THURSDAY, JANUARY 4, 1917.

GEOLOGY AND SCENERY OF THE LAKE DISTRICT.

The Geology of the Lake District and the Scenery as Influenced by Geological Structure. By Dr. J. E. Marr. Pp. xii+220. (Cambridge: At the University Press, 1916.) Price 12*s.* net.

EVER since the days of Jonathan Otley and of Sedgwick the Lake District has attracted much attention from geologists, largely on account of the variety and difficulty of the problems that it presents. As is well known, Dr. Marr has devoted a very large part of his life to the study of these problems, and the present volume contains an admirable summary of the results obtained by his predecessors, by his contemporaries, and by himself in this field. Although comparatively small when measured in square miles, there is, perhaps, no other well-defined area where so much variety of topography and of geological structure is to be found, or where the connection between geology and scenery is so clearly marked. On this latter feature the author rightly lays much stress, pointing out that each formation gives rise to its own particular type of scenery, easily distinguishable even in the distant view.

The arrangement of the book is historical. Beginning with the oldest known rocks, a clear and connected account is given of the origin and characters of each formation, and also of the events that occurred during the intervals when no deposition was in progress. The chapters dealing with the periods of non-deposition are in some ways the most interesting sections of the book, as they give more scope for originality and speculation. Even yet there remain problems among the older rocks still awaiting a final solution; perhaps the most important and the most difficult of these is the question of the true age and tectonic relationships of the Borrowdale volcanic series. The similarity of these rocks to the Charnian volcanics was long ago noted by Prof. Lapworth, who suggested that they may possibly be of pre-Cambrian age, owing their present position above the Skiddaw Slates to overthrusting. As a result of the researches of Dr. Marr and Mr. Harker, and the more recent work of Mr. J. F. N. Green, the balance of evidence seems to show that they are in reality, as they appear to be, of Llandeilo age; the question may eventually be settled by a study of the graptolites of the uppermost Skiddaw Slates. Should these be found to contain, as is possible, a Glenkiln fauna, a place would have to be found for the Borrowdales elsewhere, since the overlying Coniston Limestone Series is undoubtedly of Carodocian age. The relationship of the Eycott lavas to the Borrowdales and to the Carboniferous rocks which immediately follow them also offers an interesting field for investigation.

In the Lake District the connection between topography and glaciation is naturally close, and this is a subject on which the author is particularly competent to speak with authority. The development of the drainage system, together with its later modifications, as well as the origin of the lakes and tarns, are dealt with in a masterly manner. It is made abundantly clear that both ice-erosion and glacial deposit have played an important part in producing the characteristic types of scenery to which so much of the present beauty and interest of this region are due.

The author has succeeded admirably in the difficult task of producing a book which will be both interesting and instructive to the general reader as well as valuable to the serious student. The portions printed in large type form a continuous narrative of the main features of the geological history of the district, while the sections in smaller type provide a wealth of descriptive detail with ample references to the original literature, which will be of the greatest value to those who wish to carry out further work along special lines.

The book is well printed and the illustrations are numerous and well chosen, a feature of special interest being several reproductions of maps illustrating, among others, the classical papers of Dr. Marr and Mr. Harker on the Shap granite and of Mr. Harker on the gabbro of Carrock Fell. Both the author and Dr. H. H. Thomas are to be heartily congratulated on the beautiful coloured geological map of the district; possibly this helps in part to account for the very high price at which the book is published. R. H. R.

A HAUSA BOTANICAL VOCABULARY.

A Hausa Botanical Vocabulary. By Dr. J. M. Dalziel. Pp. 119. (London: T. Fisher Unwin, Ltd.). Price 6*s.* 6*d.* net.

DR. DALZIEL deserves imperial thanks for producing a little book of imperial importance: the names in Hausa of all the more striking and important trees and plants in the flora of Northern Nigeria. The scope of the book, so far as botanical regions extend, is probably limited by the Sahara Desert on the north, the river Benue on the south, the Chad region on the east, and the course of the Middle Niger on the west. It does not, therefore, extend into the almost oppressively rich flora of Southern Nigeria, because nearly all of Southern Nigeria lies beyond the experiences of the Hausa-speaking folk, though, it is true, that experience does cross the Benue.

Companion works to this book ought to make their appearance in all parts of British Tropical Africa. Some years ago the Scottish missionaries of Blantyre (see the present writer's work on British Central Africa) endeavoured, with the assistance of their native pupils, to print similar researches, at any rate to give the native name of every important tree and plant in Nyasaland. But, unfortunately, they were not able to combine with this in all cases correct botanical identifica-

tion. We ought to have from British East Africa and Uganda, from British Central Africa (Rhodesia and Nyasaland) and each separate colony or protectorate of British West Africa, works similar to that under review, giving in the leading native language or languages the designation of the striking and commercially important trees and plants, and side by side the correct botanical identification.

Dr. Dalziel's book is the model to be followed. It possesses an excellent index which reverses the process of identification by supplying a long list of the botanical names of trees and plants with the number of the page on which they are dealt with. It also throws much light on native drugs, poisons, and aphrodisiacs, and is further a useful catalogue of the outstanding features in the flora of Eastern Nigeria.

Hitherto botanical research—and linguistics—have not been sufficiently encouraged by the Colonial Office in our African possessions. Perhaps after the war—if those of us now writing and working live to see an after—we shall be wiser. We shall realise that Africa is as important to us and the rest of the world for its flora as it is for its minerals, and do everything we can to increase native and European knowledge of the same.

H. H. JOHNSTON.

A GERMAN PSYCHOLOGIST ON THE EVOLUTION OF CULTURE.

Elements of Folk Psychology: Outlines of a Psychological History of the Development of Mankind. By Wilhelm Wundt. Authorised translation by Prof. E. L. Schaub. Pp. xxiii + 532. (London: George Allen and Unwin, Ltd., 1916.) Price 15*s.* net.

PROF. WUNDT has been a voluminous writer on psychological and philosophical subjects, and has had a profound effect in Germany and to a large extent also in the United States of America, but of the real value of his psychological investigations this is not the occasion to form an estimate. The "Elemente der Völkerpsychologie" (1912), of which the book under notice is a translation, breaks new ground, and we have to thank Prof. E. L. Schaub for rendering it available to the English-speaking public.

The book gives a synthetic presentation of various stages of human civilisation and of the mental products which are created by communities of human beings at these several stages. The author divides the development of civilisation into four stages: Primitive Man, the Totemic Age, the Age of Heroes and Gods, and the Age of Natural States and Religions—the first three being alone dealt with at length. Prof. Wundt makes certain deductions from the data which he adduces, but before framing hypotheses it is as well to make sure of the premises, and it has been a surprise to the present writer to find upon what inaccurate data—one can scarcely term them "facts"—the superstructure is in many cases reared.

When dealing with primitive man we find various astonishing statements, thus: "If one were to connect the discovery of this primitive man with any single name, the honour would belong to a German traveller and investigator, George Schweinfurth. He was the first to discover a really primitive tribe." "When the Veddah enters into marriage, he binds a cord about the loins of his prospective wife. Obviously this is nothing else than a form of the widely current 'cord-magic' . . . to secure the faithfulness of the wife." As a matter of fact, "the bride gives her spouse a waist string of her own making" (Seligman), which may or may not have the significance Prof. Wundt attributes to it—we simply do not know. The Veddas do not use poisoned arrows, as he states they do. "Even marriage between brother and sister was originally not prohibited"; but, as Dr. and Mrs. Seligman point out, Hugh Neville said in 1886: "Much nonsense has been written by persons who ought to have known better, about marriage of Væddas with their sisters. Such incest was never allowed and never could be." He goes on to explain that "the mistake arose from crass ignorance of Vædda usages."

Further on we read that the Australian spear-thrower is a "grooved board," but of the numerous varieties of this implement in Australia not one has this construction. Again, "the shield of the Australians is long, and usually raised toward the centre. It covers the entire body." There are several kinds of shields in Australia, the most widely distributed being little more than a parrying stick. We are told that "the Papuans are the first to change the digging stick into the hoe . . . it is the man who makes the furrows with the hoe . . . and the woman follows with the seeds, which she scatters in the furrows." But the hoe as derived from the digging stick was unknown, and seeds were never sown in New Guinea until the arrival of civilised people. Another misleading statement is that "to the bow and the lance they [the Polynesians] have added the knife and sword; to the long shield, the small round shield." If Prof. Wundt had stepped across from his laboratory to the excellent Museum für Völkerkunde he need not have made these blunders. The statement that the Malays came from "the mainland of India" is incorrect; if he meant Further India he should have said so—but that, in any case, is a foolish term. There is no evidence that "the Malayans were the first to create a perfected form of boat."

It is unnecessary to give further examples of misstatements. There are also a considerable number of statements of the origin or evolution of customs and objects of material culture which are given with all the assurance of ascertained facts, though they are merely the unsupported statements of the professor. On the other hand, there are many valuable suggestions and inferences which are worthy of the attention of students.

A. C. HADDON.

MATHEMATICAL TEXT-BOOKS.

(1) *A Shilling Arithmetic.* By J. W. Robertson. Pp. viii+191. (London: G. Bell and Sons, Ltd.)

(2) *Revision Papers in Arithmetic.* By C. Pendlebury. Pp. xv+68+xviii. (London: G. Bell and Sons, Ltd., 1916.) Price 1*s.*

(3) *Preliminary Geometry.* By F. Rosenberg. Pp. vi+220. (London: University Tutorial Press, Ltd., 1916.) Price 2*s.*

(4) *Statics: a First Course.* By C. O. Tuckey and W. A. Nayler. Pp. 299. (Oxford: At the Clarendon Press, 1916.) Price 3*s.* 6*d.*

(5) *Exercices Numériques et Graphiques de Mathématiques.* By Prof. L. Zoretti. Pp. xv+124. (Paris: Gauthier-Villars et Cie, 1914.) Price 7 francs.

(6) *Ruler and Compasses.* By Hilda P. Hudson. Pp. 148. (London: Longmans, Green and Co., 1916.) Price 6*s.* net.

(1) MR. ROBERTSON'S "Shilling Arithmetic" deserves the attention of the teacher if only for the collection of carefully devised and arranged original examples. It is not overloaded with text, nor is undue space given to illustrative examples. Stress is laid upon the use of rough checks. No use is made in H.C.F. of the principle $ma+nb$. In finding prime factors the child is told to begin by removing the lowest factors first, a practice which does not make for speed, especially as the tests for divisibility by 11, 9, etc., are supposed to be at the service of the student. In the sections on fractions the figures are too small, and in the copy that has reached us they are often of varying degrees of distinctness. It is nothing short of criminal for any publishing firm in these days to issue books for the young upon which any reproach of the kind can be cast. Numbers 24 and 25 (p. 47) are instances of wickedly small type, and the strain to young eyes is greater still when the space between the lines is inadequate, *e.g.* compare numbers 26–40 on this page with numbers 41–43 on the next, and the relief is instantaneous.

In the treatment of stocks we are glad to see that the author banishes the mischievous "100*l.* stock" and uses "voucher" in its place. It is curious that in such questions as "Which is the better investment, $5\frac{1}{2}$ per cent. stock at 89, or 4 per cent. stock at 97?" few, if any, text-books suggest the investment in each stock of the *product of the prices—i.e.* in the present case, 89×97. This buys 97 bonds giving $5\frac{1}{2}$*l.* each per annum or 89 bonds giving 4*l.* each per annum. The difference is rapidly found with a minimum of fractional work. There is a useful set of forty test papers. As an instance of the practical tone pervading the book, we may take the warning that the percentage profit in actual commerce is reckoned as often on the cost as on the selling price.

(2) Mr. Pendlebury's "Revision Papers in Arithmetic" provide "a well-graduated and comprehensive examination course up to the standard of the Oxford and Cambridge Locals." They seem excellently adapted for such a purpose. The Answer pages are perforated for removal if deemed necessary, and our only grumble is with the publisher as to the strain caused here and there by small faint figures to young eyes.

(3) Mr. Rosenberg's "Preliminary Geometry" claims to be a judicious blend of the theoretical and practical. Where possible, "each important proposition . . . is preceded by introductory analytical practical work, enabling the learner to discover for himself the law formally proved in the proposition." Parallels follow the work on the angle and triangle, but otherwise the order followed is that of the Oxford and Cambridge syllabus. Where the book is not used by the private student the answers, which contain hints for the solution of many riders, should be detachable. Boys and girls are mortal. The explanations are clear and precise. Such pages as 67–70, "Hints on the Solution of Riders," are invaluable to the private student, and throughout the book there is ample evidence that the author is familiar with every trap into which the unwary beginner may fall. The book enjoys all the devices of type, etc., that are common to works issued by the University Tutorial Press.

(4) The "Statics" of Messrs. Tuckey and Nayler must be carefully examined by all who are not so satisfied as to scorn ingenious "tips" on points in the presentation of a subject which is always difficult to a certain type of youthful mind. The figures are large and clear. It would have cost very little more trouble to add the date to the sources—Army, Previous, etc.—from which the questions have been taken. The point is not immaterial, as considerable trouble to examiners might thereby be saved, as a recent trial in the courts may suggest to those who have to set papers. The young teacher will welcome chap. viii., on "The Connections between the Principles"; such pages as 242–243 will be a revelation to many who are inclined to take "laws" for granted, and whose historical instinct requires a gentle titillation. The manner in which couples are introduced is worthy of notice, as is also the chapter on geometrical methods, since it is "beginning to be recognised that the relations between three actual forces in equilibrium can be more readily grasped by the beginner than those between two actual forces and their hypothetical resultant." The book will be a great disappointment to those who share with Sir Peter Teazle a horror of principles.

(5) Prof. Zoretti's "Exercices Numériques" represents the revolt in French educational circles against a system of teaching which leaves the student unable to use the tools at his disposal. The author's experience as examiner has brought him face to face with "bacheliers" in the land of the metric system who do not know the meaning of a decimal or a significant figure; who are checked by a change of units; to whom the real

nature of a vector is a mystery, although they could write out a complete theory of the central axis; and to whom numerical calculations of any description are as the abomination of desolation. In his *Leçons* the author has provided the student with an ample supply of algebraical exercises, and to these the volume before us provides a supplement, the scope of which is indicated by the warning: "Bien entendu, il n'aura jamais de recul devant les calculs numériques, sans quoi il vaudrait mieux fermer le livre pour toujours et changer de carrière." The chapters are arranged to be worked through, *pari passu,* with corresponding sections in the *Leçons,* so that a wide extent of ground is covered in these 120 odd pages. Close attention is paid throughout to relative and absolute errors. Many of the exercises deal with problems occurring in railway management, and may be novel on this side of the Channel. The book will be a useful addition to the library of the teacher or examiner.

(6) Miss Hudson's monograph on "Ruler and Compasses," which has somehow strayed into this group of elementary text-books, takes us on to a higher plane. Class-book in its entirety it can scarcely be in the schools of to-day, but none the less will it find a place on the shelves of the teacher who is in search of leading ideas, of the folk who in other days would have exhibited their taste for geometrical study in the "Palladium," the "Apollonius," or the "Ladies'" and "Gentlemen's" Diaries of their time. There must be a considerable proportion of those possessed of general culture who see something repellent in analysis, who find generalities too great a burden for their powers of assimilation, and who nevertheless have a native talent for the elementary investigations of pure geometry. Among them is, for instance, that small coterie who feel a never-failing charm in the elusive mysteries of cyclometry. To these it will appeal as well as to the mathematical elect, beginning with the cream of the schools—who will find Miss Hudson's book uncommonly useful, for example, in preparing for their "essay paper," quite apart from its intrinsic interest and value—and passing on to the trained mathematicians, whose interests have been mainly analytical, and who will be glad to find within two covers a host of material such as that due to Messrs. Richmond, Gérard, Hobson, etc. How many of the old stagers have heard of an *Einheitsdreher,* or can state the meaning of geometrography? We cannot better describe the author's scheme than in her own words: "The connecting link through the book is the idea of the whole set of ruler and compass constructions, its extent, its limitations, and its divisions." In completeness and in clarity of exposition it ranks with a companion volume in the same series, the "Projective Geometry" by Prof. Mathews, and, though not comparable in scale, we do not think that "masterpiece" is too strong a word to apply to each. Some day, but not yet, we may forgive Miss Hudson for the omission of an index.

W. J. G.

OUR BOOKSHELF.

First Course in General Science. By Prof. F. D. Barber, M. L. Fuller, Prof. J. L. Pricer, and Prof. H. W. Adams. Pp. vii+607. (New York: Henry Holt and Co., 1916.)

THIS book is written for the American school child. It opens with the statement that "the *primary function* of first-year general science is to give, as far as possible, a rational, orderly, scientific understanding of the pupil's environment to the end that he may, to some extent, correctly interpret that environment and be master of it. *It must be justified by its own intrinsic value as a training for life's work.*" Setting out with this idea, the authors take the various phenomena with which the child is likely to be confronted, and deal with them in a manner calculated to arouse his interest. The opening chapter deals with lighting: with candles, lamps, and kerosene; these subjects lead up to evaporation, boiling temperature, etc., then to petroleum, gasolene, coal gas, and finally to electric lighting. In the second chapter the authors pass on to heating: fires, stoves, combustion and energy, chemical compounds, coal, the measurement of heat, house-heating and cooking. A third chapter is devoted to the refrigerator, which plays a large part in the domestic economy of the States; this leads on to ammonia, the freezing of water, and cold storage. The weather is next discussed. The child by this time has gathered some general physical ideas and he can the more easily grasp the somewhat complex problems now presented to him. Meteorological instruments, weather charts, the seasons, climate and its relation to health, are all described. The principles of ventilation are then treated at length, followed by an account of dust, the vacuum cleaner, and the dangerous, because dusty, hangings of rooms.

The authors then deal with a wholly different subject: food. They are concerned more particularly with its preparation on both the large and the small scale. The next chapter is devoted to micro-organisms, and later chapters to soil physics, sewage, and machinery.

Thus the whole range of a child's experience is fairly well covered. It is difficult to form an opinion as to the general suitability of a book of this sort: usually one tells children about these things, and adapts one's methods to the audience, developing a theme when it seems desirable, but never treating two different audiences in the same way. Probably the best use of the book is as a teacher's guide to give him "copy" which he can work up and adapt to his own class.

The Mechanical Star-bearing Finder: A Simple Guide to Night Marching in Southern England and North France. By E. T. Goldsmith. (London: George Philip and Son, Ltd.) Price 5*s.* net.

THIS is a convenient pocket arrangement by means of which one can solve several of the problems which are capable of solution by the

celestial globe. It is intended primarily for the determination of bearings by observations of stars, for use in night marching. Briefly, it is a planisphere in which the principal stars which are not too far from the equator are represented in a cylindrical projection; the star-chart is adjustable for different dates, and there is a movable celluloid protractor on which are marked the projection of the horizon and the projections of vertical circles at intervals of 10°. Following the simple instructions given, the magnetic bearing of a star, even if its name be unknown, can readily be ascertained. The operations are entirely mechanical, and anyone of ordinary intelligence should be able to determine directions with considerable accuracy. The form of projection adopted, however, has the defect of failing to give bearings of stars towards the north, and it is not very clear why the results are expressed in magnetic instead of in true bearings. A protractor adapted for southern Scotland and northern England is obtainable alternatively or separately.

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.]*

The Temperature Coefficient of Gravity.

IN *Phil. Trans.*, May 17, 1916, Dr. P. E. Shaw published an account of a research from which he deduced that the gravitational constant is increased by one part in eighty thousand when the temperature of the larger mass is raised one degree. According to Dr. Shaw's interpretation of the experiments, it is the mean temperature of the system which affects the coefficient of attraction, so that in the case of extremely unequal masses it is the temperature of the larger mass only which counts. The evidence does not seem strong enough to support so revolutionary a conclusion in view of the almost insuperable theoretical objections.

One or two of the more obvious difficulties may be formulated in a few words.

Take as an example the earth and a mass of 1 kg. Divide up the earth (ideally) into "terrestrial particles" of, say, 1 mgrm. each. When the temperature of the kilogram mass alone is raised one degree its attraction for each "terrestrial particle" should be increased proportionally by $1{\cdot}2 \times 10^{-5}$. But by the same reasoning the attraction between the kilogram mass and the earth as a whole should remain sensibly unaltered. In like manner, if we keep the kilogram mass at constant temperature and alter the temperature of the earth, the attraction between the kilogram and each "terrestrial particle" will be sensibly unaltered, while the attraction between the kilogram and the earth as a whole will have changed. This seems so essentially paradoxical that it is difficult to conceive of any supplementary hypothesis elastic enough to reconcile the contradiction involved.

The only way of avoiding this inconsistency is to admit that it is the product of the two values of a temperature-function which counts—*i.e.* that the temperature of the smaller mass is just as important as the temperature of the larger mass. Once this is admitted the experiments of Poynting and Phillips prove that no variation exists greater than 10^{-9} per degree Centigrade.

It may be argued that the temperature of the *attracting* body determines the attraction—*i.e.* that action is not necessarily equal to reaction. In addition to violating the principle of momentum, this involves the possibility of constructing a *perpetuum mobile*. An elongated body, kept hotter at one end than at the other by means of ideal thermal insulation, would experience a resultant force in the direction of its length, and could be made to do work indefinitely by harnessing it like a horse to a mill. Is anybody prepared to believe this on any but the most conclusive experimental evidence?

Again, it has been suggested by Prof. Barton that the temperature of the intervening radiation may determine the attraction. But the temperature of radiation is independent of the intensity, so that indefinitely feeble radiation would produce a finite effect.

If the intensity of the radiation is substituted as the determining factor, it implies that the attraction of two bodies is increased if a beam of light passes between them. If energy is to be conserved, this would imply that two bodies moving relatively to one another could increase or diminish the energy of a beam of light passing between them, and such a result would certainly be rather startling. Still more extraordinary would it be to find that a variation of 0·01 of a stellar magnitude on the part of the sun would change the length of the year by several minutes; yet this is what would be implied. There is no record of an appreciable change in the earth's orbit caused by sun-spots.

When one comes to examine the evidence out of which all these paradoxes arise, it can scarcely be said to be sufficient. Thus, for instance, as "indirect experimental evidence," Dr. Shaw cites Cornu, who found 5·50 for the earth's mean density from winter work, and 5·56 from summer work, a difference of 1·1 per cent. To reconcile the sign of this variation with his own temperature coefficient, Dr. Shaw suggests that the apparatus in a laboratory may have a higher temperature in winter than in summer. He can scarcely have noticed that the excess of temperature in winter would have to be some 900 degrees. Again, from Prof. Boys's work on the gravitation constant, Dr. Shaw deduces a temperature coefficient of 10^{-3}, of which, according to his own results, 98·7 per cent. must be ascribed to error. Can we have much confidence in the remaining 1·3 per cent.?

While we must all admire the experimental skill which enabled Dr. Shaw to observe a change of 0·2 mm. at either end in a range of 200 mm., using a telescope and scale (especially when we know the difficulties he had to contend with), we can scarcely be expected to make these radical changes in our theories on the strength of such a very small effect. Though his reasons for rejecting experiments which gave a negative value for the temperature coefficient were no doubt excellent, the fact that such readings occurred is a little disquieting. Again, the readings vary amongst themselves by as much as the whole effect, and one knows how misleading a mean value of, say, 176·2, 175·9, 175·75 may be when the whole residual effect is only 0·4 mm.

In conclusion we should like to express our admiration for Dr. Shaw's experimental work. We feel that as the result of such an elaborate research a null result is quite as important as, if less sensational than, a positive one. To have reduced the apparent temperature coefficient of gravity from the 10^{-3} deduced from Prof. Boys's measurements to one-eightieth of that value is certainly no mean achievement.

F. A. LINDEMANN.
C. V. BURTON.
South Farnborough, Hants, December 4.

THE general view held by philosophers seems to be that when temperature rises the gravitative attraction changes (if at all) by a function of temperature only. This leads to the results stated in the beginning of their letter by Dr. Lindemann and Mr. Burton. But it is commonly conceded that at present there is no trustworthy theory of gravitation, so that one seems entitled to suggest that any increment in the force may be a function of both mass and temperature. The simplest formula, that of the weighted mean temperature, brings the facts as at present known into line. It seems that we must await further data; for, of course, a fact, however slight, may shatter a theory lying in its course.

If M, m, μ are the masses of earth, kilogram, and milligram, we have the cases cited thus. When m alone rises in temperature the increment of its force on μ is $Gm\mu\alpha T/d^2$, and on M is $Gmm\alpha T/d^2$. The first is sensible, the second insensible, compared with the forces when cold. Again, when μ alone rises in temperature the increment of its force on m is $G\mu\mu\alpha T/d^2$, but the increment of the force of M (considered as an aggregate of μ particles) on m is $G\mu\mu\alpha T/d^2$, multiplied by

$$\frac{M}{\mu}\cdot\frac{M}{M+m}\cdot\frac{\mu+m}{\mu}=GMm\alpha T/d^2.$$

This is identical with the increment of force on m due to M (considered as a whole), and is sensible compared with the force when cold. The series forms a consistent whole.

If the increments are due to radiation and resonance (see NATURE for July 13 last), there is an acoustical parallel. A medium fork will set up resonance to a slight degree in a large fork, to a greater degree in a small fork, all the forks having one frequency.

I cannot understand how the idea arises that action and reaction would ever, on this theory, be unequal. Let the force of m on M, both cold, be F. When m only rises in temperature the force is $(F+f_1)$, and when M only rises it is $(F+f_2)$, f_2 being of a higher order than f_1. But in each of the three cases the attraction is mutual and equal between M and m.

As regards Cornu's results, I stated that we could "deduce nothing" from them, so there is a misapprehension. I made no attempt to reconcile his results with mine.

I do not consider that the indirect results obtained from Prof. Boys's research can be laid by the side of mine for comparison. In his experiment any rise of temperature would involve *both* masses. Supposing the increment is due to molecular or other agitation of m due to radiation in my case, in his case there would be an enormously greater agitation in m due to direct rise in temperature. I see no reason why this should not be one hundred times as great as the effect due to radiation. The weighted mean formula was used to account for the effects observed when *either* mass is heated. The case when *both* masses are heated is different, and has not been at present considered, the data at hand being indirect and inconclusive.

The probable result from my experiments is $\alpha=+(1{\cdot}2\pm0{\cdot}05)\times10^{-5}$, or, as amended recently at Newcastle, $\alpha=+(1{\cdot}3\pm0{\cdot}05)\times10^{-5}$. Thus, while individual results differ among themselves, in some cases, by as much as the whole effect, yet the collective result is not weak.

I wish to express my appreciation of the generous terms used regarding my experiments by the authors.

P. E. SHAW.

University College, Nottingham, December 13.

THE USE OF METEORITIC IRON BY PRIMITIVE MAN.

METEORITES, as they reach our planet, are of three different kinds, namely, *siderites*, composed chiefly of nickel-iron; *aerolites*, composed chiefly of stony matter; and *siderolites*, composed of a mixture of iron and stone. The first and third only are of interest to us in this inquiry.

Great diversity of opinion has always prevailed among archæologists concerning the source of iron used in antiquity before it was intelligently produced from the ore. On the whole these opinions are about equally divided, though perhaps the majority are inclined to the verdict that meteoritic iron was *not* used by primitive man, for the following reasons:—First, because nearly all iron implements of antiquity extant, at least from the Old World (including the piece found in the Great Pyramid of Cheops), are of terrestrial origin; secondly, because it was believed to be non-malleable; thirdly, because it was said to be too scarce; and fourthly, because it was argued that small fragments could not have been detached from meteoritic masses by the means available to primitive man.

There is, to the casual observer, a great deal of truth in these four arguments, and they prove that there were several sporadic sources from which the early iron was drawn; perhaps in one locality they were chiefly terrestrial, while the use of extra-terrestrial or meteoritic iron predominated in other localities.

The fact that iron, in the earliest ages and from whatever source, was extremely rare is beyond all doubt. One might say that it was at least as rare as, and perhaps more valuable than, gold. It might therefore be asked: If meteoric iron was so rare and valuable, why was it not more carefully preserved by the people of antiquity? For, whereas we have plenty of gold objects of ancient workmanship in our museums, those of meteoritic iron are conspicuous by their absence. To this we may safely reply that the value of the meteoritic iron lay in its actual employment in the form of tools, implements, and weapons, and to have hidden such objects in treasure stores would have nullified their value, and that is one reason at least why so few were preserved. This disposes of argument number one.

We must bear in mind also that in the New World this argument does not apply with the same force, as we shall see that objects of meteoritic iron are not so rare there as in the Old World. The reason for this is that, whereas iron was produced in the Old World from the ore more than three thousand years ago, it was not introduced into the New World until the discovery of that continent about four hundred years ago, and it is obvious that objects more than three thousand years old have become rarer in our day than those comparatively new ones of only four hundred years ago.

A paper on this subject was contributed by the present writer at the autumn meeting of the Iron

and Steel Institute. One of the principal features of this paper is a table including practically all known falls of meteoritic iron, their original weight, whether malleable (that is, suitable for being wrought into objects of utility) or non-malleable (not suitable for such purposes). This table was compiled with the object of removing all doubt concerning argument number two. The *résumé* of this table gives us the amount of meteoritic iron known at the present day—about 250 tons. Of this total the very considerable amount of more than 99 per cent. is malleable. Since this considerable mass of approximately 250 tons has been accumulated practically within the last century, we might dispose of argument number three, concerning the scarcity of meteoritic iron.

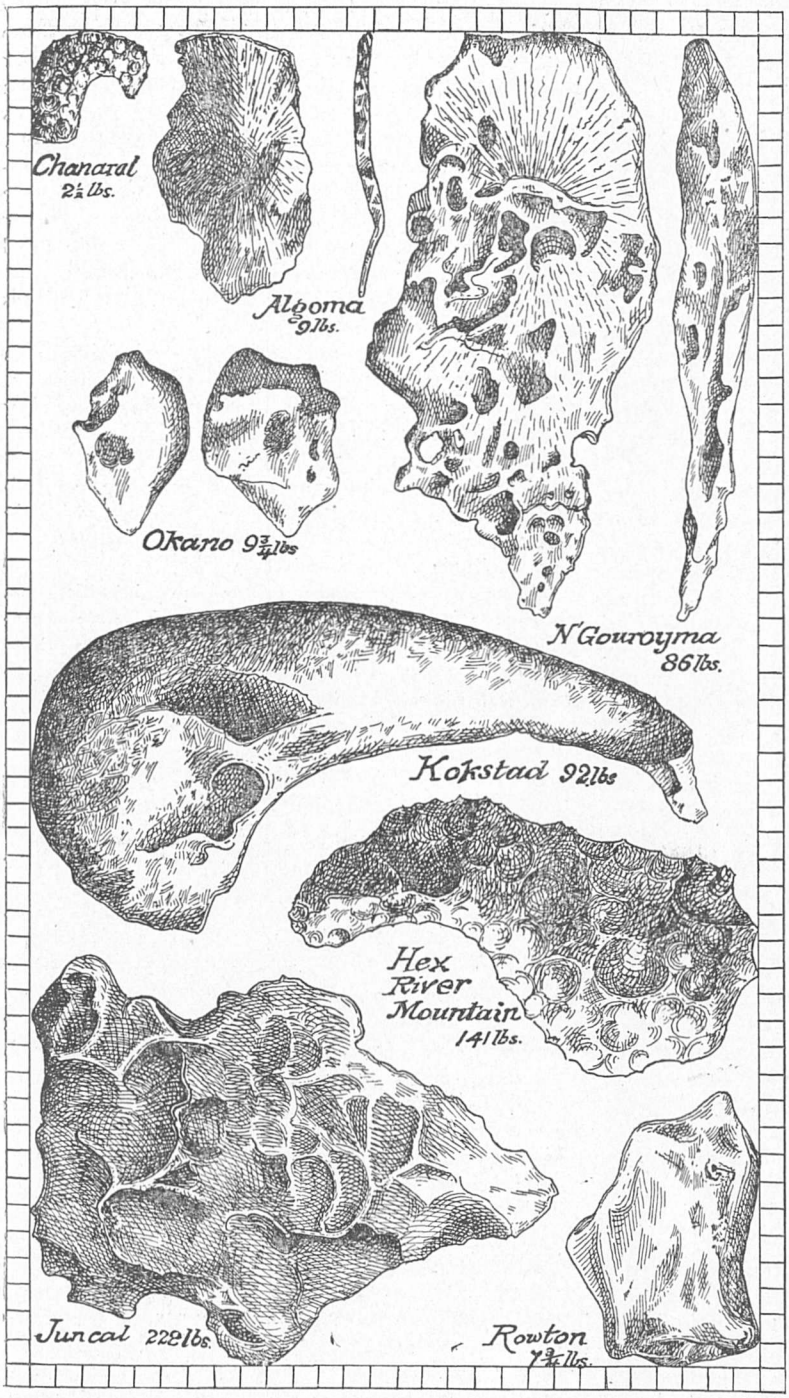


FIG. 1.—A number of iron meteorites showing their fragmentary form, from which it will be seen that some might be used entirely to form weapons and implements, whilst the protuberances of others might be cut off by primitive implements in order to form other weapons. Algoma, N'Gouroyma, and Okano are shown in two views each. Rowton is the only British specimen known; it fell near Wellington, Shropshire, on April 20, 1876. These meteorites are all drawn to the same scale, each square surrounding the illustration representing 1 in.

This *résume* cannot be surprising, as meteoritic iron is, generally speaking, pure iron-nickel alloy, such as we are now producing artificially; and the latter is certainly ductile and malleable.

The general appearance of the majority of meteorites gives one the impression that they were fragmentary, and suggests that they formed portions of larger masses. A single fall might spread over a considerable area, and it is obvious that many masses of known falls must thus be difficult to find, or be lost, particularly such smaller pieces as might be wrought into useful objects.

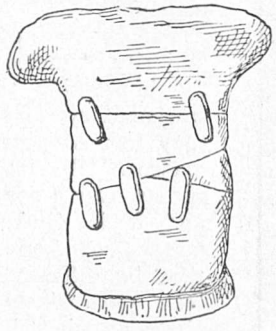
The accompanying illustration (Fig. 1) shows the fragmentary form of a few masses of meteoritic iron, from which we see that it is not like a cannon-ball, as is frequently supposed, and that it should not be so very difficult to sever such fragments. This disposes of argument number four.

Meteoritic iron was cut by the ancients in the same way as they cut pieces off the large masses of native copper found on the banks of Lake Superior, though it is not of course suggested that iron can be cut as readily as copper. When Cortez completed the conquest of Mexico the Spaniards noticed that the Aztecs possessed knives, daggers, etc., made of iron, and the question as to whence they had procured this iron became a perplexing problem to the Spaniards, which they were never able to solve. When asked, the natives mysteriously pointed to the sky, and indicated that they obtained their iron from the regions above. It was left to science to unravel the mystery. The

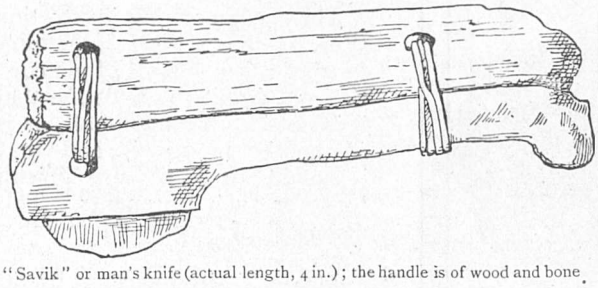
Aztecs were quite correct; the iron of which they had made their implements had come to them from the unknown regions of space, and was, in fact, of meteoritic origin.

Others, including Eskimos, certain Indian tribes, and the inhabitants of Yakutsk, in Eastern Siberia, used weapons and implements of meteoritic iron.

It would be impossible to mention here, even briefly, all the numerous meteorites of note which have fallen from time to time since the very earliest days. We may mention, however, in passing, the large meteorite which fell in the time of Pindar, 403 B.C., at Ægos Potamos, which is recorded in the Parian Chronicle, engraved in marble; and the stone at Orchomenos, of which Pausanias says that it fell from heaven before the siege of Troy, and during the reign of King Eteocles. Many falls are also mentioned by Pliny. Livy alone mentions twenty-one falls



"Oodoo" or woman's knife; the handle is of ivory.



"Savik" or man's knife (actual length, 4 in.); the handle is of wood and bone.

FIG. 2.—Ancient Eskimo knives made from the Melville Bay meteorite found by Rear-Admiral R. E. Peary.

in fifty-one years which fell during his lifetime. Another meteorite of note is the stone in the Kaaba, the most sacred jewel of Islam, called "The right hand of God on earth," which was probably worshipped formerly at the temple sacred to the Moon that used to stand in Mecca. These few examples will show how well it was understood in antiquity that meteorites came from an extra-terrestrial source; this is also the reason why, in practically all the languages of antiquity, iron is called "metal of heaven." The author believes that the very word *metal*, from the Greek verb *metallao*—"to search diligently for other things"—has reference to the diligent search which had to be made by the people of antiquity for meteoritic iron, being the "other things" more coveted by them than their usual raw material, namely, stones.

If we compare the mention of meteorites in ancient and modern literature, it would almost seem that meteorites were more plentiful in olden times; for we must bear in mind that when primitive man used iron first, he used it most probably in the same way in which he used copper 8000 B.C.—that is, for pins and needles, and such other objects in which, for instance, small flakes of iron could be inserted in bone handles, like the knives and other implements of the Eskimos (Fig. 2). Where larger masses were used they were probably employed in the same way and form as stone axes and adzes with the haft tied on. Better chisels and knives were probably not made until experience had been gained in the making of needles and pins, and after the use of the smith's fire was understood.

In conclusion we may say that primitive man before 1200 B.C. used iron more or less sparingly, which iron was obtained from the following sporadic sources:—

(*a*) Iron meteorites.

(*b*) Chance productions by a camp fire, a flash of lightning, a forest fire, or through volcanic agency.

(*c*) Telluric or native iron.

We thus see that in using the nickelliferous meteoritic iron primitive man had the advantage of a metal that was not available to modern man until 1809, which is the approximate date at which nickel steel was first manufactured in the modern steel industry. G. F. ZIMMER.

SURVEY WORK IN THE SINAI PENINSULA.[1]

IN the latest volume of the Egyptian Survey Dr. John Ball describes the geology and geography of an oblong district about 380 square miles in extent, the south-west angle of which rests on the Gulf of Suez, the northern part of it including some of the Gebel el Tih. This is an intensely dissected limestone plateau of about Cretaceous age, rising to nearly 4000 ft., with northward-facing scarps. South of this comes an undulating sandy upland, about 1600 ft. above the sea, and then (forming about half the district) a highly eroded mountain tract, the highest point of which, Serabit el Khâdim, reaches 3596 ft.

This tract consists mainly of crystalline rocks—gneisses, granites, diorites, and porphyries—probably Archæan, capped in places with sedimentaries. Of these the oldest are two sandstones, parted by a limestone, which represent the Carboniferous system, and the latter is shown by its fossils to be homotaxial with the Mountain Limestone in the North of England. The Nubian Sandstone, some 2000 ft. in thickness, which is, roughly speaking, Cenomanian in age, succeeds the upper of these sandstones without any marked break, and its lower part, as it is almost unfossiliferous, may represent something older. In one district, however, it includes carbonaceous

[1] "Survey Department, Egypt. The Geography and Geology of West-Central Sinai." By John Ball, Ph.D., D.Sc., etc. Pp. xi+219+xxiv plates and 54 illustrations in the text. (Cairo: Government Press.) Price P.T. 30.

shale and a thin seam of coal, neither being of any value. The remainder of the Cenomanian, above the Nubian Sandstone, contains many fossils, and includes some beds of oil-bearing marls, not, however, valuable. The limestones above these represent the Turonian and Santonian, but are not nearly so rich in fossils as the underlying beds. Eocene strata succeed, chiefly clays, and to them sandy clays and grits representing the Miocene, both being fossiliferous; the coastal deposits are Pleistocene and Recent. The rather frequent dykes and sheets of basalt are probably Miocene, to a later part of which belong the numerous faults. In the neighbourhood of these the strata are often much tilted, but otherwise are not far from horizontal. In one district occur associated ores of iron and manganese, which are now being worked.

The climate is temperate, dry, and very healthy.

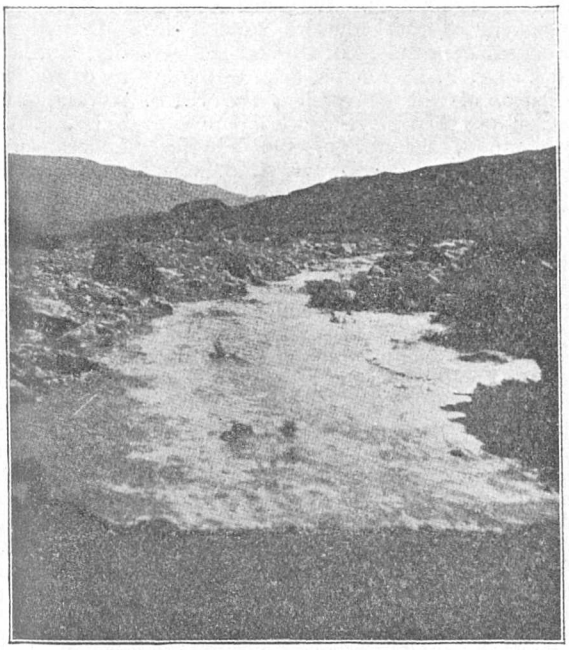


FIG. 1.—View of the "Seil" in Wadi Abu Qâda, February 14, 1913. From "The Geography and Geology of West-Central Sinai."

In winter the frequent north winds cause sharp frosts in the higher districts, but on the coastal lowlands it is often warm and misty. The rainfall is very slight, generally not more than an inch in a year. But a heavy rainstorm may occur every four or five years, when the water, running rapidly off the steeply sloping sides of the valley, gives rise to a sudden flood which sweeps everything before it. Dr. Ball was fortunate enough to secure a photograph showing the front of one of these torrents, of which Fig. 1 is a reproduction. One such flood in 1867 swept away an Arab encampment in Wady Soláf, drowning forty persons, with many camels, sheep, and cattle. But at other times the only sculpturing agents are wind-blown sand and strains set up in rock surfaces by changes of temperature, both, as Dr. Ball describes, of considerable importance. But it is scarcely possible that the deeply carved valleys can be the result of existing conditions; probably they were produced when the rainfall was much greater, its later part corresponding with an age of ice in our own islands, when a great lake occupied the Jordan valley.

There is, as a rule, little vegetation or animal life. Of what is found Dr. Ball gives particulars. In short, we are indebted to him for a very full and clearly written account of the geology, geography, and natural history of this part of the Sinai Peninsula, the value of which is enhanced by many illustrations—photographs of scenery, drawings of fossils, and a coloured geological map. Both he and the Survey may well be congratulated, especially in existing circumstances, on the publication of so excellent a memoir.

T. G. BONNEY.

THE PHYSIOLOGY OF FATIGUE.

ONE effect of the war has been to increase the strain thrown upon industrial workers as a result of longer working hours and insufficient holidays, and efforts are being made not only to counteract the ill-effects of extreme physical fatigue, but also to devise means for the recognition of fatigue and to study the conditions under which it occurs. The latter aspect of the question is dealt with by Prof. Kent in a report on industrial fatigue recently issued by the Home Office.[1] For this purpose Prof. Kent employed as tests of the occurrence of fatigue, in the first place, alterations in the length of the reaction time and in the visual and auditory acuity of the worker, and, in the second place, the influence of overtime upon the actual output of the worker. A number of workers were examined, the observations in some cases extending over several weeks.

The general conclusion drawn from the inquiry is that overtime—that is to say, a longer working day—leads to increased fatigue, this being manifested both by the physiological tests employed and by its effect upon the efficiency and output of the worker. The evidence furnished by the physiological tests is, however, quite unconvincing; not only do the figures obtained by these tests vary enormously from day to day, but in some instances the tests indicate that the workers are less fatigued in the evening than in the morning, and less tired after a long working day than after a short day. Further, the purely subjective character of these tests renders them liable to be influenced by many causes other than fatigue, and they appear to have little or no value as an index of general fatigue.

The observations on the effect of overtime upon the daily output of work are of interest because, in some instances, the output of the same workers was noted during weeks when overtime was worked and during weeks when no overtime was worked; the total output was unaffected

[1] Second Interim Report on an Investigation of Industrial Fatigue. By Prof. A. F. Stanley Kent. [Cd. 8335.] (Issued by the Home Office.) price 1s. 6d.

or even lessened by lengthening the working day. The author does not take into consideration, however, the view, now becoming recognised, that a worker with a long day before him tends, consciously or unconsciously, to conserve his energy and to distribute it uniformly throughout the day. It is not improbable, indeed, that the ill-effects of unduly long working hours may be not so much the direct result of a greater expenditure of energy as the indirect result of shortening of the time available for leisure and recreation.

NOTES.

LONG lists of New Year honours—mostly conferred for services rendered in connection with military or naval operations—were published on Monday. We notice in these lists the following names and distinctions:—*K.C.S.I.*: Sir Francis E. Younghusband, the distinguished traveller and geographer; Maj.-Gen. R. C. O. Stuart, Director-General of Ordnance in India. *C.I.E.*: S. M. Burrows, secretary to the Oxford Delegacy for Oriental Students; P. J. Hartog, lately secretary to departmental committees on the organisation of Oriental Studies in London. *Kaisar-i-Hind Medal for Public Services in India, First Class*: Sir F. A. Nicholson, Honorary Director of Fisheries, Madras; and Dr. H. H. Mann, principal, Agricultural College, Poona, and agricultural chemist, Bombay. The following medical men are among those on whom honours are conferred for services in the field:—*K.C.B.*: Surgeon-General H. R. Whitehead. *C.B.*: Col. J. M. Irwin, Col. R. L. R. Macleod, Col. G. Cree, Col. A. A. Sutton, Col. G. H. Barefoot, Temp.-Col. T. Sinclair, Lieut.-Col. E. T. F. Birrell. *K.C.M.G.*: Col. M. P. C. Holt. *C.M.G.*: Col. T. Daly, Col. W. L. Gray, Col. F. R. Newland, Col. H. T. Knaggs, Col. H. I. Pocock, Col. B. H. Scott, Col. R. W. Wright, Col. T. Du Bedal Whaite, Col. F. J. Morgan, Temp.-Col. T. C. English, Lieut.-Col. A. R. Aldridge, Lieut.-Col. J. D. Ferguson, Lieut.-Col. F. H. Withers, Lieut.-Col. F. R. Buswell, Lieut.-Col. L. F. Smith, Lieut.-Col. F. A. Symons, Temp.-Lieut.-Col. G. M. Holmes, Temp.-Lieut.-Col. H. L. Eason.

WHEN the Germans introduced the use of poisonous gases into warfare, immediate steps were taken by our military authorities to provide the troops with means of protection from them, and action was taken later to organise offensive as well as defensive measures. The matter was put into the hands of leading chemists, physicists, and physiologists, with the result that our gas attacks are now more effective than those of our enemies. Field-Marshal Sir Douglas Haig, Commanding-in-Chief the British Forces in France, makes the following reference to this subject in his despatch dated December 23, 1916:—"The employment by the enemy of gas and of liquid flame as weapons of offence compelled us not only to discover ways to protect our troops from their effects, but also to devise means to make use of the same instruments of destruction. Great fertility of invention has been shown, and very great credit is due to the special *personnel* employed for the rapidity and success with which these new arms have been developed and perfected, and for the very great devotion to duty they have displayed in a difficult and dangerous service. The Army owes its thanks to the chemists, physiologists, and physicists of the highest rank who devoted their energies to enabling us to surpass the enemy in the use of a means of warfare which took the civilised world by surprise. Our own experience of the numerous experiments and trials necessary before gas and flame could be used, of the great preparations which had to be made for their manufacture, and of the special training required for the *personnel* employed, shows that the employment of such methods by the Germans was not the result of a desperate decision, but had been prepared for deliberately. Since we have been compelled, in self-defence, to use similar methods, it is satisfactory to be able to record, on the evidence of prisoners, of documents captured, and of our own observation, that the enemy has suffered heavy casualties from our gas attacks, while the means of protection adopted by us have proved thoroughly effective."

THE Canadian Government has appointed an honorary advisory council on scientific and industrial research to advise a committee of the Cabinet on all matters relating to scientific and industrial research, with the view of securing the united efforts of scientific workers and industrial concerns, and of selecting the most pressing problems indicated by industrial necessities to be submitted to research institutions and individuals for solution. We learn from *Science* that the members of this advisory council are:—Dr. A. S. Mackenzie, president of Dalhousie University, Halifax, N.S.; Dr. F. D. Adams, dean of the faculty of applied science, McGill University; Dr. R. F. Ruttan, professor of chemistry, McGill University; Dr. J. C. McLennan, director of the Physical Laboratories, University of Toronto; Dr. A. B. Macallum, president of the Royal Society of Canada, University of Toronto; Dr. W. Murray, president of the University of Saskatchewan, Saskatoon; Mr. R. Hobson, president of the Steel Company of Canada, Hamilton, Ont.; Mr. R. G. Ross, consulting electrical engineer, Montreal; and M. Tancrède Bienvenu, manager of La Banque Provinciale, Montreal. The question of co-operation between the scientific men of the country and industrial concerns with the view of solving the problems raised by the war and of placing the industrial resources of the country in a position to meet the conditions that will arise after the war has been under consideration by the Government and by representatives of science and industry for some time, as it was felt to be desirable to follow the example of the British Government in this matter. In a memorandum Sir George E. Foster, Minister of Trade and Commerce, has pointed out "the urgent need of organising, mobilising, and economising the existing resources of scientific and industrial research in Canada with the purpose of utilising waste products, discovering new processes—mechanical, chemical, and metallurgical—and developing into useful adjuncts to industry and commerce the unused natural resources of Canada."

METEOROLOGY has lost one of its most ardent supporters by the sudden death of Mr. William Marriott at Dulwich on December 28. He was sixty-eight years of age, and throughout his life had been remarkably free from illness, but latterly heart trouble had developed. Mr. Marriott commenced his meteorological work at Greenwich Observatory in January, 1869, and he left the observatory at the end of 1871. Whilst at the Royal Observatory he was in the magnetic and meteorological department under Mr. James Glaisher, F.R.S., who was very actively associated with the Meteorological Society. Mr. Marriott became assistant-secretary to the Meteorological Society in 1872, and he maintained the position until his retirement in September, 1915, after forty-three years' service. He had become a member of the society whilst serving at Greenwich, in 1870. The science of meteorology has steadily developed during the last half-century, and Mr. Marriott, in his official capacity, took the keenest

interest in furthering its advancement. From 1881 to 1911 he edited the *Meteorological Record*, which contained the monthly results of meteorological observations over England and Wales. For climatological questions the *Meteorological Record* has afforded material of great value. Since 1911 this work has been taken over by the Meteorological Office. Mr. Marriott was the author of "Hints to Meteorological Observers," a work which constitutes instructions for taking observations, also "Some Facts about the Weather." He was a frequent writer for the Quarterly Journal of the Royal Meteorological Society, his contributions dealing with many and very varied subjects.

LIEUT.-COL. SIR FREDERIC S. EVE, who died on December 15, in his sixty-third year, was at one time senior surgeon to the London Hospital. In the earlier part of his career, while acting as curator of the museum of St. Bartholomew's Hospital and pathological curator to the museum of the Royal College of Surgeons of England, he investigated certain obscure forms of tumour which are apt to occur in the jaws, and cleared up their nature. He published several investigations on tuberculosis and other diseases of bones and joints. In 1915 he gave the Bradshaw lecture at the Royal College of Surgeons on "Hæmorrhagic and Chronic Inflammation of the Pancreas."

ON November 27 the Finnish entomologist, Dr. B. R. Poppius, died at Copenhagen, where he was acting upon the Norvego-Swedish Committee on the Grazing-grounds of Reindeer. He was only forty years old.

THE death is announced, in his eightieth year, of Dr. J. Little, Regius Professor of physic, Dublin University, and a past-president of the Royal College of Physicians, Ireland, and of the Royal Academy of Medicine, Ireland.

THE Royal Swedish Academy of Science has elected as foreign members Sir William Crookes, O.M., Dr. C. A. Angot, director of the Bureau Central Météorologique de France, and Prof. August Gärtner, professor of hygiene, University of Jena.

IT is announced that the Welsh National Museum Committee has received a gift of 20,000*l.* from anonymous donors, and that this will enable the committee to complete the building contract.

CAPT. CHARLES BATHURST, M.P., has, on becoming Parliamentary Secretary to the Ministry of Food, relinquished the post of organiser of the Land Settlement Scheme for ex-Service Men which he has held under the Board of Agriculture and Fisheries in an honorary capacity for the last eight months. The duties have been taken over by Sir Richard Winfrey, M.P., Parliamentary Secretary to the Board of Agriculture and Fisheries.

THE Massachusetts Horticultural Society has awarded its George Robert White medal to Mr. W. Robinson, of Gravetye Manor, Sussex, for his eminent services in the advancement of horticulture.

IT is announced in the issue of *Science* for December 15 last that a bequest of more than 20,000*l.* has been left to the American Museum of Natural History by the late Mr. James Gaunt, American representative of Messrs. A. and F. Pears, of London. The bequests are to be paid upon the death of Mr. Gaunt's brother.

THE Optical Society has arranged an exhibition of workshop methods of optical testing to be held at King's College, Strand, on Thursday, January 11, from 5 to 9.30 p.m.

THE Alvarenga prize of the College of Physicians of Philadelphia will be next awarded on July 14 of this year. It will be of the value of about 50*l.* Competing papers may deal with any medical subject, but they must not have been already published. They must reach the secretary of the college on or before May 1. Further particulars are obtainable from Dr. F. R. Packard, 19 South 22nd Street, Philadelphia, Pa., U.S.A.

A METEOR of unusual brilliance is reported to have been seen at Churchstoke, in Montgomeryshire, about 5.30 p.m. on December 19 last. It crossed the sky from south to north, and is said to have been "accompanied by a slight explosion." Many people were alarmed by the brilliance of the object, which lighted up the whole countryside.

THE report of the council of the Scottish Meteorological Society, read at the general meeting of the society on December 15, states that the encouragement of rainfall observation in Scotland has been kept steadily in view, and that there are now available in the journal monthly and annual returns for fully 750 stations. There are still, however, large areas in the North of Scotland for which information is either extremely scanty or entirely wanting. The officers and members of the council for the ensuing twelve months will be as follows:—*President*, Prof. R. A. Sampson; *Vice-Presidents*, Dr. A. Crichton Mitchell and Mr. M. M'Callum Fairgrieve; *Council*, Mr. J. Watt, Sir R. P. Wright, Prof. T. Hudson Beare, Dr. J. D. Falconer, Mr. J. Mackay Bernard, Mr. D. A. Stevenson, Mr. R. Cross, Mr. S. B. Hog, and Mr. G. Thomson; *Hon. Secretary*, Dr. E. M. Wedderburn; *Hon. Treasurer*, Mr. W. B. Wilson.

THE American Forestry Association has called a conference, to be held at Washington on January 18–19, to discuss measures for saving the white pine forests of North America from being destroyed by the blister rust. The Governors of all the States in the white pine belt, and the Government of Canada, are invited to appoint delegates. The disease came from Germany in 1907, when the Forestry Bureaux of several States imported thousands of seedlings and transplants from the nurseries of that country. That they were thus affected was not discovered until many of the trees had been set out, and only during the last year did the disease attain dangerous proportions. The blister rust is described as a fungous growth, which lives one year in the white pine and the next in currant and gooseberry plants. It cannot spread from pine to pine, but travels from pine to ribes and from ribes to pine. In the ribes it appears in the form of raised reddish-brown patches on the under-side of the leaves. In the pine it is more difficult to recognise, and can only be discovered by a scientific expert during the "fruiting period" in the spring, when the base of small trees just above the ground shows a yellowish growth of fungus and is often itself swollen. At present the only effective method of saving the pines that has been suggested is to root out all ribes in the neighbourhood of the forests—a costly remedy in some parts of New York State, where the farmers raise large crops of currants and gooseberries. Mr. G. D. Pratt, the New York State Conservation Commissioner, has announced that no more white pines will be seeded until it has been found what can be done.

IN the *American Museum Journal* for November Mr. M. D. C. Crawford discusses the value of design and colour in ancient fabrics to the manufacturer of our day. The Philadelphia Museum has recently obtained a collection of textiles from Peruvian graves which are believed to antedate the Spanish Conquest by some 2000 years. They are said to contain some of the most

wonderful colour combinations in any fabrics hitherto known. Compared with them, we are told, "the Coptic fabrics represent a very limited development, and even the interesting cloths recently excavated in Turkestan by Sir Aurel Stein are but a fragmentary record of the art they represent. In Peru every process of decoration of which we know is found, every trick of the weaver's art, every skilful blending of colours. Nor is this a record of scattered fragments. Even the rarer techniques are well represented, and there is enough material to furnish inspiration for a century of design." The article contains good photographic reproductions of these interesting fabrics.

DR. W. E. ROTH contributes to the thirtieth annual report of the Bureau of American Ethnology a comprehensive paper on the animism and folklore of the Guiana Indians, of which the best hitherto known accounts are those of Brett, im Thurn, and Wallace. He finds no evidence of a belief in a Supreme Being, but the Spirits of the Bush are held in great respect. He describes a remarkable Carib String Puzzle, designed to deceive these Bush Spirits, the object being to remove, without cutting or breaking, an endless string from two sticks upon which it has been placed. If an Indian loses his way in the forest, the Spirit is the cause. So he leaves this puzzle on a pathway, and the Spirit, passing by, sees it, starts examining it, and tries to get the string off. So engrossed does he become that he forgets all about the wanderer, who is now free to find the road again. Brett describes an analogous case of a boy on the Lower Amazon, who, in order to protect himself from the Curupari, took a young palm-leaf, plaited it, and formed it into a ring, which he hung on a branch in the track of the party.

THE American Museum of Natural History, New York, continues to make good progress with the preparation and study of the remarkable Dinosaurians discovered in the Upper Cretaceous fresh-water deposits of Alberta, Canada. In the latest *Bulletin* (vol. xxxv., art. 38) Mr. Barnum Brown describes perhaps the strangest of the Trachodonts, *Corythosaurus casuarius*, which is a reptile about 20 ft. long, shaped much like the familiar Wealden Iguanodon, but with a high, rounded, bony crest along the top of its head. One well-preserved skeleton is covered with remains of the skin, proving that it did not bear any bony armour. The whole body must have been invested with small epidermal tubercles, which are without any definite pattern over the sides, back, and tail, but are partly modified into rows of larger limpet-shaped tubercles over the ventral surface. If these herbivorous Dinosaurs had any marked external features, it is now clear that they must have been due to colour rather than to special developments of the skin itself.

PROF. S. W. WILLISTON, of the University of Chicago, continues his important researches on the osteology of American Permian reptiles, and has just published a useful synopsis of all the American Permo-Carboniferous Tetrapoda (Contributions from the Walker Museum, vol. i., No. 9). The various families are defined, and the diagnosis of each genus is accompanied by a statement as to the parts of the skeleton by which it is known. There is still much difficulty in defining and naming the higher groups, owing to the discovery of intermediate forms and the imperfection of the fossils on which the nomenclature was originally based. It becomes, indeed, continually more evident that the Permo-Carboniferous Tetrapoda are the generalised forerunners of several later groups which soon became very distinct. Prof. Williston's work is illustrated by numerous excellent figures, from which it is possible to realise how many of these strange ancestral land animals are now known by nearly complete skeletons.

THE Carnegie Institution of Washington has just published an important monograph of the Coal Measures Amphibia of North America, by Dr. Roy Lee Moodie (Publication No. 238). It is a most exhaustive work, sumptuously illustrated, and not only adds much to our knowledge, but also provides a synopsis which will form a useful basis for future researches on the rare fossils with which it deals. The technical and descriptive part of the monograph is preceded by a historical sketch, notes on the localities whence the fossils were obtained, and a general chapter on the anatomy of the group. Many forms were discovered by the late Sir J. William Dawson in decayed tree-stumps in the South Joggins coalfield, Nova Scotia, but the author remarks that no geologist appears to have collected in this locality during recent years. Other specimens in ironstone nodules from Mazon Creek, Illinois, are so beautifully preserved that the black pigment of the choroid can be seen in the orbit, and the course of the alimentary canal may be traced in the trunk, arranged almost exactly as in a modern salamander. The whole of the ossified skeleton is well known in many families, and dermal scales occur in several genera of the Branchiosauria and Microsauria. There is remarkable uniformity in the structure of all these early four-footed animals, notwithstanding the numerous variations in general outward shape and the relative proportions of parts. Some are even so much specialised as to have lost their limbs and become snake-like.

WHILE some animals exhibit wide powers of accommodation to their environment, and hence are numerically abundant, others display very limited responses in this regard, and hence are restricted in numbers. This is well illustrated by Miss Maud Haviland in *British Birds* for December, in the course of a brief but illuminating account of her observations on Temminck's stint, made during her stay at Golchika, on the estuary of the Yenisei. For miles along the river bank not a specimen would be seen, but it was abundant wherever running water and dwarf willow were found in association. Similarly, she found the little stint, *Tringa minuta*, breeding near running water only when this occurred in association with a sphagnum swamp. During the pairing season Temminck's stint gives utterance to a long-sustained trilling, which "is musical enough to deserve the name of song." It is "louder and less mechanical than the note of the grasshopper warbler, more musical than the whir of the fisherman's reel, and may be likened more truly to the croaking of many natterjack toads in chorus." This song is heard at its best when the bird hangs suspended some 40 ft. in the air, but it is also uttered while it is perched on a tree-trunk or on a block of ice. But on such occasions the trill is less perfect.

THE new part of the Proceedings of the Prehistoric Society of East Anglia (vol. ii., part ii.) contains several papers on flint implements illustrated in the usual effective manner, besides two important discussions of the wider problems of British late Tertiary geology. Mr. A. E. Peake, in a presidential address, returns to the subject of Grime's Graves, and after describing and figuring a considerable number of newly discovered implements from these old flint mines, reiterates his opinion that they are all of Palæolithic type. He thinks their date would never have been doubted had they not been associated with a mine and a recent fauna. Mr. W. J. Lewis Abbott, in a rather discursive paper, claims that both marine

and fresh-water deposits of Pliocene age are much more widely distributed in south-east England than is commonly supposed to be the case. The late Mr. Charles Dawson's discovery of rolled remains of Pliocene mammals at Piltdown makes it especially desirable to re-examine all the superficial deposits in the Wealden area. Mr. A. S. Kennard contributes an important summary of the results of his long-continued researches in English Pleistocene geology. He concludes that there is no evidence of more than one glacial period, which occurred towards the close of the Pleistocene, and is represented near London by the Ponders End arctic bed. He is also of opinion that before the end of Pliocene times man was already in the Palæolithic stage of culture in this country.

THE recently published Bulletin of the Imperial Institute (vol. xiv., No. 3) contains a brief but highly interesting description of the new Udi-Okwogu coalfield of Southern Nigeria, which is now being energetically developed. It lies immediately to the east of the River Niger, and has been opened by means of a railway line running northwards from Port Harcourt, which has already reached the coalfield and is being continued. The coal is of Cretaceous age, and a number of seams, up to six in the Udi district, have been proved; four of these are considered workable, with thicknesses ranging from 2 ft. to 5 ft. 8 in. The coal is semi-bituminous, and contains a high proportion of volatile matter, averaging about 40 per cent. on the ash-free coal. The percentage of ash varies within very wide limits; in many of the samples it is between 4 and 8 per cent., but is very much higher in some of the others; the coal is everywhere of a non-coking character. The calorific power is, of course, variable, but not very high as a rule, most of the samples giving 6000 to 7000 calories. A certain amount of development work has already been done, the quantity produced up to the end of 1915 having been 7812 tons. It is unnecessary to point out that this discovery is of the highest economic importance, and will necessarily prove to be a factor of the utmost value in the industrial development of our West African Colonies.

AN informing lecture on the subject of "The British Coal-Tar Colour Industry and its Difficulties in Time of War" was delivered at the Society of Arts on December 8 by Mr. C. M. Whittaker, head of the experimental dye-house of British Dyes, Limited. The lecturer replied to the criticism directed at British dye-producers for not assisting dye-users with pattern cards and expert advice in dye practice by referring to the manual of dyeing issued in five languages so far back as 1906 by Messrs. Read Holliday and Sons, Ltd. He also pointed out the difficulty of producing dyes of well-known constitution owing to the circumstance that the primary coal-tar products essential in this manufacture are required for the production of high explosives. In war-time the first duty of the coal-tar industry is to furnish the munitions of war, after which the next important task is the production of colours needed for the military and naval equipments of the British, Colonial, and Allied Governments. That these requirements have been satisfied is a great achievement, which should be remembered by the private dye-users, whose demands necessarily take a third place. The lecture deals with other shortages of raw materials, and shows how very promising has been the progress of the British dye industry in spite of these numerous handicaps. Notwithstanding all these adverse circumstances, the shares of leading colour-consuming companies in this country have appreciated considerably during the war, and the dyeing trade has never been so prosperous. Continued progress depends on the highly trained chemist, and research is now being organised on a scale never before attempted in Great Britain. One of the first-fruits of this endeavour is the production of chloranthrene-blue, made by British Dyes, Limited. In the discussion, the chairman, Sir William Tilden, referred to the encouraging outlook to be derived from the lecture. In replying to various questions the lecturer stated that bromine was the only product for which we should have to depend on Germany. The dye-makers had now mended their ways in regard to teaching institutions, and the grant of 5000*l.* for dye research by British Dyes, Limited, to the Huddersfield Technical College was a practical proof of this. As regards khaki dyes, the British productions were equal in fastness to any dyes made abroad.

IN 1913 the Rubber Research Committee in Ceylon, in co-operation with the Department of Agriculture in the Colony, started a scheme of research work, to be carried out partly on plantations in the island and partly at the Imperial Institute in London. The work in Ceylon includes the preparation of rubber in various ways and under different conditions, with the view of ascertaining the effect of the several factors on the quality of the rubber. The samples so prepared are sent to the Imperial Institute, where they are chemically examined, vulcanised, and their mechanical properties determined. Some results of this work are described in Bulletins 23 and 24, issued recently by the Department of Agriculture in Ceylon, which contains a number of interim reports from the Imperial Institute. It appears from these reports that as regards tensile stress required to rupture and elongation at the point of rupture, well-prepared Ceylon plantation rubber is in no way inferior to "fine hard Para" rubber from Brazil. The variability in properties of plantation rubber of which manufacturers have complained appears to be limited to the "time of vulcanisation," which, according to these reports, may vary within wide enough limits to cause trouble in the smooth working of a factory. The cause of this variation is being systematically sought by a careful study of the effects of various coagulants, "improvers," mechanical treatment, etc., employed in the process of preparation, on the working quality of the rubber, and especially on its "time of vulcanisation." Attention is also being given in Ceylon to the experimental tapping of Hevea trees. In Bulletin No. 25 Mr. Petch gives a further instalment of the results of this work, which has been in progress since 1912, and is designed to ascertain the difference in yield and the final effect on the trees of methods of tapping, which differ in the time interval allowed for resting the trees and in the spacing adopted between the tapping cuts. The results already obtained are of considerable interest, but do not permit of final conclusions being drawn.

THE practical value of the storm warnings issued by the Meteorological Department at Calcutta has twice been illustrated within the past two months, says the *Pioneer Mail* of December 2 last. Madras had due notice of the approach of the gale which visited it on November 29, the "Great Danger" signal having been hoisted a considerable time before the arrival of the storm. Similarly the hoisting of the "Great Danger" signal warned Calcutta of the approach of the storm of September 21, and the Committee of the Bengal Chamber of Commerce has publicly expressed its appreciation of the "usefulness and efficiency" of the work of the Meteorological Department on that occasion. "The warnings," it states, "were communicated to the public in good time before the storm actually broke, and proper precautions were consequently taken. The result was that the casualties to shipping were confined to a few launches and boats, no large vessels being sunk or damaged."

OUR ASTRONOMICAL COLUMN.

COMET 1915*a* (MELLISH).—A postcard from the Copenhagen Observatory gives the following ephemeris for comet 1915*a*, for Greenwich mean midnight:—

	R.A. h. m. s.	Decl. ° ′	Log Δ
Jan. 1	5 17 31	+43 4·1	0·7406
9	11 34	42 59·8	0·7502
17	6 28	42 51·8	0·7610
25	2 16	42 41·2	0·7726
Feb. 2	4 59 5	42 29·0	0·7848
10	56 53	42 16·2	0·7975
18	55 40	42 3·7	0·8103
26	55 23	41 52·0	0·8231
Mar. 6	4 55 59	+41 41·3	0·8357

The estimated brightness of the comet is from the 14th to the 15th magnitude. At the time of discovery, on February 10, 1915, the comet was of the 9th magnitude, and became visible to the naked eye during the following summer.

ROTATION AND RADIAL VELOCITY OF N.G.C. 4594.—At the Mount Wilson Observatory an ingenious device has been employed by Mr. F. G. Pease to facilitate spectroscopic investigations of motion in faint nebulæ (Proc. Nat. Acad. Sciences, vol. ii., p. 517). In this arrangement a silvered glass plate replaces the ordinary slit, and a slit is cut in the silver film at a place corresponding to each bright spot shown in a direct photograph of the nebula to be investigated, taken with the telescope to which the spectroscope is to be attached. The slits, of course, are chosen so as to prevent overlapping. For the comparison spectra another silvered plate is prepared, but with interrupted cuts, so that the central portions cover the parts previously exposed to the nebula when the comparison spectra are impressed. In view of the long exposures required, great economy of time is thus secured. Mr. Pease has successfully employed this arrangement on the spiral nebula N.G.C. 4594, for which a total exposure of eighty hours was given. It was found possible to determine the velocity at five places in the nebula, and the values are represented by the equation $y=-2{\cdot}78x+1180$, where y is velocity in km./sec. and x the distance from the nucleus in seconds of arcs. The radial velocity of the nebula is +1180 km./sec., while the rotational velocity at a point two minutes of arc from the nucleus is more than 330 km. Within the limits of error the rotational velocity increases linearly in passing from the nucleus, indicating that the nebula is rotating as a solid body, or, as seems more probable, that the material is moving in accordance with a law which will give a linear velocity curve. On certain suppositions the parallax would be 0·00013″. In observations of such exceptional difficulty it is satisfactory to find a close accordance with the velocity +1100 km. given by Slipher for this nebula.

THE COOKEVILLE METEORITE.—A recently found iron meteorite, from Cookeville, Putnam County, Tennessee, is described by G. P. Merrill in the Proceedings of the U.S. National Museum (vol. li., p. 325). The meteorite is obviously very old, and so much oxidised that its original form is greatly obscured. The weight before cutting was 2132 grams. A cut surface shows an unusual feature in its very regular octahedral coarse crystallisation. Practically the entire mass is made up of broad kamacite bands 2 to 6 mm. in width, between which lie very thin plates of taenite. The total iron, of which nearly 20 per cent. occurs as oxides, is 81 per cent., while nickel amounts to 6 per cent. in the metallic form and 1 per cent. as oxide. Cobalt, phosphorus, sulphur, and carbon are present in small quantities.

THE PYROGENESIS OF HYDROCARBONS.

THE growing demand for low-boiling paraffins for use as fuel, and aromatic hydrocarbons for the manufacture of dyes and other materials, is directing increased attention to the possibilities of their synthetic production from natural sources, namely, the higher-boiling paraffins, coal and shale. It is well known that the superheating of the higher-boiling paraffins causes them to break up, or "crack," into lower-boiling liquids, and the effect of temperature on the nature of the distillation products of coal has long been recognised.

In a paper read before the Institution of Petroleum Technologists on November 21 the authors, Messrs. E. L. Lomax, A. E. Dunstan, and F. B. Thole, brought together not only a valuable bibliography of the literature on the subject (part i.), but, in the latter section (part ii.), also discussed in a comprehensive way the scientific aspects of this obviously complex process, and the various theories advanced by different workers in this field of inquiry.

The earliest systematic study of "pyrogenic decomposition" (*i.e.* decomposition at high temperatures) of hydrocarbons was initiated by Berthelot, who regarded the change as due either to simple polymerisation or condensation with loss of hydrogen. Moreover, each change being reversible, at a given temperature an equilibrium was established between a complex series of decompositions, polymerisations, and condensations. Among the decomposition products acetylene was assumed to play an important *rôle* and to be the source more especially of aromatic hydrocarbons. Berthelot, in fact, obtained the latter by heating acetylene to a dull-red heat. Later observers have opposed this view on the ground that the presence of acetylene could not be demonstrated, and as an alternative suggested that hydrogen was first eliminated with the production of olefine and that the carbon chain was broken down atom by atom as methane.

From a careful series of experiments on the thermal decomposition of methane, ethane, ethylene, and acetylene by Bone and Coward, it appeared that acetylene was the source of aromatic hydrocarbons, and was derived from the decomposition of ethylene. This polymerisation of acetylene takes place at 600°–700°. At these high temperatures the "nascent radicals," CH≡, CH_2=, and CH_3—, are assumed to be formed, and either unite or, if hydrogen is present, undergo reduction.

The authors of the present paper proceed to discuss the possible changes which may occur based on thermochemical data, and point out that the reactions which proceed by absorption of hydrogen are in the main exothermic, and the products, therefore, relatively stable, whereas cracking or decomposition is mainly the result of endothermic change. Now, according to the law of Le Chatelier, an exothermic synthesis will, at a high temperature, tend to be reversed, and the same is true of increased pressure, the tendency here being to bring about, under increased pressure, that change which diminishes the total volume of gaseous products.

That the process of cracking is necessarily complex is easily realised when the nature of the material, and especially the temperature conditions, are considered; for an exothermic reaction which may occur at low temperatures may very well be replaced by an endothermic one at a higher temperature with a complete change in the nature of the products. Thus, at moderate temperatures up to 500° the tendency is for the formation of a mixture of paraffins and olefines, whilst at about 700° the effect is the generation of aromatic hydrocarbons. The effect of temperature has been well illustrated in the experiments made on ethane, coal, and isoprene.

According to the authors "the thermal decomposition of petroleum into aromatic compounds occurs at temperatures considerably in excess of those needed for simple cracking, and in consequence much more serious losses occur in the shape of carbon and fixed gases. Paraffin hydrocarbons at these temperatures are almost completely decomposed. The desired products are not the primary results of cracking; they are obtained from them by further decompositions and synthesis. Accompanying them are other characteristic bodies, usually classed under the heading of unsaturated hydrocarbons, but which are far more reactive than the simple olefines. . . . Summing up, therefore, the effects of temperature on petroleum may be said to be: (1) temperatures up to 500°–600° yield in the main mixtures of olefines and paraffins; (2) temperatures about 700° yield a mixture of olefines, diolefines (*e.g.* butadiene), and aromatic hydrocarbons, with little paraffins; (3) temperatures about 1000° yield mainly permanent gases and a tar similar to coal-tar, in that they both contain aromatic hydrocarbons."

The effect of pressure on cracking appears in general terms to be that increased pressure favours synthesis, whilst diminished pressure promotes dissociation.

A very interesting development in the thermal decomposition of hydrocarbons is the effect of catalysts. Moissan first observed the production of liquid hydrocarbons (among them being benzene) by the contact of acetylene with metals, and in the well-known method of reduction of Sabatier and Senderens finely divided nickel, cobalt, iron, and other metals have been employed with and without hydrogen with very noteworthy results. Acetylene on reduction in presence of nickel yields both paraffins and cycloparaffins in proportion resembling Baku, Galician, and Pennsylvanian petroleum. Coke also behaves as a catalyst.

At the end of this very informing paper the authors give a summary of the mechanism of pyrogenesis, which does not admit of abbreviation, and is too long for reproduction. Those who are interested in the subject will feel that the authors have accomplished an important service to the coal-tar and petroleum industry in presenting to the public at such an opportune moment this valuable and exhaustive memoir.

J. B. C.

METALLIC TUNGSTEN POWDER AND HIGH-SPEED STEEL.

ONE of the most successful of the manufactures which have been established in this country by reason of the war is that of metallic tungsten. This metal occurs naturally in the form of oxide, together with the oxides of iron, manganese, and calcium. Pure tungsten powder is obtained by first isolating the tungstic oxide and then reducing it, whilst ferro-tungsten is obtained by reducing the mixed oxides. For the production of the best high-speed steel metallic tungsten powder is necessary, because ferro-tungsten contains impurities which are eliminated only when the process of separating the tungstic oxide from the ore is employed. Before the war almost all the pure tungsten powder was supplied by Germany, whilst ferro-tungsten was manufactured in France and, on a small scale, in this country. On the declaration of war only a limited stock of tungsten existed in this country, whilst the necessity for a large output of high-speed steel was urgent. The way in which it was supplied is described in an article in the *Chemical Trade Journal* for December 9.

An inquiry instituted by the Government showed that a factory for the production of metallic tungsten powder was essential. The Committee of High-Speed Steel-Makers, which took the matter in hand, recommended the engagement of the services of Mr. J. L. F. Vogel, and a company (High-Speed Steel Alloys, Ltd.) was formed, in which thirty firms manufacturing high-speed steel became shareholders. A site chosen at Widnes was taken over in November, 1914, and building was sufficiently advanced in July, 1915, for the commencement of production. The factory, which occupies a site of about six acres, is divided into eight departments. The first department comprises a warehouse for the storage of the ore, grinding and mixing plant, and the magnetic separator. The second department contains furnaces for roasting the mixed ore with soda, whereby all the tungsten is converted into sodium tungstate. In the third department the furnace product is broken up and conveyed automatically into the next department, where it is extracted with boiling water. The solution of sodium tungstate passes to the fifth department, where it is treated with acid. The resulting yellow tungstic oxide is dried in the next department, and prepared for reduction. The seventh department contains the furnaces for heating the crucibles to reduce the tungsten. The metal is washed and dried in the last department. The product has contained on an average 98·5 per cent. pure tungsten, which is one per cent. better than the German product.

The Government took control of all wolfram ore in the British Empire on September 1, 1915, but the amount being insufficient to meet the full demand, the High-Speed Steel Alloys Co., to improve the output, has purchased mines in Burma, and has sent out Dr. W. R. Jones, formerly of the Indian Survey, to take charge of operations.

EDUCATIONAL CONFERENCES.

AT the opening meeting of the Conference of Educational Associations, the chairman, Sir Henry Miers, directed attention to the wide interest aroused of late in educational questions, and laid down three lines of general agreement: continued education beyond fourteen, an improvement in the position and prospects of teachers, and a reorganisation of the scholarship system. We need to promote in young people a desire for further education and the power to carry it on, and to provide facilities for the exercise of that power. Mr. A. L. Smith, the Master of Balliol, in his inaugural lecture, struck a similar note. That all recently published programmes of reform should be working in the same direction, that so many suggestive experiments in the psychology and practice of education should be in progress, and that so wide an interest should have been aroused among workers, employers, and business men he regarded as very hopeful signs. As head of a great Oxford college he welcomed the controversy between classics and science, and expressed the opinion that much of the old curriculum should be discarded, that no one could be considered fully educated who was ignorant of the processes, standards, and history of natural science, and that it was possible to give a general scientific training which should provide useful equipment and valuable mental exercise for all. It would be both feasible and beneficial for science to enter into all early education, with specialisation later where aptitude was shown. Public opinion has not yet put the teacher in his right place, or rewarded him sufficiently, yet only so can we foster the power for development and heroism latent in the ordinary man. Educational methods have great influence on the efficiency and contentment of workers, and a great modern commonwealth needs at its centre a democracy which shall be intellectually, socially, and morally educated.

The Headmasters' Conference, which is held

annually at some school or college, met at Rugby School on December 21–22. About 110 schools—including all the great public schools—are represented by the Conference. Among the conditions under which a school may be represented are that it contains 100 boys, counts at least ten among the undergraduates of Oxford and Cambridge, and sends to these universities an average of five or six boys each year. Particulars of the schools admitted to representation are given in the "Public Schools Year Book." At the recent meeting of the Conference held at Rugby the following resolutions were passed, among others :—

1. That this Conference welcomes the letter with regard to war memorials sent to headmasters in the early autumn by H.R.H. the Prince of Wales, as the chairman of the Statutory Committee, and endorses the suggestion that provision of scholarships and exhibitions should form part of the measures taken at public schools to commemorate the fallen.

2. (*a*) That it is essential to a boy's general education that he should have some knowledge of the natural laws underlying the phenomena of daily life, and some training in their experimental investigation. (*b*) That, in the opinion of this Conference, this can best be ensured by giving to all boys adequate courses of generalised science work which would normally be completed for the ordinary boy at the age of sixteen. (*c*) That, after this stage, boys who require it should take up science work of a more specialised type, while the others should for some time continue to do some science work of a more general character.

3. That, while desirous of improving the teaching of science and making it a reality in all public schools, this Conference deprecates the present proposals of the Oxford Hebdomadal Council for making the passing of an examination in science an essential qualification for an Oxford degree.

4. Board of Education Circulars 849, 933, and 956. That this Conference approves the general educational policy indicated by these circulars, and in particular the principles :—(*a*) That all boys in secondary schools should pursue a normal course of education up to the age of about sixteen, unimpaired by premature specialisation and unimpeded by the varying demands of external examinations. (*b*) That the universities should continue to be the responsible examining authorities in secondary schools, but holds that no further compulsion or restriction of any kind can be usefully applied to schools until a general acceptance of an approved "first examination" by universities and professional bodies has been secured. If in any case acceptance is only conditional, the conditions must be of the simplest kind, and a clean sweep must be made of the present absurd complexities. In the details of the proposed first and second examinations there are many points calling for further discussion, and two only will be mentioned in the present resolution :—(i) The Conference holds that natural science and mathematics should count as two "groups," not as one only; (ii) it adheres to the view expressed in Circular 849, section VI., regarding such subjects as music, drawing, manual work, and housecraft, to which may be added physical exercises. It is as far as possible from undervaluing such subjects as essential parts of a good education, but believes that their adequate inclusion can be better secured in other ways than by formal examination at the age of sixteen.

5. That this Conference reaffirms its conviction that Greek ought no longer to be retained as a compulsory subject in the Entrance Examinations to the Universities of Oxford and Cambridge. In urging this, the Conference in no way wishes to deny that for those boys who are fit for it there is no finer educational instrument than Greek, nor that there are other compulsory subjects which are open to grave objections.

THE U.S. NATIONAL RESEARCH COUNCIL.

IN the Proceedings of the National Academy of Sciences for October a report is given of the first meeting of the National Research Council, held in New York City on September 20 last. Dr. G. E. Hale was unanimously elected permanent chairman.

Dr. Hale, as chairman of the organising committee of the council, announced an agreement between the National Academy of Sciences and the Engineering Foundation by which the foundation has placed its funds at the disposal of the council for a period of one year, and has given the services of its secretary, Dr. Cary T. Hutchinson, to the National Research Council, to serve as its secretary. Dr. Hale announced that in accordance with this agreement the National Academy of Sciences has appointed Dr. Hutchinson secretary of the National Research Council.

Later in the meeting Dr. Pupin emphasised the great value of co-operation in industrial research, as evidenced by the work of the Research Laboratory of the General Electric Company, and spoke of the difficulty in securing men adequately trained. Dr. Noyes urged the need that universities and colleges should interest more men in research work and train them more effectively. Dr. Carty pointed out that industrial research has as its objective commercial development, and that scientific research has no such immediate purpose. Dr. Vaughan believed that much good could be done by the council in stimulating the Congress of the United States to make larger grants to help pure science. Mr. Manning explained the assistance given to the U.S. Bureau of Mines by the great chemical and smelting companies, and suggested similar assistance for pure scientific research.

After an adjournment for dinner, Mr. Rand dwelt upon the essential need of co-operation with the great industrial research organisations, instanced the assistance that the research laboratories of the U.S. Steel Corporation had rendered to the Institute of Mining Engineers, and expressed the belief that the co-operation of the U.S. Steel Corporation with the Research Council could be secured. Mr. Herschel pledged the support of the American Society of Civil Engineers, and Mr. Dunn explained the relations of the Engineering Foundation with the council.

Two meetings of the Executive Committee were held in New York on September 21 and 29. At the first meeting it was resolved that the efforts of the Research Council shall be uniformly directed to the encouragement of individual initiative in research work, and that co-operation and organisation, as understood by the Research Council, shall not be deemed to involve restrictions or limitations of any kind to be placed upon research workers.

The following resolution was adopted, inviting the American Association for the Advancement of Science to co-operate with the Research Council :—"That the American Association for the Advancement of Science be informed that the National Research Council has been organised by the National Academy of Sciences at the request of the President of the United States for the purpose of bringing into co-operation existing governmental, educational, industrial, and other research organisations, with the object of encouraging the investigation of natural phenomena, the increased use of scientific research in the development of American industries, the employment of scientific methods in strengthening the national defence, and such other applications of science as will promote the national security and welfare, and that the association, which has itself established the Committee of One Hundred on Research, be invited to co-operate with the Research Council in the promotion of research, and that to this end it be asked to appoint a committee of three

to meet with a similar committee of the Research Council to consider how such co-operation can be made most effective."

Among the committees appointed by the Executive Committee may be mentioned those on Research in Educational Institutions, on Promotion of Industrial Research, and on a National Census of Research.

It was agreed that joint committees on research in various branches of science be formed in co-operation with the corresponding national scientific societies.

In addition to the officers mentioned, Dr. C. D. Walcott and Dr. Gano Dunn have been appointed vice-chairmen of the council.

MINERAL RESOURCES OF THE BRITISH EMPIRE.

A PAPER on "The Mineral Resources of the British Empire with regard to the Production of the Non-Ferrous Industrial Metals," by Dr. C. Gilbert Cullis, professor of economic mineralogy in the Imperial College of Science and Technology, was read before the Society of Engineers on December 11.

The particular metals dealt with were copper, lead, zinc, tin, and aluminium. The object was to demonstrate the Imperial position with regard to each of these, and to show in respect of which of them the Empire was, on one hand, self-sufficing, or, on the other, dependent upon foreign countries. In the latter case the extent of the dependence was indicated, and methods suggested by which it might be diminished.

The situation with regard to four out of the five metals was shown to be wanting in independence and security, and the necessity for a full investigation of the British mine- and smelter-production was insisted upon.

With regard to copper, not only were the ore resources, as at present exploited, deficient, but the smelting facilities also were seriously inadequate for the Empire's metal requirements. The production both of ores and metal could be substantially increased by suitable organisation and administration.

Lead and zinc ores, raised in British territory, had in the past been exported on a large scale to foreign countries, notably Germany and Belgium, for metal recovery, with the result that the Empire had been placed in an anomalous position of dependence which ought never to have arisen. The shortage of zinc, in the early days of the war, and the consequent jeopardising of supplies of cartridge-brass were referred to. The mine-production of lead and zinc was more than sufficient for the Empire's requirements, but the smelting facilities were lamentably deficient, especially in the case of zinc. It was urged that all the lead and zinc concentrates of Broken Hill should in future be smelted within the Empire.

In the case of aluminium, while the actual bauxite resources of the Empire were so small that dependence had to be placed upon the French or American deposits —which were being more and more utilised in their countries of origin—large potential supplies, in the form of laterite, had a very wide distribution in the tropical colonies, but were almost untouched and untried. The systematic examination of these and other potential sources of aluminium, with a view to their utilisation, was seriously needed.

The only metal with regard to which our position was really strong was tin. The British mine-production of tin in 1912 was 66,000 metric tons out of a world's total of 125,000, and the smelter-production 85,500. Estimating the consumption at 32,500 tons, there remained 53,000 tons available for export. Now that the German market for Bolivian tin ore was closed, an opportunity had arisen of securing the whole of the Bolivian output for British smelting.

In a series of general conclusions, a plea was put forward for the elimination of wasteful methods in ore and metal recovery, for the fuller utilisation of by-products from ores, and for the adoption of large-scale operations of high engineering efficiency by which capital and labour might be advantageously used. The widespread export of raw or partially smelted materials, produced within the Empire, to foreign countries for the recovery of the finished products was condemned, and the promotion of industries making for independence as regards essential products advocated.

The expediting of geological and mineral surveys of all British territory, and the organisation of advance investigations with the object of improving current processes, or of discovering new ones by which geological materials hitherto unexploitable might be made productive, were urged.

The development of the mineral resources of the Empire had taken place in the past without any constructive Imperial policy; it had lacked co-ordination and control, and was in need of scientific and business-like administration, and the suggestion that a Government Department of Minerals and Metals should be established to foster and safeguard British mineral resources and to promote the welfare of related industries was strongly supported. If formed and properly conducted, such a department should do much to give security and order to what was now full of danger and disorder.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. A. SHEPARD CHURCHILL, who died on October 18, leaving estate of the value of 109,495*l*., bequeathed 50,000*l*. to Harrow School for two scholarships, one on the classical and one on the modern side, of the clear yearly value of 150*l*. each, to be known as the "Shepard Churchill" scholarships, tenable at any college at Oxford for four years. In the election regard is to be had to literary and scholastic attainments, fondness and success in manly outdoor sports, such as cricket and football, qualities of manliness, courage, truthfulness, devotion to duty, sympathy with and readiness to protect the weak, kindness, unselfishness, and love of comrades; exhibition during school days of force of character and of instincts leading to the exercise of good and kindly influence over schoolfellows. There are also to be founded four entrance scholarships of 120*l*. each for two modern and two classical students. The residue of the property is also left for the benefit of Harrow School in such manner as the governors, with the approval of the headmaster, shall direct. The total bequest is expected to amount to 100,000*l*.

IN an important letter published in the *Electrician* for December 15, 1916, Mr. A. Gray, of Cornell University, points out that the American electrical engineering firms are in much closer touch with the teachers of electrical engineering than British firms desire to be according to Mr. J. Swinburne. The Westinghouse Electric Company takes in a large number of university graduates each year, and the officials of the company, in order to improve the graduates they receive, have instituted summer schools for teachers, of whom thirty are selected and assigned to special departments in which they work from 8 a.m. to 5 p.m. They are paid about 12*l*. for five weeks' service, and are allowed to visit any part of the works. In his department the teacher is generally given some problem to solve which has had to be put aside owing to the limited time at the disposal of the regular staff. The

evenings are occupied in discussions on points connected with the work of some department to which a visit has been previously paid by the whole body of teachers under the guidance of the engineers of the company. The arrangement appears to have benefited both teachers and company, and seems worthy of a trial in this country.

PROF. ARNOLD WALL, of Canterbury College, has published "A Plea for a System of Internal Examination in the New Zealand University" (Christchurch: Whitcombe and Tombs, Ltd.; price 1s.). The University at present possesses the unique disability that its examination papers are set and the answers marked in exactly the opposite part of the globe—in London—a plan originally introduced in order to enable the University to maintain a standard identical with that prevailing in Great Britain. The system has the disadvantage as at present worked that the professors and teachers have no voice in the setting of the papers, nor are their opinions from personal knowledge of the candidates available for the guidance of those who mark the scripts. We hope Prof. Wall will succeed in introducing some reform which will bring teachers and examiners into closer touch with each other. At the same time the system which he proposes has proved to be a failure in at least one university in this country, and it cannot be said that it is altogether satisfactory to have examinations conducted by a board in which both the external and internal examiners are in a minority, and the majority are teachers interested in other colleges or in other subjects than the one under examination.

A COPY of the calendar of the University of Sheffield for the session 1916–17 has been received. The arrangement of the contents follows the plan of previous years, and detailed particulars are given of the courses of work arranged for students who desire to graduate in the various faculties of the University. It will be remembered that, as in the case of other of our more modern universities, there is at Sheffield a very comprehensive faculty of applied science, and the degrees of bachelor, master, and doctor may be gained both in the various branches of engineering and in metallurgy. There is a department of glass technology which provides facilities for systematic study and research in the manufacture and general technology of glass, and students who attend and qualify in a full-time course may obtain a diploma in the subject. The mining department of the University, under arrangement with the West Riding County Council, provides courses of extension lectures in mining science, and inspects and examines local mining classes in the southern portion of the West Riding. Similar instances could be multiplied of the successful efforts being made by the University authorities of Sheffield to keep in touch with the industries of the area served by the University, and to give local manufacturers the benefit of the assistance of expert advice on scientific matters.

READERS who have copies, which they may be willing to spare, of advanced text-books, models, specimens, and apparatus for the study of geology are invited to communicate with the British Prisoners of War Book Scheme (Educational) at the Board of Education, Whitehall, S.W. A request has just reached the committee of that war charity from Ruhleben for about fifty books, etc., to enable the camp school there to establish a general course in dynamic geology and crystallography. The class will be conducted by two of the prisoners, who are (to quote the letter) "professionally engaged in geology"; and more than a dozen students, mostly engineers, have already given in their names. The following books are specially asked for, and they may serve as an indication of the scope of the classes at this camp and of the type of book desired:—Haug, "Traité de Géologie"; Launay, "Traité de Métallogénie"; Hobbs, "Earthquakes"; Murray and Hjort, "The Depths of the Ocean"; Dana, "System of Mineralogy"; Groth, "Physikalische Krystallographie" (or any other good English book of the kind); Braune, "Chemische Mineralogie"; Rosenbusch, "Microscopische Physiographie der Mineralien und Gesteine"; Harker, "Petrology for Students." Among the requirements for the equipment of the classes are a microscope, slides for crystal, mineral, and rock specimens, crystal models, mineral powders and apparatus for blow-pipe analysis, and goniometers. A detailed list of the requirements may be obtained from the chairman of the Book Scheme, Mr. A. T. Davies, at the Board of Education, Whitehall, S.W., to whom all offers (accompanied by a detailed list) should be addressed. Books in almost every subject are urgently needed to meet the steadily increasing demands which are daily being received from British prisoners interned in enemy or neutral countries.

THE report on the work of the Department of Technology of the City and Guilds of London Institute for the session 1915–16 has been published by Mr. John Murray. The work of the department has been carried on with some difficulty during the year. Half of the office staff has joined the Army, and the secretary of the department himself is serving in the Army in France. Whereas the number of classes registered in technological subjects in the session 1913–14 was 5049, in 1915–16 the number had fallen to 3961. The students in attendance in these two years numbered 55,996 and 35,203 respectively. The report points out that recognition is due to the authorities and teachers of technical schools for the successful efforts which they have made to carry on the work of their classes uninterruptedly, notwithstanding the absence of members of their staffs on active service, and many other difficulties due to the war. Valuable help has been given to the Ministry of Munitions by the technical schools in general, either by directly manufacturing articles and gauges for munitions of war, or by undertaking special work and training men in it. In connection with the examiners' reports on the results of the examinations, it is again put on record that candidates frequently enter upon their technical instruction very poorly equipped in the matter of general elementary education, ability to do simple calculations, or even to write simple English correctly. The institute goes so far as to endorse the opinion of one examiner that "the standard of general education of the candidates is not improving." The report concludes by insisting that, speaking generally, employers must change their attitude towards technical training, so that those who foster the education of their younger employees should become the great majority instead of the minority, and so that attendance at continuation schools and day schools, or, if this be too much to expect, at least at evening technical classes, should become the rule. Nothing short of a strong national movement in this direction can prove adequate to meet the requirements of the case.

SOCIETIES AND ACADEMIES.

LONDON.

Aristotelian Society, December 18, 1916.—Dr. H. Wildon Carr, president, in the chair.—A. N. **Whitehead**: The organisation of thought. Science is a thought organisation of experience. The most obvious aspect of the field of actual experience is its disorderly character. It is for each person a *continuum*, fragmentary,

and with elements not clearly differentiated. The fields of experience from which science starts are of a radically untidy and ill-adjusted character, whereas the neat, trim, tidy, exact world which is the goal of scientific thought is a world of ideas. The first great steps in the organisation of thought were due exclusively to the practical source of scientific activity, without any admixture of theoretical impulse. The whole apparatus of common-sense thought arose in this way: concepts of definite material objects, of the determinate lapse of time, of simultaneity, of recurrence, of definite relative position, etc. Science is rooted in the apparatus of common-sense thought. Science is essentially logical; the nexus between its concepts is a logical nexus, and the grounds for its detailed assertions are logical grounds. Four departments of logical theory may be discriminated, which by analogy may be called the arithmetic section, the algebraic section, the section of general-function theory, and the analytic section. The last, which is concerned with the investigation of the properties of special logical constructions—that is, of classes and correlations of special sorts—includes the whole of mathematics.

PARIS.

Academy of Sciences, December 11, 1916.—M. Camille Jordan in the chair.—M. P. Painlevé was elected vice-president for the year 1917.—A. **Lacroix**: The phenomena of exomorph and endomorph contact phenomena of the ægyrine and riebeckite granites of North-West Madagascar.—G. **Bigourdan**: The position and co-ordinates of the observatories of Boulliau, of Gassendi, and of P. Petit.—E. **Ariès**: The determination of free energy by the equation of Clausius.—C. E. **Guillaume**: Wire-drawing and the expansion of invar.—G. **Charpy** and M. **Godchot**: The oxidation of coal. Fourteen samples of coals from St. Eloy, Ferrières, and Noyant were heated at 100° for periods of from two to three months. After this heating there was a gain in weight due to oxidation of from 3 to 5 per cent. Comparisons were made of the ash, volatile matter, and calorific value before and after heating. The loss of calorific power varied from 3 to 13 per cent. The ash and volatile matter were practically unaltered, and hence it follows that the deduction of the calorific value of a coal from its ash and volatile matter must be liable to grave error, since a similar oxidation process is often found to have occurred in stored coal, and sometimes even in the coal in the mine.—M. **Mesnager**: Formulæ of the thin plate fixed on a plane rectangular contour.—C. **Benedicks**: A new effect relative to thermo-electricity and to the thermal conductivity of metals. From theoretical considerations the author has arrived at the conclusion that the well-known deduction from the Wiedemann-Franz law made by Drude is inadmissible, and experimental evidence in support of this is given in the present communication.—R. **Ledoux-Lebard** and A. **Dauvillier**: The K series of tungsten and the production of the X-rays from the point of view of the quanta theory. The relation between the frequency and the voltage according to the quanta theory should be linear; for voltages between 24 and 140 kilovolts the experimental data give a curve, the deviation from the theoretical straight line increasing with the voltage. The K series appears at about 80 kilovolts instead of the 95 indicated by Whiddington's formula.—G. A. **Hemsalech**: The grouping of the lines of the iron spectrum under the selective influence of thermal and chemical actions. The lines in the iron flame spectrum can be arranged in three groups: lines emitted by the external flame of a Bunsen burner and reinforced in flames of higher temperature, lines produced under the influence of chemical actions, very marked in the cone but feeble in the flame, and the third group, the lines of the "supplementary" spectrum. Examination of the normal spectra has shown the existence of curious groups of lines in each of the three classes, distributed according to a law as yet unknown.—A. de **Gramont**: Remarks on the preceding communication, emphasising the importance of the results obtained by G. A. Hemsalech and pointing out the desirability of the study of a more extended portion of the iron spectrum by the same method.—J. **Deprat**: The discovery of numerous fossil-bearing horizons in the Middle and Upper Cambrian of South Yunnan, and on the succession of the fauna in these strata.—Ph. **Glangeaud**: The first volcanic eruptions (Oligocene) in the lacustral geosynclinal of Limagne (Côtes de Clermont, Chanturgue).—J. **Amar**: An instrument for measuring and re-educating the movements of pronation and supination, the gyrograph.—A. **Lardennois**, P. **Pech**, and J. **Baumel**: Study of the gangrenous infections of wounds by means of radiography. The information which can be obtained by the radiographic examination of gas gangrene is useful not only for the study of the process of destruction and its localisation in the muscle, but also it is useful for the diagnosis of the focus of a gangrene, and especially for determining its extent.—J. **Beauverie**: New experiments on the influence of osmotic pressure on bacteria. Studies of the effects of increasing proportions of common salt on the growth of bacteria.—A. **Paillot**: New parasitic micro-organisms of the cockchafer.

NEW SOUTH WALES.

Linnean Society, October 25, 1916.—Mr. A. G. Hamilton, president, in the chair.—E. F. **Hallmann**: Revision of the genera with microscleres, included, or provisionally included, in the family Axinellidæ (Porifera). Part iii. The genera Thrinacophora, Dragmatyle, Holoxea, and Higginsia are revised; five genera and one species are described as new.—A. H. S. **Lucas**: An efflorescence on some New Zealand kelps.—C. **Hedley**: Studies on Australian Mollusca. Part xiii. Six species referable to the genera Arca, Loripes, Solecardia, Tellina, and Tugalia are described as new, and figured; additional particulars and illustrations of a number of imperfectly known species are supplied.—F. H. **Taylor**: Australian Tabanidæ. Part ii. One genus and twelve species are proposed as new; a change in the names of two is made, and notes on, and additional localities for, known forms are recorded.—A. M. **Lea**: Descriptions of new species of Australian Coleoptera. Part xii. Twelve species of the family Curculionidæ and eight of the Cerambycidæ are described as new.—G. F. **Hill**: Notes on the bionomics of *Lyperosia exigua*, de Meijere. The buffalo-fly, a formidable pest to cattle and horses in the Northern Territory, is believed to have been introduced with early shipments of buffaloes, cattle, or ponies from the East Indies, so far back as 1824. The local distribution, habits, oviposition and life-history, natural enemies, and methods of control are discussed.

VICTORIA.

Royal Society, November 9, 1916.—Mr. W. A. Osborne, president, in the chair.—F. **Chapman**: The probable environment of the Palæozoic genus Hercynella in Victoria. The complete fauna of the Yeringian beds containing this supposed pulmonate mollusc in Victoria was recorded, and, from the presence of corals and many gasteropods, it was shown that these sediments must have been laid down under fairly deep water marine conditions, as in Bohemia. The thin-shelled fauna of the Yeringian sea was probably due to the marked terrigenous element in the deposits produced by fluviatile action. This evidence was compared with that given by Miss O'Connell, of Buffalo,

U.S.A., who has described the Hercynellas of the Waterlime group as being associated with a brackish or estuarine fauna containing eurypterids and pod-shrimps, and therefore differing considerably from the Victorian occurrence.—R. **Etheridge**, jun.: Reptilian notes. (1) The identity of *Megalania* (vel *Varanus*) *prisca*, Owen, with *Notiosaurus dentatus*, Owen. Some vertebræ, limb-bones, dentary, and tooth from King Creek, Condamine River, in the Australian Museum, confirm Lydekker's conjecture of the identity of these two forms. (2) *Megalania prisca*. A cave fossil from the Wellington Caves Reserve. Remains of this lizard have now been recorded from fluviatile, spring, and cave deposits. (3) An opalised reptilian dentary from Lightning Ridge, Walgett, of Cretaceous age, described as *Crocodilus* (*? Bottosaurus*) *selaslophensis*.

PETROGRAD.

Imperial Academy of Sciences, September 28, 1916.—E. S. **Fedorov**: The determination of the density of the atoms in the surfaces of crystals.—V. P. **Amalickij**: Geological and palæontological explorations on the northern Dvina and the Suchona. Palæontological results. Reptilia. Part i., Anomodonta, Owen; Dicynodontidæ, Broom; Dvinosauridæ, n.f. Part ii., Seymouridæ.—G. N. **Frederiks**: The genera Reteporina, d'Orbigny; Phyllopora, King; and the allied forms of the Fenestellidæ.—R. **Abels**: Magnetic observations in W. Siberia, 1914–15.—S. V. **Orlov**: Simplified formulæ applied to investigating the curve in the tail of comet 1908*c* (Morehouse).—S. **Kostinskij**: The new variable 1916 Cassiopeiæ.—A. A. **Bělopolĭskij**: A new method of determining the radial velocities of stars with the spectro-comparator.—B. **Gorodkov**: A journey to the southern limit of the conifer forests of the Tobolsk Government.—D. **Smirnov**: Observations on the life of *Ellobius talpinus*, Pall., in the Merv oasis (Mammalia, Rodentia).—A. R. **Prendel**: The Hirudinea of the ancient beds of the Dniester.—A. V. **Martynov**: A new species of the tribe of the Apataniini and other forms from the Minussinsk district.—V. and E. **Martino**: Materials for the classification and geographical distribution of the Mammifera of the Kirgise Steppe. Part ii.—A. **Birulia**: Miscellanea scorpiologica, xi. The scorpio-fauna of Lower Mesopotamia, Kurdistan, and N. Persia.—A. A. **Borisiak**: Tertiary mammals of Russia. No. 1, Indricotherium, n.g.—V. I. **Palladin** and V. V. **Levčenko**: Glycuronic acid in plants.

SECTION FOR HISTORICAL SCIENCE AND PHILOLOGY, October 12.—A. N. **Samojlovič**: The adages of the Crimean Tatars.—Vl. **Kotvič**: Mongolian inscriptions of Erdenidzu.—E. D. **Polivanov**: A note on Japanese riddles.—V. M. **Alekseev**: The immortal doubles and the tao-sse with the golden toad in the suite of the god of riches.—N. J. **Marr**: The migration of the Japhetic peoples from the southern to the northern Caucasus.—V. V. **Bartold**: The folk-tale of Dido's ruse.

BOOKS RECEIVED.

The Towns of Roman Britain. By the Rev. J. O. Bevan. Pp. viii+65. (London: Chapman and Hall, Ltd.) 2*s.* 6*d.* net.

Stars at a Glance. Pp. 48. (London: G. Philip and Son, Ltd.) 1*s.* net.

Genetics and Eugenics. By Prof. W. E. Castle. Pp. vi+353. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press.)

Joseph Pennell's Pictures of War Work in England. Pp. xii+plates li. (London: W. Heinemann.) 6*s.* net.

Cosmical Evolution: Critical and Constructive. By E. McLennan. Second edition. Pp. xxi+490. (Corvallis, Oregon: The Author.)

God's Progressive Revelations of Himself to Men. By the Rev. Canon J. M. Wilson. Pp. 62. (London: S.P.C.K.) 1*s.* net.

DIARY OF SOCIETIES.

SATURDAY, JANUARY 6.

GEOLOGISTS' ASSOCIATION, at 3.—The Age of the Chief Intrusions of the Lake District: J. F. N. Green.—The Ibex-zone at Charmouth: W. D. Lang.

MONDAY, JANUARY 8.

ARISTOTELIAN SOCIETY, at 8.—Hume's Theory of the Credibility of Miracles: C. D. Broad.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geography of South American Railways: W. S. Barclay.

TUESDAY, JANUARY 9.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Recent Progress in Dredging Machinery: W. Brown.

WEDNESDAY, JANUARY 10.

GEOLOGICAL SOCIETY, at 5.30.—Notes on the J. A. Douglas Collection of Graptolites from Peru: Dr. C. Lapworth.—The Palæozoic Platform beneath the London Basin and Adjoining Areas, and the Disposition of the Mesozoic Strata upon it: H. A. Baker. With an Appendix by Dr. A. M. Davies.

THURSDAY, JANUARY 11.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—The Amazon River and Unexplored South America: J. Campbell Besley.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Principles Involved in Computing the Depreciation of Plant: F. Gill and W. W. Cook.

FRIDAY, JANUARY 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—*Patella vulgata*, L., and its so-called Variety, *P. depressa*, Penn.: Rev. Dr. A. H. Cooke.—The Occurrence of Manganese in Mollusca: Dr. A. E. Boycott.—Note on the Holotype of *Crioceratites bowerbanki*: J. de C. Sowerby and G. C. Crick.

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