THURSDAY, MARCH 29, 1917.

FISH MIGRATION.

The Migrations of Fish. By Prof. Alexander Meek. Pp. xviii+427. (London: Edward Arnold, 1916.) Price 16*s.* net.

UNDER the stimulus, and largely by the instrumentality, of the International Council for the Investigation of the Sea, enormous progress has been made in marine biological research in its bearings upon economic fishery problems since the founding of that body in 1902. The lapse of its active functions pending the settlement of the question of the "freedom of the seas" affords a convenient opportunity for considering the general results achieved, and thus the time is ripe for the appearance of Prof. Meek's volume, the material for which has been gathered from the numerous publications of fishery investigators in this and other countries. The book, however, is not merely a compendium or plain digest of other men's work, but possesses an individuality of treatment which is the author's own. While practically all aspects of modern fishery research—or at least their results—are set forth in this treatise, which thus affords far more subject-matter than the title implies, the main theme is the development of a theory of migration at various stages of growth in relation to currents. In this connection Prof. Meek introduces the terms *denatant* and *contranatant*. These are useful words, and will doubtless find permanent employment, but the idea tends to be somewhat overdriven, and the referring of migrations to one or other of these two classes, while satisfying a desire for logical completeness and formal systematisation, is liable to give rise to misapprehension in omitting consideration of all the factors involved in fish migration.

The rather self-evident fact that the pelagic ova and larvæ of fishes will migrate passively in the same direction as the mass of water which constitutes their habitat—or, in the author's terms, will migrate *denatantly*—is a fundamental factor in the distribution of fish species and is rightly emphasised. Also, if A represents the locus of a spawning ground, and B the area to which the passive migration of the early planktonic stages is made and where the individuals grow to maturity, then, if the mature fish return for spawning to their natal area A, the spawning migration from B to A will be against the direction of the current which was responsible for their first passive migration. This is described as a *contranatant* migration. In our opinion this mechanical and frequently misleadingly simple representation of the movements of the older stages leads one very little towards a scientific understanding of the migrations of fishes. The author apparently belongs to that school of ichthyologists who depreciate the value of hydrographical research in relation to the problems associated with fish life. In the preface he says: "It is obvious that currents are importantly associated with migration, but beyond this I have not found it necessary to introduce hydrographical considerations." One may mention the researches of Schmidt and other Scandinavian naturalists upon the migrations of cod, plaice, eels, etc., as demonstrating the fundamental importance of hydrographical factors in determining the spawning migrations of these species, while English investigations also point to the correlation between hydrographical conditions —*i.e.* temperature and salinity of water—and the movements of fishes. It may be that the author considers such correlations insufficiently established as yet; but in ignoring them he would appear, consciously or unconsciously, to dissociate himself from the trend of present-day fishery research.

The omission of reference to food and feeding habits also detracts from the value of this work as a treatise on migration, and further deepens the impression of a too mechanical and pedantically systematised presentation of the phenomena of migration, in terms of which the following is a sample: "The mackerel are denatant migrants in the young condition, and it is evident that the denatant migration is the dominant feature of the migrations when they become mature. It is, as a fact, usually denatant, but in some cases it may be said to be denatant in direction only."

Since the larval stages of practically all fishes are planktonic, the exposition of the idea of denatant migration is carried laboriously, but without any serious hitch, throughout the chapters on the various species. In suggesting that the landward migration of the leptocephalus larvæ of the eel is purely a matter of passive denatant drift, however, the author surely departs from the views of the authorities on the subject. In fact, leptocephali, though doubtless assisted by the drift of Atlantic water towards the European coasts, have quite considerable swimming power.

The distribution and migratory habits of North Sea plaice have been investigated by the international collaborators with a thoroughness and with conspicuously conclusive results which may be said without bias to constitute a monumental fabric of fishery research. These results being available in reports published between 1904 and 1916, it is a drawback that detailed consideration of plaice migrations should have been limited to the relatively insignificant and unrepresentative fraction of the plaice fauna which occurs off the Northumberland coast and in the Firth of Forth.

After the unfortunate quotation from Izaak Walton in the introduction repeating the old but now quite exploded notion that a salmon returns from the sea to the river which it left as a smolt or samlet "usually about six months after," one naturally approaches the chapter on Salmonidæ with shaken confidence. The above erroneous view is repeated on p. 119 in dealing with the definition of a grilse, and the statement that male *smolts* are present on the spawning beds is a misuse of terms. Nor is it correct to assume that female salmon must have spent at least two winters in the sea before spawning, since female grilse are quite common, though not propor-

tionately so numerous as males. Again, in the life of salmon at sea, while growth is more rapid in summer than in winter, it is erroneous to say that feeding is practically confined to the summer.

Regarding purely marine species, the general information is voluminous and authoritative. The author should, however, revise his impressions as to the relative sizes of the two sexes of the conger; the species of the dog-fish pest of the English Channel, which is predominantly *Acanthias vulgaris*, and not *Scyllium canicula*; and the adequacy of the scale-reading method for the determination of the age of haddock.

Notwithstanding what we have criticised as faults of commission or omission in this substantial work, it is one which no one interested in fishery science or desirous of an up-to-date grasp of some of the phenomena underlying practical fishery questions can afford to overlook.

THE PARTITIONS OF NUMBERS.

Combinatory Analysis. By Major P. A. MacMahon. Vol. ii. Pp. xix+340. (Cambridge: At the University Press, 1916.) Price 18*s.* net.

WHEN the first volume of this work was noticed in these columns, the reviewer of that volume expressed the hope that the second would not be long delayed. This hope has been fulfilled, and the reader can now obtain, for the first time, a connected account of all the modern work—so largely due to Major MacMahon himself—which has been done in connection with the partitions of numbers and with allied problems. For the more historical side of the subject the author refers the reader to Netto's "Combinatorik," and he is more concerned to present the newer processes and ideas which lie at the root of the present rapid development of the subject, and have not hitherto found a place in any book. Thus only the earlier sections of the present work overlap that of Netto, and certain investigations which are arithmetical rather than algebraical are dismissed briefly.

It is not possible, in a short space, even to enumerate the many problems of interest which are discussed in this volume—whether problems of analytical development of functions, or problems of a general interest to the non-mathematician, but the solution of which depends on the partitions of numbers. We must perforce confine attention to certain outstanding features, and make no attempt at a summary of the contents of the work.

The introduction contains a list of the memoirs to which reference is made, and the index to both volumes is at the end of the book. Chap. i. begins with Euler's "intuitive" theory of partitions, and gives an account also of the powerful graphical method devised by Ferrers, and used so much by Sylvester. In the next chapter more special attention is given to Durfee's method of studying the graph of a partition, and a very complete set of expansions of generating functions is a notable feature.

The most remarkable of such expansions are the pair discovered intuitively by Ramanujan. Only a few months ago it was found, by Ramanujan himself, that all the arithmetical labour of many mathematicians who have tested one of these expansions, for example, to eighty-nine terms in the supposed default of a real proof, has been wasted, for the theorem was, in fact, proved by Rogers more than twenty years ago, and at the time attracted little attention. Major MacMahon has made some very significant applications of these theorems to a branch of the theory of partitions on which work was scarcely possible before their discovery.

The author has succeeded in basing the theory of partitions upon the theory of Diophantine inequalities. This method is much more fundamental than that of Euler, and its use has rendered the theory of partitions highly general, so that it has now quite lost its earlier character—undoubtedly hitherto the cause of its comparative neglect by mathematicians—of a set of somewhat isolated, though elegant, solutions of special problems. It seems fair to claim, in fact, that we are indebted to the author for a new branch of mathematics, and a branch which must dominate future treatises which make a prominent use of algebraical processes.

Many chapters must be passed over without specific reference, but special mention must be made of those on magic squares, partitions in two dimensions, and the further theory of the Latin square. It is probable that many mathematicians are not aware of the extent to which these subjects have developed, and of the field of work which is still unexplored, and capable of yielding results which are fundamental not alone in connection with the partitions of numbers. By collecting these researches, which are so very much his own, from their hiding-places in scientific memoirs into these two volumes, the author has done much towards the promotion of a more general outlook on the whole range of analytical work usually classed somewhat vaguely as "algebra."

OUR BOOKSHELF.

Nature Study Lessons Seasonally Arranged. By J. B. Philip. Pp. ix+147. (Cambridge: At the University Press, 1916.) Price 2*s.* 6*d.* net.

IT is generally agreed that in the early stages science teaching should consist of "Nature study." But it is seldom that teachers realise that this should afford a sound foundation on which later, more serious, study can securely rest. Mr. Philip's little book is a bright and outstanding exception to the general rule. It concerns itself solely with botanical material in its twelve chapters; but the child of from twelve to fourteen years of age who works through its pages in the course of a year will not merely have learnt to observe, but also will have gained a firm grasp of fundamental botanical principles. From the outset the author is at pains to impress the fact that the

organs of a plant are not in mere haphazard positions, but that they occupy definite positions in relation to one another; and that the whole plant is a "living, breathing, feeding, energy-producing organism." The student is thus led on by easy steps to the clear conception of modification of organs, and of homologies; and is thus furnished with a clue by which to solve riddles presented by an apple, a cocoanut, the corm of a crocus, seeds, buds, flowers, etc. Practical work enters largely into the scheme; and by means of questions and exercises the attention of the pupil is frequently directed to the wild plant life of the countryside in a way that is entirely admirable. We cordially commend the book to all teachers of elementary botany. O. H. L.

Poverty and its Vicious Circles. By Dr. Jamieson B. Hurry. Pp. xiv+180. (London: J. and A. Churchill, 1917.) Price 5*s.* net.

DR. HURRY has, in a previous volume, discussed the vicious circles of disease. He now enters the domains of sociology and economics and deals with poverty in a similar manner. "Poverty" he defines as the condition of a person who lacks the necessaries for subsistence and efficiency, and a "vicious circle" is the process by which a primary disorder provokes a reaction which aggravates such disorder. In the ordinary course of economic law the reaction provoked by a social disorder tends to arrest such disorder, but when a vicious circle becomes established the usual sequence is modified, and the reactions which should be beneficent are the reverse and intensify the disorder. As an instance of one of Dr. Hurry's vicious circles we may quote that associated with malnutrition: Poverty leads to malnutrition; this begets debility, which causes diminished earning capacity, and this accentuates the poverty.

The vicious circles of poverty are discussed under twenty-two headings, and a chapter is devoted to "artificial circles," *e.g.* when injudicious relief aggravates the poverty it seeks to remove. The "effects of vicious circles" and the "breaking of vicious circles" form the subject-matter of succeeding chapters.

The book is largely made up of quotations from official reports and from standard authors, and as an outline of the complex subject of poverty should be of considerable value to the student of sociology and economics. It is illustrated with five plates.

Determinacion de la Latitud por Alturas Absolutas, Circunmeridianas, Meridianas é Iguales de dos Estrellas. Por Carlos Puente, Astronomo. (Madrid: Bailly-Baillière, 1917.)

AFTER a short introduction, four chapters of this short manual describe the methods of finding the latitude from altitudes observed outside the meridian, from circummeridian altitudes, from meridian altitudes (this is the longest chapter), and from two different stars observed at the same altitude when the time is known. Each chapter is divided into two parts, the first giving the necessary formulæ, the second and longer part showing how the method is carried out in practice, describing the various instruments (sextant, theodolite, transit circle) and explaining how the instrumental errors are found. Lastly, some auxiliary tables are given. The little book should prove useful to astronomical beginners and travellers.

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.*]

Muscular Inefficiency and Possible Speeds of Walking.

IN walking over a level surface, were there no muscular loss or imperfect elasticity in the ground, the only work to be done would be that required to start the body and limbs at the walking speed, which work might be recovered when stopping. Thus any energy expended in walking on the level is due either to work taken up by the ground, or lost by muscular inefficiency. (Air resistance may be neglected at walking speeds.)

That there is, for each individual, a certain speed at which walking involves a minimum effort is well known; and it seems probable—in fact, almost certain—that this depends on the natural period of the leg about the hip joint. By frequent trials I have found that in my own case this period is about 1·35 sec., so that, since there are two steps to each complete period, the natural number of steps per minute would be about 88; assuming further that each pace is equal to one yard (which is very nearly correct in my own case), the natural speed of walking is 5280 yards, or three miles per hour.

In walking at this pace the accelerations of the masses are effected by gravity.

A pendulum giving 44 beats per minute is 1·46 ft. long, and this corresponds very fairly with the equivalent length of a leg which measures 3 ft. from hip joint to the sole of the foot, taking into account the distribution of mass.

At this speed the only work required is that lost in the muscles or expended on the ground. At any other speeds the muscles are called on to accelerate or retard the various parts, and such work is apparently not recoverable. I do not know of any experiments on this point, but it would be of interest to examine whether, for instance, the muscular effort required to move a body, with a given velocity against a force, is the same as would have to be expended in preventing acceleration when the force is in the direction of motion; or, in other words, whether for equal motions the muscular effort required to cause acceleration is the same as that required to prevent it.

Assuming for the moment that it is, it is possible to calculate the greatest speed at which walking is possible, the speed, namely, at which the mere acceleration of the masses absorbs the whole work of which the muscles are capable.

If, as the simplest supposition, the motion of the leg be represented by the harmonic motion of a mass m, with period T and amplitude a, then—

The energy is $\frac{1}{2}\frac{4\pi^2 m a^2}{T^2}$. When the period is the

natural period (T_0) this energy (except for the loss in extending the muscles and in the ground) is conserved by the action of gravity.

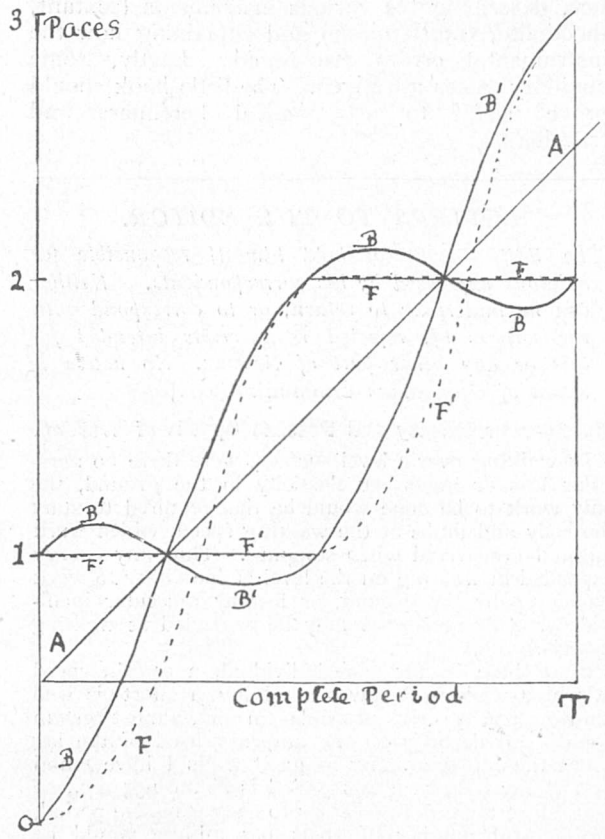

FIG. 1.—AA, motion of body (assumed uniform); BB, trace on ground of right femur (produced); B′B′, trace on ground of left femur (produced); FF, position of right foot; F′F′, position of left foot.

For any other period (T_1) an amount of energy equal to

$$2\pi^2 ma^2\left(\frac{1}{T_1^2}-\frac{1}{T_0^2}\right)$$

has to be expended four times in each pace, twice for acceleration and twice for retardation.

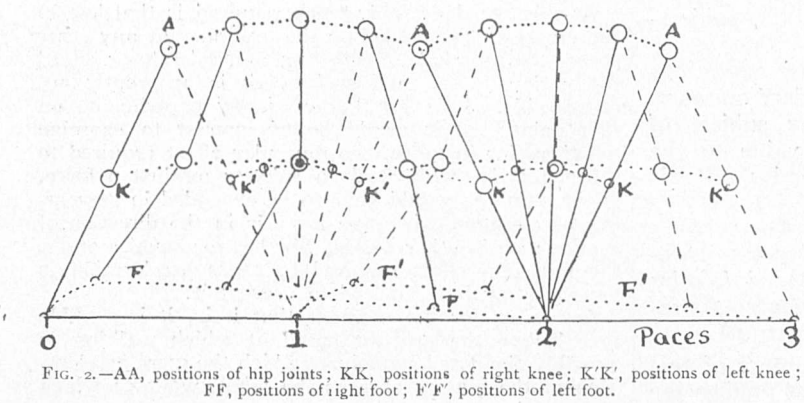

FIG. 2.—AA, positions of hip joints; KK, positions of right knee; K′K′, positions of left knee; FF, positions of right foot; F′F′, positions of left foot.

Thus for both legs, in each complete period, the amount of energy to be supplied by the muscles is

$$8\pi^2 ma^2\left(\frac{1}{T_1^2}-\frac{1}{T_0^2}\right),$$

and the power required is

$$8\pi^2 ma^2\frac{1}{T_1}\left(\frac{1}{T_1^2}-\frac{1}{T_0^2}\right)$$

If $P-Ca$ is the maximum power available (where Ca represents loss from muscular extension), then—

$$\frac{P-Ca}{8\pi^2 ma^2}=\frac{1}{T_1}\left(\frac{1}{T_1^2}-\frac{1}{T_0^2}\right),$$

or, putting $T_1=pT_0$,

$$T_0{}^3\frac{P-Ca}{8\pi^2 ma^2}=\frac{1-p^2}{p^3}.$$

As a numerical example, assume that $P-Ca$ is 1/10 h.p., or 55 ft.-lb. per sec., also that (as given above) $T_0=1{\cdot}35$ sec.

The weight of each leg is about 30 lb. (so that $m=1$ nearly). The length of the leg being 3 ft., and that of the pendulum of 1·35 sec. period 1·48 ft., then, since each half pace = 1·5 ft., $a/1{\cdot}5=1{\cdot}48/3$, or $a=0{\cdot}74$ ft. nearly.

Thus $$T_0{}^3\frac{P-Ca}{8\pi^2 ma^2}=2{\cdot}46\frac{55}{79\times 0{\cdot}55}=3 \text{ nearly},$$

whence $p=0{\cdot}6$ nearly.

Thus the speed of walking at which 1/10 h.p. is consumed in acceleration would be about 5 miles per hour, or rather more.

This is on the assumption that all the conditions can be represented by one simple harmonic term.

The actual motions[1] in walking, however, are represented in Figs. 1 and 2, and some work must be done in bending the knee joint. The details of this motion vary considerably in different individuals, but in all cases the work required would reduce the maximum walking speed to something a little under 5 miles per hour, which, as a fact, is about the limit for hard walking.

Although the above estimate rests on nothing except common knowledge and casual observation, the result gives a high probability to the assumption that muscular inefficiency, *i.e.* the loss of work in accelerating and retarding their own masses, sets the limit to the speed at which they can be worked.

A. MALLOCK.

[1] In the diagram, for the sake of simplicity, the motion of the body is taken as being uniform. This is not strictly correct, but the difference from uniformity is small.

Gravitation and Thermodynamics.

DR. TODD (NATURE, March 1) suggests that when one gravitative mass approaches another it acquires heat. This might occur when, as is usually (but not always) the case, the body moves up the gradient of potential; for then the energy of field displaced by the body would increase.

There is one development of the above speculation which is not explicitly mentioned by "J. L." (NATURE, March 15), though it may have been inferred. Suppose two cases: (*a*) A metal disc is in a vertical plane at the earth's surface. If it be started spinning on a horizontal axis through its centre the descending half warms and expands, the ascending half cools and contracts, there will arise a turning moment, and the disc will now continue to spin of itself provided the friction is small enough. (*b*) The extreme top and the extreme bottom of the disc will be cold and hot points respectively, so that if metal brushes be applied there, we

could obtain a continuous current in a closed circuit. These are two cases of perpetual motion. The principle of conservation of energy which is here apparently violated is inapplicable to such cases where the forces are so much smaller than any experimental results on which that principle rests.

The temperature effect of gravitation is a residual effect of gravitation which is itself apparently a residual effect, so that we are dealing with forces of, say, 10^{-12} dyne.

The fact that the forces involved in the above suggested cases (*a*) and (*b*) are far too small to render any perpetual effects observable, of course does not affect the argument, which is that the speculation does involve a theoretical continuous motion.

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Talbot's Observations on Fused Nitre.

SOME years ago in studying the position of the *solidus* curve in the binary system consisting of the nitrates of potassium and sodium, the present writer became well acquainted with the phenomena referred to by Lord Rayleigh in his interesting letter in NATURE of February 1. A number of photomicrographs were made of thin layers of the nitrates, crystallised from fusion, between crossed Nicols, and it was found very necessary in the work that the exposures should be made before the secondary change, the arrival of which, as Talbot observed, is hastened by scratching, had set in. There is, of course, now no mystery as to the cause of this secondary change upon cooling in the character of the crystals first formed from the melt, for potassium nitrate is known to be dimorphous, with a transition temperature at ordinary pressure about 129° C. A considerable degree of under-cooling often occurs, and the transition, initiated at Talbot's needle-point, spreads "like a wave" if the slide be cooler than 129°, as Lord Rayleigh found using a temperature near 100°.

If Wallerant is correct in supposing that there is a third, in all circumstances metastable, crystalline variety of potassium nitrate, still further entertainment from this interesting, if old-fashioned, salt is at least possible. ALAN W. C. MENZIES.

Princeton University, Princeton, N.J.
February 24

POSITION AND PROSPECTS OF PROFESSIONAL CHEMISTS.

IN August, 1914, chemists, in common with other professional men, volunteered in considerable numbers for active service with the fighting forces. Many were already attached to the Officers Training Corps of their universities, or to Territorial units—the call was the same to them as to others. The need for fit men was the first consideration, and the need for chemists, as such, in other spheres directly connected with war was not at first recognised. Offers to the War Office of scientific assistance emanating from organised bodies and from individuals were politely acknowledged and pigeon-holed for future reference in case of necessity.

We possessed, fortunately, a number of chemists acquainted with the production of explosives, but as the magnitude of the task before us became better realised a much greater demand arose for chemists to control the operations of manufacture.

In the early months of the war lists of chemists available for the service of the country were prepared by the Institute of Chemistry, the Chemical Society, and other bodies interested in chemical science, with the result that when the Ministry of Munitions called for them a ready response was forthcoming from all parts of the country, from industrial concerns and private laboratories as well as from the universities and colleges, both at home and in the Overseas Dominions. The majority of chemists with experience in the explosives industry were already engaged on war work, and arrangements were made for the training of others to take charge of operations in new factories erected in various parts of the kingdom. Additional chemists were also needed for the increasing work of the staffs of Government laboratories and factories and to control and assist in the production of war material of all kinds. For certain requirements essential to the production of armaments and munitions, for a number of drugs, for laboratory glass and porcelain ware, filter-paper and other necessaries, we had hitherto been almost entirely dependent on Germany and Austria, and this state of affairs would have led to serious difficulties if our chemists had not speedily and successfully dealt with such matters. Students in college laboratories assisted, under the supervision of their professors, in the preparation of drugs and the examination of materials, or left before finishing their courses to take up positions in works. Women science graduates, mostly teachers in time of peace, obtained appointments in analytical laboratories as substitutes for chemists who had joined the forces or been transferred to war work. The demand for trained analysts and works chemists still persists, and has been accentuated by the undoubted fact that manufacturers generally are learning to appreciate more and more the value of science in industry.

In addition to the activities referred to above, mention must be made of the help rendered to the Government by leading consulting chemists, professors of chemistry, and technologists, in an advisory capacity, with regard to inventions and to offensive and defensive measures, wherein many of our best are pitted against the much-vaunted chemists of the enemy. German chemists had obviously devoted attention to the employment of scientific frightfulness in warfare which other nations, if such means had occupied the minds of their men of science at all, would have refused to believe that any civilised people would adopt. British chemists, therefore, were perforce called upon to investigate problems wholly repugnant to their inclinations and degrading to their science in order to fight the enemy with his own weapons. Much of what they have done must remain, and probably will always remain, a sealed book; but the results are shown in the well-deserved praise accorded them in the despatches of Lord French and Sir Douglas Haig.

When the Germans started using asphyxiating gases, the War Office called for volunteers with training in chemistry and formed with little diffi-

culty a new fighting force, selecting the officers from chemists already holding commissions and transferring non-commissioned officers and men with scientific qualifications from other units. Their work did not call for much scientific attainment, yet the force was for the most part made up of graduates and qualified professional chemists, a body of men far too valuable to the country to risk in hazardous enterprise. However, they proved good soldiers and "carried out their unfamiliar duties during a heavy bombardment with conspicuous gallantry and coolness," as reported by Lord French.

Later, the force was augmented, and many of the original corporals were promoted or, as the demand for chemists became more pressing at home, were withdrawn for work in Government and controlled establishments. Chemists were also promptly engaged on research for devising methods of defence against poisonous gases, and for inspection work in that connection.

Apart from measures of offence and defence, however, the work of chemists in the Royal Engineers and in the sanitary companies of the Royal Army Medical Corps engaged on active service for the purification and examination of water and for other sanitary matters, has doubtless contributed to the maintenance of health in the armies on the Continent, in the East, and in Africa, while we must not overlook the fact that not a few of these chemists are also first-class bacteriologists, and their work as such has been indispensable. Mention must also be made of the chemical advisers to the various armies, inspectors of ordnance, instructors in gas defence, chemists with the Army Service Corps concerned with chemical supplies and those attached to the Air Services.

Many of these men have been promoted to high rank, so that we find among them quite a number of colonels, lieutenant-colonels, and majors. One professional chemist who enlisted as a private in the early months of the war has risen to the rank of lieutenant-colonel through his scientific and inventive ability. Comparatively few qualified men who have seen active service have not been afforded the opportunity of taking commissions, and a remarkable number have won honours in the field.

We yet hope to see, however, due recognition accorded others, less in the foreground, who have given loyal service and have materially contributed to the results achieved. We refer especially to chemists working at home, including those in the Civil Service and in Government and controlled factories, the majority of whom we do not doubt would willingly have volunteered for active service had they been permitted to do so. Not a few have worked throughout the war quite gratuitously, while some are in receipt of salaries out of all proportion small in comparison with the responsibility of the duties entrusted to them. There are many chemists attached to different departments of the Civil Service, but few are in receipt of remuneration which would compare favourably with that of men of similar qualifications and attainments engaged in private work or in industry.

The terms and conditions of service offered to qualified temporary assistants in the Inspection Department at Woolwich were, we understand, improved towards the close of 1914, partly as the result of the publicity given to the matter, but also owing to the dearth of candidates for the appointments. Even though the remuneration of 2*l.* 0*s.* 6*d.* a week was increased to 150*l.* a year, and a miserable allowance (about 1*s.* 4*d.* an hour) made for overtime, in the prevailing circumstances the position is distinctly unsatisfactory. If the work is not of a responsible character, the authorities need scarcely be so insistent on high qualifications. We cannot but conclude that such matters have been too much in the control of the clerical establishments, who are ignorant of the significance of chemistry and its vital importance to the interests of the country; yet, perhaps, they are not entirely to blame for the existence of a system prevailing in several places under which, if insufficient financial provision is made for chemical assistants, such men find themselves classified as "foremen" or "draughtsmen," or that some sort of shuffle has been made to bring them within the funds allotted to the expenses of their department.

It is greatly to be deplored that competent professional men have not been graded and treated as such, paid proper salaries, without talk of overtime, and afforded more encouragement generally in the service they render to the State. Now that the Inspection Department is under the Ministry of Munitions we look for a more enlightened appreciation of scientific work. The terms attaching to the appointments of shift chemists in works controlled by the Ministry when they were first decided on were fairly satisfactory for younger men and made allowance for increments up to a moderate limit; but these again call for revision under the altered conditions of living to enable educated professional men to maintain their status and to lessen the sacrifice many of them have made.

In other Government laboratories and chemical establishments many assistants are continuing their work under pre-war rates of pay, and although there is a graded scale of war bonuses we trust their case also will receive due consideration. Throughout the war chemists have made good wherever they have been in request, and we repeat the time has come for a more substantial acknowledgment of their services.

We have already indicated that in industries the demand for chemists is now in excess of the supply, due not only to the fact that so many are with the forces, but also to the growing appreciation of the value of their work and the development of scientific methods of manufacture. The shortage of qualified men has compelled employers to offer better terms, and, as a consequence, a considerable number of teachers have been attracted to works appointments, and in the production of munitions many are engaged as "shift chemists" in charge of plant in factories where scientific control is essential to the safety of the employés. The colleges, at present, have fewer

students than in normal times, but there is much difficulty in securing sufficient lecturers and demonstrators, and, with the professors and heads of departments engaged on war work, the junior staffs are in most cases overburdened. It is doubtful whether many who were teachers before the war will return to their former work, the remuneration and outlook being usually unsatisfactory for any but those of outstanding ability. Yet the majority of our science graduates have hitherto turned to teaching for lack of opportunity of securing appointments in industry, few being in a position to start practice individually.

The private practitioners in chemistry who are really successful are not numerous, and these rely in most cases mainly on consulting and analytical work in some branch in which they have acquired a reputation. The fees for commercial work leave no great margin for the principals when all expenses of maintenance have been taken into account, and they are seldom able to afford high salaries, even to their chief assistants. Much of the routine analytical work is entrusted, as in the factories, to men with no special qualifications. Thousands of men who have received an elementary training in secondary and technical schools are available and can be utilised for a limited range of analyses and comparatively simple operations. The more competent are thereby crowded out.

Reviewing the position as a whole, we come to the conclusion that qualified professional chemists will find in future an increasing demand for their services in industry, either as research chemists, works chemists in control of plant, or works managers, the routine testing work being relegated to the less qualified assistants, only the best of these being eligible for promotion on the works on showing promise of real ability. In progressive concerns arrangements will be made for such assistants to receive systematic training in neighbouring universities and colleges. Works chemists will be wise to take every opportunity of improving their training and experience on the engineering side, whereby they may become capable of designing and erecting plant as required. In the course of time many such men will establish themselves in independent practice, along with public analysts, official agricultural analysts, metallurgists and other specialists, and general consultants.

Appointments in governmental and municipal departments, for which in the higher grades only qualified chemists should be accepted, will probably become more numerous, and should, in the interests of the community, be made attractive to men of the right stamp. Under this head we embrace appointments in arsenals, factories, and dockyards, with those of inspectors under the Alkali, etc., Works Regulation Act, and similar statutory offices, as well as those under county and municipal authorities, health departments, river boards, sewage works, etc., gas examiners, water examiners, and so forth. Chemists engaged in official laboratories should have prospects at least equivalent to those in industry and private practice, a principle which applies in a limited number of the higher appointments of the Civil Service. Nor should we omit the staffs of the National Physical Laboratory, the Imperial Institute, and similar institutions where research is the primary function.

Finally, but by no means the least important, there are the professors and teachers of chemistry, who represent a very large body, engaged in our universities and technical colleges, public and secondary schools, whose positions generally should afford far better prospects than they have in the past. With all these openings there should be no lack of recruits for the profession of chemistry, either in the Mother-country or in the Overseas Dominions, where also competent chemists are afforded opportunities corresponding to those here indicated.

THE WEATHERING OF COAL.

THE Canadian Department of Mines has lately issued a volume of 194 pages, constituting an extra volume supplementing Report No. 83, and forming a portion of the "Investigation of the Coals of Canada with reference to their Economic Qualities," which has been prepared by Dr. J. B. Porter, of McGill University. This is devoted to a discussion of the literature of the subject and of the results obtained by the author and his assistants in their researches upon this difficult and important problem. It has very long been known that whilst all coals are liable to undergo deterioration on storage, some give rise to marked heating, whilst others are even liable to spontaneous combustion. The latter, as being attended with most obvious disastrous consequences, was the first of these effects to attract attention, and a Royal Commission on Coal Cargoes was appointed to study the matter exactly forty years ago. It is only within the last few years that much progress has been made towards its solution, and that mainly through the labours of a few first-class chemists under the scientific guidance of Dr. J. S. Haldane, in a laboratory the expenses of which have been defrayed by the Doncaster Coalowners' Association; this association took up the question from a slightly different point of view, namely, with the object of discovering the causes of, and finding a remedy for, the "gob-fires" to which some coal-seams are particularly liable. Dr. Porter's attention has been directed mainly to the question of the safe storage of coal and the prevention of deterioration in its quality.

It was soon obvious that all these problems are closely related, and depend, indeed, essentially upon the oxidation of coal, and this, again, upon the absorption of oxygen by the coal. Dr. Porter has presented his conclusions in the form of a brief summary, in which he shows that oxidation depends upon the presence of moisture in moderate amount, absolutely dry coal and thoroughly wet coal (*e.g.* submerged in water) being both less liable to oxidation than coal in the presence of a small quantity of moisture; it depends also upon

the rate of admission of oxygen or air, too large a quantity, as well as too small a quantity, checking the oxidising action. He throws but little light upon the part played by the pyrites in the coal, a problem that has not yet been fully solved, but considers that the oxygen is mainly absorbed by the resins and the humus bodies present in the coal.

With respect to the storing of coal, he finds that any coal can safely be stored under water; lump bituminous coal, from which slack and dust have been screened out, can usually be stored with little or no danger; coal stored in the winter is less likely to give trouble than if stored in the summer, and in the latter case it is best if cool or cloudy days are selected; shallow piles are less likely to give trouble than deep ones; some coals, particularly those high in sulphur, undoubtedly heat more readily when damp; the ventilation of coal piles by means of perforated pipes or otherwise is very advisable; and, finally, a coal storage pile should be carefully watched, particularly for the first few weeks after it has been built.

The report is worthy of careful study, and forms a notable contribution to a subject of the greatest importance to coal producers and coal users alike, and at least as much so in this country as elsewhere.

It is significant of the British attitude towards the scientific investigation of such economic problems of great national importance that in Canada they are attacked by State institutions subsidised and supported by the State authorities, whilst in this country the work is left to private individuals and to private resources. Is it too much to hope that the attention of the Committee of the Privy Council for Scientific and Industrial Research may be directed to the admirable work done in Canada, and that it may decide that the time has at last arrived to initiate something of the kind in this country?

REV. O. PICKARD-CAMBRIDGE, F.R.S.

FEW, whatever their nationality, who have been especially interested in spiders during the last forty years have failed to make the pilgrimage to Bloxworth, where the Rev. O. Pickard-Cambridge, who died on March 9, had been rector since 1868, and to enjoy the delightfully informal hospitality of the Rectory. The famous "den" was no doubt their first objective, but those who were privileged to walk with their host in the surrounding country must have realised that they were in the company of a born naturalist of the widest sympathies, keenly observant, and on the friendliest terms with every living thing—beast, bird, insect, or plant—encountered by the way. There can have been few naturalists of equal calibre less revealed by their published work. This in his case was almost exclusively systematic, and was concerned for the most part with a single Arachnid order, the Araneina. It is true that he was selected to write the article "Arachnida" for the ninth edition of the "Encyclopædia Britannica" (1875); that he published useful little monographs on the British Phalangids and Pseudoscorpions (1890 and 1892); and that he occasionally described a tick or a Tartarid; but these were excursions, and through a long series of years his leisure was devoted mainly to the identification and description of spiders.

This most useful and necessary work does not stand very high in the estimation of some zoologists, though it is noticeable that a worker in some other field—a morphologist, for example—forced by stress of circumstances to try his own hand at identification, soon acquires an added respect for the necessary qualifications. In any case, it is on his work as a systematist that the reputation of Pickard-Cambridge is solidly based. His natural *flair* for minute points of difference, his facility as a draughtsman, his tireless patience, and his unflagging enthusiasm through a long series of years were his equipment for his self-imposed task. The mantle of John Blackwall fell upon him. He set himself to continue Blackwall's work, and to him he dedicated, in 1881, his most important book, "The Spiders of Dorset," "as a small token of long friendship and respect, as well as of gratitude for constant and ready assistance in the study of spiders during the last twenty-five years." This book (its title is altogether too modest) still remains essential to the student of British spiders, supplemented by the papers since annually published by its author in the Proceedings of the Dorset Field Club, and by his "List of British and Irish Spiders" (1900).

As regards exotic species, Mr. Pickard-Cambridge published brochures on spiders collected by himself in Palestine and Egypt (Proc. Zool. Soc., 1872–4–6), and on collections by members of his family, private friends, or scientific expeditions from various regions; but his chief work in this field was in connection with the "Biologia Centrali Americana." The task of dealing with the mass of material involved proved eventually beyond his powers, and failing health obliged him to hand it over to his nephew, the late Frederic O. Pickard-Cambridge, but he continued his work on the native Arachnid fauna until the end.

Many will miss the help he was always eager to give to those who applied to him for information or advice, and not a few will mourn the loss of a picturesque and interesting personality.

NOTES.

THE annual meeting of the British Association, arranged to be held at Bournemouth in September next, has been cancelled; and there will be no meeting, therefore, this year. The two main considerations which have led to this decision are the restriction of railway communication and difficulties of accommodation on account of buildings being required for various national purposes. There will probably be a meeting of the General Committee of the association in London to receive reports and transact other business.

IT is refreshing to note that some of the museums of this country, by making themselves of immediate use, are justifying the authorities who have kept

them open. The Leicester Museum, which led off with the first public exhibition of mothercraft, is now seeking by means of models to aid those who find themselves handling a spade for the first time and have yet to learn that a potato has two ends. Norwich Museum, which also had its mothercraft show, has opened a thrift and economy exhibition. Food values, cheap cooking, home-washing, thrift garments, fuel economy, saving of man-power, and the cultivation of potatoes are among the subjects dealt with. It seems to us that the rate-supported museums are quite the proper instruments for the education of the public in these homely ways of helping the country, and we hope that more will follow the example of Leicester and Norwich.

SIR J. WOLFE BARRY is to deliver the "James Forrest" lecture to the Institution of Civil Engineers on Wednesday, May 2, taking as his subject, "The Standardisation of Engineering Materials and its Influence on the Trade and Prosperity of the Country."

NEWS has just reached us of the death on February 6, at sixty-three years of age, of Dr. H. F. E. Jungersen, professor of zoology in the University of Copenhagen and director of the department of vertebrates in the University museum.

THE death is announced of Col. Walter Katte, the civil engineer who built the elevated railways of New York. He was born in London in 1830, and was educated at King's College School. He emigrated to America in 1849. At the outbreak of the Civil War he commanded an engineer regiment. He superintended the construction of the first steel-arch bridge to span the Mississippi.

ANOTHER national park has been set apart by vote of the American Congress. This new reservation has an area of 2200 square miles, and lies in south-central Alaska. It contains within its boundaries the highest mountain in America, Mount McKinley, and will consequently bear the name of the Mount McKinley National Park. As a game refuge and breeding-ground the park is expected to preserve Alaskan game, which elsewhere is rapidly disappearing.

THE expedition which the American Museum of Natural History has maintained for the last six months in Nicaragua has returned to New York, bringing with it a collection of 1500 fishes and 2000 reptiles, together with a large series of photographs and unusually complete œcological notes. The material thus obtained is said to be of special value, as no specimens of reptiles have ever before been brought out of this region, although it has a reptile fauna of no ordinary interest, not only because of the great diversity in the topographical features, but also because the isthmus to-day forms a transition tract between the two continents, and is supposed in the past to have had land connection with Cuba and Jamaica. The expedition was in charge of Mr. C. R. Halter, an assistant in herpetology at the museum, and Mr. L. A. Mannhardt, of Yale.

WE learn from the *Times* that it has been decided to introduce summer time this year, as recommended by the Home Office Committee, throughout the United Kingdom, beginning at 2 o'clock in the morning of Sunday, April 8, when the clocks will be put forward one hour, and ending at 2 o'clock in the morning of Monday, September 17. An Order in Council will be issued to give effect to this decision. The Rome correspondent of the *Times* announces that summer time will be adopted in Italy on April 1, and will remain in force until the end of September. Under the Daylight Saving Act, clocks in Australia were put back one hour on Sunday, March 25.

THE annual general meeting of the Ray Society was held on March 22 in the apartments of the Geological Society, Dr. S. F. Harmer, in the absence of the president, being in the chair. The report of the council showed a slight increase in the membership, a large increase in the sale of publications, and a very satisfactory balance-sheet, and stated that two volumes had been issued for 1916, and the issue for 1917 would be the "British Characeæ" by Mr. James Groves and Canon Bullock-Webster. One of the rules was amended so as to require authors to agree to assign the copyright of their works to the society. Vacancies on the council were filled by the election of Sir David Prain and Dr. A. B. Rendle. Prof. W. C. McIntosh was re-elected president, Dr. F. Du Cane Godman treasurer, and Mr. John Hopkinson secretary.

THE President of the Board of Trade has appointed a committee to consider and report what steps should be taken, whether by legislation or otherwise, to ensure that there shall be an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, particularly industries which depend upon a cheap supply of power for their development. The members of the committee are:—Mr. F. Huth-Jackson (chairman), Mr. H. Booth, Mr. J. Devonshire, Mr. J. Falconer, Mr. G. H. Hume, Mr. J. Kemp, Mr. H. H. Law, Mr. C. H. Merz, Sir Charles Parsons, Sir John Snell, Alderman C. F. Spencer, and Mr. A. J. Walter. The secretary of the committee is Mr. M. J. Collins, to whom all communications on the work of the committee should be addressed at the Board of Trade, 7 Whitehall Gardens, London, S.W.1.

THE President of the Board of Agriculture and Fisheries has appointed a committee to consider practical means for increasing the supplies of sea-fish for the home markets and for encouraging the consumption of such fish, whether cured or fresh, in substitution for other foods. The committee has received a grant from the Development Fund, with authority to expend the grant, subject to limitations and conditions recommended by the Development Commissioners and approved by the Treasury, at their discretion for the increase of the fishing power of vessels other than steam fishing vessels. In general their expenditure will be confined to assisting fishermen who are owners of their own boats to develop their fishing power and to secure greater quantities of fish. The committee consists of:—Mr. Cecil Harmsworth (chairman); Mr. H. S. M. Blundell, of the Admiralty War Staff (Trade Division); Mr. H. G. Maurice, of the Board of Agriculture and Fisheries; Mr. E. H. Collingwood, of the Board of Agriculture and Fisheries; Mr. Stephen Reynolds, representing the Development Commissioners; Mr. A. Towle, representing the Food Controller. The secretary and manager is Mr. G. K. Hext. Communications should be addressed to the secretary, Fish Food Committee, 43 Parliament Street, S.W.1.

THE President of the Board of Agriculture and Fisheries has appointed a committee to consider whether any considerable addition to the home food supplies of fish could be provided from the rivers, lakes, and ponds of England and Wales. The committee is requested to have special regard to considerations affecting the practicability of any scheme for bringing fresh-water fish supplies into consumption, such as the machinery and labour required to make the supplies available, facilities for their transport to market,

the food value of the different kinds of fish, the probability of its proving acceptable to the consumer, the necessity for interference with private rights, and the risk of damage to more valuable fisheries. Further, the committee will consider and report upon measures which might be taken for securing a greater output of eels from the waters of the United Kingdom for home consumption. The members of the committee are:—Lord Desborough (chairman), Mr. R. B. Marston, Mr. A. R. Peart, Mr. F. G. Richmond, Mr. H. T. Sheringham, Mr. A. Tate Regan, Sir John Wrench Towse. The Hon. A. S. Northcote will act as secretary to the committee. All communications should be addressed to the secretary, Fresh-water Fish Committee, 43 Parliament Street, S.W.1.

MR. E. HERON-ALLEN devoted his recent address as president of the Royal Microscopical Society to an elaborate account of the career and observations of Alcide d'Orbigny, the founder of our knowledge of the Foraminifera (Journ. Roy. Microscop. Soc., 1917, part i.). Alcide's father, Charles d'Orbigny, a doctor at Esnandes, near La Rochelle, initiated the studies which made his son's name immortal. Félix Dujardin, moreover, in 1835, not ten years after the publication of d'Orbigny's "Tableau méthodique," first appreciated the simple nature of the foraminiferal organism, and removed the group, which he styled Rhizopoda, from any alliance with the Mollusca. But d'Orbigny's skill in minute observation, in collation, and in delineation makes a permanent claim upon our gratitude, and Mr. Heron-Allen proposes to publish, when peace returns, the remarkable series of "planches inédites" that he has brought once more to light in the museum at the Jardin des Plantes in Paris. Two coloured examples of these beautiful plates accompany the address, and the other illustrations add touches of human interest to what has become, in its author's hands, a genuine biographical and bibliographical research.

THE *Atti dei Lincei* (xxvi. (1) 1) contains an account of the work of Prof. Angelo Battelli, whose death, at the age of fifty-four, occurred on December 11 of last year. Born in 1862, Battelli entered the University of Turin at the close of his school career, and by 1884, when he graduated, he had already qualified for substantial researches in physics. His earliest interest was in thermo-electricity, in which he made the first determination of the so-called "specific heat" of electricity. The Peltier effect was the subject of repeated experiments, and he described an arrangement in which reversal took place at a moderate temperature. Later researches dealt with the effects of pressure on the temperature of fusion and that of magnetism on thermal conductivity, as well as on thermo-electric effects. In 1887 Battelli commenced an extended series of investigations on the critical point, the density of saturated vapours, and of liquids at the maximum vapour pressure, specific heats, and allied phenomena. In particular, he traced the isothermals in the neighbourhood of the critical point. In 1898 he gave his attention to the study of oscillatory discharges and the attendant phenomena. He was also the author of a number of books, including some text-books, besides works of a more substantial character, on electrolytic dissociation and radio-activity. On his appointment at Pisa, Battelli found the physical laboratory quite inadequate, both for instruction and for higher studies, and it became necessary for him to get it properly equipped. He also took an active part in educational discussions in the Italian Second Chamber. The author of the notice, Dr. A. Naccari, expresses the opinion that his end was accelerated by his constant activity, which he would not allow to flag even in his last sad illness.

THE twenty-sixth annual meeting of the Royal Society for the Protection of Birds was held at the Middlesex Guildhall on March 22, her Grace the Duchess of Portland, president, being in the chair. As might be supposed, the war has adversely affected the work of the society, though not to any serious extent. It was mentioned that the large camps now scattered over the country have often, inevitably, invaded areas under the protection of the society. But the damage done, it is hoped, will be less than was feared, for in many cases the men were induced to take an interest in the birds, and thus reduced the damage to the lowest possible limits. The work of the society's watchers, all of whom are ineligible for military service, has for the most part gone on successfully, and some interesting items have been recorded. We are glad to note that the breeding season of 1916 was highly successful in the case of the Kentish and Norfolk plovers, chough, phalarope, peregrine falcon, and buzzard. The gannet nested for the first time on Noss, in the Shetlands; the redshank for the first time on one of the Cumberland lakes; while the great skua has spread to a new region. A strong expression of opinion that the recent prohibition of the importation of plumage during the war should find a permanent place on the Statute Book was warmly supported. For it was pointed out that otherwise the work of the plume-hunters would still go on, their ill-gotten gains being hoarded until after the war, when they would be dumped upon the market. The Dutch Committee for the Prohibition of the Exportation of Birds and Bird-skins from Dutch Colonies was very emphatic on this point. A number of valuable leaflets on the need for the protection of insectivorous birds has been issued by the society for distribution, and these should be widely read.

THE following are the lecture arrangements at the Royal Institution after Easter:—Prof. C. R. Beazley, two lectures: "Russian Development": (i) "The Old Free Russia," (ii) "The Rise of Moscow"; Prof. C. S. Sherrington, two lectures: (i) "Tetanus: Its Prevention, Symptoms, and Treatment," (ii) "Rhythmic Action in Muscle and in Nerve"; Prof. D'Arcy W. Thompson, two lectures: "Architectural Design in Organisms," "The Laws of Growth and Form"; Prof. W. W. Watts, two lectures: "The Flow of Ice and of Rock"; Prof. H. S. Foxwell, two lectures: "Industrial Finance after the War"; Prof. Gilbert Murray, two lectures: "Pagan Religion at the Time of the Coming of Christianity"; Prof. W. Bateson, two lectures: "The Chromosome Theory of Heredity and the Alternatives"; Alfred Noyes, two lectures: "Modern English Poetry"; Prof. G. H. Bryan, two lectures: "Principles of Aerial Navigation"; Sir J. J. Thomson, six lectures: "The Electrical Properties of Gases." The Friday evening discourses, which will begin on April 20, include:—Prof. R. H. Biffen, "The Future of Wheat-growing in England"; J. Dundas Grant, "The Organs of Hearing in Relation to War"; H. Wickham Steed, "Some Guarantees of Liberty"; Prof. John Joly, "Radio-active Haloes"; Prof. F. Soddy, "The Complexity of the Chemical Elements"; J. Barcroft, "Breathlessness"; J. H. Balfour Browne, "The Brontës: a Hundred Years After"; Sir J. J. Thomson, "Industrial Applications of Electrons."

"THE War and Our Supply of Drugs" was the subject of a paper read before the Royal Society of Arts recently by Mr. F. A. Hocking. Out of about eighty drugs of vegetable origin in use at the London Hospital during 1914, only a few are drugs ordinarily derived from enemy countries, the chief being aconite, belladonna, colchicum, digitalis, gentian, henbane,

opium, and possibly valerian. After the outbreak of war the main difficulties were in respect of the supply of belladonna, henbane, and valerian. The needs are now being met partly by products grown in this country and partly by drugs obtainable from abroad. Thus India supplies opium, Japan aconite and valerian, and Egypt henbane. Of the alkaloids and their salts, seven out of the fifteen used in the hospital were, and of course still are manufactured here on a large scale, both for home use and for export. The remainder were obtained from enemy countries. Of the acids and their salts, the majority are home products, but in some cases the raw materials, especially potassium and bromine, were either in enemy hands or under neutral control, with the result that their prices rose enormously. The most important of manufactured organic drugs, such as ether, ethyl chloride, chloroform, iodoform, carbolic acid, glycerine, and alcohol, are produced here in large quantities; but most of the synthetic drugs, like aspirin, phenacetin, salvarsan, and veronal, were German products. Many of these articles, however, are now being made here. On the whole, for our drug supplies we are much less dependent upon enemy sources than has generally been recognised. The author, indeed, suggests that the necessity for the home cultivation of medicinal plants has perhaps been over-emphasised, since the demand for belladonna and digitalis is strictly limited.

IN No. 7, second series, of the Bankfield Museum Notes, Miss L. E. Start publishes a monograph on Burmese textiles from the Shan and Kachin districts, based on a collection of examples made by Mr. E. C. S. George, at the end of last century, whilst he was engaged on the Commission for the delimitation of the Burma-China boundary. The monograph is illustrated by an excellent collection of drawings showing the modes of dress and the forms of ornamentation used by the native weavers. The illustrations to some degree suffer from the absence of colour, but designers of fabrics, who can examine the original specimens in the Bankfield Museum, will be well advised not to neglect this important collection of Oriental art, which may enable them to follow some of these graceful designs, and prepare new schemes of decoration suitable to the native races of Burma.

MR. J. H. GURNEY makes grave charges against the rook and the wood-pigeon in *British Birds* for March. As to the former he remarks: "It has always seemed an anomaly to me that hawks in Norfolk, and even owls, should be persecuted, while rooks go almost unscathed, although there is not a farmer who has a good word to say for them." They eat potatoes and newly sown grain, riddle the cornstacks with holes and thus admit the rain, and destroy a large quantity of swede turnips. The wood-pigeons levy a heavy toll on the thousand-headed kale and on the pea-fields. The starling, in Norfolk, is tolerated on account of its usefulness in destroying the white slugs, which infest the clover-fields.

INTERESTING "Observations on Some Habits of the Coot" are described in the *Scottish Naturalist* for March. These more especially refer to the behaviour during courtship. At this time the white shield, so conspicuous a feature of this bird, enlarges so as to project on each side of the crown. But the author leaves the reader in some doubt as to whether this is a permanent increase during the breeding season or whether it is an inflation evident only during moments of excitement, comparable to the distension and contraction of the wattle of the turkey-cock in similar circumstances. The adults were found to be still feeding their offspring two months after hatching, and therefore long after they had become fully fledged. During October the male frequently gave the "spring call," and the pair frequently repeated the behaviour characteristic of the spring courtship, as many game-birds are known to do.

A VALUABLE contribution to our knowledge of the genetics and evolution of an interesting group of Lepidoptera is given by J. W. H. Harrison in a recent paper entitled "Studies in the Hybrid Bistoninæ" (*Journal of Genetics*, vol. vi., No. 2). The species with which he has worked are the common British moth (*Biston hirtaria*), the well-known local sandhill-haunting *Nyssia zonaria*, whose female is wingless, and four species of the northern genus Poecilopsis, one of which, *P. lapponaria*, is a rarity in Scotland. The Biston males, if successfully crossed with the wingless females give winged males, and females with reduced wings, and closely similar results followed the pairing of *P. pomonaria* males with *Biston hirtaria* females. Hence, "as regards potency in transmitting the secondary female character of wing-reduction, *pomonaria* males and females are alike." Two of these male *hirtaria-pomonaria* hybrids were successfully crossed with *hirtaria* females. With one exception, all the offspring were indistinguishable from *hirtaria*, a result explained by the production of "a few functionally active spermatozoa carrying to all intents and purposes *hirtaria* characters, with hosts of spermatozoa carrying a varied array of novel chromosome combinations, all possibly ineffective." However, there was a single intermediate specimen which "lacked the sexual instincts and was unable to walk or to fly." Mr. Harrison notes that the North American *Poecilopsis rachelae*, when crossed with the European species, gives a very small proportion of fertile eggs, and concludes that "geographical separation caused the physiological condition of the species to diverge enormously."

VARIOUS schemes for the promotion of afforestation in Scotland, by co-operation between the landowners and the State, are discussed in three articles in Transactions Roy. Scottish Arboricultural Society, xxxi., part i. (January, 1917). The Development Commissioners, who have lately forwarded their proposals for afforestation and land reclamation to the Reconstruction Committee, do not favour the purchase of land by the Government, but recommend that it should be taken on lease, the landowner to receive, in addition to a rent, a bonus or percentage on the profits of the undertaking. Mr. S. Gammell advocates a scheme of planting by the landowner, who would receive from the State a loan for this purpose, to be repaid, after the lapse of a period of forty years, in twenty annual instalments, calculated on compound interest at 2½ per cent. Mr. James W. Munro gives an illustrated account of the life-history of *Hylastes cunicularius*, a beetle which destroys recently planted conifers by girdling the bark just below the root-collar.

THE *Revue Scientifique* of March 3 contains an article by Prof. Henri Devaux, of Bordeaux, in which the attention of French wheat-growers is directed to the excellent results obtained by him with special methods of cultivation of wheat which are said to be widely and successfully practised in Russia. The two methods singled out for special commendation are the planting out of selected plants from a seed-bed, and the cultivation of the wheat in wide rows, permitting of an earthing-up of the plants at a later stage. It is claimed that by either method a very much larger individual plant can be obtained, and the total produce of a given area greatly increased. Full details for practical cultivation on these lines are given, and the article is illustrated by photographs of specimen plants.

These methods have previously been advocated in this country, and are worthy of investigation, but the obvious increased demand for labour as compared with ordinary methods of cultivation must render them largely impracticable for adoption under present conditions.

THE *Irish Naturalist* for March contains the annual report of the Royal Zoological Society, from which it is clear that the society has passed through a very troublous year, and one which came dangerously near to disaster. During the week of the Easter rebellion the difficulty of conveying food for the larger carnivores to the gardens was so great that some of the less valuable stock had to be sacrificed, including "an old pony, a donkey, a goat, and a few dingoes." These had to go to feed the lions and tigers. The keepers, for the time, had to be housed in the gardens owing to the danger of venturing into the streets of Dublin. Further, owing to the social unrest, the receipts for the month practically ceased. This loss, with the falling off of revenue owing to resignation of subscribers, has seriously crippled the society, but, fortunately, thanks to the generosity of some of its members, the deficit at the end of the year was much less than at one time seemed inevitable. The young female gorilla, we are glad to notice, is not only still alive, but is, further, in better health than was the case when the report for 1915 was issued. During midsummer a female bison calf was born and is still thriving. For the first few weeks it was of a bright red colour, but has now assumed the typical dark coat.

THE plans of a projected aerial expedition to New Guinea by Dr. Eric Mjöberg, of Stockholm, are outlined in the February issue of the *Geographical Review* (vol. iii., No. 2). In view of the great difficulties presented by climate and vegetation in reaching the mountains of the interior, Dr. Mjöberg proposes to use aeroplanes or even hydroplanes. He considers that the interior will afford four different possibilities of landing: alpine meadows at 12,000–13,000 ft., open or thin savannas at lower altitudes, steppes of *alang* grass known to occur here and there, and lake surfaces. These last are not certain to occur. A reconnaissance is first to be made with a light machine. Then a heavier machine capable of carrying five passengers and stores is to leave the base for the interior. Subsequent communication would be maintained between the coast and the interior stations of the expedition in a few hours' time. Dr. Mjöberg proposes to take with him two surveyors, a botanist, a zoologist, and a geologist, besides several expert airmen.

THE annual report of the Weather Bureau of the Manila Observatory for 1915 has been published. It contains the full hourly meteorological observations made throughout the year. In addition to the central observatory at Manila, the Weather Bureau maintained fifty-six other stations throughout the Philippines, and one at Yap, in the western Carolines. There seems, however, to be some doubt whether the station at Yap has been maintained in working order since the change in ownership of the Carolines. The lack of communication with Yap interfered with the typhoon warnings sent out by the Manila Observatory. The volume directs attention to the fact that the Manila Observatory has now been in existence for fifty years.

MESSRS. KODAK, LTD., have just issued an illustrated booklet on "Kodak Bromide Pictures, by Some who Make Them," a collection of seven articles, supplemented by the firm's own instructions. Though obviously of chief interest to those who use bromide papers for pictorial purposes, there are suggestions that may be of much wider utility, and the illustrations show what a great range of possibilities is offered by this method of printing. The scientific worker will need, however, to add to these the results obtainable on papers that have a glossy surface, which emphasises feeble and minute details, and will note the "transferotype" paper which permits of the film that bears the image being transferred to surfaces such as those of glass, porcelain, wood, metal, canvas, etc.

CERTAIN species of lichens have long been used by the inhabitants of Ireland, Scotland, and other parts of Northern Europe for dyeing wool various shades of yellow or reddish-brown. Four of these lichens, *Parmelia saxatilis*, Ach., *Ramalina scopulorum*, Ach., *Ramalina cuspidata*, Nyl., and *Physcia parietina*, De Not., have been examined by Dr. Hugh Ryan and Mr. W. M. O'Riordan (Proceedings of the Royal Irish Academy, 1917, xxiii., Section B, pp. 91–104) with the view of isolating their tinctorial constituents. The first three lichens were submitted to a preliminary extraction with ether. By this means a colourless, crystalline substance was obtained from *Parmelia saxatilis*, probably identical with Zopf's stereocaulic acid, whilst *Ramalina scopulorum* and *R. cuspidata* gave Zopf's *d*-usnic acid. After the treatment with ether the three lichens were extracted with boiling acetone. By this means a colourless, crystalline substance, apparently identical with Zopf's salazinic acid, was obtained from *Parmelia saxatilis*. The lichen *Ramalina scopulorum* gave a white, microcrystalline substance probably identical with Zopf's scopuloric acid, whilst *R. cuspidata* also yielded a white, crystalline substance, which, however, was not identified with any known compound. That these three substances are the tinctorial constituents of the respective lichens is shown by the fact that when wool is boiled with water containing them it is dyed in a manner similar to that produced by the lichens. *Physcia parietina* when extracted with chloroform gave a quantity of physcione (probably identical with frangula-emodin-monomethyl-ether), which has little or no dyeing properties, but which when demethylated gives frangula-emodin. The latter dyes unmordanted wool a dull orange-yellow colour.

A USEFUL catalogue (No. 67, March) of books of science (many of them scarce) has been issued by Messrs. Dulau and Co., Ltd., Soho Square, W.1, which should appeal to many of our readers. It is arranged conveniently under the headings Botany and Horticulture, Geology and Palæontology, Entomology (with subdivisions), Ichthyology, Mammalia, Mollusca and Conchology, Ornithology, Reptilia and Batrachia, and Scientific Voyages and General Zoology.

OUR ASTRONOMICAL COLUMN.

THE SPECTRUM OF N.G.C. 7023.—Dr. Max Wolf has previously pointed out that many nebulæ in the Milky Way are encircled by a nearly circular space which is void of faint stars, and that this lacuna is usually situated at the end of a long, starless channel. Such nebulæ are designated "Höhlennebel," or "cave-nebulæ," and Dr. Wolf has recently given an account of spectroscopic observations of some of them which have been made at Heidelberg (*Ast. Nach.*, No. 4875). One of the finest examples is H. IV. 74 Cephei (N.G.C. 7023), in which the cave has a diameter of nearly half a degree, and the nebula surrounds the star B.D. + 67° 1283, of magnitude 6·8. The photographs show that the star is of type A, and that the spectrum of the nebula exactly resembles it, without showing any trace of the lines characteristic of gaseous nebulæ. It

is therefore highly probable that, as in the case of the ρ Ophiuchi nebula described by Slipher (NATURE, vol. xcviii., p. 236), the nebula shines by reflected light of the star which it encloses. Other nebulæ have also been investigated, and some of them show feeble traces of bright nebular lines in addition to continuous spectrum. Very long exposures were of necessity given in taking the photographs, and it is still uncertain to what extent the photographed spectrum is influenced by light of the associated star which is diffused in the earth's atmosphere.

IMPERIAL ASTRONOMICAL SOCIETY OF RUSSIA.—A cordial welcome will be extended to the bulletins of the Imperial Astronomical Society of Russia, the first number of which has recently been distributed. It contains a series of notes by M. Viliev, including an ephemeris of the planet (67) Asia, a search ephemeris of comet 1846 IV. (De Vico), and a note on the possible return of the comet of 1532. In opposition to Olbers, M. Viliev finds reason to believe that the comet of 1661 may have been a return of that of 1532, in which case its reappearance would be due about the present time; it remains, however, to make a new reduction of the observations made by Hevelius in 1661, and to calculate the perturbations during the three revolutions. A further note refers to the central line of the total eclipse of the sun of May 28–29, 1919. One of the notes is in English, and the remainder in French.

MONTHLY STAR MAPS FOR 1917.—In response to requests from naval and military officers and others, the annual publication of the Scottish Provident Institution has again taken the form of a star atlas and astronomical calendar, which has been prepared for the twentieth year in succession by Dr. Blaikie. In addition to the monthly maps, showing the stars in the now familiar gold on dark blue, there is a stereographic projection intended for the solution of many problems for which the celestial globe is ordinarily employed. There are the usual tables relating to the sun, moon, and planets, and these, together with the interesting series of explanatory notes, form an admirable popular guide to the heavens. This publication has doubtless done much to encourage a general interest in observational astronomy, and its usefulness in this respect might be increased if it were made available to anyone who was prepared to pay for it.

SCIENCE LECTURES TO THE TROOPS IN FRANCE.

AT the invitation of the War Office, the Young Men's Christian Association recently organised a special service of lecturers to visit suitable centres in France for periods varying from a fortnight to three months or more in order to provide the troops behind the line with recreation of a thoughtful kind. The lectures were arranged because of a desire expressed by many of the troops for occasional entertainment of a more solid or instructive character than is offered by moving pictures and concert parties. Their aim has been not merely to afford amusement to the men in their unoccupied hours, but to give an understanding of the causes and aims for which our troops are fighting, and to deal with military, naval, and political history, with science, literature, travel, and other subjects of general interest. The scheme has received the hearty support of the universities, the vice-chancellor of each of which has appointed a special committee to nominate lecturers. The details of arrangement have been in the hands of Prof. Gilbert Murray for the War Office Educational Committee and of Mr. Basil Yeaxlee for the Y.M.C.A.

In connection with this scheme a number of lectures upon scientific subjects have been, and are being, given at base camps and other centres in France. Among the science lecturers who have already completed their courses are Prof. W. Bateson, Prof. Alex. Findlay, Prof. R. A. Gregory, Mr. J. Humphreys, Prof. O. T. Jones, Rev. T. E. R. Phillips, Prof. E. B. Poulton, Mr. W. E. Whitehouse, and Dr. F. Womack. Lectures have been given to the officers as well as to the men upon such subjects as heredity, chemistry of daily life, the sun, moon, planets, and stars, primitive astronomy, protective resemblance, war among animals, the life of a river, rocks and soils of northern France, the Great Ice Age, climate and vegetation, mechanical contrivances of plants, and so on.

The lectures are given in Y.M.C.A. huts, and are usually illustrated with lantern-slides. They have proved remarkably successful, and in most cases the huts have been filled with men who listened with attention and intelligent interest to simple discourses upon natural facts and phenomena and their scientific interpretation. Even when other attractions, such as concerts, moving pictures, and revues have been going on at the same time, large audiences have attended the science lectures, and have thus shown the existence of a real demand for more thoughtful recreation. The welfare work of the Y M.C.A. with the troops abroad is admirable in every respect, and the scheme of lectures now in operation merits all the assistance and encouragement which men of science can give it.

Although a few separate lectures are given to officers, most of them are delivered to the men, and officers are rarely present at them, though they are attracted by concert parties and like entertainments. It ought not to be supposed that the officers of our Army are less interested in scientific subjects than are the men of the rank and file, and their absence from lectures may be due to the fact that the Y.M.C.A. huts are regarded as places of recreation for the men only. As, however, Mr. McCowen, the chief secretary of the Y.M.C.A. in France, reports that the lecture scheme has succeeded almost beyond expectation, it would be worth while to develop the scheme still further by arranging more lectures for officers, not so much for purposes of instruction as to excite interest in scientific matters.

Of course, lectures on history, literature, the allied countries, and similar subjects have also been delivered, and, on the whole, historical subjects are probably the most popular. There is no doubt, however, that the science lectures have been a source of pleasure and enlightenment to thousands of our troops at the base camps and further up the line, and the Y.M.C.A. is performing a very useful service in organising them. The work is of such decided educational value that it should receive practical support from the State in the form of grants. With so large a part of our population serving with the forces at home and abroad, it should be possible for the Board of Education to make the Y.M.C.A. an education authority, and provide a substantial part of the funds required to carry on and extend the educational enterprise so successfully begun.

NANNA'S CAVE, ISLE OF CALDEY.

CALDEY ISLAND, in Carmarthen Bay, two miles south of Tenby, has been occupied since the prehistoric period, and, as is shown by the raised beaches in the vicinity, has been exposed to periodical eleva-

tion and depression. From time to time caves have been found in the Carboniferous limestone. Two of these were examined by a local clergyman about the middle of the last century, but the exploration was carried out in an unscientific way, and the remains discovered, without precise identification or record of stratification, are now deposited in the Tenby Museum. A more careful examination of the rock shelter, known as Nanna's Cave, has recently been made by local archæologists, and the results are described in a paper by Mr. A. L. Leach, reprinted from *Archaeologia Cambrensis* for July, 1916. Remains of two skeletons, one female, the other male, were found. The female skull presents no characters which enable us to separate it from modern British skulls, or from remains which have been found in Neolithic or later Palæolithic deposits. It may be as old as the Aurignacean; but it showed no character which would disprove it being of Neolithic or historic age. In association with it was found a skilfully struck flint flake, similar to that obtained from the Hoyle Cave near Tenby, which is probably of the late Palæolithic age. This fact, however, is not conclusive of the age of the human remains. In the Romano-British age the cave was again occupied, and some fragments of pottery of that period formed parts of an olla, or cooking-pot, and a mortarium, probably used for rubbing down fruits and other soft food.

POTASH FERTILISERS FROM FELSPARS.

THE dearth of potassium salts in this country owing to the war has caused renewed attention to be devoted to the possibilities of preparing soluble potassium salts from the large deposits of felspar which are found in certain parts of the country. The problem has occupied the attention of chemists intermittently for many years, but the processes devised in the past have proved commercially unsuccessful, owing largely to the failure to obtain, along with the potash salts, other saleable products which might share the cost of manufacture. This difficulty would appear to have been largely overcome in the process patented by Mr. J. Rhodin, a Swedish inventor, in which, along with the soluble potassium salts, a marketable white cement is obtained. The successful results obtained by this process with Swedish felspars have been brought to the notice of the Board of Agriculture and Fisheries, and under the auspices of a sub-committee of the Fertilisers Committee of the Board further tests with British felspars from Roche, in Cornwall, and Loch Eriboll, in Sutherlandshire, have been carried out, the results of which are summarised in the February issue of the *Journal of the Board of Agriculture*.

The Roche felspar, containing 10·8 per cent. K_2O, yielded 75 per cent. in a soluble form, whilst the Loch Eriboll spar, with 8·6 per cent. K_2O, gave 60 per cent. soluble. A Swedish spar, with 12·9 per cent. K_2O, yielded 54 per cent. in a soluble form. Expert opinion described the cement as a true hydraulic cement, of satisfactory colour, but of much lower tensile strength than Portland cement.

As the result of its examination, the sub-committee expresses the opinion that encouragement should be given to any movement for the manufacture of potash and white cement by the Rhodin process on a commercial scale, and that in the event of a public company applying to the Treasury for permission to raise capital to work this process, the application should receive the strong support of the Fertilisers Committee.

THE NATURAL SCIENCES IN PUBLIC SCHOOLS.[1]

Age Limits for School Science.

THE teaching of natural science in public schools is of recent growth. Until quite recently most of the boys who took up this subject did so with the intention of making use of the training in their future careers. Even now, in some public schools, the number of boys learning science is small. It is, however, becoming recognised that science should form part of every boy's general education. For this reason it is necessary to put some, at least, of a boy's general training in science before the age at which specialising should be allowed. Too early specialising is bad policy: the age at which this may be begun by the average boy is about sixteen and a half years.

Before this age (or its equivalent for forward or backward boys) the pupil should have spent, on an average, four hours a week at science for a period of at least two years, and six hours a week for a further two years. Thus the work should be begun in the preparatory schools. The only work recommended to be done there is in nature-study and practical measurements. See "Nature-Study in Preparatory Schools" and "The Correlation of Mathematical and Science Teaching" (Bell and Sons, each 6*d*.).

After a boy has reached such a standard of general education that he may be allowed to specialise to a certain extent, he should have the opportunity of devoting about eight hours a week to science if he chooses to do so. At a still later stage the specialisation should be more marked in the case of those who choose a scientific career.

Science in Examinations.

If these ideals can be reached by any means other than making science compulsory in examinations, those means should be employed. If they cannot, compulsion by examination regulations must be applied. But this should then be recognised as a necessary evil. It is possible that some system of inspection of schools by examining bodies, combined with the granting of certificates on the recommendation of a properly qualified master, might prove to be the solution of the difficult problem of insisting on science being learnt by every boy, without the restrictions necessarily imposed when there are examination syllabuses. But the details of such a scheme would require careful thinking out.

But there is, at present, a yet stronger argument against the attempt to foster the teaching of science by making the subject compulsory in examinations. So long as instruction in science was given only to those who were destined for a scientific career, it was natural (if, perhaps, unwise) to aim chiefly at inculcating scientific method, with a certain disregard of general knowledge of natural phenomena. This was done, for the most part, by logical courses in hydrostatics, heat, light, electricity, and chemistry. But in some of the schools where science has already become a compulsory subject it has been recognised that such courses may be unsuitable for the non-scientific mind. The attempt is made to arouse a boy's appreciation of the value and scope of science rather than to teach him the elements of a subject which he will drop even before leaving school. In such schools a considerable proportion of his science hours is devoted to studying subjects ranging from the universe to the electron: astronomy, geology, biology, physio-

[1] Abridged from a memorandum drawn up by the committee of the Association of Public School Science Masters to serve as the text of the evidence offered on behalf of the association to the Government Committee on the Teaching of Science.

logy, etc., are all drawn upon in such teaching; and science is taught in a general manner by directing the attention of pupils towards objects rather than by making them learn "subjects." In other schools the study of science is *approached* through its applications in engineering or agriculture.

Now that science is becoming recognised as an essential part of a liberal education, it is probable that the kind of teaching indicated above will be more generally adopted. The inevitable effect of making science compulsory in examinations would be to hinder experimenting in educational methods, at a time when this is most important.

Examination for Entrance to Public Schools.

The work recommended to be done in the preparatory schools is not systematic science, but rather a preparation for this. The kind of nature-study and observational work adopted in the various schools should differ according to their locality and other circumstances. This makes the subject a difficult one for examination purposes, and anything of the nature of a rigid syllabus would have a deadening influence. But so important is this preliminary work that unless preparatory schools will adopt it without compulsion through examinations, the subject should form an essential part of the Common Entrance Examination. The questions set should cover a wide range and offer plenty of choice to the candidate.

It is of the utmost importance that every candidate for scholarships on entering a public school should be examined in such work, and that a high proportion of the total marks should reward him for good work in this subject. The reason for this is obvious. So long as science forms no part of the examination for scholarships, the cleverer boys at the preparatory schools will be tempted to neglect the subject, even when provision is made for teaching it, in order to *specialise* in more paying subjects. Having found these subjects pay, and having attained a certain proficiency in them, they are unlikely to wish to change to science, or to be allowed to do so if they wish. Thus the most clever boys are diverted from science quite early in their lives; it is not putting it too strongly to say that in the large majority of public schools only those boys who show no signs of becoming scholars in other subjects can take up science seriously. We see here the evils of early specialising in their most pronounced form.

Entrance Examinations to Universities and Equivalent School Certificate Examinations.

Compulsory Greek *must* be abolished. Science should take at least as important a place as Latin.

One of the worst things that can be done in these examinations is to group science with mathematics (as is suggested in recent Board of Education circulars and in the reports of the Previous Examination Syndicate). That means filling the upper science divisions of the schools with boys who are weak at mathematics, merely because of that weakness.

Entrance Scholarships offered by the Universities.

The work of schools is affected greatly by these examinations. In their present form these encourage boys to specialise too early. This statement applies to all the subjects of examination. There is little doubt that at present scholarship examinations are exerting a bad influence on general education.

With regard to science in particular, the examinations often have the effect of making boys specialise too strictly within the limits of the subject itself, to the detriment of their general training in science. If a boy knows, for instance, that he may get a scholarship in chemistry alone, he is tempted to neglect the study of kindred subjects. Scholarship papers should test the candidates' general knowledge of science more thoroughly than they do at present.

Fees.

Laboratory work is expensive. It is customary to make special charges for this. In schools where science is compulsory for all boys, the charges do not keep the boys from doing some science; but in some schools where science is not compulsory the charges do have this effect. In certain instances the charges are grossly unfair (in view of the small expenditure on laboratory equipment), and the boys who learn science are robbed in order to provide cheap education for those who do none.

Organisation.

In nearly every school the rate of a boy's progress through the various forms is controlled to an unfair extent by his proficiency in classical subjects. This might be improved by giving a better range of marks for science, but the real remedy is that boys should be grouped for science and mathematics separately from form subjects. Otherwise the logical sequence necessary for science must be broken.

The Teaching of Mechanics.

This is in a most unsatisfactory position. The subject is fundamental for a right study of science. But, as a rule, it is in the hands of mathematicians, who too often do no experimental teaching and treat the subject deductively. Laboratory work in mechanics is essential.

Laboratory Equipment.

During the past twenty years great improvement has been made with regard to equipment for science teaching. Laboratories for the teaching of practical mathematics, including mechanics, are now the most general need.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. D. Keilin, of Magdalene College, has, with the consent of the Vice-Chancellor, been appointed assistant to the Quick professor of biology.

The next combined examination for entrance scholarships and exhibitions at Pembroke, Gonville and Caius, Jesus, Christ's, St. John's, and Emmanuel Colleges will be held on Tuesday, December 4, and following days. Mathematics, classics, natural sciences, and history will be the subjects of examination at all the above-mentioned colleges. Forms of application for admission to the examination at the respective colleges may be obtained from the masters of the several colleges, from any of whom further information respecting the scholarships and exhibitions and other matters connected with the colleges may be obtained.

LONDON.—The following doctorates were conferred by the Senate at the meeting held on March 21:—*D.Sc. in Chemistry:* Mr. Frank Tinker, an external student, for a thesis entitled "The Colloidal Membrane: its Properties and its Function in the Osmotic System," and other papers. *D.Sc. (Engineering) in Metallurgy:* Mr. Andrew McCance, an internal student of the Imperial College (Royal School of Mines) and the South-Western Polytechnic Institute, for a thesis entitled "A Contribution to the Theory of Hardening." *D.Sc. (Economics):* Mr. J. F. Burke, an internal student of the London School of Economics, for a thesis entitled "The Reform of Irish Land Tenures."

The Carpenter medal for the period 1913–16 has been awarded to Dr. P. B. Ballard for the thesis

entitled "Obliviscence and Reminiscence," for which he obtained the degree of D.Lit. in 1914.

The annual report on the work of University College has just been issued. The total number of students on the college books for the academic year 1915–16 was 1133 (including 51 refugee students), whereas the normal number is about 2200. Of the 1133 there were 535 men (including 36 refugee students); of the 535 men, only 222 were in attendance throughout the session, the remainder taking up military or naval service or some special form of war-work. The normal fee revenue is upwards of 29,000*l.*; the fee revenue for 1915–16 was 14,983*l.* By means of drastic economies and postponement of expenditure, and with the help of generous donations from members and friends of the college, supplemented by the special Treasury grant, expenditure was kept within income. The financial outlook for the current session (1916–17) causes anxiety, the fee revenue having further declined. The chairman and the acting treasurer are asking for help to meet the threatened deficiency, and also to cover the expenditure on the new chemistry buildings that has not yet been provided; this amounts to 15,000*l.* The third issue of the *Pro Patria* list, with the supplement recently prepared, contains 1554 names of members of the college, 1516 of whom are on active service. Of these, 122 have fallen in the war.

OXFORD.—The Departments of Geography and Anthropology have published their arrangements for next term. In geography, lectures will be given on map projections, the historical geography of Europe, the West Indies, and British lands round the Indian Ocean. Practical classes, field work, and informal instruction are also announced. The list of lectures in anthropology includes human anatomy, ethnology, the distribution of man, comparative technology, stages of human culture, the Bronze and early Iron ages, and questions relating to ancient Egypt. Lectures and informal instruction are also announced on various topics of social anthropology and on primitive language in its relation to thought

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THE presidential address delivered by Prof. A. N. Whitehead to the Mathematical Society last January is printed in the current issue of the *Technical Journal*. The subject of the address was the relation of technical education to science and literature, and Prof. Whitehead's ideas deserve wide and careful consideration. The immediate need of the nation, he maintains, is a large supply of skilled workmen, of men with inventive genius, and of employers alert in the development of new ideas; and there is only one way to obtain these, namely, by producing workmen, men of science, and employers who enjoy their work. The basis of the growth of modern invention is science, and science is almost wholly the outgrowth of pleasurable intellectual curiosity. A technical education which is to have any chance of satisfying the practical needs of the nation must be conceived in a liberal spirit as a real intellectual enlightenment as to principles applied and services rendered. There can be no adequate technical education which is not liberal, and no liberal education which is not technical; that is, no education which does not impart both technique and intellectual vision. In any system of technical education, training should be broader than the ultimate specialisation, for the resulting power of adaptation to varying demands is advantageous to the workers, to the employers, and to the nation. Prof. Whitehead applies his generalisations to the specific cases of pupils of thirteen who have completed their elementary education, and those of seventeen whose technical education, so far as it is compressed within a school curriculum, is ended.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 15.—Sir J. J. Thomson, president, in the chair.—Prof. T. H. **Havelock**: The initial wave-resistance of a moving surface pressure. Hitherto the wave-resistance associated with the motion of an assigned pressure system over the surface of water has been studied only in the steady state for uniform motion. The present work is an attempt to calculate this quantity at any time for a system which has been suddenly established and set in uniform motion at a certain instant.—Prof. S. W. J. **Smith** and H. **Moss**: Experiments with mercury jets. (i) The relation between the jet-length and the velocity of efflux. (ii) A comparison with jets of other liquids. It has probably been noticed by those who have worked with mercury "dropping electrodes"—in which the mercury issues in a narrow stream from the drawn-out end of a vertical tube—that the length of the jet alters in a peculiar way with the length of the mercury column producing it. The results of a study of this phenomenon are given.—Prof. W. H. **Young**: The mode of approach to zero of the coefficients of a Fourier series.—R. O. **Street**: The dissipation of energy in the tides in connection with the acceleration of the moon's mean motion. On the hypothesis of non-turbulent motion harmonic with respect to the time with a period of twelve hours, an expression is obtained for the mean rate of dissipation of energy by viscosity in a portion of the ocean in the form of a surface integral over that area of a function of the surface current-velocities only. This integral has been evaluated over the greater part of the Irish Sea, the mean rate of dissipation obtained being 5×10^9 foot-poundals per second. In the absence of external forces, this rate of dissipation would cause the energy to be reduced in the ratio e to 1 in about two hours. If the rate of dissipation per unit area for the whole ocean were the same as in the Irish Sea, the total frictional loss of energy by the tides would be at the mean rate 6×10^{13} foot-poundals per second. If the apparent lunar acceleration is attributed to a slowing of the earth's axial rotation, a retardation of the order four minutes of arc per century per century is necessary for its explanation. This retardation implies a decay of the earth's kinetic energy of rotation at the rate of $1{\cdot}6 \times 10^{13}$ foot-poundals per second, which is about a quarter the mean rate of dissipation of tidal energy on the above hypothesis. A maximum surface current velocity of 2 ft. per second over the whole ocean would give rise to sufficient dissipation to account for this retardation of the earth.

Optical Society, March 8.—C. L. **Redding**: A simple method of determining the size of the tool required for a given block of lenses. When a new system of lenses has to be worked, it is desirable to select the best method of blocking, and to make the diameter of the tool equal to the diameter of the complete block. The size of the tool may be determined by calculation or by previous experience, but the author described how this may also be done by making use of any concave tool of known radius.—T. F. **Connolly**: A variable angle collimator. The instrument described differs from an ordinary collimator in having a bi-prism introduced between the diaphragm and the object-glass. The effect of this is to produce two separate images of the central wire, which images are collimated by the object-glass as though they were real wires. The bi-prism is mounted in a short tube sliding within the collimator body, and its position is indicated on the outside of the collimator on a longitudinal scale. A movement of the bi-prism

varies the distance between the images as it slides along, and this variable separation of the collimated images provides a convenient means for angular measurement. If the scale is graduated to correspond with angular separation, it can be used as a standard of angular measurement for such purposes as marking off or checking stadia intervals on levels or theodolites, or for checking the graticules in prism binoculars.—P. F. **Everitt**: The design and testing of telescope objectives. The author first described the four principal aberrations of the telescope objective, proceeding from them to others of less importance, and finally reducing the problem to the fulfilment of three or more of six conditions which it is desirable to satisfy. After referring to the existing tables of approximate solutions, trigonometrical formulæ are given by means of which selected rays are accurately traced through an objective, and the aberration is shown numerically in an example in which the chromatic aberration of an objective is altered at will. A short description of the main types of objectives was given, showing the purposes for which they are best adapted, and also some methods of testing, including the Hartmann system.

Physical Society, March 9.—Prof. C. V. Boys, president, in the chair.—Dr. P. E. **Shaw**: To measure the pressure in a high vacuum by observations of logarithmic decrement. In experiments on the Newtonian constant (*Phil. Trans.*, May, 1916) the author used a torsion balance in a vacuum which varied in different cases from 15 mm. to 0·00001 mm. pressure. Before sealing the vessel the pressure was determined by a McLeod gauge. Values of the pressure after sealing off were deduced, in the case of the higher vacua, from observations of the damping of the torsion system. The formula employed is due to the late Prof. Poynting, and can be expressed in the form

$$P = 35{\cdot}6\,\frac{I}{sa'T}\lambda,$$

where I = moment of inertia of suspended system, s = area of surface (supposed plane) which is experiencing the resistance, a = mean distance of plane from centre of rotation, T = period of oscillation, and λ = the observed logarithmic decrement. A table and curve are given showing the relation between P and λ.—A. W. **Clayden**: A diffraction colour box. The apparatus consists essentially of a very simple concave grating spectroscope, of which the slit and grating are situated at opposite diameters of a circle, the spectrum being formed on the arc of this circle. Two independent arms carry fittings on which may be placed either telescope eyepieces or small electric lamps. With the slit of the instrument illuminated by a suitable source, the eyepieces can be set so that any two desired wave-lengths are in the centres of their respective fields of view. The eyepieces are then replaced by the small lamps (the filaments coinciding with the previous positions of the cross-lines), and the grating is observed with a small telescope pointed towards the widened slit; the whole of its surface is seen to be illuminated with a mixture of the two colours on which the eyepieces were originally set. The "concave grating" employed consists of a Thorpe replica of a Rowland plane grating of 14,475 lines to the inch, mounted with its ruled surface in contact with the surface of a concave mirror of 4-ft. focal length. This forms an admirable substitute for the more expensive concave grating. The author prefers to state results in terms of the number of oscillations per unit of time. Observations showed that the smallest change of wave-length which could be recognised by the eye as a change of colour was greater than that which corresponded to a change of period of 10^{12} vibrations per second, or to a change of one vibration more or less in $1/10^{12}$ second.—Prof. W. M. **Coleman**: An apparatus for studying the effect of Hertzian waves on the heart. A simple pendulum, consisting of a cylindrical brass bob terminating in a pointed wire coaxial with the bob, hangs by a piece of string above one of the terminals of an induction coil, so that in its lowest position the point of the bob is within sparking distance of the terminal and vertically above it. The bob is connected by a piece of flexible wire to the other terminal of the coil. When the pendulum is set oscillating there is a shower of sparks every time the bob passes its lowest position. The frequency of intermittence can be varied by altering the length of the suspension. By adjusting the period of the pendulum nearly to the time of a heart-beat any possible effect on the rate of the beating may be observed. The condensed discharge from two Leyden jars is employed.

Geological Society, March 14.—Dr. A. Smith Woodward, vice-president, in the chair.—L. M. **Parsons**: The Carboniferous limestone bordering the Leicestershire coalfield. The inliers of Carboniferous limestone situated along the northern border of the Leicestershire coalfield crop out in two well-defined series: a western series composed of almost horizontal beds exposed by stream-erosion, and an eastern series in which the limestone is highly inclined and complicated by faulting. The thinly bedded limestones, shales, and dolomites of the western inliers are of a slightly higher horizon than that of the uppermost beds of the more massive dolomites seen at Breedon and Breedon Cloud farther eastwards. In no part of the district is the base of the Carboniferous seen, although borings have shown that the limestone rests upon pre-Cambrian rocks in the neighbourhood of Charnwood Forest.

Linnean Society, March 15.—Sir David Prain, president, in the chair.—C. E. **Jones**: Methods of preparing plants for exhibition. The experiments described have been carried out in connection with the exhibition of plants in the Department of Botany, Natural History Museum, South Kensington, where specimens of the results can be seen (see also NATURE, November 9, 1916, p. 191).—Dr. R. R. **Gates**: A systematic study of the North American Melanthaceæ from the genetic standpoint. The author's point of view is the assumption, based upon experiment during the last fifteen years, that the variations which mark species have not been universally continuous and infinitesimal, but often definite and discontinuous. Definite variation is not necessarily orthogenetic variation, but marked variation which may occur in any, or in many, directions simultaneously. The experience gained in work on the mutations in Œnothera are turned to account in this group of Liliales which has not hitherto been the subject of experiment. Pairs of species have been taken and investigated on this basis. Related genera showing marked differences in structure often co-exist side by side, showing that these differences cannot be claimed as of selective value, but have arisen from "spontaneous variation" and have been perpetuated by heredity.

Mineralogical Society, March 20.—Mr. W. Barlow, president, in the chair.—A. **Holmes** and Dr. H. F. **Harwood**: The basaltic rocks of Spitsbergen and Franz-Joseph Land, with conclusions regarding the Brito-Arctic Tertiary Petrographic Province. These rocks, which were obtained respectively from Prof. Garwood and the Geological Survey of England and Wales, are very similar not only to the basaltic rocks previously described from neighbouring localities, but

also to the basalts of the whole Arctic region stretching from Dickson Harbour to West Greenland. The essential minerals are labradorite, rich in the anorthite molecule, pyroxene of the enstatite-augite type, and titaniferous magnetite. The province as a whole displays significant variations both in time and space. The earliest eruptions are generally poor in alkalies, but tend to become more alkaline as the present period is approached. Thus, the later eruptions of Spitsbergen gave rise to olivine trachydiorites instead of basalt. Jan Mayen still possesses an active volcano, and its rocks are unusually alkaline basalts. Similarly, the later rocks of Iceland and, to a lesser extent, of Skye and the Small Isles follow the same course. In space the most remarkable variation is seen in the distribution of titanium, the percentages of titanium oxide being high in the rocks of Greenland and the Iceland Ridge, and falling away regularly on each side. The Brito-Arctic Petrographic Province can be subdivided into five regions, viz. the British, the Icelandic (including the Faroe Islands and the Scoresby Sound district), the West Greenland, the Jan Mayen, and the Spitsbergen—Franz-Joseph Land—Dickson Harbour, and the differences subsisting between them are related to the processes whereby the igneous activity was initiated. It is suggested that a petrographic province consists of a number of adjacent regions of igneous activity, in which similar rocks, or similar series of rocks, have been produced, whence it follows that the processes by which the magmas have been formed, differentiated, and intruded must be similar, and the underlying materials on which these processes have acted must also be similar.—Dr. J. W. **Evans**: A general proof of the limitation of the symmetry-numbers of crystals. On the assumption that crystals are composed of cells identical in all respects, then, if n be the degree of the symmetry of an axis and d an integer, the equation

$$\cos\frac{2\pi}{n}=\tfrac{1}{2}(1-d)$$

must be satisfied. The only possible values of d are 3, 2, 1, 0, the corresponding values of n being 2, 3, 4, 6.—E. S. **Fedorov**: The numerical relation between zones and faces of a polyhedron. The numerical relation shown by axes of symmetry situated in planes of symmetry pointed out by G. Cesàro in 1015 is only a particular case of the more general one deduced by the author in 1885.—A. **Ledoux**, T. L. **Walker**, and A. C. **Wheatley**: The crystallisation of parahopeite. Crystals in the Royal Ontario Museum of Mineralogy from the original locality, Broken Hill, North-Western Rhodesia, are triclinic with the axial ratios $a:b:c=0{\cdot}7729:1:0{\cdot}7124$; $\alpha=93^\circ\ 22'$, $\beta=91^\circ\ 12'$, $\gamma=91^\circ\ 22'$. Thirty-two forms are recorded. The crystals have perfect cleavage parallel to the brachypinacoid, and show lamellar twinning parallel to the macropinacoid. The angle of optical extinction on the cleavage is 10° with reference to the twin-lamellæ.

Royal Meteorological Society, March 21.—Major H. G. Lyons, president, in the chair.—Major G. I. **Taylor**: The formation of fog and mist. Fogs are due either to precipitation of water in the air or to a condition of the atmosphere which prevents smoke from being dispersed from the air close over the roofs of a town. The two necessary conditions for the formation of a smoke fog are that the wind velocity must be very small and the air near the ground must be relatively cold compared with the air higher up for a period sufficiently long to collect enough smoke to form a fog. The formation of fog at sea can usually be traced to the cooling of the surface air when it flows from a place where the sea is warm to a place where it is cold, but sometimes a fog is caused by air flowing from a cold to a warm part of the sea. In the former case the fogs are usually low-lying and thick, while in the latter they are more frequently light fogs which stretch up to a considerable height. Fogs consisting of small drops of water are formed on land, too, by the cooling of surface air, but in this case the air usually stays still, while the lowering of the temperature of the ground by radiation to the sky at night cools the air near the surface. Fogs of this type are not formed until the temperature has fallen considerably below the dew-point of the air during the day. This is because the formation of dew dries the air near the ground. Theoretical considerations show that the amount by which the temperature must fall below the dew-point before fog is produced depends on a complicated series of causes, but an empirical method has been devised for estimating whether, on any given night, there is enough water vapour in the air to form a fog if other conditions are suitable. This method can be used for local forecasting.

CAMBRIDGE.

Philosophical Society, February 19.—Dr. Marr, president, in the chair.—B. **Sahni**: 1. An Australian specimen of *Clepsydropsis*. 2. Observations on the evolution of branching in ferns. The evolution of the branching of the fern stem is discussed for the first time from the point of view of vascular anatomy. It is concluded that dichotomous branching is primitive and that monopodial branching is derived from it by the successive intercalation, at the base, of a series of stages, each morphologically less complex than the preceding. The process has thus been one of retrogressive evolution in the basipetal direction.—C. P. **Dutt**: Some anatomical characters of coniferous wood and their value in classification. The author directs attention to the confusion in existing accounts of the pitting associated with medullary ray cells and gives the result of an investigation on the same subject. Conclusions are drawn as to the value of such pitting as a diagnostic character.

MANCHESTER.

Literary and Philosophical Society, February 20.—Prof. S. J. Hickson, president, in the chair.—Dr. W. **Makower**: The photographic action of α rays. The first important investigation of the photographic action of α particles was made in 1910 by Kinoshita, who succeeded in showing that whenever an α particle strikes a grain of silver haloid in a photographic plate, that grain is afterwards capable of photographic development; moreover, this was true throughout the range of the α particle. Later it was shown by Reinganum and others that when α particles are projected tangentially to a photographic plate, after development the film shows definite trails of grains of silver halide, which can readily be distinguished under the microscope. These trails are produced by the impact of the α particles on the haloid grains as they pass through the film, and their length represents the range of the α particles in the film of gelatine. Photomicrographs showing the paths of α particles through photographic films were first published by Walmsley and Makower, and soon afterwards by Kinoshita and Ikeuti. The method adopted by the latter was to activate the tip of a sewing-needle by gently rubbing it on a surface coated with the active deposit of radium or some other source of α radiation. In this way a trace of active matter was transferred to the point of the needle, which was then placed for a short time in contact with a photographic film. The grains affected by the α particles can be clearly seen radiating out in straight lines from centres representing the points at which the needle had been brought into contact with the films.

EDINBURGH.

Royal Society, February 5.—Dr. Horne, F.R.S., president, in the chair.—Prof. A. A. **Lawson**: The gametophytes of the Psilotaceæ. This paper was a continuation of previous work, filling in a number of details, especially with regard to the sexual organs. The most important fact was the establishment of the structure of the protruding neck of the Archegonium, differing from that of other Pteridophytes in being evanescent. After fertilisation it falls away, leaving the basal tier of cells, which are persistent and were at first held to represent the whole neck. Important researches in the embryology will form the subject of a later paper.—J. McLean **Thompson**: The anatomy and affinity of *Stromatopteris moniliformis*, Mett. This curiously specialised fern is from the arid commons of New Caledonia. It shows many signs of reduction, and is specialised for a xerophytic existence. The construction of the stem indicated a Gleicheniacean affinity, and the form and construction of the spore-producing members confirmed this relationship. But the special form and peculiar appendages seemed to confer an individuality on the plant which could not be overlooked, and the opinion was expressed that Stromatopteris was a distinct and monotypic genus closely allied to Gleichenia.—Prof. and Mrs. A. D. **Ross**: Preliminary note on the peculiarities of the tides round Western Australia. Among the peculiarities mentioned was the frequent occurrence of daily tides instead of half-daily; a sufficient explanation was given in terms of the moon's declination. The whole subject demanded a careful investigation, which the authors were now entering on.

February 19.—Sir E. A. Schafer, vice-president, in the chair.—Dr. J. **Horne** and Dr. B. N. **Peach**: The bone cave in the valley of the Allt nan Uamh (Burn of the Caves), near Inchnadamff, Assynt, Sutherlandshire; with notes on the bones by E. T. Newton. The bone-cave, which is situated on the north side of the valley, was evidently initiated at a certain stage in the history of the Glacial period, after the deposition of some ground moraine in the valley. It yielded a series of deposits, some of which are of exceptional interest. The oldest date back to a late stage in the glaciation of the region, and point to a partial erosion of the drift during a recession of the ice. Two of the six layers in the cave, viz. the third and fifth in descending order, have furnished the remains of a northern lynx, the Arctic lemming, the northern vole, the brown bear, reindeer, red deer, and other mammals, with the bones of a number of birds, those of ptarmigan occurring in profusion. The lynx, lemming, and northern vole give a boreal aspect to the fauna. In the south of England these mammals are regarded as Pleistocene forms. Between the third and fifth layers occurs a layer of compact grey clay, with quartzite stones, which have been transported from the high ground to the east (Breabag). This material is regarded as of morainic origin, produced during a re-advance of the local glaciers. In the upper mammaliferous deposit, which is a genuine cave earth, or *terra rossa*, there is evidence, at various levels, of human occupation in the form of layers of charcoal and split and burned bones. No artifacts were recorded. Overlying the cave earth there is a lenticular bed of shell marl, composed of the remains of land shells.—A. M. **Williams**: The adsorption of sulphur dioxide by charcoal at $-10°$ C. The aim of the research was to find out how the heat evolved on the adsorption of a vapour varied with the amount adsorbed. Measurements were taken of the amount adsorbed, the pressure, and the isothermal heat of adsorption at constant volume. The adsorption isotherm was a typical adsorption curve, similar to that found by Trouton for the adsorption of water vapour. The heat of adsorption curve passed through a minimum and a maximum and, finally, ran parallel to the adsorption axis. A tentative explanation was offered.

PARIS.

Academy of Sciences, February 12.—M. A. d'Arsonval in the chair.—G. **Lippmann**: Some decisions taken by the Governments of Great Britain and the United States. An account of the Government measures for utilising scientific methods for increasing the national security and prosperity. An account is given of the constitution of the Imperial Trust and Advisory Council, the scope of its work, and the funds at its disposal. In the United States the National Research Council, nominated by the Washington Academy of Sciences, is working on the same lines.—G. A. **Boulenger**: The nuptial tubercles simulating teeth in an African fish of the genus Barbus.—M. **Balland**: Soya as a French foodstuff. The soya bean contains 40 per cent. of nitrogenous material and 20 per cent. of fat, as against 20 per cent. of nitrogenous material and 2 per cent. of fat in French haricots. Soya has already been successfully employed as a foodstuff in France, and analyses of this and other foreign leguminous foodstuffs are given.—M. **Mesnager**: A simple solution of Mathieu's problem A.—A. **Ledoux**: New method for the determination of the refractive index of liquid substances.—MM. **Massol** and **Faucon**: Absorption of the ultra-violet radiations by some chlorine derivatives of ethane, ethylene, and acetylene. No absorption bands were given by hexachloroethane and tetrachloroethane. With tetrachloroethylene in 1 mm. layer all radiations starting with $\lambda=271$ are absorbed. Acetylene in acetone or acetone-alcohol solution shows a considerable absorption, but no bands.—J. **Bougault**: Mixed anhydrides derived from benzoylacrylic acid. Some new examples of a reaction previously described, together with a discussion of the mechanism of the reaction.—V. **Commont**: The tufas of the valley of the Somme: Neolithic and prehistoric tufas, and tufa of the historic period. The tufas of the Somme valley were formed at various times in the Neolithic, protohistoric, and Gallic periods. The peat and tufa were formed simultaneously. The marine shells found are the *débris* of Gallo-Roman cooking.—M. **Russo**: Geological observations on the Tadla synclinal (western Morocco).—L. **Daniel**: The influence of grafting upon the adaptation products of the cactus. A morphological examination alone is insufficient for drawing definite conclusions as to the integral conservation of the characters peculiar to the grafted plants, since microchemical analysis of their tissues may reveal changes which, without it, would escape the notice of even a practised observer.

February 19.—M. A. d'Arsonval in the chair.—The president announced the death of M. Bazin.—G. **Bigourdan**: Some observatories of the northern part of France in the seventeenth century. Details are given of work done at Blois and Caen.—M. **Fournier**: A problem in the design of the hull of a ship.—C. **Camichel**: The calculation of large extra pressures in water-mains furnished with an air reservoir.—Ch. J. **Gravier**: The association of a siliceous sponge, of a sea-anemone, and an annelid in the depths of the Atlantic.

PETROGRAD.

Imperial Academy of Sciences, Physico-Mathematical Section, November 16.—A. A. **Bĕlopolskiĭ**: Researches on the spectrum of the variable γ Boötis.—V. **Chlopin**: Boron and its occurrence in Russia.—E. **Eremina**: Fluorspar in Russia.—I. **Ginsburg**: Mica, its properties, uses, and occurrence in Russia.—G. Ju. **Vereščagin**: Report on the work carried out at Lake Baikal in the summer of 1916.—N. F. **Kaščenko** and

M. P. **Akimov**: *Rhinolophus bocharicus*, n.sp.—M. D. **Zalesskij**: A marine sapropelite of the Silurian period formed by a cyanophycean alga.

December 3.—A. A. **Bělopolskij**: Researches on the spectrum of δ Cassiopeiæ.—A. M. **Liapunov**: A formula of analysis.—P. **Krylov** and E. **Šteinberg**: Contributions to the flora of the Kansk district, province of Jenissei.—E. **Eremina**: Genesis of fluorspar in Russia.—M. A. **Rakuzin**: Absorption in petroliferous strata.—H. **Baklund**: Fall of a meteorite at Boguslavka, neighbourhood of Vladivostok.—N. V. **Nasonov**: The Turbellaria fauna of Finland.—V. L. **Bianchi**: (1) The birds of the Government of Tver. (2) Our present knowledge of the avifauna of the Government of Olonetz. (3) Geographical distribution of birds in North-West Russia-in-Europe. (4) Synoptic table for determining the Chiroptera of Russia-in-Europe. (5) The nidification of the birds of the Government of Petrograd. (6) Preliminary notes on Russian Chiroptera.—G. B. **Florovskij**: The mechanism of reflex salivary secretion.—N. S. **Kurnakov** and S. F. **Žemčužnij**: The magnesium salt lakes of the Perekop group.

HISTORICO-PHILOLOGICAL SECTION, November 29.—S. F. **Oldenburg**: Short description of a small collection of Khotan antiquities belonging to D. V. Kossikovskij.

December 7.—V. M. **Ionov**: The study of the pre-Christian faith of the Yakuts.—K. A. **Inostrancev**: A few remarks on the religion of the ancient Turks.—A. A. **Šachmatov**: Note on the language of the ancient Bulgars.—F. I. **Ščerbatskoj**: The doctrine of the categorical imperative among the Brahmans.—A. D. **Rudnev**: Cha-Ošir. Translation of a fragment of a Buriat epic.

BOOKS RECEIVED.

The Idea of God in the Light of Recent Philosophy. By Prof. A. Seth Pringle-Pattison. Pp. xvi+423. (Oxford: At the Clarendon Press.) 12*s.* 6*d.* net.

The Combination of Observations. By D. Brunt. Pp. x+219. (Cambridge: At the University Press.) 8*s.* net.

The Psychology of Sound. By Dr. H. J. Watt. Pp. vii+241. (Cambridge: At the University Press.) 10*s.* 6*d.* net.

Domestic Economy: a Text-book for Teachers and Students in Training. New edition. Part i., Theory. By M. G. Bidder. Pp. vi+167. Part ii., The Practice and Teaching of Domestic Economy. By F. Baddeley. Pp. vi+189. (Cambridge: At the University Press.) 2*s.* 6*d.* net each.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1917. Pp. 779. (London: H. Greenwood and Co., Ltd.) 1*s.* net.

British Museum (Natural History). Report on Cetacea Stranded on the British Coasts during 1916. By Dr. S. F. Harmer. (London: British Museum (Natural History); Longmans and Co., and others.) 1*s.* 6*d.*

Year-book of the Royal Society of London, 1917. Pp. 235. (London: Harrison and Sons.) 5*s.*

The Order of Nature. By L. J. Henderson. Pp. v+234. (Cambridge, Mass.: Harvard University Press; London: H. Milford, Oxford University Press.) 6*s.* 6*d.* net.

The Banket: a Study of the Auriferous Conglomerates of the Witwatersrand and the Associated Rocks. By Prof. R. B. Young. Pp. xv+125+plates xxviii. (London: Gurney and Jackson.) 8*s.* 6*d.* net.

The Calculation and Measurement of Inductance and Capacity. By W. H. Nottage. Pp. 137. (London: The Wireless Press, Ltd.) 2*s.* 6*d.*

DIARY OF SOCIETIES.

THURSDAY, MARCH 29.

ROYAL SOCIETY, at 4.30.—The Fourth Colourless Sensation in the Spectrum Sensation Curve when Measured in the Centre of the Retina: Sir William Abney.—Magnetic Inertia: G. W. Walker.—The Selective Properties of the Copper-ferrocyanide Membrane: F. Tinker.—X-Ray Analysis of the Crystal-structure of Rutile and Cassiterite: C. M. Williams.—Discontinuous Fluid Motion: Dr. J. G. Leathem.

ROYAL INSTITUTION, at 3.—Telephony: Prof. J. A. Fleming.

AERONAUTICAL INSTITUTE, at 8.—The Necessity for New and Special Treatment of Metals Employed in Aircraft Construction: J. de Kozlowski.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—Further Experiments upon Wake and Thrust Deduction Problems: W. J. Luke.—Some Experiments on the Influence of Running Balance of Propellers on the Vibration of Ships: J. J. King-Salter.—Theory of Wave Motion on Water: Sir George Greenhill. At 3 p.m.—Marine Application of Reduction Gears of Floating Frame Type: J. H. Macalpine.—Launching: P. A. Hillhouse and W. H. Riddlesworth.—Buoyancy and Stability of Submarines: Prof. W. Hovgaard.

LINNEAN SOCIETY, at 5.—Prof. T. H. Morgan's Work on the Mechanism of Heredity: W. Bateson.

FRIDAY, MARCH 30.

ROYAL INSTITUTION, at 5.30.—Recent Developments of Molecular Physics: Prof. J. H. Jeans.

GEOLOGISTS' ASSOCIATION, at 7.30.—Cephalopoda, and their Value in Geological Study: W. F. Gwinnell.

SATURDAY, MARCH 31.

ROYAL INSTITUTION, at 3.—Russian Idealism: S. Graham.

MONDAY, APRIL 2.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Two Journeys in the High Atlas: Capt. A. J. A. Douglas.

ARISTOTELIAN SOCIETY, at 8.—Is There any Justification for the Conception of Ultimate Value? W. A. Pickard-Cambridge.

TUESDAY, APRIL 3.

RÖNTGEN SOCIETY, at 8.15.

ZOOLOGICAL SOCIETY, at 5.30.—Big-Game Shooting in India: A. Ezra.—Notes on some of the Viscera of an Okapi, *Okapia johnstoni*: R. H. Burne.

WEDNESDAY, APRIL 4.

ENTOMOLOGICAL SOCIETY, at 8.

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MACMILLAN AND CO., LTD.,
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Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.