THURSDAY, APRIL 19, 1900.

ECONOMIC SCIENCE.

The Distribution of Income. By William Smart, M.A., &c., Adam Smith Professor of Political Economy in the University of Glasgow. Pp. xv + 341. (London: Macmillan and Co., Ltd., 1899.)

POLITICAL Economy is frequently called the dismal science. Just as frequently it is denied the name of science at all, and the denial is fully justified as regards many books on Political Economy, which are full of vague speculation and rhetoric. A book like the present, however, shows the reality of the science, and how far, indeed, it is from being more dismal to the ordinary man than any other science which requires close thinking to understand it. A little reading of the present book will, indeed, prove to any intelligent reader that the analysis of the processes of exchange, which it is the function of Political Economy to examine and explain, is full of constant interest. Mr. Smart's special object is to show the distribution of the aggregate of what people call their individual incomes, and incidentally he throws a great deal of light on the production of the incomes themselves and what is meant by it, as well as on the automatic organisation of industry, which is the condition of the production and distribution. As a corollary, he discusses, from a somewhat novel point of view, the question of the socialistic organisation of society, by which so many think the present organisation can be superseded; and the proof he furnishes that production and distribution cannot but go hand in hand, and that equitable distribution is better provided for by the present organisation than in any other conceivable way, will be found most striking, and impossible for the Socialists to answer.

The initial point of the analysis is the connection which the author establishes between the aggregate of the individual money incomes of a community and the real income of that community; that is, the actual commodities and services which are represented by the money incomes. The reason for this is well set out in the introductory chapter. A man of business and individuals generally reckon their incomes in money. The income is so much "money." The economist, on the other hand,

"becomes so conscious of the inadequacy and ambiguity of the money measurement that he often fights shy of it altogether, and speaks of income as commodities and services, forgetting that in so doing he has stepped off the platform of the ordinary man. At the same time it may be confessed that he is not altogether consistent in this attitude. Usually, when he passes from the consideration of the making of goods to that of selling them and paying the various makers for the making, he falls into the habit of the people around him, and thinks of income as merely so many shillings or sovereigns."

The author does not fail, however, in his identification of the two things, and in proving the identity he establishes very clearly how production and distribution go hand in hand, and that the one, in a modern industrial community, is not conceivable without the other.

Without going into the detail of the author's classification of income, which is hardly necessary in a general study, except for purposes of illustration, we may simply notice that there are three main classes of money income in a country like the United Kingdom. First of all there is the money income arising from the rent of land and houses, and the interest or profits upon capital. Second, there are the money incomes of the professional classes, of the army, navy, and civil services, and of others who render services to the community, but who are not usually spoken of as the working classes. Third, there is the income of the working classes themselves, the sum paid to them for the labour which they expend. Practically, there is no theoretic distinction between the second and third classes of income. The income in both cases is a payment for services rendered. Even the first classes of income, however, cannot be considered as purely the return upon idle capital, which is received by the fortunate possessors of the capital. Nothing is more interesting in the author's analysis than his demonstration of the amount of labour and anxiety which goes to the making of profits upon capital in almost any form, the capital which can bring in an income to its possessor almost without labour being much more limited in fact than is usually imagined. It is clear also that the share which is paid in respect of capital for a given production still leaves the amount of the share which is paid in respect of labour enormously greater, in fact inconceivably greater, than the amount which would come to labour without the capital. The author shows very clearly also, in a most interesting chapter (Chapter xi.), that a vast amount of service is rendered to the community which is unpaid, particularly, in this country, the labour of men engaged in public services, such as members of Parliament, municipal, county and parish counsellors, magistrates, students, explorers, managers of public institutions, and the like. To these must be added the greatest unpaid service of all, that of women in the household. The resources of a community accordingly are not merely the paid services which constitute the aggregate of the money incomes, but those other services also by which the community benefits, although they are not paid for or assessed in any way.

The main point of the analysis, as it proceeds, is apparently to be found in Chapter xii., in which it is established that the money income is limited by the real income, the two things being identical, and that in the distribution of the real income an increase that goes to one contributor means a deduction from all the other contributors and *vice versâ*. It follows from this also that the total production of the community is the measure of what can be distributed, and the only way in which the community as a whole can advance is by an increase of the total production or an improvement in quality.

The author gives here a very good illustration, that of a rich man's daughter, of whom the complaint is sometimes made that by going into the labour market and competing with working women who have to depend upon their work for a livelihood she takes the bread out of their mouths.

"Let us suppose that she has been getting a dress allowance of 30*l.* from her father, and that in view of her making 12*s.* 6*d.* a week in typewriting he stops the allowance. There is no difference to the girl except the honest glow of independence. But what of the father?

He has now a sum of 30*l.* of unspent income. Suppose, to make the argument quite clear, that with this sum he engages another typist in his own office. Is this not a new opening in the industry? And granted that Miss Dives has displaced another typist, if this displaced one gets the new situation, has this competition taken the bread out of Miss Lazarus' mouth? The position, of course, practically, is that the new typist has added a new sum of wealth to the community, and is paid by the value of this new sum."

In this way the author deals with the popular fallacy that there is in a community only so much work to go round, and that if some are unemployed, the way to get this margin into work is to shorten the hours of those who are employed. The exact reverse is the truth. The way to produce more employment is to increase the production of those who are already employed, and so cause a greater demand for labour upon which the value of that increased production is spent.

The author discusses at great length, in the second part of the book, the principles of distribution, and we are sorry that we have not left ourselves space to follow him as much as we should like. The demonstration is clear, however, that no distribution of the aggregate income of a community upon any principle of equal needs or other such principle dreamed of by Socialists is even conceivable, and that the only way, in fact, that rough justice can be done is by the income of each individual being assessed at what his services fetch in the open market. This is the essence of the individualistic structure of society, and its justification is that there is no other way of measuring individual services against each other.

Altogether, we must commend the book very highly as a careful study of most difficult problems. The author's style is clear and pointed, and there is not an obscure page in the book. It is an excellent work to put into the hands of the economic student. R. GIFFEN.

PRACTICAL MATHEMATICS.

Practical Mathematics. Summary of Six Lectures delivered to Working Men by Prof. John Perry, D.Sc., F.R.S., February and March 1899. (London: Eyre and Spottiswoode, 1899.)

THESE Lectures were delivered as introductory to the new subject of Practical Mathematics, recently established in the examinations of the Science and Art Department; but, incidentally, they serve to show how we have come by our state of lethargy, out of which we have had so rude an awakening.

Recent events in South Africa have given a shock to our insular self-sufficiency, and made the reflective tremble to think what would have happened, remembering the fate of France, if we had been involved with a real European power, with no opportunity of gaining time for a reorganisation of our antiquated methods.

We have lost initiative and flattered our own superiority, instead of observing the marvellous progress of other countries; and this self-sufficiency is especially noticeable in our scientific and practical methods, so that among us it was considered hopeless for a benighted foreigner, French or German, however hard he might work, to rival methods we could acquire without effort.

Our practical men have been content to jog along by rule of thumb and the knowledge acquired from endless mistakes, imagining the rest of the world felt its way in the same blind fashion; holding no communication with the theorists, who, as mostly engaged in the educational line, were high up in an æthereal plane of thought, and despised all practical applications of theory to nature, ignoring the ideas which are in the course of transforming the conditions of civilisation.

These Lectures on Practical Mathematics are useful in lifting the thoughts of the working man out of his narrow groove; and are also worth the study of the pure theorist, in showing him how to take the additional and difficult steps, hitherto neglected, but required for making his theory of immediate practical utility; at the same time to give him some useful hints for smoothing the initial path of mathematics from needless difficulties.

The Lectures begin with some valuable advice on the proper method of performing the simple arithmetical operations, a subject which is carried out with us in a scandalously antiquated manner. The keynote of practical numerical computation is given in § 3:—

"When calculating from observed quantities, it is *dishonest* to use more figures than we are sure of."

Suppose π is to be squared, taking its value as 3·1416; according to our obsolete methods, the result would be worked out to nine significant figures, even if five only were to be retained; the proper method, of writing the multiplier in reverse order, is explained on p. 4; so, too, with division on p. 5. Mantalini had the true arithmetical sense when he passed his remark on the bill of sale; but our schoolmasters proceed on the proverb—"Take care of the pence, and leave the pounds to take care of themselves"—thus reversing the relative importance of the figures.

Prof. Perry is a true disciple of Squeers, the discredited inventor of our modern system of technical education, hampered as he was by an incompetent demonstrator. After giving the smallest possible preliminary explanation, he makes the student think out the principles for himself in the course of a variety of well-chosen applications of actual interest. The Slide Rule, never mentioned in scholastic treatises, is introduced at once for practical calculations; this instrument rejects automatically all the unimportant and *dishonest* figures in the arithmetical operations of multiplication, division, involution and evolution. After a short description with a diagram, Prof. Perry finishes with the sound advice:—

"Think it out for yourself; practise multiplying simple numbers; *ask nobody to help you*, and you will rapidly get familiar with, and fond of, the Slide Rule."

The celluloid scale of the latest patterns enables the figures to be read off with such increased accuracy that the Slide Rule may now supplant all books of Mathematical Tables and Logarithms for physical and engineering purposes, as measurements can rarely be made beyond four significant figures in Lord Kelvin's opinion.

A Table of four-figure Logarithms and Antilogarithms is appended, and further on a method is given (due originally to Mr. Edser) of calculating these logarithms, with which must be contrasted the elaborately difficult treatment of ordinary mathematical treatises, depending on

that elusive abstraction, the Exponential Theorem, which, as these Lectures show, may be omitted and disregarded in a course of Practical Mathematics. We remember the elaborate and majestically slow overture of Todhunter's Differential Calculus, wherein the initial motive of the Exponential Theorem is developed at such length, pausing to investigate the influence of fractional as well as infinite steps in the neighbourhood of the limiting infinity. No wonder the subject of the Calculus was a sealed book to all but a few of our students. Contrast this with the good fortune of the French schoolboy, who is introduced to the notions of the flow of variable quantities, and to the sacred symbols of the little d and the long $\int$ in a course of elementary algebra, such as "Cours d'algèbre élémentaire, conforme aux derniers programmes."

Omitting all reference to the Exponential Theorem, and dealing only with the common logarithms employed in ordinary calculations, the number x is defined as the logarithm of y from the relation $10^x=y$, $x=\log y$.

Then, by employing the ordinary arithmetical operation of square root, Mr. Edser has given a ready method of starting a calculation of the logarithms, or rather the antilogarithms, as follows :—

x	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{32}$
y	$\sqrt{10}$	$\sqrt[4]{10}$	$\sqrt[8]{10}$	$\sqrt[16]{10}$	$\sqrt[32]{10}$
y	3·1623	1·7783	1·3336	1·1548	1·0746
$\log y$	0·5000	0·2500	0·1250	0·0625	0·03125

The cube root of 10, worked out by ordinary arithmetical methods, and the fifth root of 10, obtainable by Horne's method, will provide additional antilogarithms ; and thence by multiplication, we find y for $x=\frac{3}{32}$, $\frac{5}{32}$, . . ., $\frac{3}{16}$, . . . ; and plotting these relations by a curve on squared paper (NATURE, p. 415, March 1, 1900, Dr. A. Dufton), we can arrive at the simple results of $10^{0\cdot30103}=2$, $10^{0\cdot4771}=3$, $10^{0\cdot8451}=7$, . . . ; and thence construct the chief divisions of the Slide Rule, and by further interpolation calculate the Table of four-figure antilogarithms and logarithms, which suffice for all practical purposes.

Even the theoretical student, who cultivates mathematics as a subject which he will be called upon to teach in his turn, but never to employ on vulgar practical applications, would profit by approaching the study of logarithms in the same way. Afterwards he may open a page of seven-figure logarithms, and consider how much calculation has been expended on it ; he will be surprised to find that, after he has written down the logarithms of a few of the composite numbers to serve as bench marks, the Arithmometer set at a constant difference will run out the intermediate logarithms as fast as the handle can be turned, with an occasional change in the eighth decimal of the difference, wherever a bench mark shows that it is required. A little elementary drill of this kind will soon substantiate Prof. Perry's complaint (p. 38) :—

"Some friends of mine assert that no man or boy ought to be allowed to use logarithms until he knows how to calculate them. They say this, knowing that the calculation is a branch of Higher Mathematics, and that the average schoolboy, after six years of mathematics, finds it hopeless to even begin the study of the Exponential Theorem. It is a hard saying ! It is exactly like saying that a boy must not wear a watch or a pair of trousers until he is able to make a watch or a pair of trousers. It is the sort of unfeeling statement which so well illustrates the attitude of the superior person."

The essentials of the subject of Analytical Geometry, which blocks the way in our present system of mathematical instruction, are given here under the title of Squared Paper. After an encomium on its practical virtues, Prof. Perry has the audacity to follow the Continental lead, and carry his audience straight up to the Calculus.

Accurate diagrams on this squared paper are given of the elementary curves, the graphs of x^n, x^{-n}, $\sin x$, $\cos x$, $\tan x$, e^{kx}, . . ., as well as of the ellipse and hyperbola, practically all the mathematical principles required for the graphical representation of the variation of physical quantities.

The exponential curve, the graph of e^{kx}, represents a quantity which grows or dwindles at constant compound interest or discount like a row of organ pipes, the rate of extinction of light, or the diminution of the density of the atmosphere in a balloon ascent.

The graphs of $y=x^n$ and x^{-n} are the representation of quantities, such that 1 °/₀ increase in x causes n °/₀ increase or decrease in y. This is the familiar statement of a complicated mechanical law, such as Froude's Law, which asserts that in similar steamers over a given voyage 1 °/₀ increase in speed requires 6 °/₀ increase in tonnage and coal capacity, and 7 °/₀ increase in engine power.

When the practical man is compelled to invoke theory to his aid, it is generally in some such manner as the above ; from a known performance, say, of a steamer, he has to argue the requisite alterations, expressed in °/₀, for slight differences in a new design.

The empirical formulas of internal ballistics and of armour-piercing are all examples of the same theory ; the index n, sometimes carefully guarded as an official secret, is at once revealed by plotting on Human's logarithmic co-ordinate sheets, which the possessor of a Slide Rule can readily construct for himself ; and Mr. Vincent has shown, in his Report to the British Association, 1898, that the semi-logarithmic co-ordinates can be employed usefully, in which a combination is made of the Slide Rule Graduations with the equidistant graduations of the foot or metre rule.

In answer to his question on p. 53, for a method of finding a^n, where a and n are any numbers, the author may be referred to Mr. Lanchester's radial cursor attachment, as well as to the double-logarithmic scale, which he will find described in the Catalogue of the Mathematical Exhibition at Munich, 1893, as the invention of Blanc, of Hamburg ; and M. d'Ocagne's "Traité de nomographie," recently reviewed in NATURE, will provide a complete description of all such methods of graphical calculation.

Euclid supplies the place in our schools of the study of Formal Logic, so far as the essentials of strict demonstration ; but as no one employs the syllogism, not even Euclid, and time is limited now there is no longer the lack of the Middle Ages in subjects of scientific interest,

the working man student is recommended by Prof. Perry to condense the essential facts of Euclid's "Geometry" into a few pages of careful instrumental construction, supplemented by perhaps half a page of Algebra for the fifth and sixth books, and introducing at the outset the circular functions of Trigonometry, and, most important of all, the ideas and sacred symbolism of the Calculus.

Valuable collections of examples are interspersed throughout the Lectures, all having a definite practical numerical character, or the interest of the practical illiterate mechanic would be lost ; but we think the navigator would object to the units employed in Example 9, p. 113. An advertisement in the daily press warns us that these Lectures to working men are to be discontinued, and so we are disappointed of the hope of a similar course, illustrated by practical examples, on Mechanics, in which, to employ the author's words, the occult phenomena described by the writers of cram-books on Mechanics to be used in preparing for certain examinations will find no place. Each exercise will fix firmly in the mind of the student the fact that a certain principle is of importance outside examination rooms ; and the student, when he works out an answer which every practical illiterate mechanic knows to be ten times too great, will not complacently rest satisfied with this absurd answer, and talk about its being "theoretically" right.

The author has dared to introduce a lecture on Vectors and their use and treatment—that is, Quaternions in their simplest form, *pace* Prof. Tait. The resolution and composition of directed quantities follows in a simple manner, on a railroad of mathematical argument, without blowing up any culverts and bridges by such artificial obstructions as Duchayla's demonstration of the Parallelogram of Forces.

The ideal treatise is the judicious combination of the Inwit and Outwit. These Lectures, in their assigned scope of immediate practical application, work as far as possible on the Outwit principle, while there are tendencies in the world of abstract mathematics to exclude Outwit as far as possible, and to proceed entirely by Inwit ; and this latter method interests and commends itself to the philosophic contemplative mind. Thus an increasing gap is arising between the two lines of thought, as the man of action must proceed at once on the available rational theory ; and he will incline to the treatment advocated with so much eloquence in these Lectures on Practical Mathematics. A. G. GREENHILL.

A SYSTEM OF MEDICINE.

A System of Medicine by Many Writers. Edited by Thomas Clifford Allbutt, M.A., M.D., LL.D., F.R.C.P., F.R.S. Vol. v. Pp. xiv + 1056. 71 illustrations ; 7 charts ; 3 plates. Vol. vi. Pp. xi + 944. 44 illustrations ; 3 plates ; 2 tables. Vol. vii. Pp. xii + 937. 34 illustrations ; 3 plates. Vol. viii. Pp. xii + 998. 16 illustrations ; 3 plates. (London : Macmillan and Co., Ltd., 1898–1899.)

PROF. CLIFFORD ALLBUTT is to be congratulated upon having completed what must have been a Herculean task. In a science which changes with the velocity of medicine, the time consumed in the appearance of a work is a very important factor. It is quite conceivable that during the period that must necessarily elapse between the first and the last volume of so monumental a work some discovery in medicine, or the cognate sciences of transcen dental importance, might occur. Such a discovery might affect equally profoundly both the written and unwritten volumes. A system thus astride an epoch-making advance in the subject-matter of its theme might bring the editor into serious embarrassment. In this respect the lot of the present system has fallen in pleasant places. It has been launched into the tide of medical literature without any such contretemps, and the first volume may be considered, from the practical standpoint, as much up-to-date as the last.

In the space at our command it is of course impossible even to enumerate the contents of the four massive volumes before us.

Vol. v. is devoted to diseases of the respiratory and circulatory systems. Dr. Ewart writes two comprehensive articles on bronchitis and bronchiectasis. The monograph on pneumonia is from the pen of Dr. Pye Smith. This article contains an interesting critique of the bacteriology of pneumonia from the standpoint of the physician, and concludes with copious clinical statistics. Dr. Percy Kidd contributes a succinct account of consumption, and what must be regarded as a very fair *résumé* of the different methods of treatment and their results. Dr. Goodhart writes an able account of that enigmatical disease, asthma.

The second part of the volume treats of diseases of the circulatory system. The first three articles of this subdivision are of general interest. Sir Michael Foster contributes an essay on the general features of the blood. The clinical examination of the blood is fully dealt with by Dr. Copeman. In this article the massive literature of this subject is well condensed, no easy task ; the essay is well up-to-date, and should prove most useful in conjunction with its copious and well-classified bibliography, not only to those who are simply interested in the subject, but to actual workers in the field. Prof. Sherrington has condensed much matter into little volume in his article on cardiac physics. What to leave out, and what to put in, in an article upon this subject, in this place, must be a matter of very great difficulty. We think the absolute value of the article has suffered somewhat from its condensation, and that more space should have been devoted to this subject. The physical and physico-chemical aspect of dropsy, which has received very scanty attention elsewhere, might well have been included in it. Functional disorders and mechanical strain of the heart are treated of at length by the editor. Here (p. 847), we notice a misprint ; Prof. Zuntz' collaborator was Geppert, not Goppert. The volume concludes with articles on endocarditis and valvular disease.

In vol. vi. diseases of the circulatory system are continued. Sir Richard Douglas Powell contributes a full account of angina pectoris. After a preliminary division of the cases into two main classes, the author proceeds to give clinical examples. The article concludes with a consideration of prognosis and treatment. Dr. F. T. Roberts writes upon diseases of the mediastinum and thymus gland. The greater part of the author's space is devoted to the interesting and complicated

subject of intra-thoracic new growths, which he handles in a most satisfactory manner. The articles on thrombosis and embolism are from the pen of Prof. Welch, and are treated very fully. A most copious bibliography is appended, amounting to six pages.

An interesting illustration of the essential unity of the nerve muscle machine is afforded by a study of the editor's attempt to consider in two separate sections diseases of the muscles and diseases of the nervous system. How far one can divide, from the standpoint of disease, the neuro from the muscular element is naturally of interest. As a matter of fact, however, it is to be noted that, whereas the division between these two classes of diseases in the general page of contents takes place between the articles upon facial hemiatrophy and general pathology of the nervous system, in the text this is not so, the division occurring between the articles upon erythromelalgia and diseases of the nerves. This may be due, of course, to accident; at any rate, it should be cleared up.

In the section devoted to dise ases of the muscles, Prof. Sherrington contributes a most interesting article upon tremor, tendon-phenomenon and spasm, and Dr. Bevan Lewis one on the general pathology of the nervous system.

Space equivalent to two whole volumes or rather more is devoted to diseases of the nervous system, and the various articles upon the different subjects in this section are very complete. A few monographs are to be found here and there, in appropriate places, upon the general physiology and pathology of the subject. Noteworthy amongst these is Dr. Ferrier's essay upon the regional diagnosis of cerebral disease. In it the chief parts of the brain are considered seriatim, the effect of lesions of them described, some clinical cases given, and a bibliography appended to each section. This latter method will greatly facilitate reference, and might with advantage have been adopted in other instances. Dr. Bastian contributes an able essay upon aphasia and other speech defects. Hysteria forms a subject of an interesting monograph by Dr. Ormerod. The author discusses at some length the hypotheses of hysteria, and criticises the psychical speculations of Janet. Neurasthenia is treated of at length by the editor. He defends the entity of the disease, describing different forms of it according to the organ or set of organs presenting functional aberration. Prof. Victor Horsley writes upon traumatic neurasthenia. Under this term cases of nervous disturbance after railway accidents and other agencies produc ing sudden fear or emotion, &c., are considered. The article should prove useful to the medical advisers of railway companies; it concludes with a suggestive paragraph upon malingering and points of medical jurisprudence.

A section, occupying some four hundred pages, is devoted to mental diseases. In the editing of this section Prof. Allbutt has been assisted by Dr. Savage. Dr. Mercier contributes a philosophical article upon vice, crime and insanity. The volume concludes with a series of essays upon diseases of the skin. A short appendix, comprising an account of the recent researches on the malarial parasite, has been wisely added to supplement Prof. Osler's article on malaria in vol. ii.

The editor and his collaborators must be immensely relieved that so prolonged an effort has finally terminated. The fact that the system is somewhat more bulky than was originally intended can scarcely be considered a disadvantage. Portability is hardly expected of a "system"; further, Prof. Allbutt's work, taking in regard the voluminous increase which has occurred in medical literature in the interim, compares favourably, in so far as bulk is concerned, with its predecessor. It is sincerely to be hoped, and indeed expected, that the book will meet at the hands of the profession with that success which it richly deserves. F. W. TUNNICLIFFE.

THE NATURAL HISTORY OF WHALES.

A Book on Whales. By F. E. Beddard, M.A., F.R.S. With 40 illustrations by W. Sidney Berridge. Pp. xv + 320. (London: John Murray, 1900.)

THE editor of the "Progressive Science Series," Mr. Beddard, has undertaken the preparation of the volume "On Whales." Amongst the mammalia, no order is more remarkable than the Cetacea. The huge size, both in length and bulk, attained by many of the species, their fish-like habitat, the modifications in mammalian structure necessary to adapt them for a life in the water, and the difficulties attendant on their capture, have invested them with an interest which appeals to the popular imagination as well as to the naturalist. In writing this book, Mr. Beddard has had in view the compilation of a volume which, whilst based on scientific lines, should be expressed in language divested as far as possible of technicalities, so that the descriptions might be understood by educated persons generally. In this respect he has succeeded.

In the earlier chapters he describes the most characteristic features in the external form and in the internal structure of whales, and he compares them with other aquatic mammals. In their size, such species as *Balaenoptera musculus* and *B. sibbaldii* are not only the largest of living mammals, but there is no evidence of animals having in past times existed which possessed a greater magnitude, the most gigantic extinct Saurian reptile, or even the Iguanodon, dwindling into insignificance beside these monsters of the deep. The skeleton in the largest species, more especially the skull and spine, is characterised by the bulk of the bones. There seems to be a relation in the thickness of the tegumentary blubber and the quantity of its contained oil to the weight of the bones. In the Greenland Whale the individual bones are much heavier in relation to their size than in the Balænopteridæ, and the blubber is so much thicker in the former, that a *Balaena mysticetus*, without taking into account the much greater value of its whalebone, and estimating only that of its oil, repays the whaling seaman much more than the capture of Sibbald's Whale, although the latter may be from 20 to 30 feet longer. In the Sperm Whale, again, in addition to the valuable oil in the blubber, the cavity in its huge head contains many gallons of the peculiar fat, which, when solidified after the death of the animal, forms the well-known commercial article called spermaceti. The fat with which these animals are so abundantly provided, being of much less specific gravity than the

medium in which they live, enables them, with comparatively little muscular exertion, to float on and near the surface of the water, and to breathe directly the air which is required in mammalian respiration. A feature in Cetacean anatomy is the great capacity of the thorax, the consequent large size and expansibility of the lungs, and the mobility of the ribs, which in the whalebone whales only articulate with the sternum by a single pair. The external configuration of the chest varies in different species; in *B. mysticetus* it is rounded laterally and somewhat barrel-shaped; but in the Finners it is more elongated in the dorsi-ventral diameter, and with a smaller diameter from side to side. In both forms it is capable of great expansion, so that the whale can dive to a great depth and remain under water for a considerable time, until the need arises to come to the surface to expire the contaminated air in the act of "blowing," and to take in a fresh supply.

In the chapters on classification, Mr. Beddard has very properly rejected many of the generic names introduced by the late Dr. E. Gray, who in his later life gave to each species a new generic name, and almost went so far as to regard each skeleton, or part of a skeleton, in the British Museum as representing a distinct species. He has adopted the more restricted nomenclature employed by van Beneden, Flower, Turner, and other recent cetological authorities. His descriptions of the specific characters are tersely put, and can be readily understood even by those who are not trained anatomists. The figures of the species, so far as he has provided illustrations, are characteristic, though in at least five instances his drawings have been made from the series of casts displayed in the Whale-room in the British Museum, the last administrative work discharged by Sir W. H. Flower, and not from the original drawings. We observe, however, that several of our British species are not figured; three species of Balænoptera, the Humpbacked Whale, the White Whale, *Lagenorhynchus albirostris*, and even the common Porpoise, except in its embryonic form, have not been included in the illustrations. This is much to be regretted, as one of the main objects of a semi-popular book of this kind should be to place in the hands of those who live at the seaside a work which will enable them to discriminate the species of whales, examples of which from time to time are stranded on our shores, and not to class them all together, as is too often done, as "bottle noses." How important it is to familiarise people who have some taste for natural history studies, with the means of recognising specific differences, is illustrated by Sowerby's Whale. The first example of this Cetacean was described by James Sowerby from a specimen stranded in 1800 on the shores of the Moray Firth. No further specimen was recognised in Scotland until 1872, since which date two specimens have been obtained in the Shetland Isles, two in the Firth of Forth, and in September of last year Mr. William Taylor secured three specimens—male, female and young—stranded in the Moray Firth only a few miles from the spot where Sowerby's original example was found. On the English coast a specimen was got in 1885 at Spurn-point, and another in 1892 at Overstrand, near Cromer; but we know of only one specimen identified on the coast of Ireland. It is obvious, therefore, that this Cetacean is not so uncommon as was originally supposed. When those who dwell by the sea become more alive to the recognition of the specific characters of whales, we may reasonably hope that other species, now considered rare, may be found to be not infrequent visitors to our shores.

RESEARCHES ON GLYCOGEN.

Microscopic Researches on Glycogen. Part ii. Glycogen of Snails and Slugs, in morphological and physiological correspondence with the Lymph System of Vertebrates. By Charles Creighton, M.D. Pp. 127; 9 coloured plates. (London: Adam and Charles Black, 1899.)

PART I. of this work, which appeared about three years ago, treated of the physiological functions of glycogen. It contained a number of interesting records of microscopic work, and showed that glycogen is present in a number of situations, particularly during embryonic life, in which its presence was previously unsuspected. Claude Bernard, in his classical work on the subject, recognised the presence of glycogen in the placenta and many other embryonic structures, and Dr. Creighton amplified this by more numerous observations. As development progresses, and specialisation of function occurs, the glycogenic function is narrowed down to the liver and muscles instead of being widespread throughout the tissues. Dr. Creighton concluded, on what we regard as insufficient grounds, that the function of glycogen is much more important than physiologists have hitherto considered to be the case. He insists on its "formative" function, by which we suppose he means that it is an all-important or even essential substance in the construction of living matter, and he even assigns to it a respiratory function, believing that in early life it takes the place of hæmoglobin. His proofs of its oxygen-carrying capacity were even less complete than those of its formative properties.

All physiologists admit the importance of glycogen; they would require very stringent evidence, however, before they admitted that it is essential to the formation of protoplasm, or that a carbohydrate is capable of doing the work of a complex nitrogenous and iron-containing material like hæmoglobin. It is regarded rather as a storage or reserve product, part of the cell-contents rather than part of the cell-substance, and its use is doubtless principally by its subsequent combustion to contribute to the liberation of energy in the form of molar and molecular movement, work and heat.

In Part ii., which is now before us, we have as before a very elaborate series of microscopic observations, undertaken with infinite pains, and illustrated by excellent drawings. It treats of the various invertebrate classes, and shows the presence of glycogen in numerous situations; the work of others in the same connection has been collected with care. The proof that the substance is always glycogen would have been more complete if the observer had not limited himself to one test, namely, the micro-chemical reaction with iodine. Still, if we regard this as trustworthy, we have before us a valuable collection of observations which show how

widespread the distribution of glycogen is, and we may safely draw the conclusion that its function is extremely important.

As before, however, we hesitate to follow Dr. Creighton in his speculations regarding the nature of these functions. For in addition to its formative and respiratory functions, the multifarious duties of lymph are now ascribed to this single and comparatively simple material. The arguments that lead to this startling conclusion are extremely curious to follow. He finds that in snails and slugs which have been specially worked at, glycogen is chiefly deposited in certain connective tissue corpuscles, which are designated plasma cells. These are principally arranged along the course of the blood-vessels, and in some instances they form a complete coating to the vessels. This is considered to indicate the existence of a primitive lymphatic system. If this is so, there should be evidence in the higher molluscs that this becomes more perfect, and the different stages in the evolution of the lymphatic vessels should be capable of demonstration. There is, however, no attempt to do this ; in fact, it is admitted that in the highest molluscs, the cephalopods, which have a very perfect vascular system with arteries, veins and capillaries, this arrangement of the plasma cells does not occur, and these animals have little or no glycogen in their tissues. Moreover, if the arrangement and chemical construction of the plasma cells of the snail has the great morphological value attached to it by Dr. Creighton, it is remarkable that it is not found throughout the class of gastropod molluscs, to which the snail belongs ; it is apparently limited to quite a few members of the group. So much importance is attached to this idea by the author, that he almost seems, though his words are not quite clear on this point, to assume that the snail and slug are, in the line of descent, very near ancestors of the vertebrate family. There is no attempt to show the links in the chain, nor to explain why an exceptional and almost accidental arrangement of connective tissue cells in one or two isolated molluscs should confer this honour upon such isolated specimens. We do not think that a theory of this kind will do much to shake the thoroughly well-grounded work of Haeckel and other morphologists.

To the physiologist the next conclusion drawn will be even more startling ; it runs as follows : if the plasma cells represent a lymph system, the glycogen of those cells must represent lymph. It hardly seems worth while to argue against such an unwarrantable suggestion. Any other constituent of the plasma cells might equally well have been selected. Lymph is a complex fluid acting as a middle-man between blood and tissue elements ; it is contained in spaces between and around the cells, not in the interior of their cell-substance. If one seeks for an analogy between the two mobile fluids of the vertebrate, in the invertebrates it will be found much more easily in many members of the worm group which have coloured blood in their vessels, and colourless fluid in certain parts of their body-cavity.

Dr. Creighton's production, therefore, though interesting as a record of observations, is most disappointing so far as conclusions are concerned. Wide, sweeping, almost revolutionary theories are advanced without a shred of real evidence to support them. If the book serves no other purpose, it will at least act as a warning example of the danger of drawing hasty generalisations from imperfect data, data gathered from the exclusive study of one particular small point with one exclusive method.

OUR BOOK SHELF.

The Elements of Alternating Currents. By W. S. Franklin and R. B. Williamson. Pp. 212. (New York : The Macmillan Company. London : Macmillan and Co., Ltd., 1899.)

IN this book will be found a very fair *résumé* of the theory and practice of alternate current working, and of the modern developments associated with the use of polyphase currents and the induction motor.

It is interesting to compare a work such as the present, characteristic as it is of American methods, with similar works published in this country. Messrs. Franklin and Williamson's treatment of their subject is distinguished by conciseness, and by the almost total exclusion of anything of historical interest, though the authors, in the preface, acknowledge their great indebtedness to Steinmetz, "whose papers are unique in their close touch with engineering actualities." The beginner will, perhaps, find that the brevity of treatment renders the theory, and the usually excellent graphical constructions, here and there obscure. But, on the other hand, the comments upon the practical aspect of each question taken up are of great value, especially to readers in this country, where experience with polyphase currents is limited to some half dozen installations of but few months standing.

Continental engineers, accustomed to use the well-known Hartmann and Braun instruments, will be astonished to learn that "the only hot-wire instrument which is much used is the Cardew voltmeter." Under the heading "Revolving Contact Makers," the only form described is that using a jet of conducting liquid making contact with a revolving pin connected through the shaft of the alternator ; while the much more convenient form with two brushes and a revolving piece of metal let into an insulating disc, which enables an electrostatic voltmeter to be momentarily connected across *any* two points in the alternator circuit, is not mentioned.

The chapters relating to the theory of the synchronous motor, the rotary converter and the induction motor contain information not easy to find elsewhere in accessible form. The short concluding chapter on the transmission of power, however, lacks a simple statement of the relative amounts of copper required by different systems of electrical transmission, and the respective merits of these systems as regards regulation.

Much information is to be found in this book in small compass, and it will prove of value to engineers engaged in alternate current practice. D. K. M.

Oysters and Disease : An Account of Certain Observations upon the Normal and Pathological Histology and Bacteriology of the Oyster and other Shellfish. By Profs. W. A. Herdman, D.Sc., F.R.S., and R. Boyce, M.B. Lancashire Sea Fisheries Memoirs. No. 1. Pp. 60 ; 8 plates. (London : George Philip and Son, 1899.)

THE monograph before us gives the results of three years' work by the authors on oysters and disease. This thesis is, of course, by no means new to either the general scientific reader, the medical officer of health, or, indeed, the general public. Oysters have for several years been suspected, and, indeed, in some cases almost proved, to be the source of typhoid fever. A most interesting report was issued upon this subject by the Local Government Board, which, if the reviewer remembers rightly, was

fully noticed in these columns. As the readers of NATURE are probably aware, as a result of this report, an Oyster Bill has been laid before Parliament.

So far as the present memoir is concerned, it may be divided into two parts. The first part deals with the "greenness" of oysters. This appears to be due in different kinds of oysters to different causes. In certain oysters it seems undoubtedly connected with the presence of an excess of copper; and so far as the Falmouth oyster is concerned, the authors confirm the earlier work of Prof. Thorpe in this connection. From the general histological standpoint, it is interesting to note that the authors found Macallum's hæmatoxylin method to be a very delicate test for copper as well as iron. But the presence of "greenness," even when connected with copper, does not necessitate the oyster in question being unfit for food. Some "greenness" has no relation with the presence of copper, as, for instance, in the case of Marennes oysters.

With regard to the bacteriology of oysters from the standpoint of disease, the monograph does not contain any very important additions to our knowledge. So far as concerns the subject of deepest interest to the public, namely, the relation between oysters and typhoid fever, the general reader will be relieved by Conclusion 12, p. 54:—

"Although we did not find the *Bacillus typhosus* in any oyster obtained from the sea or from the markets, yet in our experimental oysters, inoculated with typhoid, we were able to recover the organism from the body of the oyster up to the tenth day. We show that the typhoid bacillus does not increase in the body or in the tissues of the oyster, and our figures indicate that the bacilli perish in the intestine."

Scientific Papers. By John William Strutt, Baron Rayleigh, D.Sc., F.R.S. Vol. i. 1869–1881. Pp. xvi + 562. (Cambridge: At the University Press, 1899.)

THE publication of collections of scientific papers serves a three-fold purpose. It renders easy of access scattered papers for which search would otherwise have to be made through a considerable mass of proceedings, transactions and journals; it furnishes a history of the part played by the author of the papers in the onward progress of scientific knowledge, and it affords an insight into the thoughts which the author has put into writing at various stages of his lifetime. To adequately serve the last object the collection must be comprehensive, and no paper should be deemed too short or of too passing interest to be included in the series. We cannot do better than quote Lord Rayleigh's remarks on this point in the preface:—

"Some short papers of a rather slender character have been included: these may serve to mitigate the general severity. In consulting similar collections I have usually felt even more grateful for the reproduction of short and often rather inaccessible notes than for the larger and better-known memoirs."

Even the questions set by Lord Rayleigh in the Mathematical Tripos for 1876 are here reprinted, and the pages containing these will, we are certain, be well fingered in the copy which finds its way into the Cambridge University Library.

An analysis of the seventy-eight papers in the present volume, and which represent Lord Rayleigh's work in the period 1869–1881, gives the following results:—Acoustics and vibrations, 24 papers; optics, 23; hydrodynamics, 9; electricity, 6; dynamics, 5; pure mathematics, chiefly harmonic analysis, 6; various, 5.

It will be seen that the main portion of Lord Rayleigh's work in this period deals with sound and light. Many of the papers on the former subject have been included in his well-known "Theory of Sound," and are not reproduced; but readers of the latter book will learn from the references here given how much of the theory is due to Lord Rayleigh himself. We need only refer to the theory of resonance, the general theory of vibrations and its particular case of "approximately simple systems," the pitch of organ pipes. Of optical papers, the best known are Lord Rayleigh's investigations on the scattering of light by small particles, and on the colour and polarisation of the sky. We have also in the present volume papers on the construction of diffraction gratings and their reproduction by photography, experiments on colour, and optical investigations relating to the spectroscope. Lord Rayleigh's hydrodynamical papers on the stability and instability of jets are well known. The last paper in the volume is that on the infinitesimal bending of surfaces of revolution, which subsequently formed the subject of discussion at the hands of Prof. Love. The volume will be a welcome addition to our libraries, as will be those to follow containing Lord Rayleigh's later papers. G. H. B.

Ueber das System der Nagethiere; eine phylogenetische Studie. Von Tycho Tullberg. Pp. v + 514; 56 plates. (Upsala: Berling, 1899.)

THIS separately published memoir, with its own pagination, is an excerpt from the *Nova Acta* of the Royal Society of Upsala. It is not too lengthy for the due treatment of the subject, and it is very copiously illustrated. Dr. Tullberg has performed a useful piece of work in bringing together the bulk of what is known about the rodents into one comprehensive monograph; his proceeding might be well imitated for other orders, in view of enormous and increasing literature. The present memoir, however, is not a compilation in any sense of that word. The first part, which is rather more than one-half, consists of a series of descriptions of a large number of species of rodents examined by the author. These descriptions are quite full, and deal with external, as well as internal, characters. In some of the facts there detailed, we observe that the author is at variance with the statements of others. For example, he does not distinguish the two genera of Lemmings, which are a little apt to be confused, by the occurrence or non-occurrence of fur upon the soles of the feet. At this moment we are unable to confirm or to dispute his correction of current statements. The list of literature is an abundant one; but the author seems to have overlooked Mr. Beddard's paper upon the rodent brain, and Mr. Parson's account of the anatomy of the little known Cape Jumping Hare, Pedetes. Perhaps the MS. of the work was in type before the appearance of the last of these papers. The scheme of classification adopted by the author will not commend itself to all. The Sciuromorpha and Myomorpha of many are associated into a tribe, Sciurognathi, which is contrasted with the only other tribe of "simplicidentate" rodents, viz. Hystricognathi. The genus Pedetes, to which we have referred, is placed in the former, a view which we do not share. We would also follow Mr. Thomas and regard the genus Bathyergus as belonging to the Myomorpha, and not to the "porcupiny" rodents, where Dr. Tullberg places it. The criticisms, however, do not affect the general merits of this important contribution to our knowledge of the mammalia. F. E. B.

A Surgical Operating Table for the Horse. By J. A. W. Dollar, M.R.C.V.S. Pp. vi + 42. (Edinburgh: David Douglas, 1900.)

VETERINARY surgeons are well aware of the difficulty of controlling horses during operations. Mr. Dollar describes the methods in general use, and various operating tables used in France, Germany, Spain and elsewhere. A table devised by him, and described in detail, is a machine by means of which a horse can be supported in any position and operated upon. Numerous illustrations show the table in different positions during the actual progress of veterinary operations.

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 Eclipse-Wind.

ALTHOUGH meteorological observations during total eclipses of the sun are of secondary importance, the changes of temperature and humidity being well known, yet it is still uncertain whether those changes do occur in atmospheric pressure, and, consequently, of wind, which, theoretically, ought to result from the sudden chilling of the air by the passage of the moon's shadow, and the consequent increased barometric pressure out of which the wind should blow in all directions.

The letter of Mr. J. W. Evans, in NATURE of December 28, 1899, describing his observations during the Indian eclipse of 1898 is an interesting contribution to the subject of the "eclipse-wind," and brings to mind the special investigations undertaken by Prof. Winslow Upton and myself during the total solar eclipses of August 19, 1887, in Russia, and of January 1, 1889, in California, the results of which are described, respectively, in *Amer. Meteor. Journal*, vol. iv., and in *Annals Astron. Observatory of Harvard College*, vol. xxix. No. 1. Aneroid barometers, including a recording instrument, all with open scales, were used, and, in addition to the anemometer, a recording wind-vane was taken to California. There the sky was clear, but in the Russian eclipse it was heavily clouded. As regards the atmospheric pressure, it must be said that, while in both eclipses minute rises occurred during the total phase, yet they cannot be attributed with certainty to its influence, since similar fluctuations occurred on other days. As regards the wind, the eclipse appeared to produce an appreciable effect, for the wind backed (contra-clockwise) before totality, and veered (clockwise) to its original direction afterwards, its velocity diminishing as the eclipse progressed. This is what would be expected to happen at a station situated near the central path of a shadow moving north-east. In both eclipses it was nearly calm during totality.

With the hope of settling these questions, the writer joined the Harvard Observatory party that observed the total solar eclipse of April 16, 1893, in Chile, where not only was clear weather assured, but the regular diurnal period of the barometer afforded an excellent opportunity to study any non-periodic disturbance due to the eclipse. Besides the previous instruments, Richard's "statoscope," or differential barograph, was employed, with which, when the temperature is kept constant or allowed to change at a uniform rate, variations of pressure approximating 0·025 millimetre (1/1000 inch) of mercury are recorded. In order to secure a free exposure in all directions for the observations of wind, the station was located on the summit of a mountain. Notwithstanding perfect conditions—the day being clear, and a counterpart of those preceding and following—no unusual changes in pressure during any of the phases of the eclipse could be detected, and if any variation occurred, it was insufficient to disturb the regular diurnal period, and must have been of the order of a thousandth of an inch. The record of wind-direction again showed a backing of the wind prior to totality, and a veering round afterwards; but as these oscillations were not infrequent at other times, they cannot be ascribed certainly to the eclipse. The wind reached its minimum velocity soon after the first contact of the moon's limb, and steadily increased until after the fourth contact.

While these observations seem to prove that any change in the atmospheric pressure during a total solar eclipse is so small as to escape measurement, yet there does appear to be evidence of changes in the wind. Mr. Evans observed a contrary rotation of the wind to that described above; and the reports of the changes in wind during many eclipses, which were collected by the late Mr. Ranyard (*Memoirs Roy. Astron. Soc.* vol. xli. chap. xxxv.), are very contradictory.

Therefore, it would be interesting if, on May 28, observers along the path of totality in the United States and elsewhere would make frequent observations of the direction and strength of the wind. Still more valuable data could be obtained from a few self-recording wind-vanes and anemometers exposed high enough above the ground to be free from local influences.

A. LAURENCE ROTCH.

Blue Hill Meteorological Observatory, U.S.A., April 3.

Lord Kelvin's Origin of Granite.

IT is a sound maxim that if you want a thing done you must do it yourself. So, as no expert has replied to my query as to the soundness of Lord Kelvin's theory of granite, propounded in my letter of February 23, I have consulted a big Dana's "Mineralogy" with the following results.

It may be premised that Lord Kelvin assumes for his liquid lava a specific gravity of 2·50, but as according to Dana the basaltic lava of Kilauea is in one case as high as 3·20, the primeval liquid lava may have averaged 2·60.

Although 2·50 will work out well enough, 2·60 is much more striking as an illustration of the effect of the assumed convection currents upon volcanic minerals.

The following is a list of volcanic minerals in the order of their density, with a rough indication of their composition so far as soda, potash, lime, magnesia and iron are concerned:—

Nosean	...	Soda	... 2·25–2·40
Hauyne	...	Soda-lime	... 2·24–2·50
Leucite	...	Potash	... 2·44–2·56
Nepheline	...	Soda	... 2·50–2·65
Sanadine	...	Potash	... 2·56
Labradorite	...	Lime	... 2·67–2 76
Amphiboles	...	Magnesia, lime, iron	... 2·90–3·40
Pyroxenes	...	Magnesia, lime, iron	... 3·23–3·50

Free silica is represented by tridymite 2·28–2·33, instead of by the heavier quartz.

If we take 2·60 to be the specific gravity of the primeval liquid lava, the division between crystals that would float and those that would sink comes between sanadine and labradorite. Some little allowance should be made for expansion on heating.

According to these specific gravities, it would appear that the snow shower produced by the convection currents would not have the effect of silting up the lava ocean with granitic crystals set in a mother liquor of basalt, but would have the effect of differentiating the lava into light and heavy strata, until the convection currents themselves would be checked and the surface stratum, composed largely of potash and soda silicates, left free to freeze. And, we may note, that the upper stratum is composed of the raw materials of granite, while the lower stratum is composed of the raw materials of basalt.

At this point geology and petrology commence work, and what subsequently befals the primeval crust, after the advent of water and sediment, may be read between the lines of the great works of MM. Daubrée, Fouqué and Lévy.

The question of a floating crust affects no doubt the problem of the age of the earth, but that is beside my point, which is strictly confined to the origin of granite.

Torquay, April 3. ARTHUR ROOPE HUNT.

Is New Zealand a Zoological Region?

IN your issue of January 11, Mr. H. Farquhar wrote drawing attention again to the incongruity of associating New Zealand with Australia in a zoo-geographic sense. He correctly insists that the New Zealand fauna is *not* most closely allied to that of North-east Australia (Queensland). It is significant that those writers who advocate the alliance of New Zealand to Queensland have not seen either country, while those who deny such relationship have studied or travelled in both or either areas. No observer who had a first-hand knowledge of the two countries could agree with Dr. Sclater that "it is probable that the whole fauna of New Zealand has been originally derived from" Australia.

In the following number (p. 273), Dr. A. R. Wallace, writing in support of his own and Dr. Sclater's views, does not demonstrate or reaffirm their accuracy, but merely lays stress upon the inconvenience of an opposite view.

That an error is convenient is no good reason for its maintenance. Regardless of the direction in which they point, our first care must be the accuracy of facts and deductions.

But, as Dr. Wallace implies, there may be fairly laid upon destructive critics the burden of restoring by constructive work the effects of their ravages. "If," says Dr. Wallace, "antipodean naturalists restrict the 'Australian Region' to Australia and Tasmania, what shall be done with the remainder of his own Australian Region?" I have proposed (*Journ. Malacology*, iv. 1895, p. 55) that New Zealand, New Caledonia and neighbouring groups (inclusive certainly of the Solomons, perhaps of New

Guinea) might be collected into a Melanesian sub-region, and subordinated to the Oriental Region. Since I have elaborated these views in another place, I will here limit my argument to a couple of supporting references.

(1) When Dr. Wallace first returned from his Eastern travel his impression of a natural region was one "extending from the Nicobars in the north-west to San Christoval, one of the Solomon Islands, on the south-east, and from Luzon on the north to Rotti, at the south-west angle of Timor, on the south" (Report British Assoc. 1863, *Trans.* p. 107).

(2) Dr. W. Botting Hemsley has stated: "There is no doubt that the combined Fijian, Samoan and Tongan flora is eminently Malayan in character" (*Journ. Linn. Soc.* Botany, xxx. p. 211).

To map New Zealand thus as an extreme and impoverished outlier of the Oriental or Malayan Region would express but a part of her affinities, since it would ignore the Antarctic relationship. But zoo-geographic problems are too complex to be expressed in terms of colour on a map. If, however, New Zealand and related areas must be forced into one or other of the recognised divisions, then I submit that this arrangement would do less violence to nature than that accepted in the text-books.

Australian Museum. CHARLES HEDLEY.

Mercury Jet Interrupters.

MY attention was attracted recently by a brief notice that appeared in NATURE of March 1 (p. 421) of a new form of mercury jet interrupter devised and placed on the market by Messrs. Isenthal, Potzler and Co.

As that form of break appeared to be of interest to the readers of NATURE, a short description of one that I designed some months ago, along similar lines, may be of interest to some.

While experimenting with wireless telegraphy an interrupter of great frequency of break seemed desirable, and as I wanted also to know the rate of interruption accurately, it was deemed best to use some form of mechanical one. After investigating several kinds, the following one was finally decided upon as the most promising:—

An iron vessel, arranged as a Mariotte flask to maintain a constant head, holding about a pint of mercury, formed one terminal and a metallic plate the other. The plate was arranged below the vessel, and the mercury fell upon it, completing the circuit. In the bottom of the flask was a row of ten holes, arranged around in a circle, with nozzles fitted into them. On a vertical shaft, concentric with the row of nozzles, a series of mica sectors were arranged, so that, when revolving, they would cut the mercury jets falling from the vessel above. These strips were placed with the line of their edges parallel to the axis of the shaft. Thus they would break the circuit in several places at the same instant, giving a very sharp break.

It was found better to break the circuit by interposing an insulator than to break by opening the circuit with a conductor, as the wear at the spark tended to keep them all equal, so they automatically adjusted themselves to the best positions.

The object of the row of jets was to get a more rapid interruption. To break a single jet in five or six places simultaneously, and at the same time with a satisfactory frequency, was found to require too great a head and velocity of jet to be practicable, so by adopting a row of ten the frequency could be increased that many times. These jets are all in parallel, and when the mica strips are revolving the head is so adjusted, by the Mariotte flask arrangement and screws on the sides of the reservoir, that at the instant of interruption of one jet, all the others are in a state of interruption; but the one directly in front of the mica strips will be the first to make the circuit. Thus it continues to break at a rapid rate.

Greater rapidity of break can easily be obtained by increasing the speed, by increasing the number of nozzles, by increasing the number of sets of mica strips, or by any combination of the three.

This form of interrupter will be found quite useful to any one desiring a known rate, high frequency interrupter.

S. M. KINTNER.

Western University of Penna, Allegheny, Pa., April 2.

Tyndall's Ice Crystals.

WOULD you, or some of your readers, kindly inform me whether the ice crystals, as shown in Tyndall's "Form of Water," p. 33, are considered to represent skeleton crystals or solid ones arranged in patterns? J. A.

Tunbridge Wells, April 14.

MARINE ZOOLOGY IN AUSTRALIA.[1]

IN these columns was noticed recently the admirable activity of the various Australian museums in making known to science the natural objects of southern lands and seas. On that occasion it was an important addition to our knowledge of mammalian palæontology—Prof. Stirling's description of *Diprotodon* remains—that was especially under discussion. Now we have to record equally important investigations in marine zoology undertaken by the staff of the Australian Museum, Sydney.

Besides "guides" and "miscellaneous publications," the Sydney Museum issues a series of "records" for minor papers; "catalogues," which are large and fully illustrated, contain descriptions of many new species, and are really in some cases monographs; and "memoirs," such as the natural history of Lord Howe Island (1889); that on the Atoll of Funafuti more recently, in ten parts; and, finally, the "Scientific Results of the Trawling Expedition of H.M.C.S. *Thetis*," of which Part i. is now before us. From the introduction, by Mr. Edgar R. Waite, we learn that this expedition was the outcome of a desire on the part of the Government of New South Wales to investigate the trawl fisheries of their coast. In 1898 H.M.C.S. *Thetis* was commissioned, the expedition was financed by the Colonial Government, and an experienced North Sea trawler was obtained, upon whose skill depended the successful working of the apparatus. Finally, the Trustees of the Australian Museum were asked to appoint one of their officers to join the expedition, and Mr. Waite was selected to act in that capacity. He tells us how a large and valuable collection was obtained and preserved (not without considerable difficulty, as experience showed that the *Thetis* was a most unsuitable vessel for the purpose), and promises that the various groups will be dealt with in detail by members of the museum staff in succeeding parts of the memoir. An "Addendum to the Introduction" on fishing with electric light—not yet brought to perfection—concludes with the sentence: "I lowered an incandescent lamp in a tow-net, and obtained a number of small invertebrates, thus reproducing the experiments conducted at the Liverpool Biological Station" (p 132). He does not tell us what the forms were which were obtained in the illuminated net. In the Liverpool experiments they were all actively swimming forms provided with eyes.

The remainder of the present part contains Mr. Waite's report upon the fishes. One hundred and seven species were taken, representing ninety-five genera, including one new genus, viz. *Paratrachichthys* (formed for *Trachichthys trailli*, Hutton). Nine new species are described, a number of others are new records for the colony. But it is very evident that, as Mr. Waite says, "the interest of the results is, however, not exhausted by an enumeration of the new or rare species; the expedition has been the means of materially extending the known range, both geographically and vertically, of several of our common food fishes. The breeding season of one or two species has been ascertained, . . . and our knowledge of the habits of the soles has also been extended." As the trawling was for the most part not carried on in really deep water, but within the limit reached by line fishermen, the scientific and economic success was all the more marked. As an example of the latter may be taken the information as to *Zeus australis*, a rare and valuable food fish, which was found under circumstances indicating that it may yet take its place as a popular and cheap food fish.

Of the nine new species described, perhaps the most interesting is the "ghost-shark" (*Chimaera ogilbyi*),

[1] Australian Museum, Sydney. Memoir IV. "Scientific Results of the Trawling Expedition of H.M.C.S. *Thetis*," &c. Part i. Pp. 132; 31 plates, frontispiece, and a chart. (Sydney, 1899.)

this being the first record of the genus south of the equator in the Eastern Hemisphere—seven specimens were taken, all, unfortunately, females.

The results of this expedition are evidently such as to encourage the Colonial Government in continuing the work, as Mr. Waite has been able, not only to add to scientific knowledge, but to obtain much information directly bearing on the fisheries. If all of our Sea Fishery Districts Committees were to combine in carrying on similar operations round our own coast, notable progress would be made towards obtaining that approximate "census" of our territorial waters which is required for the solution of both scientific and economic problems.

W. A. HERDMAN.

THE ORIGIN AND OCCURRENCE OF CAVE-ICE.

ALTHOUGH ice-caves and their phenomena present some of the most interesting problems in the whole range of physical geography, it is singular to note how comparatively little attention has been directed to their investigation, and how inadequate still is the sum total of observation and experiment hitherto carried out, for the full elucidation of the many questions which arise in connection with their study. A recent investigator in this field of research is Dr. Hans Lohmann, who, in an admirable treatise on cave-ice ("Das Höhleneis unter besonderer Berücksichtigung einiger Eishöhlen des Erzgebirges," Jena, 1895), has brought together the results of previous work on the subject, and incorporated an account of his own observations in the ice-caves of Saxony. It is here only possible to set forth in the merest outline some of the more interesting facts connected with these natural ice-stores, and to indicate in brief the theories that have been advanced to account for some of their phenomena.

Ice-caves have been defined as natural or artificial cavities in the earth, in which ice, formed within them, is preserved either the whole year round or for a greater part of it. They may be roughly divided into two classes, termed by Thury "static" and "dynamic," or, according to Fugger, the ice-caves properly speaking and the "wind passages." The first are blind caves with only a single outlet, while the caves of the second class have connection by passage or cleft between their inner end and the outside air at some point in the hillside higher than the main entrance. Almost all known ice-caves are situated in the north temperate zone (roughly, between 40° and 60°), and the few exceptions which lie nearer the equator are so highly situated that in winter the temperature within them falls below the freezing point. Generally speaking, the caves do not lie in high mountain regions, though all are located where snowfall is possible.

The causes which bring about the formation of the ice are to be looked for solely in the meteorological and climatic conditions of the localities in which the caves occur. In the case of blind caves, the floor of the cavity is situated at a lower level than that of the entrance, and when the outer atmosphere becomes cooled below the temperature of the inner air, the former, by reason of its greater density, sinks into the cave, slowly displacing the contained air and thus giving rise to an air-current which brings about the chilling of the cave. When the outside temperature rises, that of the cave begins to rise also, but only slowly at first, because the warmer outside air possessing a smaller specific gravity can no longer sink into the cave, and the heat is conducted to the interior very slowly. During such periods (the "closed periods" of Trouillet) a temperature curve, shown by a registering thermometer placed within the cave, assumes the form of an almost straight line. The inner temperature then lingers for a long time in the neighbourhood of the freezing point, but rises again with comparative rapidity when all the contained ice is at last melted.

The cold produced by evaporation within the cave also tends to lower the temperature, and in those ice-caves classed as "wind passages" the influence of evaporation in this direction is very marked. While in summer the air contained in the blind caves is perfectly still, a strong air-current is found to prevail at this season in the wind-passages. It has been observed that when the outer temperature was considerably higher than that within, the wind-stream was passing outwards; at such time as the inner and outer temperature were alike, the current was intermittent or not observable; but when the outer temperature was lower than the inner, the draught was passing inwards. In such cases we have two separate air columns of equal height, one situated within the mountain, the other formed by the outer atmosphere. As soon as a difference of temperature in the two columns is brought about, the tendency to restore equilibrium gives rise to the air-current through the cave, as a result of which the latter becomes cooled in the winter and gradually warmed during the summer. But the downward current which prevails in summer may sometimes bring about a considerable cooling within the cave through evaporation, and if the outer air be very dry the formation of ice may even take place. Systematic observation has made it clear that the potent factor in the production of ice within the caves is the air-current.

The ice itself, formed principally during the spring-time, when the conditions of temperature and water supply are most favourable, is distributed in a varying manner; it may clothe the floor, the walls and the roof as a close-fitting sheet, or may hang in curtain-like form from the roof, or give rise to the formation of ice-stalactites and stalagmites, according to the distribution and manner of the water supply from above.

In connection with the thawing of ice-stalactites, an interesting phenomenon may sometimes be observed. Since the collecting point of the drip which gave origin to the stalactite is situated in the centre of the base of the latter, the thawing action of the water from above may proceed in such a way as to eat out the centre of the stalactite, leaving its peripheral parts hanging as a mere shell or tube. This has been explained by the fact that the warmer water introduced, having a greater specific gravity than water at the freezing point, will tend to sink to the base of the little hollow formed at the root of the stalactite as a first result of thawing, and thus rapidly carry out its work as a vertical borer.

But perhaps the most interesting phenomenon exhibited by cave-ice, to the description and elucidation of which Dr. Lohmann has devoted special attention, is the peculiar structure known as the "prismatic" or "honeycomb" structure. At certain times the surface of the ice is found to be broken up by a net-like system of fine crevices, resulting in the production of meshes of varying and more or less irregular form. It has been found that, strictly speaking, this structure does not appear during the winter, nor does its formation occur in all cases at the same time of the year. While in some caves this splitting process has never been observed to take place before the end of August, the ice in the caves of Saxony have exhibited the structure in an advanced stage as early as the month of March. The size of the meshes is very variable, and they may reach dimensions so great as 400 square centimetres, or be so minute as to be observed with difficulty by the naked eye. The crevices may be merely superficial, or may penetrate the ice to a depth of several centimetres, there to cease abruptly, and thus give rise to a superficial "prismatic layer" sharply separated from the compact ice beneath. But the development of honeycomb structure often proceeds so far that a thin ice-sheet is completely penetrated

by the net system, in which case the meshes on either surface of the ice-plate are of equal size.

As to the explanations which have been offered to account for the formation of the honeycomb structure, no theory seems to have been recently proposed which is not based upon that of Robert Emden, who supposed

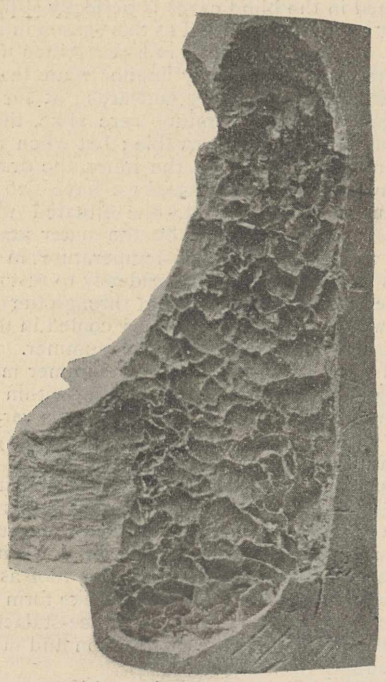

FIG. 1.—Structure of exposed surface of wall-ice.

that in all ice masses exposed for some time to a temperature neighbouring on the freezing point, the minute first-formed crystals, even when possessing an irregular original arrangement, tend to undergo a complete rearrangement, and to form crystal units of ever-increasing size, having similarly directed axes. The dimensions to which these new crystal units will attain is determined by the temperature variations. Should the temperature rise and a thaw set in, those portions of the ice where the individual crystals are in contact with one another will be the first to be attacked, and the melting process will produce the appearance of the net system.

Since the rock in which the caves or drifts are formed always possesses a somewhat higher temperature than the air within the cavity, the coalition of the individual ice crystals in contact with the cave wall will take place at a somewhat earlier period than that of the crystals on the exposed surface of the wall-ice, for the inner side will be sooner raised to a temperature closely approaching the freezing point. But in like manner, as the general temperature rises, the inner surface of the wall-ice will become exposed to the action of actual thawing earlier than the free outer surface, and the development of the growing crystal units—the groundwork for the "cells" of the honeycomb structure—will receive an earlier check on the inner surface than on the free surface. This explanation has been given to account for the fact that the meshes in contact with the rock are smaller than those exposed to the cave air, as shown in the accompanying illustrations reproduced from Dr. Lohmann's paper, for which photographs were obtained from plaster casts of the ice surfaces.

But Emden's theory, as briefly sketched above, does not seem to explain certain facts observed in connection with the "prismatic" structure shown by some forms of ice. The peculiar form of the network developed, for instance, on the surface of an ice-stalactite, with its radially arranged tiers of "cells," requires further explanation. Lohmann ascribes an important part in determining the arrangement of the "cells" to the expansion and contraction of the ice under changes of temperature. Since the coefficient of expansion of ice is great, the surface when exposed to variations of temperature will undergo a splitting process, which will result in the production of so-called "elementary cells." These will then become crystal units (if not already such) by the process of coalition which Emden supposed to occur, and the ultimate dimensions of the prismatic structure are then

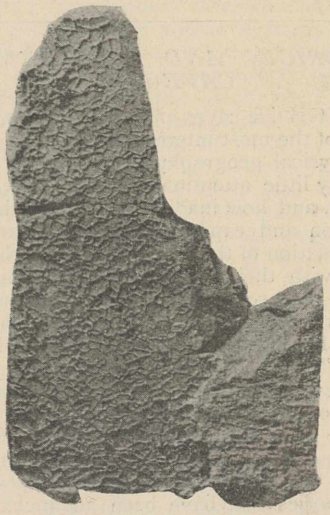

FIG. 2.—Structure of ice surface in contact with rock.

finally determined by a rise of temperature, forming spaces between the "cells" as above indicated. But while this improved theory seems to offer a fuller explanation of the observed facts, final proof of its value as a sound hypothesis is only to be sought in the evidence of further experimental investigation.

F. L. K.

NOTES.

PROF. A. A. MICHELSON, professor of physics in the University of Chicago, has been elected a correspondant of the Paris Academy of Sciences.

THE first meeting of the International Conference for the Protection of Wild Animals in Africa will be held at the Foreign Office on April 24. The British representatives will be the Earl of Hopetoun, G.C.M.G., Sir Clement Hill, K.C.M.G., C.B., head of the African department of the Foreign Office, and Prof. Ray Lankester, F.R.S., director of the Natural History Museum.

TO encourage the study of aërial navigation, a member of the Aéro Club of Paris has given the sum of 100,000 francs, to be awarded as a prize to the inventor of an efficient aërial machine. The test to be applied is that the machine shall travel from the grounds of the Club, or from the hills of Longchamps, to the Eiffel Tower, and then to return to the starting point. The length of the whole journey is about eleven kilometres, and it has to be accomplished in half an hour or less. The competition is international, and the offer will remain open for five years from the middle of the present month. The interest upon the sum placed at the disposal of the Club will be awarded annually for

works or inventions bearing upon the problem of aërial navigation. Further particulars can be obtained from the secretary of the Club, M. Emmanuel Aimé, 48 rue du Colisée, Paris.

IT is proposed, in recognition of the great services rendered by the late Dr. D. G. Brinton to anthropological science by his teachings, numerous publications, and untiring zeal, to establish in his memory a Brinton chair of American Archæology and Ethnology in the University of Pennsylvania. At a memorial meeting held in January, the plan was favourably mentioned and grateful recognition was accorded to Dr. Brinton's unselfish devotion to his chosen life-work. The place selected for the chair seems especially appropriate, since the University of Pennsylvania now possesses Dr. Brinton's valuable library, his own gift shortly before his death. The association of Brinton's name with the University from 1886, when the chair of American Archæology and Linguistics was created for his occupancy, may in this way be made permanent. In order to accomplish the proposed plan, it will be necessary to secure an endowment of 50,000 dollars from individual sources. Patrons of science and others interested in the scheme should communicate with the Brinton Memorial Committee, 44 Mount Vernon-street, Boston, Mass., where further information is to be obtained if desired. Messrs. Drexel and Co., Bankers, Philadelphia, have consented to act as treasurers of the fund being raised.

WE regret to see the announcement of the death of Sir William Priestley, the distinguished physician, at seventy-one years of age. His father was a nephew of the discoverer of oxygen. Sir William Priestley received his medical education in London, Paris, and Edinburgh, and graduated as M.D. at the University of Edinburgh in 1853. He was a Fellow of the Royal Colleges of Physicians of London and Edinburgh, and of the Linnean Society, and also a member of several other learned associations. He published several works on natural history and medical science.

AT a meeting of the Liverpool Geological Society, held on April 10, reference was made to the death of Mr. G. H. Morton, whose services to geology were briefly described last week (p. 571). The following resolution was passed:—"That the members of the Liverpool Geological Society desire to record their deep sense of the loss which they and geologists generally have sustained in the death of Mr. George Highfield Morton. Mr. Morton was founder of the Society, serving it for many years both as president and honorary secretary, and up to the time of his decease he was a constant and highly-valued contributor to its *Proceedings*, enriching them with the results of his untiring energy and devotion to geological science. Whilst deeply regretting the irreparable loss, the members wish to express their keen appreciation of the value and extent of Mr. Morton's scientific work, especially of that portion of his work relating to Liverpool and its vicinity."

THE Paris correspondent of the *Chemist and Druggist* gives the following particulars about the late Dr. Henri Beauregard, professor of cryptogamy at the Paris School of Pharmacy. Dr. Beauregard was appointed assistant professor at the School in 1879, and held the post until 1894. He was soon afterwards nominated as the titulary professor of cryptogamy, and was also assistant for comparative anatomy at the Paris Museum. During this time he published several important works treating of insects, some of which have been recognised as standard works by the Academy of Sciences. At the School of Pharmacy he specialised in the study of micrography and cryptogamy, and published his "Guide to Practical Work in Micrography." In 1892 he was called upon to take the professorship of cryptogamy for twelve months, and thenceforward devoted himself entirely to that science. Dr. Beauregard's premature death is a distinct loss to French pharmacy and to the Paris School, where his scientific attainments and personal qualities were much valued and appreciated.

THE Athens correspondent of the *Times* announces that the excavations carried out by Mr. Arthur Evans and Mr. D. G. Hogarth in Crete continue to yield results of the highest interest. On that portion of the site of ancient Knossos which Mr. Evans has selected for investigation (Kephala) a Mycenæan palace has been discovered containing relics of extraordinary importance, by means of which the hitherto uncertain question of Mycenæan writing has been finally settled. In the chambers of the buildings have been found a whole series of clay tablets, analogous to the Babylonian, but with indigenous Cretan script.

DR. BERTHOLD LANFER, of the American Museum of Natural History, has just returned from two years of exploration in Northern Asia, as the representative of the Jesup North Pacific Expedition.

MESSRS. W. GOODFELLOW AND C. HAMILTON have lately returned from a successful expedition in the Colombian and Ecuadorian Andes, during which they made a collection of upwards of 5000 bird-skins, comprising examples of many rare species. The travellers landed at Buenaventura, on the Pacific Coast, in April 1898, and thence crossed the Andes into the valley of the River Cauca. This was ascended, and, passing through Popayan, Messrs. Goodfellow and Hamilton entered the Republic of Ecuador, at Tulcan, proceeding thence to Quito, where a lengthened stay was made. From Quito excursions were effected to Pichincha, and to the low country on the Pacific Coast near Santo Domingo. Leaving Quito on March 1 last year, Messrs. Goodfellow and Hamilton crossed the Andes to the upper waters of the Napo, and descended that river in canoes to Yquitos, in Peru, whence the journey home was effected by steamer. Mr. Goodfellow is preparing an account of the birds collected during this remarkable journey for the *Ibis*.

THE Council of the Zoological Society of London has given instructions for the publication of an Index-Volume to the new generic names mentioned in the volumes of the *Zoological Record* since 1879. This Index-Volume, in order to increase its usefulness, will include names accidentally omitted from Scudder's "Nomenclator" and from the volumes of the *Zoological Record*. Thus zoologists will have at their disposal (in the "Nomenclator Zoologicus," and the new "Index" together) a complete list of all the names of genera and subgenera used in zoology up to the end of 1900. It is earnestly requested that any one who knows of names omitted from Scudder's "Nomenclator" or from the volumes of the *Zoological Record*, will forward a note of them, together, if possible, with a reference as to where they have been noticed or proposed, so that the new list may be made as complete as possible. Such information should be addressed to the Editor of the *Zoological Record*, 3, Hanover Square, London, W.C., or to Mr. C. O. Waterhouse, British Museum (Natural History), South Kensington, London, who is engaged in compiling the list.

PROF. GUIDO CORA, of Rome, is engaged in the preparation of a work on his journey in Montenegro last summer, in which he explored particularly the eastern part of the land and some of the adjoining districts. He also examined the ruins of the Roman town of Doclea, where he found some new inscriptions.

MRS. LANKESTER, who died on April 9, was the widow of Dr. Edwin Lankester, and was well known as a popular writer on science. Among her books are "Wild Flowers Worth Notice," the literary portion of that large series of volumes "Sowerby's British Botany" (now in course of republication), and "Talks about Health."

THE first of four zoological lectures arranged by the Zoological Society will be delivered to-day by Mr. A. Smith Woodward, who takes for his subject "The Animals of Australia." The remaining lectures are:—"The Freshwater Fishes of Africa," by Mr. G. A. Boulenger, F.R.S.; "The Gigantic Sloths of Patagonia," by Prof. E. Ray Lankester, F.R.S.; and "Whales," by Mr. F. E. Beddard, F.R.S.

ON Tuesday next, April 24, Dr. H. R. Mill will deliver the first of a course of three lectures at the Royal Institution on "Studies in British Geography." On Thursday, April 26, Prof. Dewar will commence a course of four lectures on "A Century of Chemistry in the Royal Institution." On Saturday, April 28, Prof. Stanley Lane-Poole will deliver the first of a course of two lectures on "Egypt in the Middle Ages." The Friday Evening Discourse on April 27 will be delivered by Lord Kelvin, on the subject of "Nineteenth Century Clouds over the Dynamical Theory of Heat and Light." The discourse on May 4 is to be on "Pottery and Plumbism," and the lecturer will be Prof. T. E. Thorpe, F.R.S.

THE annual general meeting of the Society of Chemical Industry will be held in London in July next. As the president, Prof. C. F. Chandler, and with him a considerable number of the members of the New York section of the society, will attend, it is hoped that the members of the London section will exhibit their appreciation of the hospitality extended in 1895-6 to the then president and the hon. foreign secretary of the society when visiting the United States. London members of the society have been invited to contribute to an expense guarantee fund.

THE Jacksonian prize of the Royal College of Surgeons of England for the year 1899 has been awarded to Dr. Harry Lambert Lack, for a dissertation on the pathology, diagnosis and treatment of inflammatory affections of the nasal fossæ and associated sinuses and air cells. The subject for the prize for the ensuing year 1901 is "The Diagnosis and Treatment of Bullet Wounds of the Chest and Abdomen." The John Tomes prize, founded by the dental profession in honour of the late Sir John Tomes, F.R.S., has been awarded to Mr. John Howard Mummery, for his original and other scientific work on the subjects of dental anatomy, histology and pathology.

THE fifth annual congress of the South-Eastern Union of Scientific Societies will be opened at Brighton on Thursday, June 7, when the Mayor of Brighton (Alderman Stafford, J.P.) will receive the members of the congress, and the president-elect, Prof. G. B. Howes, F.R.S., will deliver the annual address. On the following day, papers will be read on the skin of liquids, by Dr. C. H. Draper; the structure of the Lower Greensand near Folkestone, by Dr. H. C. Sorby, F.R.S.; dust, by Dr. H. Gabbett; science at the end of the eighteenth century, by Mr. Arthur W. Brackett; and the colouring of pupæ in relation to their surroundings, by Mr. F. Merrifield. A reception by the Mayor of Hove will be held on Friday evening, June 8, and Mr. Fred Enoch will lecture on "Wonders and Romance of Insect Life." On Saturday, June 9, Mr. F. Chapman will describe the Brighton Raised Beaches and their microscopical contents. In connection with the congress, a photographic exhibition is being organised in order to illustrate the various applications of photography to scientific work. The exhibition will not be limited to work done by members of the affiliated societies, and the committee will welcome any offers of loans that would be likely to prove interesting and suggestive. Intending exhibitors should communicate with Mr. H. E. Turner, Lindfield Lodge, Folkestone, not later than May 7.

AN article in the current number of the *Fortnightly Review*, by Mr. Rollo Appleyard, states the case for engineers of the Royal Navy, and draws attention to their inadequacy, owing to defects on the Admiralty Board, to meet the demands which the conditions of naval war entail. It also gives an outline of the scheme of studies and examinations at Keyham College and at the Royal Naval College, Greenwich, through which the Engineer R.N. has to pass, and an account of his complex duties afloat. Notwithstanding these defects, it appears that engineers have not a single representative on the Admiralty Board. The question is scarcely one which can be discussed in our columns. On the other hand, it is too technical for the daily Press. It could best be dealt with by a great civil body of experts, such as the Institution of Civil Engineers, and it is sincerely to be hoped that they will give it consideration at an early date.

DURING a heavy thunderstorm at Herbertsdale, Cape Colony, on February 25, a remarkable fall of hail occurred. Mr. O. D. Deacon sends us a description of the storm received from his brother, who witnessed it. From this we learn that the hailstones ranged in size from marbles to small hen's eggs, and very many were of the size of turkey's eggs. Some of these had a very peculiar shape, being round and surrounded with spikes so as to present an appearance not unlike a hedgehog when rolled up in a ball, or like a bristly sea anemone. The hailstones were the largest Mr. Deacon had seen during a thirty-seven years' residence in South Africa, and their spiky character is of peculiar interest.

WE have received from the Danish Meteorological Institute its *Nautical Meteorological Annual* for 1899, prepared under the superintendence of Captain V. Garde, R.D.N. With the exception of a slight change in the title, and the use of English instead of French alongside the Danish explanatory text, the form is the same as in the two previous years. The contents form a most valuable contribution to the meteorology of the northern parts of the North Atlantic, consisting (1) of the state of the ice on the east and west of Greenland, with charts, (2) of wind and sea-surface temperature charts, and (3) of meteorological observations taken every four hours at light and coast stations. We have already referred to the ice charts (NATURE, March 1, p. 422) from an advance sheet. The wind charts comprise the area between Scotland, Iceland, and the west coast of Greenland, and very clearly represent, by means of roses, the relative percentage of frequency of the eight principal directions, and the average force in each of the months April to October, from ships' observations, from 1876 to 1895; each chart is accompanied by a short discussion of the chief results, and a statement of the average number of stormy days experienced in various districts. The charts of the sea-surface temperature show the mean values for each one-degree square, for the first and last halves of the month.

A GOOD general view of the position of the mineral industries of the world can be obtained from Prof. Le Neve Foster's latest report (Mines and Quarries: General Report and Statistics. Part IV.—Colonial and Foreign Statistics.) From this rich source of information we learn that about 1,800,000 persons are employed in mining and quarrying in the British Empire, of whom nearly one-half are working in the United Kingdom. Foreign countries employ altogether at least two and a half million persons. Although the proportion of silver furnished by the British Empire is only one-ninth of the general total, it is pleasing to note that New South Wales, with its wonderful mines at Broken Hill, is now approaching Bolivia and the German Empire in productiveness. The British Empire produces seven-elevenths of the total tin supply of the world; in fact, the Federated Malay States alone yield more than one-half.

As regards safety, the collieries of the United Kingdom occupy a high place compared with those of the rest of the world. Prof. Foster sounds a note of warning to British mine-owners and points out that the parasitic disease known as ankylostomiasis is attracting the special attention of several foreign Governments, owing to the ravages which it is committing among colliers. From inquiries he has made among his colleagues, it appears that the disease is not known among British colliers; but as it has made itself a home in coal mines in Northern Europe, it might be introduced into this country by foreign workmen.

TWO interesting papers on changes in iron and steel rails were read at the meeting of the Institution of Civil Engineers on April 10. In the first of these, on "The development of the manufacture and use of rails in Great Britain," Sir Isaac Lowthian Bell, Bart., F.R.S., traced the history of the development of wrought-iron and steel manufacture, with particular reference to its employment for rolling into rails. The results of an experimental investigation of the deflection of rails at various speeds of the train, indicate that the deflection, and therefore the pressure on the rail, diminishes as the speed increases. The durability of rails manufactured by the basic process has proved equal to that of steel rails manufactured from hæmatite ore. In the second paper, on "The wear of steel rails in tunnels," by Mr. Thomas Andrews, F.R.S., the effects of the deteriorating influences peculiar to rails laid in tunnels were described. Among these are the increased corrosion of the surface of the rail, due to the action of moist vapours, and the increased chemical action of the ballast on the foot of the rail; the ballast, on account of its porous nature, absorbs the vapours and hence acts with increased deteriorative force on the rails. Mr. Andrews has made a careful examination of a rail which did its life's work in such a situation. The rail was laid in a tunnel for seven years, on a straight piece of road having a falling gradient of 1 in 90, and it carried the main-line traffic during this time without fracture. The tunnel was about 1000 yards in length, and it was situated fairly near the sea-coast. It lay in a direction nearly north and south. This fact was pointed out, as Mr. Andrews has observed indications that magnetisation exerts an influence tending to increase the corrosibility of steel in certain solutions The rail, which originally weighed 84 lbs. per yard, had lost weight at the rate of 2·8 lbs. per yard per annum, and on the face the rail had worn down to the extent of $\frac{3}{8}$-inch. The chemical analysis showed that sulphur was present in considerable excess, but otherwise the general composition of the steel was excellent. The physical tests showed a very good result, the strength of the metal being normal, and an elongation of 27 per cent. being obtained. From the results of the investigations, the conclusion was arrived at that, as a general rule, rails in tunnels should only be allowed to remain in the permanent way for one-half (or in some cases only one-third) of the time that is usually allowed for the ordinary use outside tunnels.

IN the *American Geologist* for last February, Prof. E. W. Claypole gives a brief description of an earthquake felt in southern California at 4 25 a.m. on December 25, 1899. The disturbed area is thinly populated, but the shock was felt for at least 150 miles from the coast. In the two villages of San Jacinto and Hemet, which stand in an elevated valley filled with detritus from the adjoining mountains, every brick building was seriously damaged by the shock. Prof. Claypole remarks that, from the continued occurrence of light tremors, the region would be a good one for making seismological observations.

AN important memoir, by Mr. R. D. Oldham, on the propagation of earthquake motion to great distances, has just been published in the *Phil. Trans.* of the Royal Society. The complete record of a distant earthquake, he remarks, shows three principal phases, differing in character and amount of displacement. During the first two phases, the motion is principally of a to-and-fro nature; while in the third phase, the movement is composed of long surface undulations resembling the swell of the ocean. In the first two phases, the surface-velocity increases with the distance from the origin, and in accordance with the hypothesis that they consist of elastic waves propagated through the earth at rates which increase with the depth below the surface. If the time-curves for the beginnings of the first and second phases are continued to the origin, they give initial rates of propagation which agree fairly closely with the probable initial rates of propagation of condensational and distortional waves in continuous rock; and Mr. Oldham therefore concludes that the first phase represents the arrival of condensational waves, and the second phase of the distortional waves, both having travelled along brachistochronic paths through the earth. In the third phase, the surface-velocity appears to be constant at all distances from the origin, from which we may infer that they are propagated as surface undulations. The velocity is not, however, the same for all earthquakes, but increases with the intensity; and from this fact, and the high velocity in the case of great earthquakes, it seems probable that the propagation of these waves is, at least in part, gravitational.

IN the *Transactions* of the Institution of Engineers in Scotland, Prof. Andrew Jamieson gives an account of his visit to Cape Town last year, undertaken for the purpose of investigating the action of electric tramway currents in disturbing the action of the submarine cables landed at the Cape. Prof. Jamieson summarises the various probable actions of the tramway currents on the cables as arising from (1) electrolysis; (2) affecting the potential of the earth connection to the receiving instrument; (3) direct electro-magnetic induction; (4) disturbances due to leakage or stray return currents from the tramway rails. It would appear probable from the discussion that the influence of earth-resistance is very considerable at the Cape. Prof. Jamieson reported that nothing short of a symmetrically arranged and specially made twin *twisted* core with double armouring would do for the shore end, and that it would not require to be more than from two to three nauts. It has since been stated that the recently laid shore end of the new cabl from Cape Town to St. Helena has been made and connected in this way.

MR. SAMUEL CUTLER, JUN., who has given especial attention to the development of the carburetted water-gas industry, describes the process of production, and various modern types of plants, in *Feilden's Magazine* for April. Carburetted water-gas, as its name implies, is water-gas carburetted, or enriched, with extraneous hydro-carbons, usually derived from petroleum distillates. The gas is now manufactured at more than sixty important gasworks in the United Kingdom, and the number of installations is rapidly increasing. As produced at the present time, the gas is as luminous and odorous as coal-gas, and in the United States it is supplied and used in its undiluted state, though it contains a much larger proportion of carbon dioxide than exists in coal-gas. Here, however, it is chiefly employed to enrich coal-gas. A Department Committee, appointed in 1898, reported in favour of a somewhat stringent limitation of the percentage to be supplied for illuminating purposes, but no legislative measure has yet been based upon the recommendations.

THE present commercial conditions in the vast Chinese Empire, and the possibilities of future development, are described in detail, and from many points of view, in the Monthly Summary of Commerce and Finance of the United States (December 1899), prepared by the Bureau of Statistics. During the short time in which foreigners have been admitted to the commerce of China,

important developments have taken place. The 400,000,000 people have hitherto been served by 350 miles of railway, or less than one mile for each million persons. More than ten times this length of railway is, however, now projected, and not only projected in the ordinary sense of the term, but in many cases being actively pushed forward and with prospect of a comparatively early completion. With telegraphs connecting the capital with every province and also with the outside world; with steam navigation and foreign steam vessels penetrating to the very head of the many navigable waterways; with new treaty ports opening upon the coast and far inland; and with foreigners permitted to travel for business or pleasure to the remotest corners of the Empire and carry with them their merchandise and machinery, the changes which the commercial conditions of China are undergoing are well worthy of attention. The present report is full of valuable information to business men and students of political and commercial geography.

AN interesting and suggestive article, by Monsieur E. de Cyon, on the means whereby the "homing" pigeon ascertains the direction in which it should fly—in other words, its orientation—appears in the *Revue Scientifique* of March 24. After referring to the intimate connection between the migratory and the "homing" instinct, the author points out an important difference in the conditions under which migration and "homing" are carried out. In the former case the bird may have experience to guide it; and it is at least well acquainted with the neighbourhood in which it lives. On the other hand, a "homing" pigeon, after being carried a longer or shorter distance by train in a dark compartment, is suddenly let loose in some place it has never seen before, yet, after mounting in circles to a considerable elevation in the air, it suddenly starts in the direction of home, not unfrequently following the course of the railway by which it travelled. As the result of experiments, the author is of opinion that the retina and the nose take an important share in the orientation; the other conditions being a keen "local memory," and a high development of the cerebral organs connected with the nerves upon which this sense of orientation depends.

THIRTY-NINE new species of Weevils are recorded and diagnosed from Madagascar by J. Faust, and eighteen new and imperfectly-known species of beetles belonging to the genus Lomaptera and its allies from the Papuan region, are described by K. M. Heller in the *Abhandl. u. Berichte K. Zoolog. Anthr. Mus. Dresden*, 1899, Bd. viii. (*Festschrift für A. B. Meyer*). In the same volume, B. Wandolleck has an important memoir on the anatomy of the cycloraphous larvæ of Diptera, the form more particularly studied being the larva of *Platycephala planifrons*. It is illustrated by two plates of photographs of transverse sections through the larva, and by several cuts in the text. The volume closes with a paper, by J. Jablonowski, on the development of the medullary cord in the pike, illustrated by one plate. There is very little difference between the stages here described and those which other observers have recorded in various species of the Salmonidæ.

THE twenty-second annual meeting of the German Ornithological Society was held in Dresden in May 1897, and the papers read before that body have been published in the *Abhandl. u. Berichte K. Zoolog. Anthrop. Mus. Dresden*, Bd. vii. 1899. Besides other papers in the same volume there s one on new beetles from Celebes and from the Philippines, by K. M. Heller, and a memoir on the mammals of Celebes and the Philippine Archipelago, collected by the Sarasins and described by A. B. Meyer. This is a valuable piece of work from a faunistic point of view, several new forms are recorded and figured. An appendix on the spoon- or spatula-shaped hairs occurring in certain bats is added by J. Jablonowski.

A REPORT on the working of the Botanical Department (Jamaica) for the year ending March 31, 1899, appears in a supplement to the *Jamaica Gazette* for February 1, 1900.

"STUDIES of North American Grasses: The North American species of *Chaetochloa*," by Messrs. F. Lawson-Scribner and Elmer D. Merrill, is the subject of *Bulletin* No. 21 of the U.S. Department of Agriculture (Division of Agrostology).

OF equal value, from a systematic point of view, are the contributions from the Gray Herbarium of Harvard University, contributed to the *Proceedings* of the American Academy of Arts and Sciences. No. xvii. of the new series comprises new species and varieties of Mexican plants, by J. M. Greenman; synopses of the genera *Jaegeria* and *Russelia*, by Mr. B. L. Robinson; new *Dioscoreas* from Mexico, by Mr. E. B. Uline; new Phanerogams from Mexico and Central America, by Mr. B L. Robinson.

THE firm of Gustav Schmidt, Berlin, is publishing, in twelve parts, a collection of forty-eight excellently-coloured plates of garden flowers and plants, under the title "Die schönsten Stauden für die Schnittblumen und Gartenkultur." The series of pictures, and the accompanying descriptive text, are edited by Messrs. Max Hesdörffer, E. Köhler and R. Rudel.

MESSRS. J. AND A. CHURCHILL have just published the third edition of an "Elementary Practical Chemistry and Qualitative Analysis," by Dr. Frank Clowes and Prof. J. B. Coleman. The book contains a good course of laboratory work, commencing with simple measurements and manipulations, which lead in an instructive way to analytical reactions of the commonly occurring metals and inorganic acid-radicles, and the means of detecting them.

WITH the copper apparatus for the preparation of fluorine, recently described, M. Moissan has been able to take up the examination of fluorides which could only be obtained hitherto in quantities too small for detailed study. It was shown some years ago that sulphur took fire in fluorine, and in the number of the *Comptes rendus* for April 2, M. Moissan gives a description of the properties and methods of isolation of one of the sulphur fluorides thus formed. Fluorine is passed over sulphur contained in a copper boat in an atmosphere of nitrogen, and the resulting gases cooled to -80° C. in a mixture of solid carbon dioxide and acetone. By allowing the liquid thus obtained to boil off at the ordinary temperature, a mixture of fluorides of sulphur is obtained, partly absorbable by potash. The unabsorbed portion proved to be the hexafluoride, SF_6, which possessed remarkable properties for a fluoride, being a colourless, odourless gas, so inert in its behaviour towards reagents as to be comparable to nitrogen. It is unacted upon by prolonged contact with potash, by fused potash or lead chromate, and has no effect upon red-hot copper oxide; phosphorus and arsenic can be distilled unaltered in the gas, and sodium can be melted in it without change, the temperature having to be raised above the boiling point of the metal before reaction sets in. Further details of this interesting gas are promised.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*, ♂) from India, presented by Mr. T. Packer; a Barbary Mouse (*Mus barbarus*) from Barbary, presented by Master Chapman; a Lyre Bird (*Menura superba*, ♀) from South-East Australia, presented by Messrs. Carrick and Fry; a Roller (*Coracias garrulus*), European, deposited; two Australian Thicknees (*Œdicnennes grallarius*); two Masked Wood Swallows (*Artamus personata*); two —— Wood Swallows (*Artamus*, sp. inc.) from Australia, purchased; seven Barbary Wild Sheep (*Ovis tragelaphus*, 3 ♂, 4 ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN

COMPOUND PRISM OF UNIFORM DISPERSION.—Messrs. C. G. Abbot and F. E. Fowle, of the Astrophysical Observatory at the Smithsonian Institution, have been investigating the possibility of obtaining a combination of glasses, the relative dispersions of which would enable a compound prism to be made having a uniform dispersion similar to that given by a diffraction grating (*Astrophysical Journal*, xi. pp. 135-139). Their initial experiments were suggested by finding that a parallel-sided combination of three prisms, of which the central one was rock salt and the outer ones glass, gave a much more uniformly dispersed spectrum than either prism used separately. Sample prisms of various kinds of glass were then examined, and after finding two with considerably varying dispersions, prisms were made of such calculated angles that the irregularities of dispersion would be partly eliminated when the prisms were combined in opposite sense, *i.e.* the base of one to the apex of the other. Taking two such prisms, of 5° 10′ and 20° angle respectively, and allowing the incident light to first enter the thick prism, then after passing through this and the adjoining thin one, to be reflected back from the last face of the thin prism over its previous course, it was found that the combination had an extremely regular dispersion, and although the wave-length curve shows two points of inflection, throughout the remaining portions long stretches could be selected where the dispersion is practically uniform. It is thought that for only moderate dispersions the uniformity found will be such as to render corrections unnecessary when comparisons are being made with grating spectra.

DYNAMICAL CRITICISM OF THE NEBULAR HYPOTHESIS.—In the *Astrophysical Journal*, vol. xi. pp. 103-130, Mr. F. R. Moulton discusses at some length the bearing of modern dynamical treatment on the various problems involved in the nebular theory of cosmic evolution enunciated by Laplace. The various criticisms put forward may be grouped into three categories: (1) comparisons of observed phenomena with those which result from the expressed or implied conditions stated by the hypothesis; (2) discussion of the question whether the supposed initial conditions could have developed into the existing system; (3) comparisons of those properties of the initial system with the one now existing, which are invariable under all changes resulting from the action of *internal* forces.

Under the first section of the discussion it is pointed out that the fact of the planes of the planetary orbits presenting considerable variations among themselves, and also that four satellites revolve in planes making practically right angles with the average plane of revolution of the system, are in direct contradiction with one of the chief deductions from the hypothesis. Other objections concerning observed phenomena are the unaccountable and suspiciously irregular distribution of the masses of the planets, and the unexplainable anomaly in the motion of the inner ring of Saturn.

The objections considered under the second category are that the lighter elements would have escaped from the mass; that matter would have been detached continually instead of in rings at rare intervals; that if a ring were contracted into a planet except an infinitesimal remainder distributed along its path, the process of aggregation could not complete itself; that the gravitation between the masses occurring in the rare media would be so feeble that they would seldom come in contact, and that Roche's limit and a similar new criterion show that fluid masses of the density which must have formerly existed would be disintegrated by the disturbing action of the sun.

In the third section of the inquiry the question of conservation of *moment of momentum* is alone considered, but the results obtained are in such discordance with those required by the hypothesis as to indicate that the original nebulous mass, so far from being in any sense *homogeneous*, was *heterogeneous* to a degree hitherto considered improbable.

Involved in the validity of the above statements is the question of the age of the earth, which has been calculated on the theory of the sun's contraction from a gaseous sphere arranged in concentric envelopes.

THE CAPE STAR CATALOGUE FOR 1890.—We have lately received from Dr. Gill, Her Majesty's Astronomer at the Cape of Good Hope, a copy of the catalogue compiled from observations made at the Royal Observatory. The measures were made with the Cape transit circle during the years 1885-1895, all being reduced to the mean equinox, 1890·0, *without proper motion*. Until June 2, 1889, observations of all stars were made by the "Eye and Ear" method, but on that date the chronographic method of recording was introduced, and since that time has been included for all stars except those within 10° of the Pole. Except in a few cases, a reversing prism has been generally used, thus eliminating any error due to the direction of the star's apparent motion through the field of the eye-piece. In the determination of the declinations, evidence of considerable wear was found in the brass screws of the micrometers. These were replaced by new ones of steel, and, as a further precaution, three of the six micrometers were rearranged so as to reverse the direction of the readings. The discussion of the ten years' observations with steel screws shows that the non-periodic corrections are still very marked, but that the effects of wear are practically eliminated by the plan of reversing the alternate microscopes.

In addition, the declinations have had to be corrected for flexure, refraction, and change of latitude, this latter being taken from Albrecht. Tables of the flexure and latitude variations are given.

The transit circle with which the observations comprising the present catalogue were made is non-reversible, and will be in future exclusively utilised for zone observations, a new instrument being in course of construction for fundamental work hereafter. Considerable pains have been taken to investigate the degree of error introduced by variations in magnitude. No sensible systematic error in declinations is traceable to this source, but in right ascension it is found that the average observer measures the transits of faint stars too late as compared with bright stars, and it is emphasised that in all future catalogues of precision this personal error depending on magnitude should be carefully determined for all the observers.

The catalogue proper consists of the positions for 1890 of 3007 stars, each being designated by its Cape number, and its respective numbers in the catalogues of Lacaille, Bradley, Piazzi, British Association, and Gould. After the positions the corrections are given for annual precession, secular variation and annual proper motion.

The volume closes with three appendices giving comparisons with other catalogues, special observations of α Canis Majoris, α Canis Minoris, β Centauri and α_1, α_2 Centauri, owing to these stars having companions of considerable mass, and a discussion of the places and proper motions of twenty-four circumpolar stars used at the Cape for determinations of azimuth.

FLINT IMPLEMENTS FROM THE NILE VALLEY.

THE latest number of the *Bulletin* of the Liverpool Museums contains a profusely illustrated paper, by Dr. H. O. Forbes, on a collection of stone implements from the Nile Valley, made by Mr. Seton-Karr in 1896, and purchased for the Mayer Museum. The great bulk of the collection was made in Wady el Sheikh, a tributary of the Nile, opening from the south-east into the mud-plain of the river opposite El Fent, which is situated half-way between the stations of Feshn and Maghagha on the railway from Cairo to Assiout.

The material of which the implements are made is chiefly a yellowish-brown or pale grey, opaque, earthy chert, and is but rarely of the translucent chalcedonic variety from the chalk of England. The collection contains a large number of types which may be classed as bracelets, axe-like tools, leaf-shaped flints, knife-like instruments, hoes or agricultural implements, fabricators, scrapers, cores and flakes, and nondescript stones. The bracelet series shows all the stages in the manufacture of these delicate ornaments, and proves that the suggestion of General Pitt-Rivers, who figured two complete similar examples in the *Journal* of the Anthropological Institute in 1881, is probably incorrect, that they were formed from "morpholites," or siliceous sphæroid-shaped bodies occurring in the marine limestone, encircled by a belt or ring, which is divided from the main body only by a thin partition, while sometimes the ring alone is found. The series figured in the paper shows that a flat disk of flint was first prepared, and that this was then perforated by a dextrous stroke of a chisel, and the opening gradually enlarged till sufficiently wide to admit the hand. Of the axe-like tools of which nine, and the knife-like instruments of which sixteen, are illustrated, several specimens

almost identical in form and size are figured by Prof. Petrie from Kahun, a XIIth Dynasty town, while others of the knives are of the same form as those seen in the process of manufacture in the wall-paintings of Beni Hasan. Many of the knives also bear a remarkable resemblance to the finest of those from Scandinavia. Several of the scrapers are almost black in colour, and, having a soft velvety surface, would pass for true palæoliths anywhere. Cores and flakes occurred in thousands along the Wady banks. Why so many thousands—all perfect as flakes—should have been struck off and never carried away is difficult to comprehend. Lastly, the collection contains a large number of long bars of stone partially worked, the use of which it is impossible to conjecture.

A map and several views are given showing Mr. Seton-Karr's collecting grounds along the Wady (Fig. 1); and these prove that the implements were scattered round the mines, excavations or pits whence the material was quarried. Each mine was also the site and the workshop of the skilled artificer. In many places shafts two feet in diameter were met with, often filled up with drifted sand, and surrounded by masses of excavated material neatly arranged round them. Their depth does not seem to have been great, nor do the flint-workers appear to have driven lateral galleries from the shafts. Most of the mines had a central work-place, round which the excavated material was heaped, and where most of the implements were found.

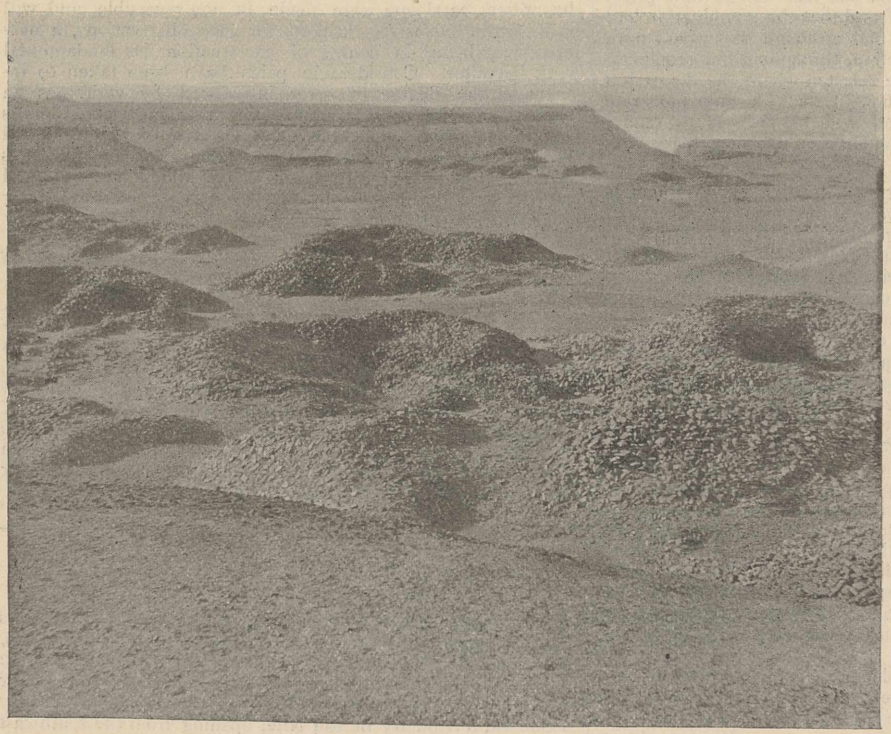

FIG. 1.—View of shafts on the level terrace-tableland, near Camp XI., 1896; showing the excavated material heaped round the central work-place.
(*From a Photograph by Mr. Seton-Karr.*)

The next questions discussed are the probable age of the Wady el Sheikh implements and how long the mines were worked. As no help in these questions is obtainable from legend or tradition, some clue is sought for in the patina or amount of discoloration the flints exhibit, for, according to Sir John Evans, "the safest, and indeed the most common, indication of an implement being really genuine is the alteration in the structure of the flints . . . and the discoloration it has undergone." A large proportion of the flints from the Wady el Sheikh are specimens broken in the making. In many instances the two portions, in falling to the ground from the maker's hands, dropped the one part with the upturned surface the reverse of that of its fellow, with the result that when the pieces are re-united the surfaces of the completed implement have each a moiety dark, the effect of exposure, and a moiety, in striking contrast, of nearly the original light yellowish-grey colour of the chert. In the two faces of the two halves every shade of patination from black through shades of yellow to the almost unchanged flint is to be found. Some gauge of the rate of this "æonic tinting" is given by Prof. Flinders Petrie, who states that "the old desert surfaces are stained dark brown by exposure during long ages, and this colour, varying from orange to black, is characteristic of all the flints of early age from this [Nile] plateau. It is certain that only a faint tinge of brown is produced on flints that are at least 7000 years old under like conditions, and this may give a slight scale of the ages that have passed since flint was worked here by palæolithic man." Dated by this standard, the bulk of the Seton-Karr collection ought to be many times 7000 years old. The great majority of the specimens, even the deepest stained, have their edges and the outlines of the flakings as sharp and unworn as the day they were made. A few, however, are deeply eroded by drifting sand, and others, in addition to their patination, have the glossy rounded angles and edges generally considered characteristic of palæoliths; there is nothing about them, however, to point to their being of a different age from their associates in the same workshop. All the implements were found round the mines; some are rude, because unfinished, and some are most beautifully flaked and finished knives (Fig. 2). A considerable number of the flints are so close in material, form and character to those figured by Prof. Petrie from the XIIth Dynasty town of Kahun, that there can be little doubt that both sets were made about the same centuries. Many of the implements are also of the same form as those pictured in the process of manufacture on the walls of Beni Hasan tombs belonging to the same dynasty and contemporaneous with the tombs. A few of the Wady el Sheikh instruments agree with some figured by Petrie as typical of the IVth Dynasty. The age, therefore, of the working of the quarries may be from 3900 B.C., but more probably from about the XIIth Dynasty; and consequently there is provided a scale for gauging the patination that can be acquired in that time. The amount of discoloration which appears also to vary with the quality or constitution of the flint, and the nature of the surface on which it lay exposed, would seem, according to the writer, therefore, to be a very uncertain criterion of age.

Hardly distinguishable from the flints of the Wady el Sheikh are numerous specimens found lying on the surface of the Nile plateaux by Seton-Karr, and near Esna and Ballas by Petrie and Quibell. "On the top of the 1400 feet plateau," the latter authors record, "are great numbers of worked flints of palæolithic type. . . . That the high plateau was the home of man in palæolithic times is shown by the worked flints lying scattered *around the centres where they were actually worked.* The Nile being far higher then, left no mud flats as at present for habitation; and the rainfall—as shown by the valley erosion and waterfalls—must have caused an abundant vegetation on the plateau where man would live and hunt his game." Along with the flints found in the Ballas desert, there were some "rounded flints, all stained dark brown; it is from such that these worked flints have been formed, and *the chips of working were scattered around.*" After stating these facts, Dr. Forbes

continues, "it seems an extraordinary circumstance, and to me impossible to credit, that the nodules, the flakes and the implements should, notwithstanding the enormous rainfall . . . which ploughed out the side valleys opening on the Nile, be found lying, *even in a single instance*, in undisturbed association at the present day." The same criticism is passed upon the flint instruments also brought by Seton-Karr from Somaliland (of which the Liverpool Museum possesses a series), which have been described by Sir John Evans, before the Royal Society, as in form absolutely identical with some from the valley of the Somme and other places, and proving "the unity of race between the inhabitants of Asia, Africa and Europe in palæolithic times." Additional flints were later found "scattered all over the country, covering the ground sometimes for the space of half an acre," and there was discovered also an "unfinished spear-head on the ground surrounded by a mass of flakes and chips." This remarkable distribution over the country, Dr. Forbes remarks, "where no remains apparently exist of the deposits out of which they have been washed, seems difficult to reconcile with the usual process of denudation acting through the enormous period which has elapsed since the palæolithic age of Europe," and he disbelieves that "a nodule of stone surrounded by the flakes chipped from it tens or hundreds of thousands of years ago, could have remained undisturbed when the deposits by which it was covered have entirely disappeared"; he dissents also from the opinion that identity of form in the stone implements is sufficient evidence of unity of race or of close contact between the races who made them. He is of opinion, therefore, that none of the surface so-called palæolithic implements from Egypt and Somaliland "have yet been clearly proved to belong to that period, while the probability is that the bulk of them are of much later date." The only flint implements, Dr. Forbes adds, believed to be authentically palæolithic are the flakes and very rude scraper-like flints found by General Pitt-Rivers in the stratified indurated gravelly debris from a Wady near the Tombs of the Kings.

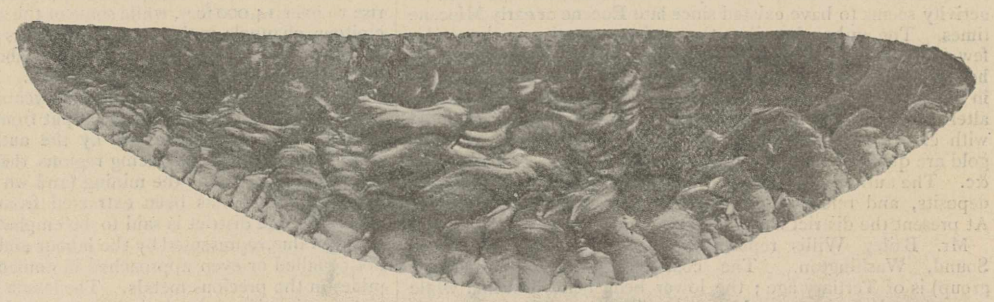

FIG. 2.—Flint knife from Wady el Sheikh.

ON THE MECHANISM OF GELATION, AND ON THE STABILITY OF HYDROSOLS.[1]

GELATINE-WATER-ALCOHOL and agar-water are colloidal mixtures which form a gel on cooling and a sol on warming. In both cases the formation of the gel is due to the separation of the fluid mixture into two partially miscible fluids or phases. When a certain critical temperature is reached, one of the phases separates out as a cloud of droplets. With a further fall of temperature either this internal phase or the external phase becomes a solid solution, and forms a framework in the spaces of which the still fluid solution is lodged. Thus two distinct types of gel occur. In the one the structure is a solid mass, in which are embedded spherical spaces filled with fluid. In the other it is an open spongework of adherent solid spheres with fluid filling the meshes. The former is firm and elastic, the latter is brittle and undergoes spontaneous shrinkage. In the ternary mixture the gel has the former structure when the gelatine content of the mixture is high; the latter when it is low.

The hydrogel of agar is built of a solid solution of water in agar, which forms a framework holding a fluid solution of agar in water. The concentration of each of these two coexistent solutions is dependent upon temperature, but the values vary according to whether the system is cooled down or warmed up to a given temperature. The system therefore manifests a striking hysteresis. From the point of view of the phase rule the hydrogel of agar is a system of two components in three phases—a fluid, a solid, and a vapour phase. The composition of the phases should therefore be fixed by fixing either the temperature or the pressure. Fixing the temperature, however, does not fix the composition, and this is probably due to two things: (1) the fact that the surface which separates the fluid and solid phases is curved, and (2) the fact that that surface is freely permeable by the mobile molecules of water, but is relatively impermeable to the immobile molecule of agar. The system obviously has two pressures which determine equilibrium, a lower hydrostatic pressure on the convex side of the curved surface, and a higher on the concave side.

Hydrosols, such as those of gold, silver or hydrosulphides, are systems in which equilibrium is between a solid phase dispersed as minute particles, and a fluid phase which is a true solution of the substance of the solid phase. The behaviour of the particles in an electric field shows that each one is surrounded by a double electric layer, which can be destroyed by the addition of electrolytes, or, in some cases, by the removal of all electrolytes. When this is done aggregation or coagulation follows. The stability of these hydrosols, therefore, is due to a contact difference of potential between the solid and the fluid phases.

The addition of an electrolyte may bring about coagulation either by altering the potential of the fluid phase, so as to make it agree with that of the solid phase, or by furnishing "nuclei" about which the particles of solid aggregate. When the particles carry a negative charge, acids act by decreasing the positive charge of the fluid; when the particles carry a positive charge, alkalies act by decreasing the negative charge of the fluid. In these cases the coagulating power of the acid or alkali is directly measured by its chemical activity when dissolved in water. The relation is expressed by the formula

$$K = na(v + \nu)$$

when K is the specific molecular coagulative power of a substance as measured by the volume occupied by one gram mol., when it just suffices to coagulate the hydrosol.

The coagulating action of a salt is due to only one ion, which is always of the opposite electrical sign to the colloid particles. The valency of the active ion exerts a remarkable influence upon its coagulative power, the relation being approximately

$$I' : I'' : I''' = K : K^2 : K^3.$$

Therefore, to express the coagulating powers of salts, a factor which is approximately squared or cubed by a change from monovalent to di- or tri-valent ions must be added to the formula given above.

$$K = na(v + \nu)A^x.$$

Thomson has pointed out that double electric layers must be separated by a region of finite thickness, in which the components are in a state of uncompleted chemical combination. The solid and fluid phases in these hydrosols, therefore, are separated by a layer which possesses considerable chemical energy, and which is of very great extent, and this may account for their marked catalytic or ferment-like properties.

[1] Abstract of two papers read before the Royal Society, on January 25, by W. B. Hardy.

NORTH AMERICAN GEOLOGY.

THE publications of the Geological Surveys in the United States and in Canada are noteworthy for the exhaustive treatment, from an economic as well as from a scientific point of view, of the subjects dealt with. In dimensions, in type, and in wealth of illustration, the numerous volumes which are issued bear favourable comparison with works published elsewhere.

Reports of United States Geological Survey.

Attention was called in NATURE of June 22, 1899, to Parts ii. and v. of the "Eighteenth Annual Report of the U.S. Geological Survey." We have lately received Parts iii. and iv. of the same Report. Part iii. is a bulky volume of 861 pages, which relate almost wholly to economic geology. Mr. George F. Becker deals with the gold-fields of Southern Alaska, while Mr. J. E. Spurr and Mr. H. B. Goodrich contribute an elaborate report on the geology of the Yukon Gold District, in the same territory. To the last-named work special reference has already been made in NATURE (December 7, 1899, p. 124). The Yukon gold-field lies close to the British frontier; that of Southern Alaska, to which we now draw attention, fringes the coast from Sumdum Bay westward as far as Unalaska, the mines being partly on the mainland, partly on islands. Mr. Becker gives an account of the volcanic activity and changes of level which have affected the region. Volcanic eruptions have occurred in comparatively recent times, and the belt of activity seems to have existed since late Eocene or early Miocene times. The author describes the various eruptive rocks, and a few schistose rocks which appear to be altered eruptive rocks; he also contributes notes on glaciation. The ore-deposits occur in a belt which coincides with the planes of schistosity in the altered rocks, and it is considered that their origin is connected with eruptive phenomena. The minerals associated with the gold are quartz and pyrites, copper pyrites, galena, zinc-blende, &c. The author gives accounts of the mines, and of the placer deposits, and refers also to certain auriferous beach-deposits. At present the district is but imperfectly explored.

Mr. Bailey Willis reports on some coal-fields of Puget Sound, Washington. The coal-bearing formation (Puget group) is of Tertiary age; the lower beds being Eocene, while the upper beds may be Miocene. The prevailing rocks are sandstones, but the deposits vary from arkoses, consisting of slightly washed granite materials, to siliceous clays, and they contain much carbonaceous material and distinct coal-seams. These strata rest unconformably on metamorphic schists and limestones of Carboniferous and Jura-trias date, and they are in places overlain conformably by marine Miocene (Tejon) strata. Tertiary eruptive rocks of younger date are associated with the Puget group. They occur as dykes and flows in various forms of intruded and extruded igneous rocks. Glacial deposits extend over large areas. The Puget strata were deposited in marshes and shallow-water areas, and subsequently were subject to considerable disturbances which led to folding and over-thrust, followed by normal faulting. Variations in the quality of the coals is attributed to the pressure and movement which they have suffered. The coals range in character from lignites to what are termed bituminous lignites or steam coals, and bituminous coking coals.

The geology and mineral resources of the Judith Mountains of Montana, form the subject of a report by Mr. W. H. Weed and Mr. L. V. Pirsson. These mountains are one of the groups of the Great Plains of the North-west, the nearest peaks of the Rocky Mountains being thirty-five miles to the west. They rise like a great island above the plains to a height of about 2500 feet above this level platform, the most elevated peak being 6386 feet above the sea. Geologically the mountains have been formed by a number of independent, coalescing, dome-shaped uplifts, involving the sedimentary series from the Cambrian to Cretaceous, and they are penetrated by laccolitic and other intrusions of igneous rocks. It is remarkable that while the great series of sedimentary rocks is apparently conformable throughout, yet the earlier strata are steeply upturned along the flanks of the Rocky Mountains, and the disturbances die out eastwards over the area of the plains. No Permian or Trias sediments occur, and the region was probably a land-area during those periods. Descriptions are given of the Cambrian, Silurian, Devonian, Carboniferous, Jurassic and Cretaceous rocks, and of the numerous laccolitic intrusions which are all of acid type. Granites, syenites, diorites and nephelite-syenites are found, the latter being represented by rocks of phonolitic character. The ore-deposits (chiefly gold) and the Cretaceous coal are described.

Mr. Waldemar Lindgren furnishes an account of the mining districts of the Idaho basin and the Boise ridge, Idaho, with a report on the fossil plants of the Payette formation, by Mr. F. H. Knowlton. The region includes a portion of the lower Snake River Valley and adjacent mountains on the northern side, together with the entire drainage of the Payette, Boise, and Wood rivers. The Boise mountains attain elevations of over 7000 feet. The area consists largely of granite together with the "Snake River Tertiaries." These latter comprise early Neocene (Miocene) lake-beds, known as the Payette formation, with which are associated vast masses of basalts and rhyolites; and later Neocene (Pliocene) deposits together with the Snake River basalts. Sands and gravels of Pleistocene age also occur. Gold occurs in the granitic rocks or associated dykes and veins, and in placer deposits. Monazite is found in the sands of the lake deposits, and there is no doubt that it forms one of the original constituents of the granite of the Idaho basin. This mineral, which is a phosphate of the cerium metals and thorium, yields products of economic value in the preparation of incandescent gas lights of the Welsbach and other burners. Silver-ores also occur in the region.

A preliminary report on the mining industries of the Telluride Quadrangle, Colorado, is contributed by Mr. C. W. Purington. This is a region of striking topographical features, the mountains rise to over 14,000 feet, while some of the streams have cut precipitous channels in the mountain cirques or basins to a depth of 7500 feet. Telluride, a town of about 1500 inhabitants, is in the heart of the mining district. The first prospectors entered the region about twenty-five years ago, and the district has made a steadily increasing output from its discovery to the present time. As remarked by the author, it has been the history of many ore-producing regions that much more money has been expended in the mining (and we might add financial) operations than has been extracted from the ore taken out. The Telluride district is said to be emphatically one where the money value, represented by the labour and capital expended, has not equalled or even approached in amount the product of the mines in the precious metals. The lesson that is taught is that conservatism in mining is poor policy, and that new methods and devices to meet new conditions, for which no rules can be laid down, are necessary for the successful production of ore in newly exploited areas. The district is composed of nearly flat sedimentary beds, which rest on Archæan and extend in geological age from the Trias to the Tertiary. This vast series has been in places tilted up, deformed, injected and broken through by igneous rocks, of Tertiary or Post-Tertiary age.

The ridges of the mountains present exceedingly irregular, sharply cut and jagged lines, whose sharp gaps are generally the result of the more rapid weathering and wearing down of metalliferous veins and zones of mineralised rock. Such zones usually have most brilliant colours—red, white and yellow—and are visible across country for a distance of twenty miles. With regard to the scenery in general, it is remarked that the beauty of form and colouring is unsurpassed in the mountain regions of the world. The metalliferous portions of the rocks are thus largely exposed to view, and their origin is attributed to the subterranean tract from which the igneous rocks have come; surface waters having descended through fissures to the horizon of the heated magma, and having subsequently ascended heavily charged with mineral matter. The vein-filling is considered to be later than the newest lavas exposed in the region. The vein-deposits are valued chiefly for the gold and silver, while much gold in a finely divided state occurs in placer deposits. It is noteworthy that none of the tellurides or other possible rare compounds of gold occur in the area, so far as the present investigation has been able to determine. No silver-ore occurs which does not contain, in the free state, more or less gold; while the galena, considered as an ore of silver, is merely the gangue or mechanical matrix of gold.

Part iv. of the "Eighteenth Annual Report" deals entirely with hydrography. It is a huge volume of 756 pages, comprising (1) Report on the progress of stream measurements for 1896, by A. P. Davis; (2) The water resources of Indiana and Ohio, by F. Leverett; (3) New developments in well-boring and irrigation in South Dakota, by N. H. Darton; and (4) Water storage and construction of dams, by J. D. Schuyler. Among the matters discussed is the temperature of the deeper artesian waters in the Dakota basin.

We have received also Parts i., iv. and vi. of the "Nineteenth Annual Report for 1897–8," and portions of Part ii. Part i. comprises the report of the director, Mr. Charles D. Walcott, and it includes observations on triangulation and spirit-levelling.

Part ii., which includes papers chiefly of a theoretical nature, contains an elaborate report on the principles and conditions of the movements of ground-water, by Mr. F. H. King. The author deals with the water-holding capacity of natural soils, the depth to which ground-water penetrates, and its general movements. Movements are due to barometric pressure and to thermal agencies, to crust deformation and to rock consolidation. The original water laid down with sediments is considered as well as the subsequent capillary movements of ground-water. Interesting results are given of experimental investigations regarding the flow of water and kerosene through sand, sandstone, wire-gauze, &c. ; and of the influence of the form, diameter and arrangement of soil and sand-grains on the amount of flow. An important record is given of the effect of the pumping of one well on another 1133 feet distant. Both wells were sunk in sandstone to a depth of about seventy feet. When pumping at the rate of about seventy-five gallons per minute from one well, a fall of water was detected in the other after the lapse of one minute and forty-five seconds. The pump was worked for ten minutes, and the fall of water in the second well continued for nearly fifteen minutes.

The article by Mr. King is followed by one on the theoretical investigation of the motion of ground-waters, by Mr. Charles S. Slichter.

An elaborate memoir on the Cretaceous formation of the Black Hills (Rocky Mountains), as indicated by the fossil plants, is communicated by Mr. Lester F. Ward, who has had the assistance of Messrs. W. P. Jenney, W. M. Fontaine and F. H. Knowlton. The forms described include a number of silicified Cycadean trunks, Conifers, Ferns and Equisetaceæ, also Dicotyledons belonging to the beech, oak, elm, mulberry and soapberry families. The work is illustrated by over a hundred plates, including one of Cycadean trunks from the Purbeck beds of the Isle of Portland, England, belonging to the U.S. National Museum.

Part iv., a volume of 814 pages, deals with hydrography : it contains a report, by Mr. F. H. Newell, on stream measurements ; and an account, by Mr. Edward Orton, of the Rock waters of Ohio. The knowledge of the Ohio waters is mainly due to the boring operations in search of oil and gas. Mr. N. H. Darton furnished a preliminary report on the geology and water resources of part of Nebraska. Several illustrations are given of tors or outstanding masses of sandstone which, from being locally hardened, have withstood the effects of denudation. Other instances of fantastic weathering, seen in the "Chimney Rock" and "Toadstool Park," are effectively shown in plates.

Part vi. (in two volumes) contains an account of the mineral resources of the United States. In the first volume, the metallic products, coal and coke are dealt with ; in the second volume, petroleum, natural gas, stone, clays, cement, precious stones, phosphates, mineral paints, &c. There are also notes on the mineral resources of Hawaii, and of the Philippine Islands.

Monographs of United States Geological Survey.

The twenty-ninth volume of the Monographs of the United States Geological Survey is a large work of 790 pages, on the geology of Old Hampshire county, Massachusetts, by Professor Benjamin K. Emerson. It is an elaborate memoir embodying personal observations which have extended over more than a quarter of a century ; and it deals with a great variety of formations—Algonkian, Cambrian, Silurian, Devonian, Triassic and Pleistocene—also with various eruptive rocks, and their many economic products. In the Algonkian series there are gneisses often granitoid, and others yielding much graphite, likewise magnesian limestone. Of Cambrian age are various gneisses and associated schists and quartzite. A detailed description is given of the granitoid gneiss of Monson, which is extensively quarried, the yearly output being from twenty to thirty thousand tons. The author draws attention to a remarkable tendency to expansion which has been stored up in the gneiss, causing blocks to elongate when they are quarried. In the same way the expansion causes the horizontal sheets of the rock to rise, often quite suddenly, in considerable anticlines, with the arch as much as fifty feet long and the rise three or four inches. These anticlines form sometimes with explosive violence, throwing large fragments of the rock more than two feet from their original position. Evidently the rock has an elastic stress which expresses itself in expansion when the surrounding masses are removed.[1]

Among the rocks classed as Lower and Upper Silurian are sericite-schists, amphibolites and serpentines, of which petrographical descriptions are given. Not the least interesting feature in the geology is the great magnetite-emery bed which lies along the junction of hornblende-schist and sericite-schist, and was discovered in 1864. The emery is distinguished from corundum (pure anhydrous alumina) which also occurs, and is regarded as an aluminate of iron. A full account of this mineral vein is given.

When we come to the Devonian rocks we still find a series highly altered, comprising in the main quartzite, and various schists, together with limestones. The rocks appear to rest conformably on, and, indeed, to pass into what are called Upper Silurian argillites ; nevertheless, the fossils, or rather impressions of them, which were obtained in the rocks, seem to be of upper Devonian type. Prof. J. M. Clarke remarks that they "are so distorted, obscure, and closely packed together, that a little imagination can construe them into species of all sorts of ages" ; but he feels "reasonably secure" about a few, among which is a large spirifer, like *Spirifera disjuncta*. Workers among the Devonian rocks in parts of Devon and Cornwall would feel sympathy with the difficulties of accurate identification, and suspend judgment about the local relations of Devonian and Silurian. In a general chapter on amphibolites the author states that he has assigned most of them with more or less confidence to the list of altered sedimentary rocks. Passing on to the eruptive rocks, he describes various granites, aplite, quartz-gabbro, tonalite or quartz-diorite, diorite, diabase, and cortlandite (hornblende-pyroxene-biotite-peridotite).

The Triassic rocks comprise a series of sandstones, conglomerates and red shales, together with diabases. The shales contain impressions of salt-crystals, and among the conglomerates the author finds evidence which suggests the former presence of shore-ice. Most interesting are the observations on the preservation of reptilian foot-prints and rain-drops which occur in sandstones that rest on the broad sheets of trap. It is thought that the iron set free from the decomposing lavas below permeated the sediments and favoured the preservation of the tracks ; it is also suggested that the heat of these great trap-sheets may have promoted rapid consolidation of the sand-layers by which they were quickly covered. In a few notes on the "Recent Progress in Ichnology," Mr. C. H. Hitchcock gives a list of the Ichnozoa of the Trias, including one marsupial, and many birds, dinosaurs, reptiles, batrachians, arthropods and mollusca.

In the account of Pleistocene phenomena we have references to Pre-Glacial drainage and erosion, descriptions of glacial lakes, and minor grooves and notches, and particular accounts of the till and various other drifts. The author remarks on the fragments worn by the agency of land-ice "into the peculiar shapes so characteristic of glacial accumulations, three- or four-sided forms, with irregular ends more or less elongate as the rock was more or less schistose, the sides flat or broadly convex, joined by rounded edges and scratched in various directions" ; and he adds that "These peculiar forms, called by the Germans *dreikantner*, are as characteristic of the till as graptolites of the Silurian." Numerous sections are given of glacial deposits, many of which remind us of the drifts so well exposed on the coasts of Norfolk and Suffolk, which exhibit similar structures and contortions. The Pleistocene beetles are described by Mr. S. H. Scudder. The volume, which is well illustrated, concludes with a chronological list of publications on the district, the earliest of which is a reference to an ancient catalogue (1734) of objects of natural history formed in New England, by John Winthrop, F.R.S.

Monograph No. 31 contains an account of the geology of the Aspen mining district, Colorado, by Mr. Josiah E. Spurr, and it is accompanied by a large folio atlas of maps and sections.

In an introduction, Mr. S. F. Emmons points out that Aspen is one of the most picturesquely situated mining towns of the Rocky Mountain region ; and that its great mineral wealth lies in a narrow belt of Palæozoic rocks, which are steeply upturned against granite, and broken in the most complicated manner by a network of faults.

[1] See also A. Strahan, on "Explosive Slickensides," *Geol. Mag.* for 1887

The mines of Aspen were mainly discovered and opened by men whose most recent mining experience had been at Leadville, where the silver-ores were found principally at or near the contact of limestone, with overlying sheets of porphyry. The ores consist chiefly of lead and zinc sulphides, carrying silver, with a gangue of barytes, quartz and dolomite. Rich shoots of ore occur chiefly at the intersection of two or more faults, and the theory is advanced that while the minerals were deposited by hot waters, the solutions ascending along one of these channels were precipitated by solutions which circulated along the other.

The fundamental rock in the district is a granite, and this is overlaid by Cambrian, Silurian, Devonian, Carboniferous, Juratrias and Cretaceous. The Cambrian and Silurian formations are comparatively thin, and they consist largely of dolomitic sandstones and shales. The Devonian beds, which are very variable in character, comprise limestones and calciferous sandstones of no great thickness, and they are characterised by the presence of fishes of Devonian type. The Carboniferous and also the Secondary formations attain a great thickness. Into these strata, probably in Cretaceous times, there were intruded dykes of quartz-porphyry and diorite-porphyry. Great physical disturbances took place, accompanied by distinct systems of faults, some developed before, others after the deposition of the ores. In the author's opinion some faults have developed almost entirely in Post-Glacial times, the evidence resting partly on the preservation of scarps with slickensided fault-surfaces. He believes also that in many cases the fault-movement is going on at the present day. Since the beginning of the great disturbances, about 15,000 feet of sedimentary rocks have been removed by denudation; in later times by glacial action. A general ice-sheet at one time covered the whole of the Aspen district, leaving evidence of its presence in the rounded and fluted forms into which the hill-tops are carved, and in deposits of morainic material. When the ice-sheet shrank to smaller dimensions, there resulted local glaciers which followed the course of pre-existing valleys, and carved them into their present forms. At this period temporary lakes were formed by the damming up of glacial waters.

The author has given considerable attention to the subject of dolomitisation. He remarks that along the channels afforded by faults, hot spring-waters containing carbonate of magnesia rose and produced the dolomitisation of the limestone. Zones in the limestone following watercourses which are parallel to the bedding, or which cut across it, are locally altered to dolomite. There is evidence also of an earlier period of such chemical interchange, some of the Silurian and Carboniferous sediments having been early converted into dolomite by the action of magnesium salts contained in the waters of a great lake or inland sea, and in which they were concentrated by evaporation. These earlier dolomites are continuous over wide areas, with an almost uniform chemical composition.

Maryland Geological Survey.

Under the vigorous direction of the State Geologist, Prof. W. Bullock Clark, the Maryland Geological Survey has just issued its third volume; one of a series which in type and illustration is one of the most excellent of all the geological reports published in the United States. The present volume deals wholly with questions of economic geology treated from a scientific as well as a practical point of view. It is, in fact, a manual on road-materials and road-construction. The dependence of the highways upon the surface configuration of the land, and the bearing of the distribution of temperature and rainfall are pointed out. Attention is rightly paid to the relationship between the stony structure of the ground and the roads. The questions of construction and repair, and the qualities of road-metals are dealt with in detail, and the construction of sample roads is described. Various administrative matters are also dealt with. Illustrations are given of the method of road-making since early times; there are numerous photographic illustrations of types of roads formed of different materials, including types of bad roads in Maryland; and there are photo-micrographs of rock-sections of road-material.

Geology of Indiana.

A bulky volume of 1741 octavo pages forms the "Twenty-third Annual Report of the Department of Geology and Natural Resources for the State of Indiana," under the direction of Mr. W. S. Blatchley, State Geologist. It comprises the result of a careful survey of the coal area of Indiana, giving full details of the physical features and stratigraphy, of the mines and method of mining, with analyses of the coal. The work is profusely illustrated with maps and sections, and not the least interesting are the sections of faults and disturbances and evidences of irregularities in the coal-seams due to local thickening by disturbance, or to original deposition, or to erosion in Carboniferous or later periods. A report is made on the natural gas which occurs in the Trenton limestone, and is sealed up beneath the Utica shale. The first boring was made in 1884, and the gas was tapped at a depth of about 1100 feet. The Trenton limestone was proved to be both the source and the reservoir of the gas.

Geological Survey of Canada.

The "Annual Report of the Geological Survey of Canada for the year 1897 (1899)" has just reached us. It is a composite volume, containing six individual reports separately paged, but all indexed together with special references to each. As the progress of the survey has been noticed already in NATURE, when dealing with the Annual Summary Reports of the director, Dr. G. M. Dawson, it will suffice to call attention to this important volume which contains detailed accounts of Archæan, Palæozoic and Pleistocene deposits, with full descriptions of the economic products. There is a special report on the mineral resources of New Brunswick, by Mr. L. W. Bailey, and another on mineral statistics and mines, by Mr. E. D. Ingall. The volume is illustrated by a number of maps and plates. One of the most effective views is that of the Devil's Rapids on Chandière river, Quebec. It illustrates a report on the surface geology and auriferous deposits of South-eastern Quebec, by Mr. R. Chalmers.

ELECTRO-CULTURE.

THE results obtained by culture under the influence of electric light are fairly well known, and the growing of lettuce for salads, in spacious greenhouses with the aid of electric light, is already a profitable industrial pursuit in the United States (near Chicago and elsewhere). However, the use of electric currents for stimulating vegetation, although it was studied more than fifty years ago (by Ross, in 1844–46; continued by Forster, Sheppard, Fichtner, &c.), still remains unsettled. A communication upon this subject, made by a Russian engineer, V. A. Tyurin, before the St. Petersburg Electro-Technical Society, contains some welcome information upon the work done in this direction in Russia by M. Spyeshneff and M. Kravkoff. The former experimented a few years ago on three different lines. Repeating well-known experiments on electrified seeds, he ascertained once more that such seeds germinated more rapidly, a nd gave better fruit and better crops (from two and a half to six times higher), than seeds that had not been submitted to preliminary electrification. Repeating next the experiments of Ross—that is, burying in the soil one copper and one zinc plate, placed vertically and connected by a wire, he found that potatoes and roots grown in the electrified space gave crops three times heavier than those which were grown close by on a test plot; the carrots attained a quite unusual size, of from ten to twelve inches in diameter. Spyeshneff's third series of experiments was more original. He planted on his experimental plot, about ten yards apart, wooden posts provided at their tops with metallic aigrettes connected together by wires, so as to cultivate his plants under a sort of network of wires. He obtained some striking results, one of which was that the growth and the ripening of barley were accelerated by twelve days. Quite recently M. Kravkoff undertook a series of laboratory experiments upon boxes of soil submitted to electric currents. The temperature of the soil was raised by these currents; its moisture decreased first, but began to increase after a course of three weeks (the same increase of moisture was also noticed by Fichtner); and finally, the amount of vegetable matter in the soil was increased by the electric currents. With what is now known upon the influence of micro-organisms upon vegetation, further research on similar lines is most desirable and very promising.

SCIENTIFIC SERIALS.

THE *Journal of the Royal Microscopical Society* for April contains the President's Annual Address, the last instalment of his valuable series of addresses on the mathematics of the construction of microscopic lenses. In this address, Mr. E. M. Nelson devotes himself to the aplanatic immersion front and the Huyghenian eye-piece, and deals with the errors of this lens, viz. chromatism, curvature of image, distortion, and astigmatism.

A new feature in the present number is the extension of the bibliography to microscopical technique and bacteriology.

THE *Journal of Botany* for February, March, and April contains several articles of more than usual interest. Mr. C. R. P. Andrews records the discovery in the Channel Islands of two grasses new to Britain, *Phalaris minor* and *Milium scabrum*, both apparently native; and Mr. Arthur Bennett, the occurrence of *Potamogeton rutilus*, also new to Britain, in Surrey. Dr. A. B. Rendle reviews the British species of *Naias*, now amounting to four (including one found at present in geological deposits only), although the first discovery of the genus as British was as recent as 1850. The very useful review of the algological literature for 1899 will, we hope, be continued in future numbers.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 5.—"Further Note on the Influence of Temperature of Liquid Air on Bacteria." By Allan Macfadyen, M.D., and S. Rowland, M.A. Communicated by Lord Lister, P.R.S.

In a previous communication (*Roy. Soc. Proc.* February 1, 1900) it was shown that no appreciable influence was exerted upon the vital properties of bacteria when exposed for 20 hours to the temperature of liquid air (−183° C. to −192° C.). Further experiments have since been made in which the organisms were again exposed to the temperature of liquid air for a much longer period, viz. seven days.

The organisms employed were *B. typhosus*, *B. coli communis*, *B. diphtheriae*, *B. proteus vulgaris*, *B. acidi lactici*, *B. anthracis* (sporing culture), *Spirillum cholerae asiatica*, *Staphylococcus pyogenes aureus*, *B. phosphorescens*, a Sarcina, a Saccharomyces, and unsterilised milk.

Instead of being exposed as formerly on the actual media in which they were growing, the organisms were submitted to the cooling process in the form of a broth emulsion in hermetically sealed fine quill tubing. This allows of complete immersion, and effects a considerable economy in the amount of liquid air used, besides greatly facilitating manipulation. The liquid air was kindly furnished by Prof. Dewar, and the experiment was conducted in his laboratory.

In the course of the experiment, the loss by evaporation of the liquid air was made up by adding fresh portions from time to time. In this way the temperature of about −190° C. was maintained uninterruptedly through the whole period of the experiment. At the same time considerable care had to be taken in conducting the first cooling, in order to avoid fracture of the quill tubes. A preliminary cooling was therefore effected by means of solid CO_2. After the expiration of a week, the tubes were removed with cork-tipped forceps, and placed in a strong glass vessel till thawing was complete. The tubes were then opened, and the contents transferred to suitable culture media. In each case, a direct microscopical examination was made to detect any possible structural changes.

It is a remarkable fact that, notwithstanding the enormous mechanical strain to which the organisms must have been exposed, a strain far exceeding in amount any capable of being produced hitherto by direct mechanical means, not the slightest structural alteration could be detected.

The sub-cultures made at the conclusion of the experiment grew well, and in no instance could any impairment in the vitality of the organisms be detected. In one or two instances only, growth was slightly delayed, an effect which might have been due to other causes. The photogenic bacteria grew and emitted light, and the samples of milk became curdled.

The above experiments show that bacteria can be cooled down to −190° C. for a period of seven days without any appreciable impairment of their vitality.

It has not yet been possible to undertake the experiments with liquid hydrogen.

Geological Society, April 4.—J. J. H. Teall, F.R.S., President, in the chair.—Additional notes on some eruptive rocks from New Zealand, by Frank Rutley. The author suggests a comparison of certain ancient rhyolites of Great Britain with those of New Zealand affected by solfataric action. As to the causes which may convert a glassy into a lithoidal rhyolite, we still seem to lack information: it is possible that the action of steam may be instrumental in effecting such a change, but this is probably only an occasional agent, and the more general cause of such changes must be sought elsewhere.—On the discovery and occurrence of minerals containing rare elements, by Baron A. E. Nordenskiöld. The first mineral referred to is scheelite, and the next cerite, which contains no less than four rare metals. The incandescent light produced when the latter mineral is fused with charcoal-powder was first observed by Cronstedt in 1751. The discovery of glucina, lithia, selenium and yttria is next referred to. Minerals containing yttria and oxides related to it were, at one time, thought to be almost limited to certain pegmatite-veins running in a broad zone on both sides of the 60th parallel of latitude. Latterly, fluocerite, orthite and gadolinite have been found in Dalecarlia; and among these minerals Benedicks discovered a silicate of yttrium containing 1·5 per cent. of nitrogen and helium. The author discovered kainosite, a silico-carbonate of yttrium and calcium, among minerals from Hitterö; and the same mineral was subsequently discovered in the flucan, fissures, and drusy cavities at the Nordmarken mines. The last-mentioned discovery and others related to it appear to suggest that the mode of formation of fissure-minerals is not so unlike that of the pegmatite-veins of the primary rocks as is generally supposed. Thorium, discovered by Berzelius in 1829, was originally obtained from the rich mineral-locality of Langesund (called Brevig in mineralogical literature), but it has since been recorded from other localities, including Arendal and Finnish Lapland. It is now obtained from the monazite-sand of rivers in the Brazils and South Carolina. Thorite contains about ·5 per cent. of inactive gas, probably a mixture of nitrogen and helium; but the latter element was first obtained from the mineral cleveite, also containing thorium, discovered by the author in 1877. Other minerals bearing nitrogen, argon or helium are referred to; and under the head of minerals bearing tantalum, mention is made of Giesecke's discoveries in Greenland. Among these is fergusonite, one of the richest sources hitherto known for obtaining that mysterious gas, or mixture of gases, which on our planet seems to be almost exclusively confined to minerals containing rare earths. "The group of earths, as well as the group of gases, of which we are here speaking, might, therefore, be compared with certain genera among organic beings, whose species, having not yet fully differentiated, offer to the descriptive zoologist or botanist difficulties analogous to those with which chemists meet in endeavouring to separate the rare earths and rare gases."

PARIS.

Academy of Sciences, April 9.—M. Maurice Lévy in the chair.—Funeral orations on the late M. Joseph Bertrand, delivered by MM. Jules Lemaitre, Maurice Lévy, Berthelot, Gaston Darboux, A. Cornu, Duclaux, Gaston Paris, and Georges Perrot.—On the transmission of the radiation of radium through substances, by M. Henri Becquerel. In order to ascertain whether the rays transmitted through a screen are transformed rays from the radio-active source or secondary rays emitted by the screen, experiments were made on the shadow cast by a body placed on the side of the screen opposite to the source. It appears that part, at least, of the secondary radiation is not deviated in a magnetic field, as is the case with the radiation of radium, whilst another portion is possibly due to partial diffusion. The absorption of the incident radiation increases with the distance of the screen from the source, as has been previously observed.—On the density and analysis of sulphur perfluoride, by MM. H. Moissan and P. Lebeau. The density of the gaseous perfluoride of sulphur, the preparation of which was described in a previous communication, is found to be 5·03, compared with air. The analysis of the compound was effected by decomposing it by the vapour of sodium at a red heat, a mixture of sodium sulphide and fluoride being thus obtained, and also by heating with sulphur or selenium in glass vessels and measuring the volume of the silicon fluoride evolved. The results are in accordance with the formula SF_6, the hexavalent character of sulphur being thus clearly demonstrated.—On the fossil ferns of coal, by M. Grand' Eury. A description of the roots of the various species of ferns occurring in the fossil forests of the coal beds at Saint-Étienne.—Immunity against symptomatic carbuncle after the injection of preventive serum and natural virus, either separately or together. Experiments with sheep show that complete immunity is produced by successive inoculation with serum and virus, but not by the

injection of a mixture of serum and virus.—M. Michelson was elected corresponding member for the Section of Physics.—Solar observations at the Lyon Observatory during the fourth quarter of the year 1899, by M. J. Guillaume.—On certain equations of Monge-Ampère, by M. J. Clairin.—On the general representation of some analytic functions, by M. Desaints.—New methods for maintaining the vibrations of tuning-forks, by MM. A. and V. Guillet. The electrical mechanism previously applied by A. Guillet to Lippmann's pendulum is perfectly adapted to the tuning-fork.—Experimental study of the movements produced in liquids by heat convection. Permanent control; cellular vortices, by M. Henri Bénard. A preliminary note. The liquid behaves as if divided into a number of regular prismatic cells, the dimensions and periodic movements of which depend on the experimental conditions.—On the duration of the emission of Röntgen rays, by M. Bernard Brunhes. The emission of X-rays produced by a rupture of the primary current of the induction coil lasts for about the ten-thousandth part of a second.—On the reflection and refraction of kathode rays and of the deviable rays of radium, by M. P. Villard. The author's experiments lead to the conclusion that the apparent transmission of kathode rays through metallic plates is due to a secondary emission. The deviable rays of radium behave like kathode rays, whilst the non-deviable rays include radiations of high penetrating power.—Negative electrification of secondary rays produced by means of Röntgen rays, by MM. P. Curie and G. Sagnac. Röntgen rays appear to bear no electric charge, but the secondary rays resulting from their transformation resemble kathode rays in being negatively electrified.—Heat of formation of hydrated and anhydrous strontium dioxide, by M. de Forcrand. The heat evolved in the conversion of strontium monoxide into the anhydrous dioxide is less by about one calorie than that evolved in the formation of barium dioxide, whilst, on the other hand, strontium dioxide has a greater affinity for water than barium dioxide.—On a new method of fractionating some rare earths, by M. Eugène Demarçay. The method is based on the crystallisation from nitric acid of the double nitrates of magnesium and the rare earths.—Formation of monomercurammonium iodide by the action of concentrated ammonia on mercurdiammonium iodide, by M. Maurice François. Monomercurammonium iodide, $NHgH_2I$, is prepared by adding successive small quantities of ammonia to mercurdiammonium iodide; it is a black, crystalline substance which does not become red on exposure to air, and is insoluble in ether.—On a crystalline selenide and oxyselenide of manganese, by M. Fonzes-Diacon. Manganese selenide, MnS, is obtained in cubical crystals by the action of hydrogen selenide on a solution of manganese acetate, by the reduction of manganese selenate with carbon in the electric furnace, and by fusing the precipitated selenide at a high temperature. Prismatic needles of the same substance are produced by the action of hydrogen selenide on manganese chloride at a red heat. A green oxyselenide is formed when manganese selenate is reduced by hydrogen at a bright red heat.—On the reducing action of calcium carbide, by M. Geelmuyden. The action of calcium carbide on boric anhydride at the temperature of the electric furnace results in the formation of calcium boride, CaB_6. Under the same conditions the sulphides of iron, lead, antimony, and magnesium yield calcium sulphide and the respective metals which, except in the case of iron, are volatilised. Aluminium sulphide is not reduced by calcium carbide.—On a new method for the preparation of double sulphates of chromium, by M. C. Pagel. In the destruction of organic matter by means of chlorochromic acid, as previously described, the double sulphates of chromium and sodium or chromium and potassium are formed; they crystallise in the hexagonal system.—Electrolytic estimation of lead in lead sulphate and chromate. Application to the analysis of lead glass and lead chromates, by M. C. Marie. The lead compounds are dissolved in a mixture of nitric acid and ammonium nitrate, and the solution electrolysed in the usual manner.—On $\alpha\alpha\beta$-trimethyl-β-oxyadipic acid, by M. E. E. Blaise. The lactonic acid corresponding with this acid is obtained by the condensation of methyl levulate with methyl bromisobutyrate in presence of zinc.—Action of amyl chloride on calcium carbide, by M. P. Lefebvre. The primary products of the action of amyl chloride on calcium carbide at a dull red heat are probably acetylene, amylene, and calcium chloride.—The nervous ganglions of the posterior roots belonging to the great sympathetic system, by M. Nicholas Alberto Barbieri.

DIARY OF SOCIETIES.

MONDAY, APRIL 23.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Eighth "James Forrest" Lecture: The Relations between Electricity and Engineering: Sir William H. Preece, K.C.B., F.R.S.

TUESDAY, APRIL 24.

ROYAL INSTITUTION, at 3.—Studies in British Geography: Dr. H. R. Mill.

INSTITUTION OF CIVIL ENGINEERS, at 4.—Repetition of "James Forrest" Lecture by Sir William Preece, K.C.B., F.R.S.—At 8.—Annual General Meeting.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—The Ethnography of Torres Straits and British New Guinea: A Genealogical Method of collecting Social and Vital Statistics: Dr. W. H. R. Rivers.—Lantern Demonstration of Native Industries: Prof. A. C. Haddon, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.—The Consumption of Alcoholic Beverages: H. Bence Jones.

WEDNESDAY, APRIL 25.

GEOLOGICAL SOCIETY, at 8.—On Longmyndian Inliers at Old Radnor and Huntley (Gloucestershire): Dr. Charles Callaway.—On a Complete Skeleton of an Anomodont Reptile from the Bunter Sandstone of Riechen, near Basel, giving New Evidence of the Relation of the Anomodontia to the Monotremata: Prof. H. G. Seeley, F.R.S.

THURSDAY, APRIL 26.

ROYAL INSTITUTION, at 3.—A Century of Chemistry in the Royal Institution: Prof. J. Dewar, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Electric Transmission of Power: Prof. George Forbes, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Road Locomotion: Prof. Hele-Shaw, F.R.S.

FRIDAY, APRIL 27.

ROYAL INSTITUTION, at 9.—Nineteenth Century Clouds over the Dynamical Theory of Heat and Light: Lord Kelvin, G.C.V.O., F.R.S.

PHYSICAL SOCIETY (Solar Physics Observatory, Exhibition Road, South Kensington), at 8.—A short account of the Physical Problems now being investigated at the Solar Physics Observatory, and their Astronomical Applications: Sir Norman Lockyer, K.C.B., F.R.S.—Weather permitting, the 36-inch, 10-inch, and 9-inch telescopes will be used for the observation and photography of celestial objects and their spectra. The Apps-Spottiswoode coil and 21-ft. Rowland grating will also be in operation.

SATURDAY, APRIL 28.

ROYAL INSTITUTION, at 3.—Egypt in the Middle Ages: Prof. Stanley Lane-Poole.

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