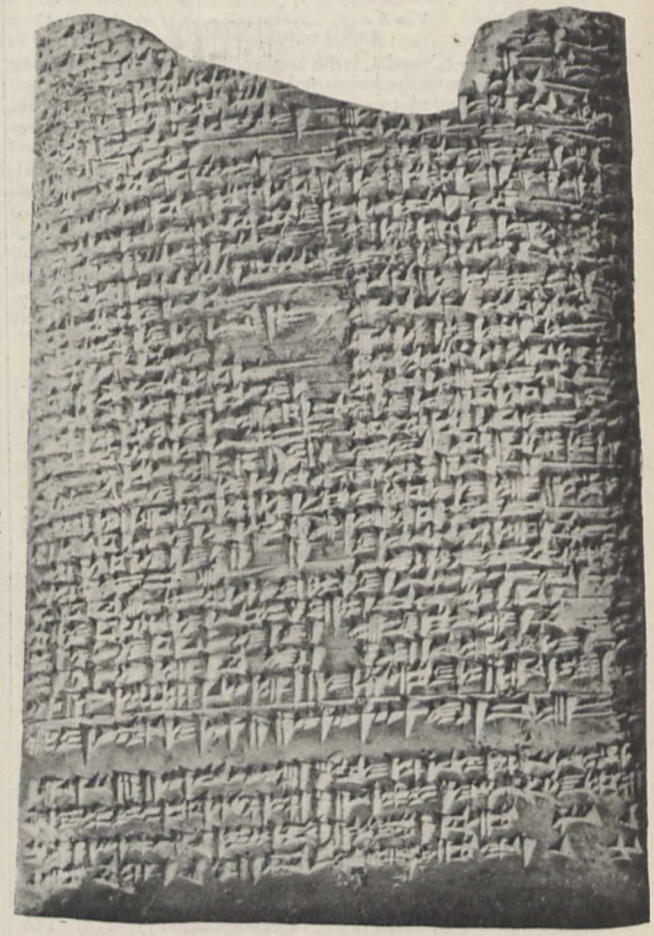

FIG. 1.—Part of the Fourth Tablet of the Creation Series (Brit. Mus., No. 93,016).

and that it contained nine hundred and ninety-four lines; those who are interested in ancient theories of numbers will note that 994 is a multiple of 7. Each of the seven sections on tablets contained, on an average, one hundred and forty lines, and it is clear that each tablet was intended to describe the events of one "day" of creation. It is difficult not to think that such artificial divisions of the legend indicate that we are dealing with a comparatively late recension of it, and this may well be the case when we remember that the oldest copies of it which we possess date from the reign of Ashur-banipal (B.C. 668-626); no one who takes the trouble to read the seven tablets and who is familiar with ancient cosmogonies and theogonies will have the slightest doubt that

[1] "The Seven Tablets of Creation." By L. W. King. Vol. i. English translations. Pp. cxxiv + 274. Vol. ii. Pp. xiii and 84 plates. (London: Luzac, 1902.)

the original form of the Babylonian and Assyrian history of Creation is many thousands of years old. Whether it originated with the Akkadians or some other non-Semitic people cannot be said definitely at present, but it is very probable that the Semitic Babylonians were only the borrowers and not the inventors of this remarkable work.

We may now note the main heads of the legend. At the beginning of all things, Apsū and Tiamat were water deities and typified chaos; to these were born Laḫmu and Laḫamu, and later appeared Anshar and Kishar, and still later Anu and other gods came into being. One of the newly-found fragments of the first tablet mentions the birth of Nudimmud (Ea), and although Damascius states that Bēl, the creator of the world, was the son of Ea and Damkina ('Αός, Δαύκη), it is clear from the fragment that Marduk, who is made to take the leading part in the later tablets of Creation, was supposed to be in existence, like Mummu and Gaga. In the earlier episodes of the Creation story, it is Ea and not Marduk who is the hero, and we learn for the first time, from the new material, that it was Apsū, a god of chaos, and not Tiamat who rebelled against the gods. Apsū disliked the new order of things and the creation of the universe for the simple reason that the beings who formed members of the new world disturbed his peace and rest; as soon as he had made up his mind as to what was likely to happen, he called Mummu his minister (the Μωϋμῖς of Damascius), and the two went to Tiamat and took counsel with her, and complained that "he could get rest neither by day nor by night." The putting of the house of the world into order by the gods destroyed his rest and peace of mind. Of the conflict which took place between Ea and Apsū and his ally Mummu we know little, but that the great god did not succeed in inflicting a decisive defeat on Apsū and his allies is clear from the fact that, later, Anshar found it necessary to exhort Marduk to do battle with Tiamat. Of the defeat and death of Tiamat we need say little, for the story of how the god of light slew her and split her body into halves is familiar to all. The actual account of the creation of the world by Marduk begins towards the end of the fourth tablet, where it is said that one-half of the body of Tiamat formed a covering for heaven, and that Marduk, having formed E-shara, made the great trinity of Anu, Bēl and Ea to dwell therein.

In the fifth tablet, we hear of the fixing of the constellations of the Zodiac, the founding of the year, &c., and it seems as if this section contained an account of the creation of vegetation. The sixth tablet, as we know from one of the new fragments, told the story of the creation of man, and it seems as if Marduk made man with the view both of punishing the gods and of providing a creature who should at all times worship him. Marduk, or Bēl, instructed Ea to cut off his (*i.e.* Marduk's) head, and man was formed out of the blood which flowed from the god's body. Marduk is made to tell Ea that he intends to create man from his own blood and from the "bone" which he will create; it is important to note that the Assyrian word for "bone" is *iṣṣimtu*, and that it is the exact equivalent of the Hebrew *'eṣem*, "bone," which occurs is Genesis ii. 23, in connection with the account of the creation of woman.

The creation of man was the final act of creation, and when this was accomplished the gods assembled in their council chamber in Upshukkinaku, with Marduk at their head, and they sang to him a hymn of praise, the text of which forms the seventh section of the Creation story and contains fifty addresses to the god. How Marduk managed to survive his decapitation is not told us, and we can only surmise that he met the gods in their council chamber in some sort of spiritual body. The space at our disposal will not allow us to call attention to many very interesting details of the legend, especially in the parallels which may be drawn between parts of it and the Book of Genesis; these prove beyond all reasonable doubt that the Jews borrowed large portions of their religious literature from their kinsmen the Babylonians, and that the seven days of Creation were imagined long before the days of the patriarch Abraham. The student of comparative folklore will find much to interest him in Mr. King's latest work, and will perhaps trace the mingling of legends illustrated in it with somewhat mixed feelings. Mr. King's texts are carefully edited and well copied, and his translations, which we have examined in several passages, are faithful and not unduly literal, and his work is a credit to English Assyriology.

A POT OF BASIL.

THERE is a widely spread belief, both amongst natives and amongst the white sojourners in Western Africa, that the presence of a certain species of plant in a room drives away mosquitos, and, in fact, a single plant is said to be sufficient to clear a room. On his recent return from Northern Nigeria, Major J. A. Burdon, of the Cameron Highlanders, brought with him and gave to me a few leaves of this plant. These, through the kindness of Mr. H. H. W. Pearson, have been identified by the experts at Kew as belonging to *Ocimum viride*, Willd., a member of the order Labiatæ, which occurs from Senegambia southwards to Angola.

Major Burdon, who is Resident of the Nupe Province, Northern Nigeria, and Hausa Scholar of Christ's College, Cambridge, has given me the following account of the plant:—

"A fragment of what turns out to be *Ocimum viride* was given me in August last at Lokoja, Northern Nigeria, by Captain H. D. Larymore, C.M.G., R.A., Resident of the Kabba Province. Capt. Larymore's notice had been drawn to the plant by a native living in a low-lying part of the native town at Lokoja, who had told him that the natives suffered very little from the swarms of mosquitos which existed in that part, as they protected themselves from them by the use of this plant.

"Capt. Larymore made inquiries and obtained a few specimens of the plant, which grows wild, though not very abundantly, in the neighbourhood of Lokoja. These specimens he planted in pots and boxes and kept in and about his house. The specimens I saw were about the size of a geranium.

"He informed me that the presence of one of these plants in a room undoubtedly drove the mosquitos out, and that by placing three or four of the plants round his bed at night he was able to sleep unmolested without using a mosquito net. This is very strong testimony to the efficacy of the plant, for the house in which Capt. Larymore was living is, as I had cause to know well in former years, infested with mosquitos."

In the fifth volume of Sir W. T. Thiselton-Dyer's "Flora of Tropical Africa," *Ocimum viride* is described as follows:—

"*O. viride*, Willd.; Benth. in DC. Prod. XII. 34. A perennial 3–6 ft. high, with much-branched glabrous stems. Leaves distinctly petioled, oblong, acute, membranous, 3–4 in. long, glabrous on both sides, or obscurely pubescent beneath. Racemes lax, copiously panicled, 3–6 in. long; rhachis finely pubescent; bracts deciduous; pedicels not very short. Calyx $\frac{1}{6}$ in. long; tube campanulate; upper lobe orbicular, as long as the tube; lower teeth short. Corolla half as long again as the calyx-lobes. Stamens but little exserted, the two upper with filaments toothed above the base.—Benth. in Hook. Niger Fl. 488; Henriques in Bolet Soc. Brot. X. 149. *O. febrifugum*, Lindl., in Bot. Reg. t. 753. *O. heptodon*, P. Beauv. Fl. Owar. II. 59. t. 94."

The plant is figured on plate 753 of the ninth volume

of the Botanical Register, 1823, under the name *Ocymum febrifugum*, or the "Sierra Leone Fever Plant." This work mentions that the plant is "in request at Sierra Leone for medicinal purposes," and describes the species as an "*under shrub* 3 feet high," "having in a high degree the smell of common balm."

The leaves of the plant are highly glandular, and in India an allied species, *O. Basilicum*, Linn., the "common sweet basil," produces a "yellowish green volatile oil lighter than water, which, on being kept, solidifies into a crystalline camphor, isomeric with turpentine camphor" (*Gmelin's Handbook*, xiv., 359).[1] The seeds of this species are widely used in the

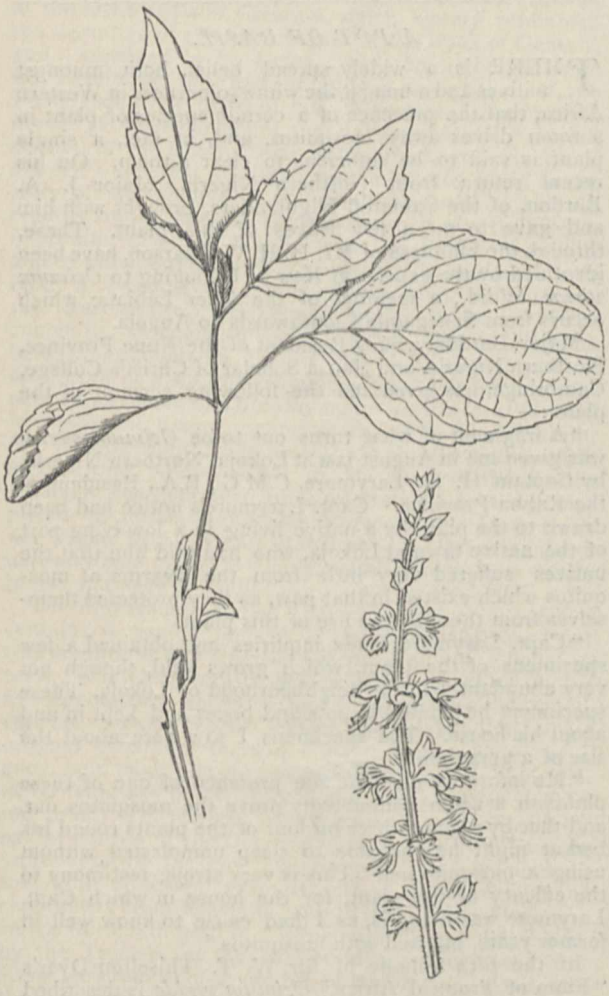

FIG. 1.—*Ocymum viride*, Willd. Some leaves drawn from a dried specimen brought back by Major Burdon. Below is a raceme of the same plant taken from the "Botanical Register," vol. ix. Both reduced.

east as a medicine, and their properties "are said to be demulcent, stimulant, diuretic and diaphoretic." "The juice of the leaves mixed with ginger and black pepper is given in the cold stages of intermittent fever." The leaves, like those of thyme, are used as a seasoning in cooking. Another Indian species, *O. sanctum*, Linn., the "sacred basil," is the most sacred plant in the Hindu religion, and is consequently widely cultivated.

In "Notes on the Medicinal Plants of Liberia,"[2] Mr. E. M. Holmes records that when chewed or rubbed, the leaves of *O. viride* give off a strong odour of lemon thyme, and mentions that Dr. Roberts, of Liberia, entirely substituted the use of the plant for that of quinine in cases of fever of all kinds, giving it in the form of an infusion.

There is thus a good deal of evidence that *O. viride* is a plant of considerable curative value, especially in cases of fever, but the question that interests a large number of people in West Africa is whether it is equally efficacious as a preventative. Does it really repel the mosquito which acts as the intermediary in conveying the malarial hæmatozoon from man to man? Further experiment on this point is needed, but there is at least some indication that in this easily cultivated plant man has another weapon with which to fight malaria.

Christ's College, Cambridge. A. E. SHIPLEY.

[1] Watts's "Dictionary of the Products of India," v. 1891, p. 441.
[2] *The Pharmaceutical Journal*, third series, viii. 1877–78.

TRANSATLANTIC WIRELESS TELEGRAPHY.

THE announcement of the successful inauguration of the Transatlantic wireless telegraphic system which we were able to make last week must have come as welcome news to all, but hardly as a surprise to those who have followed with any closeness Mr. Marconi's persevering experiments. Those who have done so and who have seen how, in almost every instance, Mr. Marconi has achieved all that he has said he would achieve can hardly have doubted that in this case also he would be successful. And when once it had been demonstrated that Hertz waves were capable of bridging the enormous distance from the Old World to the New, it was evidently only a matter of time to instal suitable stations on both sides of the Atlantic and to put them in operation. Nevertheless, the greatest interest attaches to the transmission of the first messages; one cannot help feeling that it is an historic occasion, not only marking an era in the development of wireless telegraphy, but also forging another link between this country and her colonies, and adding yet one more to the many benefits helping forward civilisation which science has conferred on mankind.

As yet, of course, not much has been done; a few congratulatory telegrams have passed from one side of the Atlantic to the other, and doubtless there will have to be much more experiment and work before a commercially useful system of communication is established. But for this we can wait in patience and confidence. It is easy to see that, though the possibilities are many and great, the difficulties also are formidable and numerous. In the first place, before the system can be commercially important, it is clear that the public must be made to feel confident that it is absolutely trustworthy; any uncertainty in this respect would be fatal to a system which has to make its way against the competition of existing methods. Again, the system is, for the present at any rate, limited in its carrying capacity, since the speed of signalling obtainable is not very great, and from what can be gathered it seems unlikely that multiplexing to any great extent, or even at all, can be regarded as a possibility of the near future. From another point of view also difficulties present themselves, for we have yet to learn what effect will be produced on existing wireless installations by a constant stream of very powerful Hertz waves sent out on either side of the Atlantic. If the Transatlantic signalling seriously interferes with the less pretentious applications of wireless telegraphy, there can be little question as to which it is more desirable to retain. But all these problems we may safely leave for the present, for we know that they are in the hands of one who has shown himself fully competent to deal with them.

Whatever else may be said of his present achievement, all must agree that it is a great personal triumph for Mr. Marconi, and one that he has fully merited by his untiring

perseverance and endeavour in the face of difficulties, opposition and adverse criticism that would have daunted many. Great indeed as the advances in wireless telegraphy have been when regarded simply as advances in applied science, few things are more remarkable than the rapidity with which they have been made. It is less than ten years since the first experiments were made in the application of Hertz waves to signalling. Mr. Marconi himself began work a few years later—in 1896. In that year he was able to transmit signals over a distance of a mile or so, and ever since he has been steadily increasing the limit until, about one year ago, it was announced that the signal "S" had been transmitted from Cornwall to America. Many who were sceptical of this result at the time must have been convinced of its genuineness when a little later (last March) messages were transmitted to the *Philadelphia* up to a distance of 1551 miles from land and the signal "S" transmitted to a distance of 2099 miles. Following on this came the cruise of the *Carlo Alberto* during July, August and September last, when extremely successful results were obtained over great stretches of land and water. Finally, at the close of 1902, we have the inauguration of a complete Transatlantic system with transmission of messages in both directions. No one can consider this as other than a splendid record for six years' work.

Little need be said of the stations on either side of the Atlantic, since both have been already described and illustrated in NATURE (see vol. lxv. p. 416, and vol. lxvi. p. 485). It is to be hoped that before long we shall be able to record that both have been in continuous and successful commercial working without producing any ill effects on other installations. When this has been accomplished, the problem of syntony remains to be solved, and we wish Mr. Marconi the same complete success in dealing with this problem as has crowned his other efforts. MAURICE SOLOMON.

A SUB-TROPICAL SOLAR PHYSICS OBSERVATORY.

WE have received from a correspondent in America the following letter by Prof. S. P. Langley, secretary of the Smithsonian Institution, suggesting the establishment of a great solar observatory in or near the tropics. Referring to the practical value of such studies of the sun as are suggested by Prof. Langley, our correspondent remarks:—"It is an amazing thing that the enormous utility of recent work on the sun's connection with the conditions which bring famine or plenty to India, for instance, is lost sight of by almost all astronomers. Astronomers and astrophysicists, even, are apt to look at it in its purely scientific interest, as if it had none other than what it might share with the discovery of the motion of a nebula."

The letter sent by Prof. Langley to the Hon. Charles D. Walcott, secretary of the Carnegie Institution, is given in the report of the executive committee to the trustees of the Carnegie Institution, published November 26, 1902, and reads as follows:—

February 28, 1902.

DEAR MR. WALCOTT,—You were saying to me that you knew of some persons who might be desirous of aiding, through the Smithsonian Institution, some large object, and I was led to write you what is in substance the following letter:

I learn from yours of February 14 that you would like to call it to the attention of the executive committee of the Carnegie Institution, and, as I have written, I shall be very glad to have you do so, asking you to make it clear that it is in no way a request from the Smithsonian Institution, but a suggestion from me of a great object which Mr. Carnegie himself may care to take up.

I do so the more readily because, considering the Institution wholly apart from its own needs, it would be the glad means of indicating to those who wish some worthy aim for expenditure, some specific object, which may be undertaken if desired *in their own name* and through any worthy medium they prefer.

One of these is the determination of the heat the sun sends the earth and the causes of its probable variation. The progress of solar physics has been such in the last few years as to make it of interest to every inhabitant of the planet that this progress should be carried further, not only in scientific, but in economic, and in even humanitarian interests.

The establishment of a great observatory in the tropical or sub-tropical regions at a high altitude would advance our knowledge of the heavenly bodies in a degree more than could be done by all the physical observatories in the world united. To the founder of such an observatory there would be enduring fame, but it is an affair of a very great deal of money, possibly to be reckoned only in millions. The establishment and maintenance for eleven years of a distinctly solar observatory under these conditions would enable us to study the sun as it has never yet been studied, and through an entire solar cycle, for much less cost.

While this latter research, then, is to be pursued at less cost than the foundation of a great general observatory, it has a specific object of literally world-wide importance and interest.

The determination of the heat the sun sends the earth annually is the determination of that through which everything on the planet lives and moves, and almost unknown slight variations of this heat are the probable, if remote, cause of the changing character of the seasons and of the lack or plenty in the crops upon the earth as a whole.

It has seemed possible within the last few years that if we had this knowledge, the years of plenty and of famine could be forecasted as we now forecast a coming storm through the advices of the Weather Bureau. It is possible, I say, but I do not wish to say more than that it is possible.

I do not know any greater or more worthy object for the expenditure of 500,000 dollars than the settlement of this latter great question would be. It is, with our present knowledge, almost a question of money; but no Government is prepared to spend such a sum except for its own interest. This is for the interest of all the people in the whole world, and I entirely concur with the recommendation of its importance from the chief of the United States Weather Bureau, which I enclose. I should gladly see it undertaken, whoever does it.

Very truly yours,

S. P. LANGLEY.

The Honorable CHARLES D. WALCOTT.

In a further letter, sent on October 20 to Prof. G. E. Hale, who asked for details of the proposed scheme of work and equipment, Prof. Langley described the principal objects of inquiry of a distinctly solar observatory, the plan of observations, and apparatus and accessories required.

NOTES.

THE management of the Imperial Institute will from January 1 be vested in the Board of Trade, assisted by an advisory committee representing various Government Departments and the Indian and Colonial Governments. The Board of Trade has appointed Prof. Wyndham Dunstan, F.R.S. (now director of the scientific and technical department of the Institute), to be Director of the Imperial Institute. Prof. Dunstan will continue in charge of the scientific investigation of economic products, and will supervise any other branches of work carried on by the Board of Trade in the building at South Kensington, including the collections of products of the Empire so far as they will be under the control of the Board. These arrangements do not affect the parts of the collections and the information offices under the special charge of representatives of the India Office and of certain Colonial Governments.

IN consequence of the presentation of a memorial in favour of the admission of women to the fellowship of the Linnean Society, the council issued a circular in March last inviting an expression of opinion on the part of the whole body of fellows. The result has been that 301 fellows have pronounced in favour

of the proposal and 126 against it, whilst 313 fellows gave no reply. This expression of opinion is considered sufficient to justify further action; accordingly the matter will be brought before a special general meeting on January 15. As the existing charter gives no power to the society to admit women as fellows, a resolution will be moved to obtain a supplemental charter for this purpose.

IN consequence of frequent cases of sickness and death caused by poisonous substances in salted raw fish used for food, the committee of the Caspian fishery and seal industries several years ago offered a prize for the investigation of the nature of the fish-poison, for indications of the methods of preventing fish from becoming poisonous, and for the healing of persons poisoned by fish. The accumulated interest and capital now amount to 7500 roubles (about 1050*l.*). The Imperial Academy of Sciences, St. Petersburg, acting with the Ministry of Agriculture and Crown Domains, have now issued particulars of a new competition on the nature of fish poison and the antidotes. The persons competing for the award offered in the interest of public health will be expected to offer solutions of the following problems:—(1) By careful experiments to define the qualities of poison contained in fish; (2) to investigate the action of the poison of the independent organs of animal bodies, the central nervous system, the heart, the circulation of blood and the digestive organs; (3) to present an accurate illustration of the pathological reactions in the various parts of animal and human bodies caused by such poisoning; (4) to present a description of the signs serving to distinguish fish containing poison from normal fish; (5) to indicate methods for the prevention of development of poison in fish; (6) to indicate antidotes and general provision against poisoning by fish. The awards for the competition will be three premiums, viz. 5000 roubles (700*l.*), and two of 1500 roubles (210*l.*) and 1000 roubles (140*l.*). The two lesser prizes may be gained should the author solve only a part of the problem, basing his experiments upon one method of science—chemistry, physiology or bacteriology. As regards the larger prize, this will be awarded only for the work which covers the problem of the nature of the fish-poison in all respects. The work sent in to compete for the awards may be written or printed in Russian, Latin, French, English or German, and should be submitted by October 1, 1903, to the Ministry of Agriculture and Crown Domains.

MR. N. F. DOBRÉE, of Beverley, has presented his collection of European Noctuæ to the Hull Municipal Museum. This collection contains more than five thousand specimens and is one of the finest in the country.

THE death is announced of Prof. Richard Baron Von Krafft-Ebing, professor of psychiatry at Vienna and author of works on psychiatry and physiological psychology.

WE regret to announce that Mr. Otto Hilger, the well-known astronomical and optical instrument maker, died on December 18, at fifty-two years of age.

MR. A. CARNEGIE has expressed to the Provost of Greenock his willingness to present to a properly authorised authority in the town the sum of 10,000*l.* to defray the cost of the erection of a memorial to James Watt; or he is willing to head a movement in America to raise a large fund which, added to what might be subscribed in Great Britain, would enable a wider scheme for a memorial to be arranged.

ONE of the subjects discussed at the recent conference of Colonial Premiers was that of an Imperial Patents Act whereby one patent would cover the whole Empire. Mr. G. C. Douglas, writing to the *Times* of December 30, points out that such a measure would help enormously in the building up of industrial concerns. In the United States of America, one patent covers a territory with an industrial population of about seventy millions, whereas it takes about forty patents to protect an invention in the British Empire. If it were decreed that one patent covered Great Britain, India and the various other dependencies, our great self-governing Colonies would probably soon unite with the Government to make the reform an Imperial one.

A REUTER telegram from Syracuse states that shortly after eight o'clock in evening of December 28 a severe shock of earthquake was felt, preceded by subterranean rumbling.

A REUTER telegram from St. Thomas on December 27 reports that a violent eruption of Mont Pelée was in progress at 10.30 that morning. Dense grey smoke and dust were pouring out to a great height. Advices from other sources state that the cone of the volcano was luminous at night.

PROF. LACROIX, the conductor of the French scientific expedition sent to Martinique, has, *La Nature* says, reported to the Colonial Minister an account of the consequences of the shattering of the cone formed in the crater of Mont Pelée. Blocks of incandescent lava rolled in the direction of the White River and filled it. Volcanic material six kilometres from the crater, which had collected in the neighbouring valley, had eight days after the eruption a temperature exceeding 100° C. On December 15, symptoms premonitory of an eruption were experienced at Kingston, St. Vincent, and on December 18 a new eruption occurred, but caused no accident.

A REUTER'S telegram from the scene of the recent earthquake at Andijan, dated December 23, states that the shocks continue and are daily increasing in violence.—December 26, *Ashkabad.* Oscillations of the earth are still noticeable. In Andijan and neighbourhood, 15,000 houses have been destroyed. Andijan as a town has existed for 400 years, and has already been visited by earthquakes.—December 28, *Ashkabad.* A long and violent earthquake shock was felt at Andijan at 10 p.m. yesterday.—December 29, *St. Petersburg.* The earthquake at Andijan on December 16 extended over an area of nearly seven hundred square miles. The epicentrum of the disturbance has been located about four miles to the south of Andijan. It is indicated by a rent made in the earth from which sand, water and mud are thrown up. The statical wave was about 28 inches high, and took a northerly direction.

WE learn from *Science* that Prof. H. V. Hilprecht has been awarded the Lucy Wharton Drexel medal of the University of Pennsylvania for his archæological researches.

AT the concluding meeting of the Egyptian Medical Congress on December 24, it was held that the international rules applying to plague and cholera required revision, and the wish was expressed that an international congress should meet forthwith to lay down rules in accord with the demands of science.

WE learn from *Science* that the Carnegie Institution of Washington has made a grant of 500 dollars to Prof. Bancroft, of Cornell University, for a systematic study of the bronzes; an annual grant of 10,000 dollars to revive the "Index Medicus," formerly published under the direction of Dr. J. S. Billings; and a grant of 1000 dollars to the astronomical department of Vassar College to enable Dr. Caroline E. Furness to make measurements and reductions of photographs of the stars in the region of the north celestial pole.

AT the dinner on December 22 to Major Ronald Ross, in honour of his being awarded the Nobel prize, the Lord Mayor of Liverpool dispatched a telegram to the King. The following message was received in reply:—"I have submitted your telegram to the King and I am commanded, in reply, to request you to congratulate Major Ross on the honour which has been conferred upon him by the King of Sweden.—KNOLLYS."

AN expedition sent by the New York Botanical Garden to Nova Scotia and Newfoundland has secured, the *Scientific American* states, 12,000 specimens of more than 2000 species of plants. A third of the specimens are marine plants. Another expedition sent to north Montana by the same enterprising institution has done much in the interest of scientific botany. Many alpine forms of plants were discovered. Ample statistics were secured establishing the variation of plant life caused by temperature and latitude, and of the general vertical distribution of flora.

REFERRING to Mr. Backhouse's letter on sunset glows in last week's NATURE (p. 174), the Rev. G. J. Bridges, writing from Salisbury, says :—"In addition to the colour growing less vivid, the 'colouring' does not occupy so much space as in the Krakatoa glows. It occurs much sooner after sunset and much nearer sunrise than in the case of those which occurred in 1883. . . . The dust wisps are so much more defined of late that it is difficult to distinguish them from faint streaks of strata except by position, which appears to be always horizontal and corresponding to the curvature of the earth."

IN most of our colonies, more particularly those which are concerned with agriculture, the official botanical staff is no longer considered to be complete without a specialist in plant diseases. The reports and pamphlets embodying the researches of these specialists bear evidence of valuable and important work. An account of the fungus diseases which attack stone-fruit trees in Australia has been prepared by Mr. D. McAlpine. The principal diseases are described at some length and illustrated with very excellent coloured plates. These present diagnoses suited to the farmer whose scientific knowledge is limited, and methods of treatment are suggested and explained. Besides, there is added an account of many less common fungi also destructive to trees bearing stone-fruit, which presupposes a certain amount of botanical training.

THE report of the Director of the Botanic Gardens, Sydney, N.S.W., for 1901, besides dealing with matters appertaining to the Botanic Gardens, includes the improvements effected in the various public gardens which come under his control. An event of considerable importance was the opening of new buildings which had been erected in order to accommodate the National Herbarium and provide space for a botanical museum. The latter occupies one of three large rooms, while the other two are set apart for the cryptogamic and phanerogamic herbaria respectively. An interesting feature of the museum is a collection of local plants ; also due prominence has been given to characteristic Australian plants, such as the Acaciæ, Eucalypti, various genera of the Proteaceæ, and Coniferæ. Reference is made to the trees planted by their Royal Highnesses the Duke and Duchess of Cornwall and York on the occasion of their visit to Sydney.

MR. F. C. CONSTABLE directs attention to the serious disadvantages of the common practice of hanging on the walls of schoolrooms maps of various countries of widely differing areas, all drawn to different scales, with the result that the countries appear, approximately, of the same size. One of the direct consequences of this custom is that comparatively few educated persons can give the relative sizes of, say, England and Africa, of Canada, Australia and British India, with any approach to accuracy. This defect in geographical teaching is by some teachers avoided by the use of wall-maps of the continents having printed in the corner a map of England to the same scale to serve as a key. It should not be difficult for teachers to prevent their pupils from obtaining an erroneous sense of proportion.

A DISEASE resembling "farcy," the cutaneous form of glanders, has been found to be prevalent in the Philippines. It is, however, not glanders, but is due to a blastomycetic parasite which can be detected in the lesions, and may be isolated and cultivated from these, though with some difficulty.

THE Punjab Government has been compelled temporarily to suspend its scheme for extensive inoculation against plague. A portion of the vaccine fluid became contaminated and induced tetanus in a small number of persons who were inoculated with it. During the month of October, no fewer than 120,000 people were voluntarily inoculated, and it had been intended to supply 70,000 doses of the vaccine fluid per diem had not this unfortunate mishap occurred.

SIR WILLIAM MACGREGOR, in an address delivered to the students of medicine of Glasgow University, dealt especially with the prophylaxis of malaria. As the outcome of his great experience, he recommended the preventive use of quinine in doses amounting to at least 15 grains a week. He stated that in Lagos the radical method of Ross for the extermination of mosquitos is being pursued by filling in the swamps with sandy soil. The large pools which cannot be drained at present have crude petroleum put on the surface periodically. Empty tins and similar rubbish are removed, and receptacles for drinking water are kept carefully covered. Native boys are now being employed as mosquito catchers, and should be upon the fixed establishment of every European resident in such a place as Lagos.

SIR CHARLES TODD has supplied the following notes on the rainfall during the past winter (April to September) in South Australia :—As compared with the average at thirty-seven selected stations distributed over the colony, the six months' fall is, without exception, far below the average amount. It is, in fact, one of the driest years ever experienced—so far as all the northern areas are concerned it is the driest—and the same applies to many parts of the south. At twenty-four out of the thirty-seven stations, the winter of 1902 is the driest on record, whilst at eight others only one other year was drier. At Adelaide, where the records go back to 1839, during the six months April to September, 1902, we have registered only 9·49 in., or 4·64 in. under the general average ; in 1891, however, we only had 7·62 in. in the same time ; in 1869, 8·73 in., and in 1876, 9·24 in., whilst in 1886 we recorded 9·43, about the same as in 1902, so that as regards the city that year is not a record.

MANY theories have been put forward to account for the so-called "black and white dot phenomenon" visible on diatom valves under high powers of the microscope. A discussion of several of these theories is given by Mr. Julius Rheinberg in the *Journal* of the Quekett Microscopical Club for November. After discarding the hypothesis of spherical aberration of the object on the ground that it does not fully account for the variations observed, Mr. Rheinberg gives reasons for his opinion that the effects are due to crossing of cones of light and darkness arising from total reflection beyond the critical angle between the mounting medium and the diatom. If this hypothesis is accepted, the dots on the diatom must be regarded as perforations the depths of which are greater than their breadth ; this appears to be Mr. Rheinberg's view. Lastly, a diagram of the critical angles of different media relative to diatom silex and of the amounts of light totally reflected agrees fairly well with observation.

MESSRS. ELSTER AND GEITEL, in a recent number of the *Physikalische Zeitschrift*, describe an improvement in Exner's electroscope rendering the reading of the deflections more accurate. To one of the glass sides of the instrument a mirror

is attached which reflects a scale fixed on the outside of the case. The positions of mirror and scale are such that the image of the scale when seen through an observing lens is in the same plane as the edges of the electroscope leaves. Parallax is thus avoided, and the deflection of the leaves can be read with great accuracy. In the same issue, these authors describe a convenient form of portable dry pile, giving a pressure of 2000 volts, for use in experiments on the radio-activity of the atmosphere. The pile is made up of gold and silver plates built up in columns of 200 pairs fitted on ebonite rods, thirty sets being connected in series inside a metal case. The pile gives no current, but can maintain the potential of a conductor at −2000 volts; it is said to keep in good order for several years if proper precautions are taken.

THE South African corals of the genus Flabellum receive attention at the hands of Mr. J. S. Gardiner in a recent issue of "Marine Investigations in South Africa" (vol. ii.). The author pays special attention to the anatomy and development of these organisms, and emphasises the importance of studying the polyp as well as the corallum if we hope to gain any real idea of their true relationships.

AN additional note by Dr. Forsyth Major on *Ocapia liebrechtsi* appears in *La Belgique Coloniale* for November 30. The author figures both the male and the female skulls, the latter of which is hornless. It is suggested, however, that in some instances female okapis may carry small horns. In conclusion, it is pointed out that as the okapis of the present day are natives of a continent where zebras and antelopes abound, so their extinct forerunners, the Palæotragi of the Pliocene, were associated in southern Europe and Asia with troops of hipparions and antelopes allied to modern Ethiopian types.

WE have received from the Smithsonian Institution three papers from the *Proceedings* of the U.S. Museum. The first, by Mr. C. B. Wilson, deals with North American parasitic copepod crustaceans of the family Argulidæ. It is the first of a series dealing with the large collection of this very remarkable group contained in the Museum, and, in addition to the description of these, will contain a bibliography of the entire assemblage. It is mentioned that the typical European *Argulus foliaceus* is the only member of the group which has hitherto been fully described. In the second paper, Miss M. Rathbun treats of Japanese stalk-eyed crustaceans, describing as new one hermit-crab and nine shrimps. In the third, Messrs. Jordan and Fowler continue their review of the fishes of Japan, treating in this instance of the berychoid group.

WE have received from the publisher (Herr G. Fischer, of Jena) a copy of the second, and popular, edition of Dr. C. Chun's "Aus den Tiefen des Weltmeeres," the original edition of which was reviewed in NATURE of March 6, 1902 (vol. lxv. p. 409). The mere fact that a second edition has been found advisable affords sufficient evidence that the work is deemed a success by the public. The present issue is, however, by no means a simple replica of its predecessor. No less than eighty-two additional illustrations have been introduced into the text, while some of the original illustrations have been replaced by better ones. Moreover, the text itself has been expanded by the introduction of additional chapters dealing with the deep-sea fauna, especial attention being devoted to the description of the eyes and light-organs of abyssal animals. The new illustrations include many of tropical landscapes and others of ethnographical subjects, while views of icebergs and of the desolate scenery of Kerguelen Island are also notable additions. The present enlarged edition forms an exceedingly handsome and attractive volume, which cannot fail to interest all lovers of travel and natural history.

THE U.S. Department of Agriculture has recently issued three pamphlets dealing with the protection of the fauna of the country and the traffic in game, skins, &c. The first of the three is an enlarged and revised edition of Dr. T. S. Palmer's summary of the legislation for the protection of birds other than those classed as game. The second is a digest of the game laws for 1902, by Messrs. Palmer and Olds, giving full information with regard to close-seasons, shipment, sale and licenses. In the third and shortest, the Secretary of the Department summarises the regulations connected with the trade in birds and game between the different States of the Union. It is satisfactory to learn that the regulations for the protection of birds of which the plumage is used for ladies' dress, &c., are now extremely stringent. "Under these statutes, birds which are in demand for millinery purposes are protected throughout the year, and sale and possession, as well as killing, are prohibited. It should be remembered that the principal centres for millinery supplies are nearly all located in States which have such laws, and the purchase of native song-birds, as well as of herons, pelicans, gulls, terns, grebes or other plume-birds, should be avoided."

IN the early days of the Hudson Bay Company, a large number of skins of birds and mammals were sent from the Kewatin territory to naturalists in Europe for description, and upon the evidence of these specimens numerous species were named. Of late years, but little attention has been paid to the natural history of this semi-Arctic tract, while most other parts of North America have been ransacked for zoological specimens. And as some of the Hudson Bay species were founded on indifferent specimens, while of others the types have either been lost or are now in too bad condition for comparison, great difficulty has been experienced in correlating the fauna of the area with that of the adjacent territories, especially Alaska. To remedy this unsatisfactory state of affairs, an expedition to collect specimens was dispatched some time ago by the U. S. Biological Survey, under the charge of Mr. E. A. Preble. The results of this expedition are now published as No. 22 of the *North American Fauna*. In this fasciculus, Mr. Preble gives a full series of notes on the mammals and birds of the area, illustrated by reproductions of a number of photographs of the scenery. Of mammals, two species and four races are described as new. Perhaps the most interesting of these is the barren-ground vole (*Microtus aphorodemus*), which is described as nearly allied to *M. drummondi*, but of larger size, with a stouter skull.

THE general report on the operations of the Survey of India during 1900–1901, prepared under the direction of the Surveyor-General in India, Col. St. G. C. Gore, has now been published. Parties were employed during the year in the determination of astronomical latitudes in the Karachi longitudinal series and also on experimental work connected with the Jäderin base line apparatus. Preparations for the commencement of the magnetic survey continued during the year, and it has been arranged to establish base stations at Bombay, Kodaikanal, Dehra Dun, Calcutta and Rangoon, at which places magnetic observatories are to be built and self-recording instruments installed. The recent introduction of electric tramways in Calcutta, and their impending construction in Bombay, have rendered it necessary to arrange for the construction of new observatories at some distance from the two cities. Four parties of observers were engaged on topographical operations in Burma, one on the Lushai Hills of Assam and one in the Kangra and Simla districts. Cadastral survey operations were conducted in Bengal, the United Provinces and in Burma. Forest surveys were carried out in Madras, Bombay, Burma, Bengal, the Central Provinces and the Punjab. The report is much more concise than in previous years, owing, doubtless, to the instructions for curtailment issued in 1899.

THE "*Knowledge* Diary and Scientific Handbook for 1903," issued from *Knowledge* office, is a compendium of scientific dates, facts and data which will be found useful to students in many departments of scientific work. In addition to a general astronomical ephemeris and a calendar of events of scientific interest for each month, the book contains six charts showing the movements of twelve of the principal planets during 1903, and twelve small charts which show the appearance of the heavens during each month. There are also many useful tables and several short articles, on practical work with the spectroscope, the observation of variable stars, systematic botany and other subjects.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY:—

Jan. 2. 4h. 37m. Transit (egress) of Jupiter's Satellite IV. (Callisto).
2-3. Epoch of Quadrantid meteoric shower (radiant 230° + 52°).
6. 4h. 33m. Transit (ingress) of Jupiter's Satellite III. (Ganymede).
10. 8h. 41m. Minimum of Algol (β Persei).
12. 19h. 20m. to 19h. 37m. Moon occults λ Geminorum (mag. 3·6).
13. 5h. 30m. Minimum of Algol (β Persei).
14. 8h. 14m. to 9h. 8m. Moon occults α Cancri (mag. 4·3).
15. Illuminated portion of the disc of Venus = 0·982, of Mars = 0·910.
17. 12h. Mercury at greatest elongation, 18° 45′ East.
20. 21h. Saturn in conjunction with the sun.
30. 10h. Venus in conjunction with Jupiter. Venus, 0° 44′ South.
30. 10h. 22m. Minimum of Algol (β Persei).

MAGNETIC STORMS AND SUN SPOTS.—In an article communicated to No. 4, vol. xvi. of the *Astrophysical Journal*, Father Cortie, S.J., discusses the probable connection between terrestrial magnetic disturbances and solar activity.

Instead of dealing with mean values over an extensive period, he has compared the times of occurrence of specific isolated phenomena which have occurred during the three years 1899–1901, inclusive, and from this comparison has arrived at the conclusion that the relation is certainly not simply one of cause and effect, but rather the relation of two effects springing from a common cause.

For example, in support of this conclusion, the writer analyses the occurrences of the first six months of the past year as follows. The only spot of any size to cross the sun's disc during this period was the one observed between March 5 and 13, yet this was unaccompanied by any striking magnetic disturbance. From March 13 to May 19, the visible disc was completely free from spots, and the faculæ observed were faint and unimportant, yet a comparatively vigorous magnetic disturbance took place on April 10.

Father Cortie concludes from his detailed analysis of the last sun-spot minimum that "It may be possible that sun spots are one of the instrumental causes of magnetic storms, though not the only one, but it is more likely that the two phenomena are correlated as two connected, though sometimes independent, effects of a common cause."

OBSERVATIONS OF THE PERSEIDS, AUGUST 10 AND 11, 1902.—In No. 100 of *Popular Astronomy*, Mr. Charles P. Olivier gives the results of the observations of this shower which were made at the Leander McCormick Observatory of the University of Virginia.

On August 10, during a watch which lasted from 9h. 26m. to 16h. 8m., 44 Perseids and 28 other meteors were seen, whilst on August 11 (13h. 38m. to 16h. 8m.) 76 Perseids and 26 other meteors were recorded. The maximum display occurred during the period 13h. 59m. to 14h. 59m. on August 11, 30 Perseids and 11 other meteors being recorded during that hour.

The colour of the brighter Perseids was generally orange, and the radiant points for the two dates were $\alpha = 39°{\cdot}5$, $\delta = +56°{\cdot}7$, and $\alpha = 46°{\cdot}8$, $\delta = +56°{\cdot}7$ respectively. The latter radiant was very accurately determined from an apparently stationary meteor which appeared directly over the sixth-magnitude star D.M. + 56°·798. The paths of about one-half of the meteors observed were plotted on two charts, reproductions of which accompany Mr. Olivier's article.

THE MOSCOW OBSERVATORY.—Vol. iv. of the second series of the "Annales de l'Observatoire Astronomique de Moscou," published under the editorship of Prof. W. Ceraski, gives all the details and results of the observations made at that observatory since the last similar publication was issued.

During this interval, important work has been done in refurnishing the observatory and providing it with new instruments, in order that it may pursue its researches on modern lines. A new Henry-Repsold refractor, having two fifteen-inch objectives, has been added to the equipment of the observatory, and one of smaller dimensions is now in course of construction. The meridian circle, which has been in use since 1855, is at present being reconstructed to suit modern requirements.

The results published include the following:—Meridian circle observations, by M. B Modestow; calculations of occultations by the moon, observations of the Leonid showers of 1897-8-9, and observations of Mars (illustrated by drawings) during 1896 and 1897, by M. S. Blakjo; observations of occultations, by MM. Sternberg, Modestow and Blakjo; and a photometric study (illustrated by two charts) of Coma Berenices, together with a description of the useful work performed with a binocular of 15 mm. aperture, by M. Ceraski.

ELECTROCHEMICAL NOTES.

THE literature of electrochemistry and electrometallurgy is rapidly increasing in volume and importance, and busy people find an increasing difficulty in keeping themselves well informed as regards the more recent developments in these new branches of science and industry. The value of periodic subject-indexes of current literature on this subject is therefore very great, and all interested in these new sciences will hail with pleasure the appearance of a monthly sheet entitled *Elektrochemische Technik*, which contains an alphabetical subject-index of all recent articles dealing with applied electrochemistry, electrometallurgy and electrotyping.

This sheet is edited and published by Dr. F. Peters, of Berlin, and the first issue is dated October, 1902. It contains references to 107 recent articles on the subjects covered by the index, and French, German, English and American papers and journals have been searched in compiling this index. In some cases, short abstracts have been given of the articles indexed.

Our issue of May 22 contained a note upon the electric resistance furnaces patented and manufactured by Heraeus, of Hanau, Germany, and the use of such furnaces for melting-point determinations. These furnaces have latterly been reduced in cost and improved in efficiency by the substitution of platinum foil only 0·007 mm. in thickness for the wire originally used, and a recent issue of the *Zeits. f. Elektrochemie* contains some notes by Dr. Haagn—the chemist to the Hanau firm, upon the use of the tube form of the improved furnace for laboratory determinations.

The most important of these for the chemist is the application of the Heraeus furnace to organic elementary analysis, and, according to Dr. Haagn, this application has been attended with success. We suppose that, when used for this purpose, the platinum spiral encircling the glass combustion tube is cut up into several sections, each with its own current connections, so that successive portions of the tube can be heated as desired. The great advantage of such a furnace, from the chemist's point of view, will be the reduction of the heat losses by radiation and by the escaping gases, since these in the usual form of gas-combustion furnace are very great, and in summer time render organic analysis a most trying and tedious operation. Other proposed applications of the Heraeus tube furnaces are for the direct estimation of carbon in steels, and for the determination of ash in coal and coke. The maximum temperature attainable with these furnaces is 1700° C., and this limit is due to the inability to produce tubes, which will retain their form at this or higher temperatures.

The use of the electric current for heating glass furnaces does not seem a very promising application of electric power to those acquainted with the high degree of efficiency obtained in the modern regenerative gas furnace now generally employed in the glass-making industry. According to a recent issue of the *Zeit-*

schrift für Elektrochemie, however, this method of heating glass furnaces has not only been the subject of practical experiments in Germany, but two glass works are now in operation, working upon this principle. Two Cologne engineers, MM. Becker and Völker, are the patentees of the more valuable and practical electric furnaces of this type, and after numerous laboratory experiments they have been able to achieve the realisation of their ideas upon an industrial scale. The first "Electric Glass Factory" was built at Plettenberg on the Lenne, where a power station of 2000 E.H.P. was available for the supply of the requisite electric energy. The results first obtained here were not very satisfactory from the economic point of view, but improvements were introduced in the process which are considered to render it a commercial success, where cheap power is available. A new company has therefore been floated, the "Aktiengesellschaft f. Elektrokeramic," and a second electric glass works has been built at Deutsch-Matrei, where electric power can be obtained at a cost of 5 pfg. per E.H.P. hour at the terminals of the furnaces. This works was to commence manufacturing operations in the summer of this year, and further details of the results obtained will be awaited with interest.

Messrs. Foerster and Müller, who have devoted much time to the elucidation of the chemistry of the electrolytic chlorate cell, contribute to the *Zeitschrift f. Elektrochemie* of August 28 and September 4 details of an extended laboratory investigation relating to the changes which occur when hypochlorite solutions are electrolysed under various conditions. Sodium hydrate, sodium hypochlorite and sodium chloride solutions were used as electrolytes in their experiments, and the results show that chlorate was formed at the anode both by primary and secondary reactions under the conditions obtaining during their tests. The primary formation of chlorate is represented by the following equation:—

$$ClO' + 2O = ClO_3.$$

This reaction, however, demands the presence of ClO′ ions with anodic free oxygen and an E.M.F. at the anode above 1·1 volts. It occurs under normal conditions only to a slight extent. Secondary chlorate formation occurs at the anode, not only in solutions containing free hypochlorous acid, but also in neutral and alkaline solutions, and may be represented by the following equation:—

$$6ClO + 3H_2O = 2HClO_3 + 4HCl + 3O.$$

The formation of chlorate by this secondary reaction is, however, most active when the conditions admit of the existence of free hypochlorous acid in the electrolyte, *i.e.* when the electrolyte is maintained in an acid condition during the electrolysis. In this connection, it is interesting to note that a recent French patent in the name of Lederlin, relates to an improvement in the usual electrolytic chlorate procedure, the improvement being the continuous addition of dilute hydrochloric acid to the electrolyte in the cell.

The use of ozonised air for the purification of drinking water is again attracting considerable attention. Some years ago, experimental trials were carried out at Paris and other places with processes of this character, but the trials appear to have been unsuccessful (probably on economic grounds), and for two or three years little has been heard of ozone in connection with the water supply of large towns. During the present year, the East London Water Company has, however, been carrying out trials at Lea Bridge with an ozone process of purification, and according to one of our electrical contemporaries, these trials have been fairly successful. Prof. van 't Hoff also gave details at this year's meeting of the German Electrochemical Society of experimental trials recently made with the Vosmaer-Lebret process in Holland, and his paper is fully reported in a recent issue of the *Zeitschrift f. Elektrochemie*. The Vosmaer-Lebret form of ozoniser differs from most of those previously invented in the absence of glass as a dielectric. The silent discharges which produce the ozone in the air passing through the apparatus take place between the walls of the metallic tubes which form its essential feature. An E.M.F. of 10,000 volts with one pole earthed is used, and no artificial cooling is employed. The chemical and bacteriological examination of the water before and after treatment with the ozonised air showed that the reduction in organic matter and in the number of colonies was equal to the best yet obtained by any other process, and Prof. van 't Hoff is of opinion that the Vosmaer-Lebret process may solve the problem of a pure-water supply for large towns and cities. Experimental trials of the process are shortly to be carried out in Rotterdam, in connection with the town water-works.

The electrolytic separation of antimony from polysulphide solutions of sodium and the metal is a difficult operation, for, owing to the separation of sulphur at the anode and its re-solution in the electrolyte, the metal deposited at the kathode has a strong tendency to enter again into solution. Izart and Thomas have recently been investigating this phenomenon, and have found that the difficulty can be overcome by using a diaphragm type of cell. Some details of their experiments are given in the *Zeits. f. Elektrochemie* of September 11. The solution of polysulphide is placed in the kathode compartment, and a solution of sodium hydrate is used in the anode compartment of the cell. The conductivity of the electrolyte can be increased by the addition of ammonium salts. On passing an electric current through such a cell, sulphur separates at the anode, but dissolves in the sodium hydrate solution with liberation of oxygen. At the kathode, antimony is deposited, and there would appear to be no limit to the thickness of the deposit which can be obtained under these conditions. The process is about to be tried upon an industrial scale at Cassagnac, in France, and the results obtained will be awaited with interest. Up to the present time, the only electrolytic process for the separation of antimony which has been worked upon a large scale is that of Siemens and Halske, but no details of the plant at Banya, in Hungary, have been published, and it is possible that the results have been less satisfactory than the patentees hoped.

A NEW JOURNAL FOR GENERAL PHYSIOLOGY.[1]

THE multiplication of journals devoted to particular aspects of the various branches of a science, although indicating the vigorous growth of the last decade, is not without its disadvantages; it tends to accentuate those subdivisions of the subject which specialisation must of necessity bring about. In this respect it is refreshing to realise that the particular periodical now under review aims rather at the consolidation than at the further separation of the different aspects of physiological knowledge. In this and in other respects it is a new departure and as such merits special recognition. This will be apparent to anyone who reads the excellent introduction with which the editor, Prof. Verworn, has prefaced the first number of the new venture and which, apart from its delightful literary style, is well worth perusal since it is more comprehensive than the majority of such utterances; it forms, indeed, in itself a noteworthy and suggestive contribution to contemporary physiological literature. Of the many different points which are dealt with in this editorial, only those can be referred to here which have a direct bearing upon the scope and conduct of the *Zeitschrift für allgemeine Physiologie*. The phrase "General Physiology" has been made familiar through Prof. Verworn's masterly treatise upon the subject, but as this very treatise appears to have given rise to some misconceptions as to the meaning of the terms, the editor now defines the position with more precision. General physiology is regarded by Prof. Verworn to be the science which deals with the objective phenomena of living things in so far as they are common to all or to large groups of organisms. It is noteworthy that the qualification indicated by the word "objective" has been introduced; the reason for this introduction appears to be the desire of the editor to make it clear that in his opinion physical and chemical changes are the only data which can be properly considered to constitute the subject-matter of physiology. His affirmation of this view is particularly salutary at the present time owing to the confusion which exists as to the relation of physiology to psychology, and the modern tendency to blur our sharpness of view in regard to the former subject by reviving the vitalistic views of the past. Prof. Verworn regards with disfavour the intrusion of such idealistic conceptions as have been made familiar by the exponents of "neovitalism," and accordingly he limits the subject-matter of general physiology. He also advocates a more exact phraseology in connection with physiological processes which have been hitherto described by a terminology belonging to psychology. The use of such terms is undoubtedly

[1] *Zeitschrift für allgemeine Physiologie.* Herausgegeben von Dr. Max Verworn. Erster Band, Erstes Heft. Pp. 128 + 28. (Jena: Gustav Fischer, 1902.) Preis Mk. 24.

extremely misleading; it is difficult, for instance, to dissociate those physiological processes which are generally described as "voluntary" from having a physiological connection with "volition," and yet with volition as such physiology itself can have no dealings. In the opinion of the writer of the present review, Prof. Verworn is to be congratulated upon the firm attitude which he has taken and upon his timely attempt to demarcate the scientific frontier of his subject.

In the editorial preface reference is also made to a misconception which appears to be rather widespread, and is fundamental as regards clear definition of the subject; this is the tendency to regard general physiology as identical with what has been called comparative physiology. The latter phrase is undoubtedly a wholesome protest against the restriction as to experimental material which pervades a large section of physiological work, and which causes generalisations to be drawn from phenomena observed only in a few vertebrates—the frog, the rabbit, cat, dog and monkey. But comparative physiology as the appropriate *vis-à-vis* for the extensive science of comparative anatomy cannot at present be said to exist at all; on the other hand, there is a considerable and rapidly accumulating mass of material for general physiology in the sense in which this phrase is used by Prof. Verworn. It is true that both studies postulate investigations carried out upon an extensive range of living material; there is, however, a very real distinction between them related to the end for which the study is undertaken. If this is directed so as to ascertain the phenomena exhibited by a particular animal as such, then it fitly forms part of comparative physiology; but if it is undertaken with the object of throwing light upon analogous phenomena existing throughout widespread groups of organisms, then it can be more appropriately described as pertaining to general physiology. In this latter case the object of study is selected because it exhibits some particular physiological process in an especially striking way or under especially modified conditions. The distinction will no doubt break down as our knowledge widens and a real comparative physiology comes into being, but at present it appears to be both sound and useful. In illustration of such practical utility the writer of this article draws attention to investigations upon the phenomena exhibited by the electrical organs of fishes; these have been undertaken by physiologists in order to throw light upon the electrical changes present in such excitable tissues as muscles, nerves, &c.; it is a mere incident that they also contribute towards our knowledge of the life-history of particular forms of fish. In this connection it is desirable to explain that the editor is particularly careful to guard against giving the impression that he attaches particular value to the study of the simplest forms of life; these are extremely suitable objects of study for particular purposes, but he rightly ridicules the notion of there being any special virtue in a "Protistenphysiologie."

It will be clear from the above review that a very wide scope is given to the possible subject-matter of the new journal; it includes a wealth of material if only in investigations upon all the excitable tissues both animal and vegetable. The editor's hope is to bring together, by means of the *Zeitschrift*, widely scattered researches upon most diverse objects, which will, however, all be linked through their authors' aims and points of view; the whole assemblage will thus have a direct bearing in regard to those large problems of the existence of which every physiologist is aware.

In order to encourage the advance of physiology along these lines, Prof. Verworn announces his intention of giving the new journal an international character, partly by publishing at the end of each number reviews of such researches appearing in various existing periodicals as come within the scope of the subject, but mainly by undertaking to print communications in any one of the languages made official at the Physiological Congress held last year in Turin. There are at present very few journals in which physiological communications, whether German, French, English or Italian, can appear; a physiological *Zeitschrift* of this cosmopolitan character will prove to be a real boon, and will, if successful, bring into touch workers of different nationalities in a way which must be most beneficial for the advance of their science.

Space will not permit any extended reference to the researches contained in the first number of the new journal; it may, however, be said that as regards importance and varied interest they are excellent, and that Prof. Verworn is to be congratulated upon the subject-matter of his first volume. The communications include the following original publications:—"Zur Kenntnis der Narkose," Hans Winterstein; "Neue Versuche zur Physiologie der Befruchtung," E. von Dungern; "Ueber die Reaktion des Blutserums der Wirbeltiere und die Reaktion der lebendigen Substanz im allgemeinen," H. Friedenthal; "Inanitionserscheinungen der Zelle," H. Wallengren.

There is, further, an article by Prof. Boruttau upon the older and the more modern conceptions as to the causation of nerve conduction, and reviews of various contributions to contemporary physiological and biological literature by a number of competent reviewers. The journal is well printed, and such plates as are present in this first volume are quite satisfactory. It is to be hoped that English contributions to general physiology may appear in some of the succeeding numbers; in the meantime, Prof. Verworn has the hearty good wishes of many English physiologists for the success of his undertaking. F. G.

INTERNATIONAL CONFERENCE ON WEATHER-SHOOTING.

IF anyone wishes to learn the history of the subject of the effect of gun firing on weather, he cannot do better than consult a most interesting and complete history, which has recently appeared as a publication of the Central Anstalt for Meteorology and Earth's Magnetism (year 1902, vol. xxxix., Vienna). The above-mentioned history is only one of several valuable articles contributed to this volume, all of which are connected with the same subject. In fact, the publication is an account of the international conference for experts on weather-shooting which took place in July last at Graz. It may be news to many people to learn that already three international and one Italian congresses have been held, and that anyone who was interested in the subject could have attended.

The congress in question was summoned to give, if possible, definite answers to two definite questions, namely, (1) Is weather-shooting effective or not? (2) If no final judgment can be given, what should be done in future and how should one proceed? In order to prepare those interested and about to attend the conference, three monographs were published and distributed a fortnight beforehand, bringing together the whole history of the subject up to that time; the methods, apparatus and arrangements of modern weather-shooting; and lastly, the criteria for judging the effect of weather-shooting and the application of the same to the numerous "effects" and "non-effects" as reported in previous congresses and publications. Each of these are printed in the present volume and are valuable contributions to the subject.

It would take too long to enter deeply into the details of the numerous meetings and discussions at the conference itself. It is of interest to state, however, that the distinguished director of the Vienna Central Anstalt of Meteorology and Earth's Magnetism, Herr Hofrath Prof. Dr. Pernter, was general reporter to the congress, and that at the end of the volume he sums up the conclusions of the conference. The first result, as he states, was that the effect of weather-shooting, based on expert evidence, appears not only—as the overwhelming majority of the opinions of experts showed—as doubtful, but as most doubtful and, indeed, improbable when all circumstances and different weights of opinions are considered.

The second main result, restricting ourselves only to two, was that the firing should not as yet be given up, but continued until it be proved that it has not the desired effect. It may be mentioned in conclusion that this publication is a model of what such a report should be, and those who have taken part in it are to be congratulated on the successful result of their labours.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—A statement of the needs of the University has been circulated by the Vice-Chancellor among members of congregation. Applied mechanics is one of the subjects for which an additional professorship is asked. Better endowment is asked for the professorship of human anatomy, the readership in pathology, the Sibthorpian professorship of rural economy (now suspended), the chairs of geology, zoology, physics and experimental philosophy, and the curatorship of the Pitt-Rivers

Museum. A large extension of the system of readerships and lectureships is asked for in natural science, archæology and other subjects. The necessity of instituting and maintaining a laboratory for experimental research in the field of psychology is urged by several professors. The urgent needs of the University Museum, the Botanic Garden, the University Observatory and other departments of science at the present time involve a capital expenditure of about 30,000*l.* and an annual expenditure of 3050*l.*

OAMBRIDGE.—Mr. L. Doncaster and Mr. V. J. Woolley, of King's College, have been awarded Walsingham medals for their researches in biology. Mr. Doncaster wrote on hybridisation, Mr. Woolley on the effect upon a nerve of strong interrupted induced currents.

Twenty-three entrance scholarships and exhibitions in natural science have been awarded at the recent examinations held by ten colleges. For classics fifty-one awards were made, for mathematics thirty-seven, and for modern languages six.

DR. CHARLES PORTER, of the Public Health Hospital, Leith, has been appointed demonstrator in bacteriology at University College, Sheffield.

DR. G. S. PARKIN summarises in the *Times* the results of inquiry made at Oxford on behalf of the trustees of the Rhodes scholarship scheme to ascertain the conditions on which scholars will be admitted to the University and also the willingness of the individual colleges to receive the men selected. Almost all the colleges have already expressed their willingness to receive a certain number of the scholars annually. The *minimum* standard of admission to be kept in view by the trustees in making their selections is the ability to pass Responsions. Dr. Parkin adds:—"As much weighty evidence has been placed before the trustees to show that in parts of the United States, and in many of the colonies, it was felt that the bequest would be made more useful and effective if scholars were accepted for post-graduate and research work, as well as for merely under-graduate standing, the colleges were asked to state their preference in this particular. The replies were varied—some colleges inclining distinctly towards men prepared for advanced study, if within moderate age limits—while some are ready to take in scholars of both classes."

SCIENTIFIC SERIAL.

Journal of Botany, December.—The article on a new Senecio hybrid, by Mr. Burbidge and Mr. Colgan, refers to a form found at Sorrento, Ireland, which is intermediate in character between the common ragwort, *Senecio Jacobaea*, and an introduced species, *Senecio cineraria*. Besides the illustrations, which do not furnish very definite proof, the authors bring forward more convincing evidence in favour of their view.—The notes published by Mr. Spencer Moore refer to *Salvia Russellii*, two species of Barleria and a recently founded species of Amphoranthus.—Mr. C. E. Salmon records the finding of *Althæa hirsuta* near Reigate and discusses the possibility of the plant being a native or an alien.—Mr. Wheldon and Mr. A. Wilson give the localities of some mosses and hepatics which have been discovered in west Lancashire since their previous list, published in 1901.—A list of Shropshire Sphagna is compiled by Mr. W. P. Hamilton.—The revised catalogue of British Marine Algæ, with localities, compiled by Mr. Batters, is concluded in this number.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 11, 1902.—Abnormal Changes in some Lines in the Spectrum of Lithium. By Hugh **Ramage**, B.A., St. John's College, Cambridge. Communicated by Prof. G. D. Liveing, F.R.S.

The author has found that the wave-lengths of the lines belonging to the principal and the second subordinate series in the oxyhydrogen flame spectrum of lithium agree closely with those given by Kayser and Runge for the lines in the arc spectrum, but, excepting the orange line, there are considerable differences between the lines of the first subordinate series. Beginning with the orange line and proceeding to the others in order, the differences found were 0·07, 0·70, 0·49, 0·39 and 0·28 unit, the wave-lengths of the flame lines being the greater. In view of these differences, the author examined the arc spectrum in an arc struck in air and in another enclosed in a magnesia brick; the spectra of different parts of the outer flame and of the inner core of the arc were studied. He also examined the spark spectra with and without a Leyden jar in the secondary circuit. The conclusions are that the lines in the principal series appear to broaden and reverse normally. The lines in the second subordinate series do not reverse, but they broaden towards the less refrangible end of the spectrum and become diffuse on that side. The first line in the first subordinate series, λ 6103·84, broadens and reverses almost normally. The other lines in that series broaden more rapidly on the more refrangible side than on the other. The inner core of intense arcs, and the parts near the negative poles of weak arcs and sparks, give a broad reversed line with its centre about λ 4602·4, whilst the part near the positive poles in weak arcs, and the flame of the arc, give a sharp bright line, λ 4603·07, coincident with the lines in the spectra of the oxyhydrogen flame and uncondensed spark. The wave-lengths hitherto recorded for these diffuse lines would appear to be those of abnormal lines; the true lines are the sharp bright ones which occur, without complication, in the spectrum of lithium in the oxyhydrogen flame.

Entomological Society, December 3, 1902.—Canon Fowler, president, in the chair.—Mr. H. W. **Andrews** exhibited a male specimen of *Theriopleetes lucidus*, from Chattenden, July, 1902. Colonel Yerbury took several females of this species at Nethy Bridge, N.B., in 1900, but there appears to be no record of the capture of the male. He also exhibited a male *Platychirus sticticus* and a female *Microdon devius* from Eltham and Shoreham (Kent) respectively; and three small dark examples of *Syrphus balteatus*, taken near Brockenhurst, where the form was not uncommon, in October, 1902.—Mr. M. **Burr** exhibited two species of Phyllium from Ceylon, sent by Mr. Green, *P. bioculatum*, Gray (=*erurifolium* Hann., and *scythe* Gray), which produces the flanged ova and is the commoner of the two, and *P. athanysus*, Westw., a scarce species with the less ornate ovum.—Mr. A. J. **Chitty** exhibited a box of insects, taken, between September 22 and October 7 last, from a decayed fence chiefly constructed of birch. The exhibit comprised about a hundred species, of which seventy-nine or eighty were Coleoptera. Four species of beetles mimicked the surroundings of lichen-covered bark, and one, *Acalles tribatus*, resembled buds.—Mr. R. **Adkin** exhibited a hybrid *Selenia bilunaria* × *S. tetralunaria*, together with spring and summer examples of both species for comparison. The hybrid presented some of the markings of each of its parents, the crescentic blotch at the apex of the fore-wings and the band on the hind-wings closely following *tetralunaria*, but no trace of the dark spot usually so distinct on each of the wings of that species, especially in the summer emergence, was visible, while the "second line" of the fore-wings closely followed *bilunaria*. In colour it more nearly resembled that of the summer brood of *tetralunaria*.

Geological Society, December 3, 1902.—Prof. C. Lapworth, F.R.S., president, in the chair.—On some well-sections in Suffolk, by Mr. William **Whitaker**, F.R.S. Notes of thirty-one new wells have accumulated since 1895, some of them giving results which could not have been expected. A trial-boring for the Woodbridge Waterworks Company gave a depth of 133¾ feet down to Eocene beds, and a thickness of Crag about double of any before observed in the neighbourhood. The author is not satisfied with any of the explanations which have been suggested. Two borings at Lowestoft show that Crag extends to a depth of 240 feet in one case and more than 200 feet in another, confirming estimates of Mr. Harmer and Mr. Clement Reid. In one of these, Chalk was reached at 475 feet. Three other wells in the neighbourhood confirm the great depth of the newer Tertiary strata. Sections are also given from the following places:—Boulge, Hitcham Street, Ipswich (corroborating the evidence for a deep channel filled with Drift given by the section at St. Peter's Quay, New Mill), Shotley, Stansfield and Brettenham Park. The last shows the greatest thickness of Drift recorded in the county, namely, 312 feet.—The cellular magnesian

limestone of Durham, by Mr. George **Abbott.** The Permian Limestone covers about 1¼ square miles near Sunderland; it alternates with beds of marl containing concretionary limestone-balls, and attains a thickness of 65 feet or so. The cellular limestones frequently contain more than 97 per cent. of calcium carbonate. Magnesium carbonate occupies the interspaces or "cells" of this limestone, and also the spaces between the balls. The patterns met with in it can be arranged into two chief classes, conveniently termed honeycomb and coralloid, each with two varieties; both classes have begun with either parallel or divergent systems of rods. The second stage is the development of nodes at regular distances on neighbouring rods, and these in the third stage, by lateral growth, become bands. Finally, in the fourth stage the interspaces become filled up. The upper beds are usually the most nearly solid. In the coralloid class, the nodes and bands are smaller and more numerous than in the honeycomb class. In both classes, tubes are frequently formed. The rods have generally grown downwards, but upward and lateral growth is common.

Anthropological Institute, December 9, 1902.—Dr. A. C. Haddon, F.R.S., in the chair.—Mr. C. **Lumholtz,** of the American Museum of Natural History, read a paper on the symbolism in art of the Huichol Indians of Mexico.—Messrs. Nelson **Annandale** and H. C. **Robinson** read a paper on some results of an expedition to the Malay Peninsula. The paper described the districts which were visited by the authors, the investigations undertaken and the material obtained. I. The *civilised tribes* are as follow:—(1) *Malays and Siamese of the district between Singora and Jambu.* Physical differences between the two are slight or absent; there is evidence of an admixture of aboriginal blood, though the aborigines are now practically extinct in the district. Two distinct physical types are to be recognised, but neither can be associated with one people or the other. Mohammedan and Buddhist customs were noted. The amusements, opium-smoking, diseases and modes of burial were described. (2) The *South Perak Malays* are distinct from the people of Patani, their standards of civilisation more occidental, but their race is non-persistent, being swamped by immigration. (3) In *Selangor* there is no long-established Malay population. (4) The *Samsams of Trang* are identical with or nearly related to the Malays of Upper Perak, but certain physical differences from the Malays of South Perak were noted, and their language, religion and weapons were described. II. The *savage tribes* are the following:—(5) *Semangs.* Their distribution, social status, physical characters and mode of life were described. (6) *Sakais.* Their distribution and relationship to Semangs were noted, and their mode of life, external relations and burial customs. (7) *Orang Laut Kappir of Trang.* Their possible relationships were discussed, with their dialect, religion and customs.

CAMBRIDGE.

Philosophical Society, November 24, 1902.—Dr. Baker, president, in the chair.—The origin of the thoroughbred horse, by Prof. **Ridgeway** (see p. 187).—Note on the resolution of compound characters by cross-breeding, by Mr. W. **Bateson.** In this note, the case of resolution of character recorded by de Vries ("Mutationstheorie," Lief. iv. p. 196) is discussed. A red Antirrhinum crossed with a white gave hybrids which on self-fertilisation gave four forms in numbers suggesting the ratio 9 : 3 : 3 : 1. These results are treated by de Vries as phenomena of "dihybridisation," but in the present communication it is pointed out that the facts so far do not preclude an apparently simpler account.—Notes on rearing the later stages of echinoid larvæ, by Mr. L. **Doncaster.** The difficulties which workers at echinoid development have met with in rearing the larvæ were pointed out, and the methods used by MacBride and others were described. At Naples in the spring and summer of 1902, it was found possible to rear larvæ of *Strongylocentrotus lividus*, *Echinus microtuberculatus* and their hybrids beyond the metamorphosis without using either a plunger or specially large jars. The larvæ were kept in four litre jars, and supplied about five times a week with fresh sea-water taken several kilometres from the coast. The larvæ usually developed healthily and metamorphosed about thirty days after the fertilisation of the eggs. Other species, such as *Sphaerechinus granularis*, however, could not be induced to develop by these means. The hybrid urchins lived for only a few days after the metamorphosis, but those of Strongylocentrotus were kept in some cases for a month, but did not change greatly during that time. The later larvæ and young urchins of the two species mentioned resembled one another very closely.—(1) On the Galois theory of differential equations; (2) On the structure of continuous groups, by the **president.**—Note on spontaneous ionisation in air at different temperatures and pressures, by Mr. J. **Patterson.** The object of the experiment was to find, if possible, the cause of the so-called spontaneous ionisation in air. To measure the spontaneous ionisation at different temperatures, the air was contained in an insulated iron cylinder containing about thirteen litres, and the rate of leak was measured between the walls of the vessel and an insulated electrode. This electrode was connected to one pair of quadrants of a very delicate electrometer and the rate of leak observed. The experiments showed that from the temperature of the room (20° C.) to about 500° C. the current through the gas was constant, the air in the cylinder being at atmospheric pressure throughout the investigation. To measure the ionisation at different pressures, the same cylinder and electrode were used. The joints were made air-tight with sealing-wax and the air filtered through glass wool. The results showed that down to a pressure of about ⅓ atmos. the current through the gas was independent of the pressure and that for pressure below 90 mm. of mercury the ionisation was proportional to the pressure. Using the value 6×10^{-10} for e, the charge on an ion, the number of ions produced per c.c. per sec. was about 30. The results of the experiments indicate that the "spontaneous ionisation" is really due to easily absorbed radiation from the walls of the vessel.—Note on the behaviour of a potassium amalgam kathode in a vacuum tube, by Mr. T. **Lyman.**

MANCHESTER.

Literary and Philosophical Society, December 16, 1902.—Mr. Charles Bailey, president, in the chair.—Mr. Frank **Southern** and Dr. Charles H. **Lees** exhibited some Japanese magic mirrors.—Mr. R. W. **Ellison** exhibited a series of eggs of the common guillemot (*Uria troile*), showing great variety in coloration and design of markings, eggs of various shades of green, blue, yellow, brown and red being prominent.—Mr. C. E. **Stromeyer** read a paper on the graphic computation of lenses, in which he described a simple method of computing oblique rays of light which do not cross the optic axis of a lens system.—Mr. A. **Adamson** read a paper on a simple form of vernier microscope. The apparatus is specially devised to suit the elementary student in a physical laboratory who is familiar with the use of the vernier and who wishes to calibrate or determine the bore of a glass tube by measuring the length of a mercury thread within it.

PARIS.

Academy of Sciences, December 22, 1902.—M. Bouquet de la Grye in the chair.—The **president** delivered his annual address.—The prizes offered for the year 1902 were awarded as follows:—In geometry, the subject proposed for the Grand Prize was to improve in an important point the application of the theory of continuous groups to the theory of partial differential equations, the memoir crowned being that of M. Ernest Vessiot, M. Jean le Roux receiving a very honourable mention; the Bordin Prize is not awarded, M. de Tannenberg receiving an honourable mention for perfecting the theory of surfaces applicable to the paraboloid of revolution; the Francœur Prize is awarded to M. Emile Lemoine for the whole of his works on geometry, and the Poncelet Prize to M. Maurice d'Ocagne for his works on nomography. In mechanics, the Extraordinary Prize of 6000 francs is divided between M. Romazotti and M. Driencourt, M. Hartmann receiving a Montyon Prize, for his experiments on the production of the lines of slipping on the surface of elastic bodies due to their deformation, and M. Renard the Plumey Prize, for the whole of his works. In astronomy, the Pierre Guzman Prize is not awarded, the Lalande Prize falling to M. Trépied, the Valz Prize to M. Hartivig, the Damoiseau Prize to M. Gaillot, for his study of the theory of the motion of Saturn, the Janssen gold medal to M. le Comte Aymar de la Baume-Pluvinel, an encouragement and a Janssen medal being accorded to M. Jean Binot. In geography and navigation, the Binoux Prize is divided between MM. Claude, Marcel Monnier and Delpeuch. In physics, the Hébert Prize is awarded to M. C. F. Guilbert, for his work

entitled "Les générateurs d'électricité à l'Exposition de 1900." In statistics, the Montyon Prize is divided equally between M. F. Bordas, for a statistical study of the mortality in infants due to gastro-enteritis, and M. H. Duchaussoy, for a memoir on the meteorological observations of Victor and Camille Chandon de Montdidier, exceptionally honourable mentions being accorded to M. Liétard, for his work on the population of the Vosges, M. Paul Dislère, for his memoir on colonisation, and M. Peyroux, for a study of the causes of the depopulation of Elbeuf, mentions being accorded to M. R. Leroy, for a contribution to the study of alcoholism in Normandy, M. L. Mayet, for memoirs on the distribution of goitre in France and statistics of alcoholism, and to MM. Passerat and Trousseau. In chemistry, M. Rosenstiehl receives the Jecker Prize, for the whole of his works, especially those bearing on organic chemistry. In mineralogy and geology, M. de Grossouvre receives the Fontannes Prize, for his work in the field of palæontology. In physical geography, the Gay Prize is awarded to M. Berthaut, for his historical studies on the cartography of France. In botany, Mr. Roland Thaxter receives the Desmazières Prize, for his studies on the parasitic fungi of American insects, and M. Vuillemin the Montagne Prize, for his memoirs on the morphology and biology of fungi. In anatomy and zoology, the Savigny and Vaillant Prizes are not awarded, the Thore Prize falling to M. R. de Sinéty. In medicine and surgery, Montyon Prizes are accorded to M. J. Dejerine, for his memoir on the semiology of the nervous system, to M. G. H. Roger, for his work on infectious diseases, and to M. P. Ravaut, for a memoir on the cytodiagnosis of pleurisy, MM. Commenge, Comby and Guillemonat receiving mentions, and MM. E. Bodin, V. Griffon, E. Fournier, C. Guérin and Cassaët citations. The Barbier Prize is divided between M. Grimbert, for his work in chemical biology, bacteriology and hygiene, and M. Le Dentri, for a clinical statistical study of cancer of the breast. M. Ed. Imbeaux receives the arrears of the Bréant Prize, M. G. Loisel the Godard Prize, for his notes and memoirs relating to the histogenesis and physiology of the male sexual elements in birds, M. Pierre Lereboullet the Bellion Prize, for his work on cirrhosis of the liver, M. A. Clerc the Mege Prize, for a study of some soluble ferments in blood serum, and M. Triaire the Baron Larrey Prize, for his biography of D. Larrey, a very honourable mention being accorded to M. Romary, the Lallemand Prize being divided between Mlle. Pompilian and M. Hauser. In physiology, the Montyon Prize in experimental physiology is not awarded, M. Pierre Bonnier receiving the Philipeaux Prize, for memoirs on orientation and sense of altitude, M. Paul Marchal the Serres Prize, for his researches on the development of the parasitic Hymenoptera, M. J. Tissot the Pourat Prize, for a comparative study of the mechanism of respiration in mammals, and M. H. Blondel de Joigny the Martin-Damourette Prize, for his work on the pathogeny and prophylaxis of myopia. Of the General Prizes, the Lavoisier medal is awarded to M. Stanislas Cannizzaro. In accordance with the decision of the Academy to award a certain number of Berthelot medals to those obtaining prizes in the sections of chemistry and physics, MM. Rosenstiehl, Minet, Clerc, Imbeaux, Bordas, Dislère, Peyroux, Grimbert, Grignard, Fosse and Marquis, and Mme. Curie receive Berthelot medals. The Montyon Prize (unhealthy trades) is awarded to M. Claude Boucher, for a report on the methods for the mechanical manufacture of bottles, the Wilde Prize to M. Schulof, for his work on comets and shooting stars, the Tchihatchef Prize to Dr. Sven Hedin, for his scientific explorations in Central Asia, the Delalande-Guérineau Prize to M. Gonnessiat, for his work in connection with the geodetic expedition to the equator, the Jérome Ponti Prize to M. André Tournouër, for his explorations in Patagonia, the Houllevigue Prize to M. Teisserenc de Bort, for his researches on the state of the atmosphere at high altitudes, the Gegner Prize to Mme. Curie, for her work on radioactive bodies, and the Trémont Prize to M. Frémont, the Saintour Prize being divided between M. Riquier, for his work on the integration of partial differential equations, and M. Adolphe Minet, for his researches on the electrolytic production of aluminium, and the Cahours Prize between MM. Fosse, Grignard and Marquis. The prize founded by Mme. la Marquise de Laplace is given to M. Aubrun, that founded by M. Félix Rivot being divided between MM. Aubrun, Niewenglowski, Barrillon and Bénézit.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 1.

RÖNTGEN SOCIETY, at 8.30.—X-Ray Work in Private Practice: Dr. G. M. Lowe.

MONDAY, JANUARY 5.

VICTORIA INSTITUTE, at 4.30.

ROYAL GEOGRAPHICAL SOCIETY, at 4.30.—Landscapes in the Volcanic Districts of France: Dr. A. J. Herbertson.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Note on the Fluorescence of Naphthalic Anhydride: Dr. J. T. Hewitt.—The Saponification of Fats and Oils by means of Dilute Acids: Dr. J. Lewkowitsch.

WEDNESDAY, JANUARY 7.

GEOLOGICAL SOCIETY, at 8.—On the Discovery of an Ossiferous Cavern of Pliocene Age at Doveholes (Buxton), Derbyshire: Prof. W. Boyd Dawkins, F.R.S.

THURSDAY, JANUARY 8.

MATHEMATICAL SOCIETY, at 5.30.—A Method of representing Imaginary Points by Real Points in a Plane: Prof. A. Lodge.—On the Mathematical Expression of the Principle of Huygens: Dr. J. Larmor.—Generational Relations for the Abstract Group simply Isomorphic with the Linear Fractional Group in the Galois Field [2ⁿ]: Prof. L. E. Dickson.—Series connected with the Enumeration of Partitions (second paper): Rev. F. H. Jackson.—On the Jacobian of Two Binary Quantics considered Geometrically: Prof. W. S. Burnside.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes of Recent Electrical Design: W. B. Esson.—Notes on the Manufacture of Large Dynamos and Alternators: E. K. Scott.

FRIDAY, JANUARY 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.

GEOGRAPHICAL ASSOCIATION, at 3.30.—The Australian Commonwealth: Sir John A. Cockburn.

TUESDAY, JANUARY 13.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electric Automobiles: H. F. Joel.

FRIDAY, JANUARY 16.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Measurement of Water: Prof. W. C. Unwin, F.R.S.

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