THURSDAY, JULY 26, 1917.

AFTER THE WAR.

The War and the Nation: A Study in Constructive Politics. By W. C. D. Whetham. Pp. viii+312. (London: John Murray, 1917.) Price 6s. net.

IN a very readable and interesting little book of about three hundred pages Mr. Dampier Whetham has made a contribution of considerable value to the literature called forth by the present world-shaking war. With clear insight and breadth of information he deals with the new conditions of life which have been created for the Empire, the nation, and the citizen by the gigantic Teuton conspiracy to grasp world-empire for the Hohenzollern dynasty and the crowd of adventurers and militarists by whom it is supported. The defeat of this nefarious project has cost and will still cost the great liberty-loving democracies of the world incalculable sacrifices in life and treasure. All that is most precious in human life is, however, at stake, and hence the work of crushing Prussian militarism must be done now, and done so effectively that it will never raise its brutal dragon-head again.

The main topic of Mr. Whetham's book is the consideration of the steps which will have to be taken to make good the inevitable losses, and to support that load of national debt which will have been incurred. The book is divided into six chapters, respectively entitled *Laissez-faire* or constructive politics; The land and they that dwell thereon; The organisation of British industry and commerce; Coal and railways; The war and the race; Finance and taxation. It will be seen that the topics handled lie as much within the realm of political economy as within that of scientific or technical work, and much has already been said or written by scientific men and industrial leaders on some of the matters discussed.

One of the most important questions is the serious loss to the nation of young, highly trained, capable, and promising men who have given their lives for the salvation of their country. Mr. Whetham remarks that one point in favour of conscription for military service is that a certain equality of sacrifice is thereby demanded from the whole nation. In the case of voluntary service it is the most public-spirited, high-minded, vigorous, and able men who proffer first and take the greatest risks, and give in consequence life or limbs. Hence such voluntary service tends to deplete the ranks of those of the nation who have most leading power or initiative, and tends to the survival of the physically weak, timid, or reluctant.

Be that as it may, we have to face the fact that there has been an appalling loss of young men of great abilities, whose training and talents are now lost to the world and whose place must be taken by still younger or older men. The immediate consequence of this is that much more scientific care must be taken to preserve child life and promote physical vigour, and to combat diseases, especially of the contagious types, affecting children, which is a matter chiefly for scientific research.

Again, Mr. Whetham touches on the utterly unscientific administration of direct taxation. By taxing the joint income of husband and wife, by insufficient allowance for families, by death duties on the careful savings of income, and in other ways, the State penalises marriage, thrift, and reproduction. Furthermore, we have to bring about with expedition the reforms in education for which scientific students of the subject have been clamouring for years, and get rid of antiquated methods in infant, board, secondary, and public schools. Happily, we have now a President of the Board of Education who means business, and is not a politician.

The second key fact is the stupendous increase in the National Debt. Mr. Whetham shows that we shall be lucky if we end the war with not more than 5,000,000,000*l*. sterling of debt and 500,000,000*l*. for our annual Budget. How is this to be obtained and liquefied? The answer is: Solely by more work, more intelligent work, and greater economy and saving of all kinds. This leads Mr. Whetham at once to discuss the coal question, which has already attracted great attention. The world's coal supply is large, but not unlimited. It is estimated at seven to nine billion tons. The available British share is 189,000 million tons, according to the estimates of the International Geological Congress held in 1913, and Prof. H. S. Jevons thinks that in fifty years the price of British coal will be rising distinctly relatively to other commodities. Hence we can afford no waste. The consumption of raw coal in household grates ought soon to be interdicted, as well as open coke ovens, which waste the by-products. Mr. Whetham discusses the question of the nationalisation of coal mines, as well as that of railways, chiefly from the point of view of economy of management and working.

An important section of the book is chap. iii., on the organisation of British commerce and industry and its relation to scientific research. There can be no question that we shall not be able to return again to the old *laissez-faire* methods and to small disconnected businesses rivalling each other and all being defeated by German organised trade and science. The war has done more to kill these antiquated methods than a century of talk would have accomplished. The chief cloud on the horizon is, however, the relation of capital and labour. An extensive adoption of profit-sharing or co-partnership in some form or other seems the only solution. Labour must have its living wage and capital its interest, which will remain for decades now at 5 to 6 per cent. After that must come an equitable division of the profits between all concerned. Labour must, however, be brought to see that there are four factors concerned in production, viz. labour, capital, scientific invention or initiative, and business management, and that without the two latter the two former are helpless.

Altogether Mr. Whetham's book is a suggestive and very thoughtful contribution to the chief topic of the day, and it ought to be in the hands of those statesmen and publicists who will have to draft workable schemes before very long to meet the demands and conditions of the strenuous life which lies before us all, even in those brighter days to come when the world will have shaken off the incubus of Prussianism with its accursed doctrine of brute force and bloodshed for the sake of German supremacy and *Kultur*. J. A. FLEMING.

AMERICAN SYLVICULTURE.

Seeding and Planting: A Manual for the Guidance of Forestry Students, Foresters, Nurserymen, Forest Owners, and Farmers. By J. W. Toumey. Pp. xxxvi + 455. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 16*s*. 6*d*. net.

THIS is the best text-book on a forestry subject which has yet appeared in America. The author, now director of the Forest School in Yale University, was formerly in the U.S. Forest Service, where he was chiefly employed in the supervision of the nurseries and plantations in the national forests. He made also a study and personal inspection of the methods of nursery work and artificial regeneration of forests in Europe. This book purports by its title to deal with the operations of sowing and planting trees, but is wider in its scope, being a manual on afforestation in general. It is clearly written, and is distinguished by its discussion of fundamental principles, as well as by its comprehensive treatment of the details of nursery and planting practice. The usefulness of the book is enhanced by its remarkably good illustrations and diagrams. Though primarily intended for American foresters, it will be found equally useful in this country.

The introduction gives an account of the present condition of the forests in the United States, their economic importance, and the need for artificial regeneration. The original forest land of the United States, before the onslaught of European settlers, approximated to 850,000,000 acres in area. This vast heritage has gradually been reduced by fire, felling for timber, and clearing for farms to 550,000,000 acres. Of this, about 240,000,000 acres, comprising the most valuable tracts of timber, are owned by large companies. Some 200,000,000 acres are scattered over the whole country in countless small holdings, called wood-lots. These often resemble in size and quality the woodlands on private estates in England, and like them might be much benefited by better management and improved sylviculture. The publicly owned forests contain more than 100,000,000 acres of saleable timber, the greater part of which is in the West and in the national forests.

The national forests are 162 in number, with an extent of 163,000,000 acres; but this is not all timber land, as it includes much grazing and treeless tracts. The national forests were set aside out of the public lands which had not as yet been alienated to settlers. The rescue of so much of the original forest from the perils of private ownership is quite recent, and is perhaps the greatest feat of American statesmanship since the abolition of slavery. The first effective step was taken in 1891, when an Act was passed which gave the President the right to create "forest reserves," now styled "national forests," by proclamation. Since then this magnificent public domain has been created, mainly through the efforts of Gifford Pinchot, who became head of the Forest Service in 1898, and whose views were carried out on a grand scale by virile Presidents like Cleveland and Roosevelt.

The body of the work is divided into two parts. Part i. deals with general methods of reproduction, with the choice of species in artificial regeneration, and with the principles which determine the spacing of plants and the density of woods. Part ii. gives a detailed account of the quality, production, collection, and testing of seeds; the protection and preliminary treatment of nursery and planting areas; the management and cultivation of the forest nursery; and the establishment of woods by direct sowing and by planting.

Mr. Toumey's main note is economy; and he quotes (p. 425) the cost of planting in Pennsylvania, where 4,329,321 trees were planted by the State Forester in 1915, at the rate of 8.61 dollars, or 1*l*. 16*s*., per acre for stock and labour. With this may be compared an example of the cost of planting in England. The Manchester Corporation, paying labourers at 25*s*. a week, planted 97 acres in 1910 at Thirlmere, at an average cost, for stock and labour, of 4*l*. 16*s*. 6*d*. per acre (see Trans. R. Scott. Arboricult. Soc., xxvi., p. 42). The comparatively low cost for effective planting in the former case is due in part to wider spacing and consequent fewer plants, and to the use of smaller seedlings; but there still remains some balance to be put to the credit of greater efficiency of labour in Pennsylvania and better planting methods.

MANUALS OF CHEMISTRY.

(1) *Chemistry for Beginners and for Use in Primary and Public Schools.* By C. T. Kingzett. Pp. vi + 106. (London: Baillière, Tindall, and Cox, 1917.) Price 2*s*. 6*d*. net.

(2) *A Short System of Qualitative Analysis for Students of Inorganic Chemistry.* By Dr. R. M. Caven. Pp. viii + 162. (London: Blackie and Son, Ltd., 1917.) Price 2*s*.

(1) MR. KINGZETT'S little book is for beginners. He points out quite rightly that our "future commercial prosperity" depends upon the greater cultivation of science, and that we ought to "give all our boys the earliest opportunity of acquiring an elemental knowledge of such subjects." That science should form an essential part of everyone's education, as did formerly the three R's, is now generally admitted. The difficulty is as to the best method of instruction at the various stages of a child's development. The present writer must confess that, however excellent the matter and arrangement of this small volume may be, it is scarcely a book for the young scientific tyro. In the first

place, it is doubtful whether systematic chemistry, entirely divorced from elementary physics, is a useful introduction. It is further open to question whether the notion of atomic weights, chemical equations, and valency can be assimilated at this stage; yet these subjects are discussed within the first twenty pages. Finally, we submit that it is unnecessary and undesirable for a beginner to be introduced to more than a small fraction of the whole gamut of the elements and some of their chief compounds, even though they may find some application in the arts and manufactures. No doubt the book is intended to be associated with laboratory practice or some form of experimental demonstration, for there is not a single illustration representing chemical apparatus. For so small a volume, which is not much larger in dimensions than the "People's Books," the price of 2*s.* 6*d.* seems excessive.

(2) The chief novelty in Dr. Caven's little book on qualitative analysis is the arrangement. Instead of presenting the reactions for the individual metals in their group order, as is usually done, the author directs the student first to the study of the individual reagents, so that the basis of group classification may become evident at the outset. Thus the action of heat and other dry tests are taken first, and are followed by the action of solvents and, finally, by that of the group reagents. This forms Part i., while Part ii. is devoted to the usual description of reactions for the metals and acids, taken in group order. Part iii. contains a short summary of the process of analysis.

The author considers that this arrangement has proved more satisfactory in actual practice than the older scheme, and, moreover, regards it as more scientific. No doubt the first claim is well founded on its alleged success; the second merely turns on a choice between the inductive and the deductive method, but who shall say which is the more scientific?

J. B. C.

OUR BOOKSHELF.

The Statesman's Year-Book, Statistical and Historical Annual of the States of the World for the Year 1917. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Fifty-fourth annual publication. Revised after official returns. Pp. xliv+1504+plates 4. (London: Macmillan and Co., Ltd., 1917.) Price 12*s.* 6*d.* net.

THE new edition of this valuable year-book has been slightly reduced in size without lessening its usefulness. Considerable difficulties have had to be faced in the revision of the statistics of belligerent, and especially enemy, countries, but these have been overcome in many cases. The value of the book is enhanced by the figures in most countries being given for at least the last pre-war year in addition to later years, where the latter were available. There are four maps, showing respectively: States engaged in the war up to May 10, 1917; Arabia, with political divisions; the railways of South America; and the canals and inland waterways of the United Kingdom. The additions and corrections contain material received too late to be embodied in the work, and include a section on Arabia. Accurate information about Russian railways is difficult enough to obtain in peace time, and the editors have been wise to give a list of lines "being built, approved for construction, or projected" without further discrimination. The Amur line, however, is now built, and we believe has been in use for a year or more. Among other useful matter in the introductory tables are the figures for the world's production of various metals, sugar, and grain. The list of the chief events of the war is brought up to May, 1917, and a further list of the chief books on the war is added.

Microscopic Analysis of Cattle-Foods. By T. N. Morris. Pp. viii+74+figs. 54. (Cambridge: At the University Press, 1917.) Price 2*s.* net.

IT is curious that whereas the chemical analysis of cattle-foods has given rise to a considerable array of text-books, the equally, or often more, important microscopic analysis has hitherto been neglected by the English writer apart from its treatment in the pages of Winton's standard treatise on vegetable foods in general.

The latter has been judiciously drawn upon in the compilation of the present work, which is put forward as "a brief guide in the recognition of the common legitimate constituents of cattle-foods," and makes no claim to be exhaustive. Within its few pages it gives an admirable summary of information on methods of examination and the chief histological characters of the common cereals, pulses, oil-seeds, cruciferous seeds, and nuts. The information is clear, concise, and accurate, and the accompanying diagrams are in many cases excellent. Very few of the common impurities of cattle-foods are omitted, the chief exceptions one notes being coffee husks, dari, gram, and sesame. A note might also have been included on the castor bean, which has frequently played a sinister part as an ingredient of oil-cakes, and in alleged non-toxic form is now seeking a place as a legitimate cattle feeding-stuff. No reference is made to animal matters, such as meat and fish refuse, which are now coming into increasing use on the farm. The book should prove very useful to the agricultural student, and within its limits also to the agricultural analyst.

Science and Industry: The Place of Cambridge in any Scheme for their Combination. By Sir Richard T. Glazebrook. Pp. 51. (Cambridge: At the University Press, 1917.) Price 1*s.* 6*d.* net.

READERS will be glad that the Rede lecture for this year, delivered by Sir Richard Glazebrook on June 9, is now available in book form. We were able to publish the greater part of the lecture in our issue for June 21 (vol. xcix., p. 333), and it will suffice here to say that we hope the essay will be widely studied, dealing as it does with matters of the highest importance which must be handled boldly if the future welfare of the nation is to be assured.

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.]*

Visibility of Interference Fringes and the Double Slit.

THE writer has found the following simple arrangement well adapted for the study of the visibility of fringes arising from a double slit and a "source" slit of variable width. A double slit, ruled without any special care on a piece of old photographic negative, was placed on the table of a spectrometer after the usual adjustments had been made. With this arrangement and a sodium flame (Mecker burner) as the source of light, no difficulty was experienced in observing the disappearance and reappearance of the fringes, with gradually decreasing visibility, some seven times.

In the experiment as ordinarily performed (V. Mann's "Manual of Advanced Optics," p. 27) the source slit is at such a distance from the double slit as to render the experiment impracticable, or at least very inconvenient, in many laboratories. Ordinarily, too, a strong source of light is used, whereas the above arrangement permits the use of a monochromatic source. It provides, further, a very simple experiment by means of which the student beginning the study of advanced optics may obtain concrete ideas on the somewhat difficult subject of visibility. With a little practice, estimates of the visibility at successive stages may be made, and the corresponding visibility curve plotted.

To make quantitative measurements, a graduated wheel was attached to the slit of an ordinary Wilson spectrometer, and afterwards calibrated by the aid of a travelling microscope. By this means the width of the slit corresponding to the places of disappearance of the fringes or to any stage of visibility could be read off directly, and in a short time a complete set of measurements taken. The following readings will give an idea of the quantitative value of the experiment:—

Width of double slit (b) ... ... =0·903 mm.
Focal length of lens of collimator (f) = 166 ,,
Mean value of increase in slit width (w) for successive orders of zero visibility ... ... =0·107 ,,

From which $\lambda = \frac{bw}{f} = 0{\cdot}000582$ mm.

The quantity w is accurate to about 1 per cent. A more accurately calibrated spectrometer slit than was at the disposal of the writer would permit doubtless of greater accuracy in the measurements.

J. K. ROBERTSON.
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Relations between the Spectra of X-Rays.

KOSSEL has found the following relations between the frequencies of the X-ray spectra:—

$$L_\alpha = K_\beta - K_\alpha \quad \text{(A)}$$
$$M_\alpha = L_\gamma - L_\alpha \quad \text{(B)}$$

As the result of recent measurements, it is known that all these series consist of many more lines. According to T. Malmer the relation (A) of Kossel must take the form:—

$$L_{\alpha_1} = K_{\beta_1} - K_{\alpha_2} \quad (1)$$

Adopting the values for the wave-length given by M. Siegbahn (*Jahrb. d. Radioakt. u. Elektr.*), we have, moreover, instead of (B),

$$M_\beta = L_{\gamma_1} - L_{\beta_4} \quad (2)$$
$$M_{\gamma_1} = L_{\gamma_2} - L_{\beta_1} \quad (3)$$

I will here also remark that the following relations hold very exactly through all the elements:—

$$\left.\begin{aligned} L_{\alpha_2} - L_{\beta_2} &= L_{\beta_1} - L_{\gamma_1} \\ &= L_{\beta_3} - L_{\gamma_2} + \Delta \end{aligned}\right\} \quad (4)$$

where Δ is a constant.

In order to account for these relations, especially (4), Bohr's theoretical formula should be modified as follows:—

$$\nu = \nu_0 \left\{ \frac{(N - C_1)^2}{(n_1 + \mu_1)^2} - \frac{(N - C_2)^2}{(n_2 + \mu_2)^2} \right\}$$

N being the atomic number, n_1 and n_2 certain integers. It should be supposed that $N - C_1$ and $N - C_2$ represent the numbers of electric quanta contained in the "effective" nucleus charge. The curve in Moseley's diagram shows further that μ_1 and μ_2 are not absolute constants, but vary gradually from element to element.

JUN ISHIWARA.
Physical Institute, Sendai, Japan, April, 1917.

METEOROLOGY AND AVIATION.

A RECENT lecture by Lord Montagu of Beaulieu to the Aeronautical Society has directed attention to the possibility after the war of conveying mails and passengers, and perhaps goods, from place to place by aeroplanes. In suitable weather such transit should present no difficulty save that of expense, provided that landing places can be found in such positions that the stages may not be too long, but it is obvious that the weather is, and must remain, a very important factor for many years to come.

Since the foundation of the Meteorological Office under Admiral Fitzroy a large part of its business has been the issuing of storm warnings at certain selected coast stations for the benefit of shipping; and there is no doubt that such warnings during the fifty years or so in which they have been issued have been of great use, and indeed are so still. But the gradual displacement of sails by steam and the increase of size, with the greater trustworthiness of the engines, have rendered vessels far less dependent upon the weather than they were in Admiral Fitzroy's time, and in these days it is seldom that any regular passenger boat fails to make its passage, though it may be more or less delayed by bad weather. The case is likely to be different with aeroplanes if they are to take the place of mail steamers, and a heavy responsibility will be thrown upon the Meteorological Office or upon whatever body undertakes to issue forecasts for their guidance.

The kinds of weather inimical to aviation are too much wind, low cloud, and fog, and of these fog is perhaps the worst, as it is also in the case of shipping. The ways in which wind affects an aeroplane are various. There is the difficulty of starting and landing, but the days on which this is serious are not numerous, even in a windy country like England. But still there are days when landing is unsafe, and it is the misfortune with an aeroplane that it must in some way or other come to the earth as soon as its stock of petrol is exhausted. It cannot, like a ship outside a port with a dangerous bar, wait until conditions are more favourable; it must come down, whatever the risk. Once in the air, a steady wind has no effect upon the flying of an aeroplane, although it has a great effect upon the direction of the course. So much misapprehension exists on this point that it cannot be put too clearly. First, however, it must be stated frankly that a perfectly steady wind does not exist in practice, but the ordinary wind becomes more and more steady as the height increases, and in so far as the drift of an aeroplane is concerned it has the same effect as a steady wind of the same mean velocity.

The pilot, therefore, if the earth is hidden from him by a sheet of clouds, is absolutely and entirely ignorant of the strength and direction of the wind in which he is flying; it is just the same to him if it be a dead calm or if it be blowing at the rate of a hundred miles an hour from the east or from the west; he is, indeed, as unconscious of the motion which he is sharing with the air as he is of his daily revolution at a rate in these latitudes of some 600 miles an hour round the axis of the earth. But the effect upon the drift of his machine may be very considerable, and as he does not know what it is he cannot allow for it. The sailor is also concerned with the drift of his vessel, but he has in general a fairly good knowledge of how much it is; the currents due to the tide can be predicted, and the leeway due to wind can be estimated, but it is not so with the airman. Moreover, the rate of drift of a vessel is mostly small in comparison with her motion through the water, but in exceptional instances the velocity of the wind may equal the velocity of the aeroplane.

Thus Glasgow lies very close to a point 400 miles due north of Plymouth, and an aeroplane leaving Plymouth and flying due north at eighty miles an hour would find itself close to Glasgow in five hours' time. Should, however, a strong west wind be blowing of which the pilot did not know, and also clouds so that he could not see the earth, he would, if steering by compass, find himself in five hours' time over the North Sea, and quite possibly much nearer to the Danish than to the English coast. In the present state of our knowledge he could obtain information at starting of the general direction and strength of the wind, but not in such detail that he could hit off Glasgow within 100 or 200 miles. If he could see the ground he could ascertain that he was not travelling in the way his machine was pointing, and would thus become aware of his drift, but if he could see the ground he could steer by the known landmarks. There would be few landmarks over the sea, but the appearance of the surface should give him information as to the strength of the wind, and also of its direction.

Hence it seems likely that in countries like England, where clouds prevail, long-distance flight, if it is to be carried on at regular times day after day, will have to be at low elevations. About 3000 ft. is the usual height of the winter cloud sheet, but it may on occasion easily descend to 2000 ft.

Wind, therefore, though when it is steady and in a favourable direction it may be of assistance for a journey in its own direction, will in general be a hindrance to aerial navigation, and when combined with low clouds may become an insuperable hindrance. In cases where its velocity and direction can be accurately foretold, the difficulty about allowing for the drift can be overcome, but such precise forecast is not yet practicable.

A gusty wind introduces difficulties of its own; the so-called holes in the air, of which one heard so much in the early days of aviation, were due to gustiness, but greater stability and speed in the machine are eliminating these difficulties.

Clouds introduce a difficulty of their own, apart from the point that has been already considered. It would seem at first sight as though a man would retain his sense of the vertical direction in any circumstances, but this is not so. Were a man placed inside a hollow vessel that was falling freely without air resistance, he would be entirely without sense of weight or direction, and the pilot of an aeroplane in an extensive mass of cloud is in much the same position. He cannot see any definite object, and apart from sight his sense of direction depends upon the reaction between him and the seat he is sitting on. So long as the motion is uniform this reaction is vertical, but any acceleration of the machine alters the direction and intensity of the reaction, and so confuses the sense of level. The same effect is produced upon a spirit-level or similar instrument, and so confusing is the effect that it is said the machine may almost be upside down without the pilot knowing it. It would seem as though a gyroscope might to some extent meet the difficulty. One result of this uncertainty of level is that astronomical observations for the determination of latitude and longitude are not possible unless the horizon can be seen, and thus the amount of the error produced by want of knowledge of the drift cannot be known.

Fog is to all intents and purposes simply a cloud touching the earth. Landing places for aviators have naturally been put in low, sheltered positions, partly because a shelter from wind is required, but probably chiefly because more or less of a dead level is necessary, and such flat places are more likely to be found at low altitudes. Such positions are especially liable to fog. The danger of a fog lies in its concealing the landing place and hiding from the pilot until the last moment his distance from the ground.

Thus it appears that the demand of the airman on the meteorologist is that he shall be able to forecast wind and fog, and, to a less extent, clouds, on the route the airman is proposing to follow. It has long been the business of the Meteorological Office to forecast wind, and a certain amount of precision has been attained. During last winter Major Taylor investigated the possibility of forecasting fog, and gave the results in lectures to the Royal Meteorological and Aeronautical Societies. His work constitutes a considerable advance in the investigation of this difficult subject. If we express the wind in terms of its two components, W. to E. and S. to N., the probable error of a forecast for each component is perhaps about ten miles an hour, and there is not much prospect of improving this; the estimate is for England and the Continent, but further south the conditions are much better.

I do not wish to emphasise the difficulties which lie in the way of regular air services, but they are there, and the first step towards overcoming them is to admit their existence. W. H. DINES.

NORTH-EAST SIBERIA.[1]

THIS is a charming book of travel on a very interesting but seldom visited country—the far north-east of Siberia. One has to travel for a month from Verkhoyansk, "the pole of cold," situated on the Upper Yana River, to reach Sredne-Kolymsk, "the queen of the country, consisting of twenty or thirty little flat-roofed log-huts scattered about on the left bank of the Kolyma." In this "town" the author was interned, by the Ministry of the Interior, in company with a dozen comrade students involved in "political disorders," and he stayed there four years.

That was thirty years ago; but nothing has changed since. The post reaches this miserable hamlet only once every four months. For three or four months, before the Kolyma breaks its ice at the end of May, and fishing can be resumed in June, the population lives in a state of semi-starvation. "By the end of March all the store of fish is consumed, and the inhabitants begin to eat the food usually given to dogs, such as fish-bones, entrails, and half-decayed fish." The last three or four months, before a fresh supply of provisions is brought by the boats coming from the south, most of the inhabitants have no salt and no flour, and are compelled to eat the fish raw, because cooked fish without salt seems to be most unpalatable. Under these conditions the physical and mental deterioration of the population is, of course, unavoidable.

In this spot the author remained four years, and he devotes interesting pages to a good-natured description of how the little community of student-exiles constructed for themselves unburned-brick stoves (instead of the usual Yakute open hearth in the midst of the hut), and made their own provisions of fish and frozen cream for the winter, as well as candles from reindeer-fat for the long arctic night; all this work being done "amidst interminable metaphysical discussions." These pages have all the freshness of youth.

Towards the end of his internment at Sredne-Kolymsk the author obtained permission to make a journey to Nijne-Kolymsk, at the mouth of the

Chukchees. From "In Far North-East Siberia."

[1] "In Far North-East Siberia." By I. W. Shklovsky ("Dioneo"). Translated by L. Edwards and Z. Shklovsky. Pp. vii+264. (London: Macmillan and Co., Ltd., 1916.) Price 8s. 6d. net.

Kolyma, and he was thus enabled to obtain a glimpse of the shores of the Arctic Ocean. He accomplished the 500-mile journey in twelve days, in a frail open boat, made of very thin wooden planks sewn together with twisted willow-strands, the holes being plugged with moss and the cracks filled with the gum of the larch. Having reached Nijne-Kolymsk at the time of the fishing, he stayed there part of the summer and the winter, so that he could visit the lonely spot of Sukharnoye, as also some Chukchee encampments.

The pages given to the description of the Yukaghirs and the Yakutes settled along the lower course of the Kolyma, especially to the Chukchees, as also the legend about the disappearance of the small tribe of the Kangenici, will be read with deep interest and sympathy. All the little scenes sketched by the author bear the stamp of truthfulness and artistic feeling.

P. KROPOTKIN.

WAR BREAD.

THE public has been led to feel some anxiety concerning the effects of the present war bread upon national health and efficiency. Suggestion plays an inevitable part in such a connection. Certain untoward symptoms in individuals, for which some other tangible cause is not immediately evident, are liable just now to be ascribed on the slenderest evidence to the bread eaten. Once the belief in a deleterious influence has arisen, it is easy to understand how widely it may spread by suggestion. In the opinion of those best qualified to know, there would seem to be little basis for any such condemnation of the bread. It rests, nevertheless, with the Food Controller to obtain the best possible evidence concerning the facts, and we are glad to know that Lord Rhondda and the Wheat Commissioners have empowered a committee of the Royal Society to make a full and thorough investigation. This committee comprises some eminent medical consultants, as well as the physiologists who have been serving on the main Food Committee of the society. Its task is to decide whether the higher extraction of the grain can in itself be held responsible for any disturbance of health, and whether the admixture of other cereals with the wheat has produced a less digestible loaf, owing, for instance, to the associated difficulties in milling and baking.

Among other matters which are also engaging the attention of the committee is a greater tendency to "rope" in the bread, alleged to be due to the higher extraction of the grain. The habits of *Bacillus mesentericus*, which, in its various strains, is responsible for ropy bread, are already well known to bacteriologists, and, empirically at least, to all the better informed among practical bakers. There is no reason to doubt that with the increased knowledge now being acquired any outbreaks of rope will in the future be easily controlled. That the presence in the loaf of cereals other than wheat can be directly harmful is most unlikely. A favourable effect should indeed be seen in a somewhat improved balance in the protein supplied. Maize, it is true, is said to be badly tolerated by certain individuals, though such cases must be rare. It is also stated that the starch of maize is not fully gelatinised when it is cooked in admixture with wheat under conditions suitable for the production of an all-wheat loaf.

These and other points will doubtless receive the attention of the investigating committee. Its most important task, however, will be to decide, by a thorough sifting of the evidence, the more general question as to whether the war bread is, as a matter of fact, producing any ill effects at all upon the public health. The public will be glad to know that the Food Controller is in possession of the facts.

Meanwhile, since it is of the utmost importance to the nation that a full supply of bread shall be maintained, while the amount of wheat available is not sufficient for the purpose, we are glad to observe that the medical Press is urging the profession to see that the privilege of obtaining high-grade wheat flour for cases supposed to have suffered from the war bread is at any rate not abused.

NOTES.

MR. ALAN A. CAMPBELL SWINTON has been elected chairman of the council of the Royal Society of Arts for the ensuing year.

THE Asiatic Society of Bengal has awarded the Barclay memorial medal to Col. H. H. Godwin-Austen, for his work in biology. The medal is awarded every two years to the individual who during that period has made the most meritorious contribution to biology with special reference to India.

DR. J. B. CLELAND has been elected president of the Royal Society of New South Wales. After graduating in medicine, Dr. Cleland visited China and Japan, and later proceeded to this country, where he remained for several years, being for part of the time cancer research scholar at London Hospital. On returning to Australia, he was appointed Government pathologist and bacteriologist in Western Australia. In 1908 he became principal assistant microbiologist to the newly instituted Bureau of Microbiology in Sydney, and in 1913, on the amalgamation of the bureau with the Department of Public Health, he was appointed principal microbiologist. He has also been associated with the experimental work of the Department of Agriculture.

REFERRING to Dr. Collinge's recent article on "The Destruction of House-sparrows" (NATURE, June 28, p. 347), Dr. W. A. Hollis writes to say that the assumption that the corn found in the stomachs of the adult birds has been taken from the fields is, he believes, an erroneous one, and that in nine cases out of ten it is obtained from horse-droppings, as the house-sparrow rarely, if ever, goes far afield. At first sight this might appear so, but Dr. Hollis has overlooked the fact that the material upon which Dr. Collinge bases his argument was purposely obtained from agricultural districts, and in his account of the stomach contents of those birds obtained from suburban districts it is stated that the wheat was obtained "most likely from horse-droppings." The house-sparrow is, unfortunately, very far from scarce in agricultural districts, and at present immense flocks from the towns and villages are adding to its number, the majority of which will remain until well into September.

WE regret to see the announcement of the death on July 22, at sixty-one years of age, of Mr. Alfred Mosely, C.M.G., whose work for industrial and educational efficiency is widely known. In the year 1903 Mr. Mosely organised an Educational Commission of leading representatives of science and education, including such men as Profs. Armstrong, Ayrton, and Ripper, to visit the United States. The twenty-six separate reports published in 1904 in the volume on this Educational Commission covered the whole field of education, from the kindergarten to post-graduate university work, and they provided the public with a very valuable statement by competent observers of the provision made for progressive education in America. In 1907 Mr. Mosely sent several hundred English school teachers to America to study the educational methods adopted in the United States and Canada, and himself about the same time made prolonged tours in those countries, during one of which he arranged for a return visit of 1000 school teachers to this country in 1908–9. Mr. Mosely was the author of a number of pamphlets and reports on industrial and educational matters and economics.

ACCORDING to a paragraph in *L'Economista d'Italia* of July 13, the Italian Royal Geological Commission has just presented the report of its work to the Government. The Commission recommends that immediate steps be taken to enable the Reale Ufficio Geologico to accelerate the preparation and publication of the geological map of Italy, which is a vital necessity in view of a recrudescence of activity being manifested in mineral prospecting and hydro-electric developments. Recommendations have also been made for the publication of the results of artesian well and mineral surveys which have been carried out in the country, since much importance is attached at present to a knowledge of the hydrological and geological data. It is also considered desirable that the collection of samples of Italian fossil-fuels at the Royal Geological Museum should be made as complete as possible, and that the authorities should proceed at once to publish the sheets (now completed) of the geological map which concern the mountainous regions, in view of the attention now being paid to the more extensive utilisation of Italy's water resources for power-raising.

THE *Indian Forester* for May contains an article on the organisation of the Chinese Forest Service, which came into existence in January, 1916, as a subordinate branch of the Ministry of Agriculture and Commerce at Peking. The heads of the service, styled "co-directors," are Mr. Forsythe Sherfesee, for six years employed in, and lately director of, the Philippine Forestry Bureau, and Mr. Ngan Han, who studied forestry in Cornell and Michigan Universities several years ago. There are other Chinese in the service, who have received a technical training in the United States, and an expert from Kew, Mr. W. Purdom, acts as botanist, and is chief of one of the six divisions into which the service is organised. In this article an ambitious programme of afforestation, education, propaganda, etc., is sketched out, but no details are given of any work that has been actually accomplished. The amount of funds available is not mentioned, and no information is given as to how the existing forests are to be brought under Government control, or of how land is to be acquired for afforestation. In the course of two or three years we may learn in what directions forestry can be developed in China.

IN his presidential address to the conference of delegates of the British Association, held at Burlington House on July 5, Mr. John Hopkinson dealt with the work and aims of the corresponding societies. Mr. Hopkinson first suggested, nearly forty years ago, that delegates from the different societies should hold an annual conference at the British Association meetings, and it must have been some satisfaction to him to preside over what is now an important annual event for many of the representatives of the scientific societies in this country. He gave a review of the work of the British Association as affecting the corresponding societies, dealing in turn with the various sections of the association. His address was so varied in its scope that each member of his audience must have felt that some of it at least had particular reference to his or her special study. It was not the address of a specialist, but on general lines, as might have been expected from a naturalist who has been so long the secretary of an important provincial society. Among the subjects dealt with were meteorology, geological photographs, bird protection, Desmids and Diatoms, maps, free trade, Kent's Cavern, the teaching of Greek, museums, and forestry. Mr. Hopkinson concluded that the chief aim of all of us should be

> To make the world within his reach,
> Somewhat the better for his being,
> And gladder for his human speech.

PROF. J. H. BARNES, whose death was announced in NATURE of July 5, was educated at Five Ways Grammar School and the Birmingham University. After obtaining his degree, he spent some time in research work under Prof. Frankland, and in 1906 was appointed agricultural chemist to the Punjab and in charge of the Lyallpur College, one of the new agricultural colleges of India, of which two years later he was appointed principal, and which post he held until a few months before his death, when he was appointed chief chemist at the Pusa Institute to the Government of India. He was responsible for a considerable amount of agricultural research work, some of which is destined to make a great addition to the resources of the country, notably in the cultivation of the sugar-cane and wheat-growing. During the last few years he had been responsible for the experiments dealing with the reclamation of the alkali barren lands, which he had shown by his experiments to produce even record crops of wheat for India, and may revolutionise agriculture in certain of these districts. At the same time, he instituted a series of experiments showing the means of preventing various insect pests which are the great drawback to the methods of storing wheat. For his work on the Indigo Commission he was accorded the thanks of the Government of India. All this was carried out under great personal disabilities, for early in his official life he was attacked by malarial fever, from which periodically he suffered severely, especially during the last year or so of his life, which was eventually cut off by an attack of enteric fever on June 2. He was greatly loved and respected by all, especially by his Indian students, who at the time of his leaving the Lyallpur College collected funds to institute a scholarship at the college as a permanent memorial of his service there.

WITH Dr. C. O. Trechmann, who died on June 29, at his residence, Hudworth Tower, Castle Eden, passed away one of the small band of private collectors of minerals and one of the still smaller brotherhood of crystallographers in this country. He was born at Hartlepool, co. Durham, in 1851. His father, who was a Dane by birth, settled in the north of England in 1843, and five years later, in 1848, founded the Portland cement works now known as Otto Trechmann, Ltd., at West Hartlepool, which are among the oldest works of the kind in the kingdom. Dr. Trechmann studied chemistry under Bunsen, and obtained his doctorate of philosophy at Heidelberg. On returning home he entered his father's business, and it was largely to his energy and ability that the development and prosperity of the works were due; on the conversion of the business into a limited liability company, he became chairman and managing director, a position he held until his death. While at Heidelberg he became interested in minerals, and started the formation of the collection which constituted the principal hobby of his life. Being a crystallographer, he had a keen eye for a well-crystallised specimen, and at his death the collection had grown to a considerable size and comprised specimens of much scientific value. At one period he was attracted by the minerals occurring in the famous quarry just off the valley of the Binn, and one of the sulpharsenites of silver found there was named trechmannite after him by its discoverer, Mr. R. H. Solly. He bequeathed some of the best specimens in his collection to the British Museum. Despite the calls of business, he contrived to find time to engage in crystallographical research, and published many papers, several of them dealing with the minerals found at Binn; his work was characterised by careful observation and skilful draughtsmanship. In later years he turned to entomology as a recreation, paying especial attention to exotic Rhopalocera and to Diptera, of which he made a local collection of considerable scientific value.

MR. HENRY BALFOUR discusses, in the July issue of *Man,* certain primitive forms of agricultural implements from the Naga Hills, Assam. A remarkable form used by the Sema, Lhota, and some eastern Nagas consists of a slip of bamboo, with a sharp edge, twisted into a shape like a necktie, which is used for eradicating weeds from crops. This has the disadvantage of being very perishable and, becoming supplanted by iron-bladed hoes, shows signs of obsolescence. But it is noteworthy that the original type of the bamboo weeder has been reproduced in iron. Thus, as the final result, we have four types: first, the bamboo "necktie" hoe; secondly, the copy of it in iron; thirdly, a two-tanged blade, hafted to two wooden rods, forming prolongations of the tangs, the ends of which are crossed, and so retain the "necktie" shape of the prototype; and, lastly, the same type of blade, hafted to a **Y**-shaped handle cut from a single piece, in which the single grip replaces the awkward **X**-shaped handle, the result being an eminently serviceable tool. The series is an admirable instance of clearly marked stages in the evolution of agricultural implements.

PROF. FLINDERS PETRIE notices a series of photographs from Abu Simbel depicting various racial types in *Ancient Egypt* (part ii., 1917). One of the most interesting represents a man with a long retreating forehead running up to a peak to the back of the head, with rolls of flesh on the back of the neck below the occiput. The same form of head is characteristic of the Armenians of to-day, though accompanied by a larger nose, and the Egyptian example seems to belong to a nation east of Asia Minor, somewhere about the head-waters of the Euphrates. Another, classed as North Arabian, has traces of an earring, which is an Assyrian characteristic, and this man may come from a region not greatly geographically separated from that of the first example. The Hittite type is marked by the thickness of hair ending in a curl below the shoulder. Another specimen, wearing a long cap with a sort of hanging tassel, is shown by the analogy of a type represented on the gates of Balawat to be that of a Phœnician boatman. Thus, of the ten examples, two seem to come from Armenia or its neighbourhood, and the others belong roughly to North and South Galilee.

THE expedition which Dr. Hamilton Rice led to the Amazon returned to New York this spring. From the *Geographical Review* for June (vol. iii., No. 6) we learn that after an ascent of the Amazon to Iquitos, the expedition returned to Manaos to undertake the ascent of the Rio Negro, which was to be the principal work of the expedition. In a river steamer the expedition reached Santa Isabel, and thence in a steam launch successfully traversed the difficult stretch of river to São Gabriel. Further progress proved to be impossible on account of low water. An attempt was made to ascend the Padauiry, a left tributary of the Rio Negro, but an immense sandbank blocked the way. The expedition then descended to Manaos, and Dr. Rice decided to return to the United States on account of the war news and other circumstances.

IN the *Geographical Review* for June there are two articles which deal in a most instructive way with the Eastern theatre of war in Europe. The first is by Prof. de Martonne on the Carpathians. Attention is paid particularly to the physical features controlling human movements, and the article gives a clear presentment of the complicated relief of the region. There is a good coloured relief map, besides several diagrams. The second article, by Mr. D. W. Johnson, on the conquest of Rumania, describes the geographical features of the country, especially in relation to the campaign of 1916. The author shows how geographical conditions favoured a Rumanian invasion of Bulgaria through the Dobrudja, but political considerations overruled this plan and embarked Rumania on an invasion of the Transylvanian plain, a project which materially assisted the success of the German plan for the conquest of Rumania.

IN a paper published in the *Scottish Geographical Magazine* for June (vol. xxxiii.) entitled "The Weddell Sea: An Historical Retrospect," Dr. W. S. Bruce has been at great pains to clear up the fog of obscurity which hitherto has enveloped the early history of exploration in that part of the Antarctic. With the exception of Mr. E. S. Balch's work on early American explorers, this paper is almost the first scholarly contribution to the history of the Antarctic, and, in view of the uncertainty that has prevailed regarding questions of priority in the Graham Land region and the trustworthiness of early accounts, this work was much needed. By persistence in following up clues Dr. Bruce has unearthed much previously overlooked material and several original log-books. The earliest explorers of the Weddell Sea were William Smith and Capt. Ed. Bransfield, R.N., in the brig *Williams,* early in 1820, subsequent to Smith's discovery of the South Shetlands in 1819. On this voyage they were the first to sight the mainland of the Antarctic continent, which Bransfield named Trinity Land. This point is of great interest, because it was previously held that the claim of the American sealer, N. B. Palmer, in 1821, has priority. As regards the discovery of the group known as the South Orkneys, Dr. Bruce recalls that priority belongs to Powell, who sighted them in December, 1821, and that Weddell six days later named them South Orkneys. Powell had regarded them merely as an extension of the South Shetlands, but they appear as Powell Group on the chart of 1822. Dr. Bruce, however, recognises the undesirableness of changing the name of South Orkneys, which has now become established by long usage. Further interesting matter in this paper is an examination of the evidence of Morell, Ross, the *Scotia*, and others of land in the western part of the Weddell Sea. A critical examination of all this matter by a man who is familiar with polar conditions from personal experience sheds a new light on the question, and is most important in view of the forthcoming publication of Sir E. H. Shackleton's results. Finally, the full bibliography accompanying the paper should be noted.

THE Ministry of Trade of the Australian Commonwealth publishes "Further Investigations into the Etiology of Worm Nests in Cattle due to *Onchocerca Gibsoni*," by Drs. J. B. Cleland, S. Dodd, and E. W. Ferguson. Experiments have been tried as to the transmission of the larval worms by biting flies. As regards *Stomoxys calcitrans* the results are negative, but the authors consider that certain Tabanidæ may possibly act as carriers.

IN collaboration with Messrs. Harrison G. Dyar and F. Knal, Dr. Howard has completed the great monograph on the "Mosquitoes of North and Central America and the West Indies" (vol. iv., Carnegie Institution, Washington, 1917). The volume now issued contains the second part of the systematic description of genera and species, with appendix and index, and extends to more than 500 pages. Each genus and species is treated with an exhaustive synonymy, a full description of the imago and of any larval stages known, and in most cases with valuable bionomic details.

PROF. ULRIC DAHLGREN, of Princeton University, contributes a further instalment of his valuable series of essays on the "Production of Light by Animals" to the Journal of the Franklin Institute for July. In the present contribution he gives an able summary of what is known in regard to the production of phosphorescent light among the Tunicates and the fishes. In thus summarising the extensive and widely scattered literature on this theme Prof. Dahlgren has performed a very useful piece of work.

DR. G. A. BOULENGER contributes to the Annals of the South African Museum (vol. xii., part vi.) a long memoir on the genus Nucras, which, he convincingly shows, must be regarded as the most primitive of the Lacertidæ. He bases his conclusions partly on geological evidence and partly on a study of its geographical distribution and coloration. The latter aspect of this subject forms the material for two plates, which will well repay careful study. In the same issue he also describes a new South African lizard of the genus Eremias.

THE second of the series of reports which are to appear on the Australian Antarctic Expedition, 1911-14, has just been published. This is devoted to the Mollusca, forming part i. of vol. iv. The author, Mr. C. Hedley, analyses the results of dredgings at twelve stations on the coast of Adelie Land and of collections at Macquarrie Island. About one-third of the Mollusca prove to extend to Kerguelen, and some range round the Pole to the Falklands. More than 125 species are enumerated, of which forty-one are new to science. Two new genera are also described. Nine excellent plates add greatly to the value of this very able report.

WHILE the construction of great dams across natural streams for the purpose of diverting, or storing, their waters must inevitably disfigure the landscape in the immediate vicinity of the dams, this disfigurement may be amply atoned for by the creation of large lakes capable of vastly increasing the supply of food-fishes. Mr. A. D. Ferguson, of the California Fish and Game Commission, in *California Fish and Game,* vol. iii., No. 2, tells how this has been done in the case of impounding dams in the Sierra Nevada mountains. The building of the Crane Valley dam created the Bass Lake, a sheet of water six miles long, half a mile wide, and 100 ft. deep. This water is now teeming with trout and black bass, artificially introduced, affording a fishing resort for hundreds of people. Huntingdon Lake, in Fresno county, was similarly created by a dam 120 ft. high, impounding 150,000 acres of water. This has been stocked with rainbow and Loch Leven trout, and is the resort of thousands of people from all parts of the State. The primary purpose of the dam was to serve as a generating station for the Pacific Light and Power Corporation. In this way purely commercial ventures have been made to add both to the natural beauties of the country and to its productiveness.

THE plant ecology of the Drakensberg Range forms the subject of a beautifully illustrated paper by Prof. J. W. Bews, in vol. iii., part iii., of the Annals of the Natal Museum. In the opening pages the geological structure of the range is briefly described, and diagram sections of the horizontally placed beds are given. The striking feature of the range is the great mass of basalt and amygdaloidal lava which forms the main portion of the escarpment and produces the magnificent scenery of the Mont-aux-Sources. The vegetation of the higher parts of the Mont-aux-Sources has long been known to be peculiar, and it is a matter for regret that Prof. Bews does not give an account of it in greater detail. He distinguishes ten types of vegetation and gives lists of the plants characteristic for each. A number of the plants appear to be unidentified, which, considering the work recently done on South African botany, both at Kew and at the Cape, need not have been the case. On the mountain-tops the vegetation shows remarkable adaptations to dry conditions, the soil occurring only in depressions, the rest of the surface remaining bare rock.

PROF. R. B. YOUNG (Trans. Geol. Soc. South Africa, vol xix., p. 61) usefully develops F. Hinden's test for calcite in the presence of dolomite. After attacking the calcite on a thin section of rock with the solution of ferric chloride, thoroughly washing, and drying, a stream of sulphuretted hydrogen is turned on for a second or so, which blackens the calcite crystals.

MR. F. S. SPIERS, secretary of the Faraday Society, writes as follows:—"Will you permit me to correct a misapprehension which may arise out of a report in NATURE of July 12 (p. 393) on a joint meeting of the Society of Glass Technology with the Faraday Society which took place last month at Sheffield, to discuss the choice of refractory materials for use in the glass industry? In referring to an appeal which was made to glass-makers to make known their difficulties regarding refractories it was stated that the main object of the Faraday Society was to concentrate on these difficulties. This reference should have been, not to the Faraday Society, but to the Conference on Refractories Research, which has been constituted from all the interests concerned with refractory materials for the purpose of considering how best to co-ordinate and promote further the study of this subject."

AT the outbreak of war there was in this country a serious shortage of refractory material and of acid-proof apparatus such as is used in chemical works;

it had been largely stoneware imported from Germany. Fused silica ware has to some extent been able to make good the deficiency, and has helped to equip numerous factories erected in connection with the supply of explosives, especially as regards apparatus for the concentration of sulphuric acid and the condensation of nitric acid. Dr. F. Bottomley gives details of plants fitted with fused silica condensers, evaporators, etc., for these two acids, in the Journal of the Society of Chemical Industry for June 15, and also outlines the progress which has been made in the production of fused silica apparatus generally. Sixteen years ago small articles of silica were made by laboriously fusing quartz a few grains at a time in the oxyhydrogen blowpipe flame; at the present day the weight of fused material which can be worked exceeds 200 lb. The temperature required is between 1800° and 2000° C. In the plastic condition the silica is very ductile, and can be drawn out like glass in lengths of 90 to 100 ft.

TECHNOLOGIC PAPERS Nos. 83 and 84 of the U.S. Bureau of Standards represent continuations of Merica and Woodward's work on the "Failure of Brass" (No. 82). In the former an account is given of the study of the effect of tensile stress on the electrolytic solution potential of brass to various solutions, the results indicating an increase of E.M.F. of about 0·1 millivolt per 10,000 lb./sq. in. of stress. An explanation is given, based upon this effect, of the decreased ductility and strength exhibited by brass, where corroded while under tensile stress, and describes the growth of fissures in brass under such conditions. In the latter the results are recorded of an investigation of the initial stresses produced by the burning-in, without pre-heating, of constrained parts of castings of manganese bronze. Results have shown that, in general, tensile stresses will be produced within the burned-in area equal in value to the true elastic limit of the material. The conclusion is drawn that burning-in of such material should not be practised without thorough pre-heating or subsequent annealing of the whole casting.

THE *Biochemical Journal* for May contains a paper by Mr. H. E. Annett describing the isolation of raffinose from the seed of the jute plant (*Corchorus capsularis*). The sugar was identified by its content of water of crystallisation, specific rotatory power, and the change of the latter when the sugar was acted upon with emulsin, invertase, and melibiase. Further, the sugar does not give an osazone, but from the products of its hydrolysis with invertase, glucosazone and galactosazone were isolated. The sugar was isolated by extracting the finely ground jute seed, which had previously been exhausted with ether and petrol, with alcohol, and precipitating the alcoholic extract with ether. The particular sample of seed examined contained 2·25 per cent. of raffinose.

OF the chemical changes induced in amino-acids by bacterial action, the most common and the one that has been most studied is simple decarboxylation. It is by this process that putrescine and cadaverine are formed in the putrefaction of ornithine and lysine respectively. The deaminisation (*i.e.* loss of ammonia) of amino-acids by bacteria is usually accompanied by reduction, *e.g.* in the production of *p*-hydroxyphenyl-propionic acid from tyrosine. Mr. H. Raistrick, however, in the *Biochemical Journal* for May, describes the formation of an unsaturated carboxylic acid by the action of bacteria on histidine. This author avoided any possible secondary reactions by arranging that the histidine was the only organic substance present in the medium on which the bacteria were cultivated. When *B. coli communis*, *B. typhosus*, *B. paratyphosus* A, *B. paratyphosus* B, *B. enteritidis*, Gaertner, or *B. dysenteriae*, Flexner, is grown on a medium consisting of Ringer's solution + histidine (β-iminazolyl-α-aminopropionic acid), from 5 to 60 per cent. of urocanic acid (β-iminazolylacrylic acid) is formed, the largest proportion with *B. paratyphosus* A, and the smallest with *B. typhosus*. The acid was identified by analysis, melting point, and preparation of the picrate and nitrate. This is the first instance on record of the bacteriological conversion of an amino-acid into an unsaturated acid.

MR. JOHN MURRAY'S list of announcements for the coming autumn contains several works which should be of interest to readers of NATURE, *e.g.* "The Life and Letters of Sir J. D. Hooker, O.M., G.C.S.I.," by Leonard Huxley, two vols.; "The Life of Sir Clements Markham, K.C.B., F.R.S.," by Admiral Sir A. H. Markham; "The Life of Sir Colin C. Scott Moncrieff," edited by Miss M. A. Hollings; "Rustic Sounds and other Studies in Literature and Natural History," by Sir Francis Darwin; "Volcanic Studies in Many Lands," by the late Dr. Tempest Anderson; second series, "Cotton and other Vegetable Fibres," by Dr. E. Goulding (Imperial Institute Handbooks), and a new and revised edition of "The Book of the Rothamsted Experiments," edited by Dr. E. J. Russell.

MESSRS. J. WHELDON AND CO., 38 Great Queen Street, Kingsway, have just issued a catalogue (New Series, No. 80) of books and papers on chemistry, pure and applied, mineralogy, mining, and geology. The list contains many works published in enemy countries and therefore difficult to obtain new at the present time; also the modern library of Mr. Andrea Angel, who lost his life in the East End explosion in January last. The catalogue will be sent free upon application.

OUR ASTRONOMICAL COLUMN.

METEORS ON JULY 19.—Though meteors were singularly rare in the two hours before midnight on July 19 they were rather abundant and brilliant after midnight. At 12h. 12m. G.M.T. one of magnitude 1 shot rapidly from 339°+72° to 261°+41°, and left a bright streak. Its radiant was probably between α and β Persei. At 12h. 18m. a meteor exceeding magnitude 1 passed from 320°+35° to 317°+27°, and was directed from Cepheus. At 12h. 37m. a very fine meteor with an extraordinarily long course of 89° travelled slowly from 328°+11° to 238°+10°, and left a bright streak in its wake. At 13h. 35m. a blue, flashing meteor shot rapidly down across the star η Pegasi, and was directed from a shower near α Cygni or at 316°+48°. At 13h. 50m. a tolerably bright meteor, leaving a streak, crossed the cluster in Perseus from a radiant at 40°+20°, and at 14h. 15m. a bright Perseid, leaving a streak, shot from 326½°+17½° to 316°+6°. Duplicate observations of any of these interesting objects, if sent to Mr. W. F. Denning (44 Egerton Road, Bristol) would enable their heights, etc., to be computed.

ANNUARIO OF THE RIO DE JANEIRO OBSERVATORY.—The thirty-third issue of this useful publication has recently been received. It contains numerous ephemerides and other astronomical data, together with an excellent collection of tables for the reduction of astronomical observations. A section is devoted to terrestrial physics, with special reference to the magnetic elements and the intensity of gravity, and another includes details of meteorological observations made at twenty-five stations in Brazil. Tide-tables for seven Brazilian ports, calculated with the aid of the Kelvin tide-predictor, are also included in the volume.

SOLAR PROMINENCES.—An important memoir on solar prominences has been published by Mr. and Mrs. Evershed (Memoirs Kodaikanal Obs., vol. i., part ii.). The total number of prominences observed and photographed at the sun's limb at Kenley and Kodaikanal during the years 1890 to 1914 was about 71,000, and in recent years the denser prominences have also been photographed as absorption markings on the sun's disc. This wealth of observational material is discussed from many points of view. It results, among other conclusions, that there are four belts, two in each hemisphere, which are specially prolific in prominences. The low-latitude belts are coincident with the sun-spot zones, and in these the prominences vary in number with the spots, although direct association of spots and prominences is comparatively rare. In the high-latitude belts the prominences are most frequent between spot minimum and spot maximum; they reach the pole about spot maximum, and die out there, to form again in latitude $\pm 50^{\circ}$. Magnetic storms appear to be more closely related to spots than to prominences, but it is possible that an overlying prominence is a necessary condition for a spot to produce a magnetic storm. Large high prominences are roughly divisible into four classes, namely, broad massive prominences, tapering forms, diffused forms, and prominences in rows. Prominences associated with spots take the form of jets, rockets, or arches. The prevailing rocket type suggests the action of an intermittent explosive force in spots, which only partially neutralises gravity, while in the large masses gravity appears to be completely neutralised by the upward force. The density of prominences is probably very low, and it is suggested that the luminosity may be due to the internal energy of the atoms, possibly derived mainly by absorption of the intense solar radiation. Numerous photographs of prominences are reproduced.

FUEL RESEARCH.

AT the request of the Board of Trade and other Government departments, the Fuel Research Board has undertaken an investigation on the most suitable composition and quality of gas, and the minimum pressure at which it should be supplied, having regard to the desirability for economy in the use of coal, the adequate recovery of by-products, and the purposes for which coal is now used. The Research Board will also act in an advisory capacity. With the great extension of the use of gas for power and heating, and the possibility of using efficiently for illuminating purposes, by means of the incandescent mantle, gas of much lower illuminating value than formerly, more importance now attaches to calorific value than to candle-power. Practice has necessarily conformed to the altered conditions, for gas engineers have gone a good way in solving the problems involved in making the best use of coal in their industry, in the recovery of by-products, on which success so much depends, together with supplying a gas satisfactory for the wide and varied requirements. The industry has indeed been exceptional in the valuable research work done, its enterprise being shown in the establishment of the Livesey Laboratory at Leeds.

Possibly the Research Board will find little scope for improvement in the general production of coal-gas, although no one would claim that finality has been reached, but some important problems remain for investigation, notably the production of low-temperature coke and the utilisation of the oils and very rich gas produced. The gas engineer has hitherto not regarded this question in an unprejudiced manner, whilst the advocates have generally been over-optimistic, so that independent investigation is really wanted. There is also a wide field for investigating how coke-oven gas may be more extensively employed to supplement the output of suitably situated gasworks, and the more extended use of water-gas.

The Fuel Research Board, with the sanction of the Committee of the Privy Council for Scientific and Industrial Research, has appointed a committee of inquiry into the utilisation of Irish peat deposits. The terms of reference to the committee are as follows:—"To inquire into and to consider the experience already gained in Ireland in respect of the winning, preparation, and use of peat for fuel and for other purposes, and to suggest what means shall be taken to ascertain the conditions under which, in the most favourably situated localities, it can be profitably won, prepared, and used, having regard to the economic conditions of Ireland; and to report to the Fuel Research Board."

Though the inquiries of the committee will ultimately lead up to the consideration of peat as a source of energy in central power stations, there are sound reasons why this aspect of the problem should be postponed to a later stage. On one hand, the Fuel Research Board is already organising an extensive inquiry into the problems of fuel economy in connection with power production, and the results of this inquiry will supply the fundamental data and information which will be required when the time comes for the consideration of any wide scheme of development in Ireland. On the other hand, any schemes of development must be based on a more exact knowledge than is at present available regarding the selection of the more favourably situated bogs and the possibilities of winning and transporting partially dried peat to centres at which it may be converted into marketable products. It is obvious, therefore, that the inquiries of the committee are likely to be most fruitful if they are concentrated on the fundamental problems, for until these are settled no satisfactory progress can be made.

The following appointments have been made to the committee:—Sir John Purser Griffith (chairman), Prof. Hugh Ryan, Prof. Sydney Young, Mr. George Fletcher, and Prof. Pierce Purcell (secretary). All communications should be addressed to the Secretary, The Peat Inquiry Committee, University College, Dublin.

GLASS TECHNOLOGY.

THE newly formed Society of Glass Technology is to be warmly congratulated on the first number of its Journal, which has just appeared. The volume contains five original papers and a considerable number of abstracts dealing with glass and allied subjects. These abstracts, in which an endeavour is made to summarise the literature of the subject—including that appearing on the Continent so far back as the beginning of 1915—form a most valuable feature, particularly as the difficult work of abstracting has been well done. If, at a later stage, the society could undertake to carry the abstracts back—if possible for a period of ten years—they would earn the gratitude of all concerned with glass. There is, of course, always the difficulty in such abstracts of discriminating between the wheat and the chaff, so as to avoid burdening the pages with abstracts of valueless material; such discrimination, however, demands a degree of intimate familiarity with the subject in both its industrial and scientific aspects which is scarcely obtainable in the case of glass, since this has only recently begun to receive in this country the attention which it deserves. It is, further, a little doubtful whether the editor of this Journal has been wise in including abstracts on purely optical subjects, since these are more fully dealt with by a special society (the Optical Society), and overlapping is most undesirable in matters of publication.

The original papers attain a very creditable standard for so young a society and so new a subject. Prof. Boswell's work on British glass sands is already widely known and appreciated, since it has already been more or less completely published elsewhere. Mr. C. J. Peddle describes trials of British sands as substitutes for some of foreign origin, and his results are extremely hopeful, provided that careful treatment in regard to grading and washing is applied to the British materials. Mr. F. Twyman deals with the annealing of glass, and describes a method of testing the glass for strain and for its disappearance by means of a special form of polarimeter; the modification ascribed to Mr. F. E. Lamplough, however, is not novel, as the writer saw it in use more than fourteen years ago. Nor does Mr. Twyman make it quite clear that his reasoning is not applicable to any but thin glass vessels, such as the beakers he refers to. In such thin glassware all that is required is uniform cooling from the "annealing temperature" of Mr. Twyman; in thicker glass, however, such uniformity as between exterior and interior portions can be obtained only by very slow cooling.

Apart from detailed criticism of particular points, the whole volume clearly shows the vitality of the new society and the need for the co-ordinated study of glass and glass manufacture from the scientific point of view. It is to be hoped that all branches of the British glass industry, which has received a rejuvenating impulse from the war, will support the new society and thus facilitate the co-operation of science in an industry that should be essentially scientific.

PLANKTON RESEARCH AT PLYMOUTH.

THE May number of the Journal of the Marine Biological Association is devoted to an interesting account of the investigations of the plankton of the sea outside Plymouth Breakwater, made during the year September, 1915, to September, 1916. The main systematic research has been conducted by Miss Lebour, while Dr. Allen describes post-larval stages of fishes, and Mr. Matthews gives an account of the variation in the quantity of phosphoric acid present in the sea-water. Miss Lebour used Lohmann's method of centrifuging small volumes of sea-water (50 c.c.), and then actually counting the organisms so obtained. Her results are in general agreement with those of Lohmann (at Kiel) and Herdman and Scott (at Port Erin). There are well-marked seasons of abundance of microplanktonic organisms, diatoms occurring in greatest quantity some time in the spring or early summer, and then again in the autumn, while Peridiniales attain their maximum of seasonal abundance a little later than the diatoms. The Peridiniales have been very thoroughly investigated, and Miss Lebour describes eight species which are new to science and twenty-one species which have not hitherto been recorded from British seas. She also gives some records of the occurrence of larval Trematodes, free-swimming in the sea, and descriptions of the Helminth parasites of Sagitta. These worms have been noticed many times, and some of them are very familiar to planktologists, but no sound identifications have been made prior to the research now under notice. Sagitta is a host for larval forms of *Derogenes varicus* and *Pharyngora bacillaris*, both well-known fish Trematodes. A larval Ascaris also occurs, and two larval Cestodes, the species of which are not identifiable.

Mr. Matthews gives detailed accounts of his methods of determining the exceedingly small quantities of phosphoric acid which occur in sea-water, at the most about 0·06 mg. of P_2O_5 per litre. There is a well-marked maximum at nearly the end of the year (in the darkest days). The variations are dependent upon the metabolism of marine plants, and the minimum quantity of phosphoric acid occurs in April and May—that is, at about the time when holophytic plants are taking most food substance from the sea-water. The larger algæ seem to be the principal factors for the curve of variation in quantity of phosphoric acid not being the reverse of that for variation in abundance of diatoms, as was at first expected. J. J.

CORRECTION FOR ATMOSPHERIC REFRACTION IN GEODETIC OPERATIONS.[1]

THE memoir before us is concerned with the correction for refraction in geodetic operations between distant stations, especially those differing considerably in altitude. The author quotes Helmert's elaborate formula, which gives the correction as a function of gravity, atmospheric pressure, coefficient of expansion of air, tension of aqueous vapour, temperature, and vertical temperature gradient. The values deduced from the formula are compared with those obtained by observation over several bases in Italy and the Alps. The results are grouped both by months and by hours of the day; they show in a clear manner that there are both diurnal and annual variations in the refraction coefficient, which appear to be mainly due to the changes in the vertical temperature gradient. The following table shows the results of two series, the coefficients in the first column being deduced from the formula, and in the second by experiment. The third column gives the observed vertical temperature gradient.

Months		Coefficient of refraction at noon		Diminution of temperature for 100 m. altitude in degrees Centigrade
		From formula	From experiment	
Jan., Dec.	...	0·175	—	0·44
Feb., Nov.	...	0·170	0·181	0·55
Mar., Oct.	...	0·158	0·168	0·68
Apr., Sept.	...	0·154	0·159	0·74
May, Aug.	...	0·145	0·154	0·79
June, July	...	0·144	0·153	0·79

The results of several measures of altitudes over long bases in Italy (length 23 km., difference of altitude 900 m.) show a range of somewhat over a metre, and indicate that better results are obtained by using the meteorological data of the lower station only than by combining those of both stations. The memoir closes with a table arranged to facilitate the application of the correction for temperature to measured altitudes in surveying. A. C. D. CROMMELIN.

THE COMPLEXITY OF THE CHEMICAL ELEMENTS.[2]

II.

The Periodic Law and Radio-active Change.

THE second line of advance interprets the periodic law. It began in 1911 with the observation that the product of an α-ray change always occupied a place in the periodic table two places removed from the parent in the direction of diminishing mass, and that in subsequent changes where α rays are not expelled, the product frequently reverts in chemical character to

[1] "Sulla Determinazione del Coefficiente di Rifrazione Terrestre in Base ad Elementi Meteorologici." By Vincenzo Reina. (Roma: R. Accademia dei Lincei, ser. v., vol. xii., Fasc. ii., 1916.)

[2] Discourse delivered at the Royal Institution on Friday, May 18, by Prof. Frederick Soddy, F.R.S. Continued from p. 418.

that of the parent, though its atomic weight is reduced four units by the loss of the α particle, making the passage across the table curiously alternating. Thus the product of radium (Group II.) by an α-ray change is the emanation in the zero group, of ionium (Group IV.) radium, and so on, while in the thorium series thorium (Group IV.) produces by an α-ray change mesothorium-I (Group II.), which in subsequent changes in which no α rays are expelled yields radio-thorium, back in Group IV. again ("Chemistry of the Radio-Elements," p. 29, first edition, 1911). Nothing at that time could be said about β-ray changes. The products were for the most part very short-lived and imperfectly characterised chemically, and several lacunæ still existed in the series, masking the simplicity of the process. But early in 1913 the whole scheme became clear, and was pointed out first by A. S. Russell, in a slightly imperfect form, independently by K. Fajans from electrochemical evidence, and by myself in full knowledge of Fleck's results, still for the most part unpublished, all within the same month of February. It was found that, making the assumption that uranium-X was in reality two successive products giving β rays, a prediction Fajans and Göhring proved to be correct within a month, and a slight alteration in the order at the beginning of the uranium series, every α-ray change produced a shift of place as described, and every β-ray change a shift of one place in the opposite direction. Further, and most significantly, when the successive members of the three disintegration series were put in the places in the table dictated by these two rules, it was found that all the elements occupying the same place were those which had been found to be non-separable by chemical processes from one another, and from the element already occupying that place, if it was occupied, before the discovery of radio-activity. For this reason the term isotope was coined to express an element chemically non-separable from the other, the term signifying "the same place."

So arranged, the three series extended from uranium to thallium, and the ultimate product of each series fell into the place occupied by the element lead. The ultimate products of thorium should, because six α particles are expelled in the process, have an atomic weight twenty-four units less than the parent, or about 208. The main ultimate product of uranium, since eight α particles are expelled in this case, should have the atomic weight 206. The atomic weight of ordinary lead is 207·2, which made it appear very likely that ordinary lead was a mixture of the two isotopes, derived from uranium and thorium. The prediction follows that lead, separated from a thorium mineral, should have an atomic weight about a unit higher, and that separated from uranium minerals about a unit lower, than the atomic weight of common lead, and in each case this has now been satisfactorily established.

The Atomic Weight of Lead from Radio-active Minerals.

It should be said that Boltwood and also Holmes had, from geological evidence, both decided definitely against its being possible that lead was a product of thorium, because thorium minerals contain too little lead, in proportion to the thorium, to accord with their geological ages; whereas the conclusion that lead was the ultimate product of the uranium series had been thoroughly established by geological evidence, and has been the means, in the hands of skilful investigators, of ascertaining geological ages with a degree of precision not hitherto possible. Fortunately I was not deterred by the *non possumus*, for it looks as if both conclusions are right! An explanation of this paradox will be attempted later. In point of fact, there are exceedingly few thorium minerals that do not contain uranium, and since the rate of change of uranium is about 2·6 times that of thorium, one part of uranium is equal as a lead producer to 2·6 parts of thorium. Thus Ceylon thorianite, one of the richest of thorium minerals, containing 60 to 70 per cent. of ThO_2, may contain 10 to 20, and even 30, per cent. of U_3O_8, and the lead from it may be expected to consist of very similar quantities of the two isotopes, to be, in fact, very similar to ordinary lead. I know of only one mineral which is suitable for this test. It was discovered at the same time as thorianite, and from the same locality, Ceylon thorite, a hydrated silicate containing some 57 per cent. of thorium and 1 per cent. of uranium only. In the original analysis no lead was recorded, but I found it contained 0·4 per cent., which, if it were derived from uranium only, would indicate a very hoary ancestry, comparable, indeed, with the period of average life of uranium itself. On the other hand, if all the lead (1) is of radio-active origin, (2) is stable, and (3) is derived from both constituents as the generalisation being discussed indicated, this 0·4 per cent. of lead should consist 95·5 per cent. of the thorium isotope and 4·5 per cent. of the uranium isotope. Thorite thus offered an extremely favourable case for examination.

In preliminary experiments in conjunction with H. Hyman, in which only a gram or less of the lead was available, the atomic weight was found relatively to ordinary lead to be perceptibly higher, and the difference, rather less than ½ per cent., was of the expected order.

I was so fortunate as to secure a lot of 30 kilos of this unique mineral, which was first carefully sorted piece by piece from admixed thorianite and doubtful specimens. From the 20 kilos of first-grade thorite the lead was separated, purified, reduced to metal, and cast *in vacuo* into a cylinder, and its density determined, together with that of a cylinder of common lead similarly purified and prepared. Sir Ernest Rutherford's theory of atomic structure, to be dealt with in the latter part of this discourse, and the whole of our knowledge as to what isotopes were, made it appear probable that their atomic volumes, like their chemical character and spectra, should be identical, and therefore that their density should be proportional to their atomic weight. The thorite lead proved to be 0·26 per cent. denser than the common lead. Taking the figure 207·2 for the atomic weight of common lead, the calculated atomic weight of the specimen should be 207·74.

The two specimens of lead were fractionally distilled *in vacuo*, and a comparison of the atomic weights of the two middle fractions made by a development of one of Stas's methods. The lead was converted into nitrate in a quartz vessel, and then into chloride by a current of hydrogen chloride, in which it was heated at gradually increasing temperature to constant weight. Only single determinations have been done, and they gave the values 207·20 for ordinary lead, and 207·694 for the thorite lead, figures that are in the ratio of 100 to 100·24. This therefore favoured the conclusion that the atomic volume of isotopes is constant.

At the request of Mr. Lawson, interned in Austria, and continuing his researches at the Radium Institut under Prof. Stefan Meyer, the first fraction of the distilled thorite lead was sent him, so that the work could be checked. He reports that Prof. Hönigschmid has carried through an atomic weight determination by the silver method, obtaining the value $207{\cdot}77 \pm 0{\cdot}014$ as the mean of eight determinations. Hence the conclusion that the atomic weight of lead derived from thorite is higher than that of common lead has been put beyond reasonable doubt.

Practically simultaneously with the first announcement of these results for thorium lead, a series of investigations was published on the atomic weight of lead from uranium minerals by T. W. Richards and collaborators at Harvard, Maurice Curie in Paris, and Hönigschmid and collaborators in Vienna, which show that the atomic weight is lower than that of ordinary lead. The lowest result hitherto obtained is 206·046, by Hönigschmid and Mlle. Horovitz, for the lead from the very pure crystallised pitchblende from Morogoro (German East Africa), whilst Richards and Wadsworth obtained 206·085 for a carefully selected specimen of Norwegian cleveite. Numerous other results have been obtained, as, for example, 206·405 for lead from Joachimsthal pitchblende, 206·82 for lead from Ceylon thorianite, 207·08 for lead from monazite, the two latter being mixed uranium and thorium minerals. But the essential proportion between the two elements has not, unfortunately, been determined. Richards and Wadsworth have also examined the density of their uranium lead, and in every case they have been able to confirm the conclusion that the atomic volume of isotopes is constant, the uranium lead being as much lighter as its atomic weight is smaller than common lead. Many careful investigations of the spectra of these varieties of lead show that the spectrum is absolutely the same so far as can be seen.

Thorium and Ionium.

A second quite independent case of a difference in atomic weight between isotopes has been established. It concerns the isotopes thorium and ionium, and it is connected in an important way with the researches of which, on two previous occasions, I have given an account here, the researches on the growth of radium from uranium which have been in progress now for fourteen years. It is the intervention of ionium with its very long period of life which has made the experimental proof of the production of radium from uranium such a long piece of work. Previously only negative results were available. One could only say from the smallness of the expected growth of radium that the period of average life of ionium must be at least 100,000 years, forty times longer than that of radium, and, therefore, that there must be at least forty times as much ionium by weight as radium in uranium minerals, or at least 13·6 grams per 1000 kilos of uranium. Since then further measurements carried out by Miss Hitchins last year have shown definitely for the first time a clear growth of radium from uranium in the largest preparation, containing 3 kilos of uranium, and this growth, as theory requires, is proceeding according to the square of the time. In three years it amounted to 2×10^{-11} grams of radium, and in six years to just four times this quantity. From this result it was concluded that the previous estimate of 100,000 years for the period of ionium, though still of the nature of a minimum rather than a maximum, was very near to the actual period.

Joachimsthal pitchblende, the Austrian source of radium, contains only an infinitesimal proportion of thorium. An ionium preparation, separated by Auer von Welsbach from 30 tons of this mineral, since no thorium was added during the process, was an extremely concentrated ionium preparation. The atomic weight of ionium—calculated by adding to the atomic weight of its product, radium, four for the α particle expelled in the change—is 230, whereas that of thorium, its isotope, is slightly above 232. The question was whether the ionium-thorium preparation would contain enough ionium to show the difference. Hönigschmid and Mlle. Horovitz have made a special examination of the point, first re-determining as accurately as possible the atomic weight of thorium, and then that of the thorium-ionium preparation from pitchblende. They found 232·12 for the atomic weight of thorium, and by the same method 231·51 for that of the ionium-thorium. A very careful and complete examination of the spectra of the two materials showed for both absolutely the same spectrum and a complete absence of impurities.

If the atomic weight of ionium is 230, the ionium-thorium preparation must, from its atomic weight, contain 30 per cent. of ionium and 70 per cent. of thorium by weight. Prof. Meyer has made a comparison of the number of α particles given per second by this preparation with that given by pure radium, and found it to be in the ratio of 1 to 200. If 30 per cent. is ionium, the activity of pure ionium would be one-sixtieth of that of pure radium, and its period some sixty times greater, or 150,000 years. This confirms in a very satisfactory manner our direct estimate of 100,000 years as a minimum, and incidentally raises rather an interesting question.

My direct estimate involves directly the period of uranium itself, and if the value accepted for this is too high, that for the ionium will be correspondingly too low. Now, on May 11 Prof. Joly was bringing before you, I believe, some of his exceedingly interesting work on pleochroic halos, from which he has grounds for the conclusion that the accepted period of uranium may be too long.

But since I obtained, for the period of ionium, a minimum value two-thirds of that estimated by Meyer from the atomic weight, it is difficult to believe that the accepted period of uranium can have been overestimated by more than 50 per cent. of the real period. The matter could be pushed to a further conclusion if it were found possible to estimate the percentage of thorium in the thorium-ionium preparation, a piece of work that ought not to be beyond the resources of radio-chemical analysis. This would then constitute a check on the period of uranium as well as on that of ionium. Such a direct check would be of considerable importance in the determination of geological ages.

The period of ionium enables us to calculate the ratio between the weights of ionium and uranium in pitchblende as 17·4 to 10^8, and the doctrine of the non-separability of isotopes leads directly to the ratio between the thorium and uranium in the mineral as 41·7 to 10^9. This quantity of thorium is unfortunately too small for direct estimation. Otherwise it would be possible to devise a very strict test of the degree of non-separability. As it is, the work is sufficiently convincing. Thirty tons of a mineral containing a majority of the known elements in detectable amount, in the hands of one whose researches in the most difficult field of chemical separation are world-renowned, yield a preparation of the order of one-millionth of the weight of the mineral, which cannot be distinguished from pure thorium in its chemical character. Anyone could tell in the dark that it was not pure thorium, for its α activity is 30,000 times greater than that of thorium. This is then submitted to that particular series of purifications designed to give the purest possible thorium for an atomic weight determination, and it emerges without any separation of the ionium, but with a spectrum identical with that of a control specimen of thorium similarly purified. The complete absence of impurities in the spectrum shows that the chemical work has been very effectively done, and the atomic weight shows that it must contain 30 per cent. by weight of the isotope ionium, a result which agrees with its α activity and the now known period of the latter.

Determination of Atomic Weights.

The results enumerated thus prove that the atomic weight can no longer be regarded as a natural constant, or the chemically pure element as a homogeneous type of matter. The latter may be, and doubtless often is, a mixture of isotopes varying in atomic weight over a small number of units, and the former then has no exact physical significance, being a mean value in which the proportions of the mixture as well as the separate atomic weights are both unknown. New ideals emerge and old ones are resuscitated by this development. There may be, after all, a very simple numerical relation between the true atomic weights. The view that seems most probably true at present is that while hydrogen and helium may be the ultimate constituents of matter in the Proutian sense, and the atomic weights therefore approximate multiples of that of hydrogen, small deviations, such as exist between the atomic weights of these two constituent elements themselves, may be due to the manner in which the atom is constituted, in accordance with the principle of mutual electromagnetic mass, developed by Silberstein and others. The electromagnetic mass of two charges in juxtaposition would not be the exact sum of the masses when the charges are separated. The atomic weight of hydrogen is 1·0078 in terms of that of helium as 3·99, and that the latter is not exactly four times the former may be the expression of this effect. Harkins and Wilson have recently gone into the question with some thoroughness, and the conclusion of most interest in the present connection which appears to emerge is in favour of regarding most of the effect to occur in the formation of helium from hydrogen, and very little in subsequent aggregations of the helium. In the region of the radio-elements, where we have abundant examples of the expulsion of helium atoms as α particles, it seems as if we could almost safely neglect this effect altogether. Thus radium has the atomic weight almost exactly 226, and the ultimate product almost exactly 206, showing that in five α- and four β-ray changes the mean effect is nil, and the atomic weights are, moreover, integers in terms of oxygen as 16, or helium 4. It is true that the atomic weights of both thorium and uranium are between 0·1 and 0·2 greater than exact integers, but it is difficult to be sure that this difference is real.

When, among the light elements, we come across a clear case of large departure from an integral value, such as magnesium, 24·32, and chlorine, 35·46, we may reasonably suspect the elements to be a mixture of isotopes. If this is true for chlorine, it suggests a most undesirable feature in the modern practice of determining atomic weights. More and more the one method has come to be relied upon, the preparation of the chloride of the element and the comparison of its weight with that of the silver necessary to combine with the chlorine, and with the weight of the silver chloride formed.

Almost the only practical method, and that a very laborious and imperfect one, which may be expected to resolve a mixture of isotopes is by long-continued fractional gaseous diffusion, which is likely to be the more effective the lower the atomic weight. Assume, for example, that chlorine were a mixture of isotopes of separate atomic weights 34 and 36, or 35 and 36. The 34 isotope would diffuse some 3 per cent. faster than the 36, and the 35 some 1·5 per cent. faster.

The determination of the atomic weight of chlorine in terms of that of silver has reached now such a pitch of refinement that it should be able to detect a difference in the end fractions of the atomic weight of chlorine, if chlorine or hydrogen chloride were systematically subjected to diffusion. It is extremely desirable that such a test of the homogeneity of this gas should be made in this way.

Clearly a change must come in this class of work. It is not of much use starting with stuff out of a bottle labelled "purissimum," or "garantirt," and determining to the highest possible degree of accuracy the atomic weight of an element of unknown origin. The great pioneers in the subject, like Berzelius, were masters of the whole domain of inorganic chemistry, and knew the sources of the elements in Nature first-hand. Their successors must revert to their practice and go direct to Nature for their materials, must select them carefully with due regard to what geology teaches as to their age and history, and, before carrying out a single determination, they must analyse their actual raw materials completely, and know exactly what it is they are dealing with. Much of the work on the atomic weight of lead from mixed minerals is useless from failure to do this. Workers must rely more on the agreement, or disagreement, of a great variety of results by methods and for materials as different as possible than on the result of a single method pushed to the limit of refinement for an element provisionally purified by a dealer from quite unknown materials. The preconceived notion that the results must necessarily agree if the work is well done must be replaced by a system of co-operation between the workers of the world checking each other's results for the same material. A year ago anyone bold enough to publish atomic weight determinations which were not up to the modern standards of agreement among themselves would have been regarded as having mistaken his vocation. If these wider ideals are pursued, all the labour that has been lavished in this field, and which now seems to have been so largely wasted, may possibly bear fruit, and where the newer methods fail, far beyond the narrow belt of elements which it is possible to watch changing, the atomic weight worker may be able to pick up the threads of the great story. No doubt it is writ in full in the natural records preserved by rock and mineral, and the evidence of the atomic weights may be able to carry to a triumphant conclusion the course of elementary evolution, of which as yet only an isolated chapter has been deciphered.

The Structure of the Atom.

The third line of recent advance which does much to explain the meaning of isotopes and the periodic law starts from Sir Ernest Rutherford's nuclear theory of the atom, which is an attempt to determine the nature of atomic structure, which again is the necessary preliminary to the understanding of the third aspect in which the elements are, or may be, complex. That uranium and thorium are built up of different isotopes of lead, helium, and electrons is now an experimental fact, since they have been proved to change into these constituents. But the questions how they are built up, and what is the nature of the non-radio-active elements, which do not undergo changes, remain unsolved.

Prof. Bragg showed in 1905 that the α particles can traverse the atoms of matter in their path almost as though they were not there. So far as he could tell—and the statement is still true of the vast majority of α particles colliding with the atoms of matter—the α particle ploughs its way straight through, pursuing a practically rectilinear course, losing slightly in kinetic energy at each encounter with an atom until its velocity is reduced to the point at which it can no longer be detected. From that time the α particle became, as it were, a messenger that could penetrate the atom, traverse regions which hitherto had been bolted and barred from human curiosity, and on reemerging could be questioned, as it was questioned effectively by Rutherford, with regard to what was inside. Sir J. J. Thomson, using the electron as the messenger, had obtained valuable information as to the number of electrons in the atom, but the massive material α particle alone can disclose the material atom. It was found that though the vast majority of α particles re-emerge from their encounters with the atoms practically in the same direction as they started, suffering only slight hither and thither scattering due to their collisions with the electrons in the atom, a minute proportion of them suffer very large and abrupt changes of direction. Some are swung round, emerging in the opposite to their original direction. The vast majority, that get through all but undeflected, have met nothing in their passage save electrons, 8000 times lighter than themselves. The few that are violently swung out of their course must have been in collision with an exceedingly massive nucleus in the atom, occupying only an insignificant fraction of its total volume. The atomic volume is the total volume swept out by systems of electrons in orbits of revolution round the nucleus, and beyond these rings or shells guarding the nucleus it is ordinarily impossible to penetrate. The nucleus is regarded by Rutherford as carrying a single concentrated positive charge, equal and opposite to that of the sum of the electrons.

Chemical phenomena deal almost certainly with the outermost system of detachable or valency electrons alone, the loss or gain of which conditions chemical combining power. Light spectra originate probably in the same region, though possibly more systems of electrons than the outermost may contribute, while the X-rays and γ rays seem to take their rise in a deep-seated ring or shell around the nucleus. But mass phenomena, all but an insignificant fraction, originate in the nucleus.

In the original electrical theory of matter the whole mass of the atom was attributed to electrons, of which there would have been required nearly 2000 times the atomic weight in terms of hydrogen as unity. With the more definite determination of this number and the realisation that there were only about half as many as the number representing the atomic weight, it was clear that all but an insignificant fraction of the mass of the atom was accounted for. In the nuclear hypothesis this mass is concentrated in the exceedingly minute nucleus. The electromagnetic theory of inertia accounts for the greater mass if the positive charges that make up the nucleus are very much more concentrated than the negative charges which constitute the separate electrons. The experiments on scattering clearly indicated the existence of such a concentrated central positive charge, or nucleus.

The mathematical consideration of the results of α-ray scattering, obtained for a large number of different elements, and for different velocities of α ray, gave further evidence that the number of electrons, and therefore the + charge on the nucleus, is about half the number representing the atomic weight. But van der Broek, reviving an isolated suggestion from a former paper full of suggestions on the periodic law, which were, I think, in every other respect at fault, pointed out that closer agreement with the theory would be obtained if the number of electrons in the atom, or the nuclear charge, was the number of the place the element occupied in the periodic table. This is now called the atomic number, that of hydrogen being taken as 1, helium 2, lithium 3, and so on to the end of the table, uranium 92, as we now know. For the light elements it is practically half the atomic weight, for the heavy elements rather less than half.

I pointed out that this accorded well with the law of radio-active change that had been established to hold over the last thirteen places in the periodic table. This law might be expressed as follows:—The expulsion of the α particle carrying two positive charges lowers the atomic number by two, while the expulsion of the β particle, carrying a single negative charge, increases it by one. In ignorance of van der Broek's original suggestion, I had, in representing the generalisation, shown the last thirteen places as differing unit by unit in the number of electrons in the atom.

Then followed Moseley's all-embracing advance, showing how from the wave-lengths of the X-rays, characteristic of the elements, this conception explained the whole periodic table. The square roots of the frequency of the characteristic X-rays are proportional to the atomic numbers. The total number of elements existing between uranium and hydrogen could thus be determined, and it was found to be ninety-two, only five of the places being vacant. The "exceptions" to the periodic law, such as argon and potassium, nickel and cobalt, tellurium and iodine, in which an element with higher atomic weight precedes instead of succeeding one with lower, were confirmed by the determination of the atomic numbers in every case. From now on, this number, which represents the + charge on the nucleus rather than the atomic weight, becomes the natural constant which determines chemical character, light, and X-ray spectra, and, in fact, all the properties of matter except those that depend directly on the nucleus—mass and weight on one hand, and radio-active properties on the other.

What, then, were the isotopes on this scheme? Obviously they were elements with the same atomic number, the same *net* charge on the nucleus, but with a differently constituted nucleus. Take the very ordinary sequence in the disintegration series, one α and two β rays being successively expelled in any order. Two + and two − charges have been expelled, the *net* charge of the nucleus remains the same, the chemical character and spectrum the same as those of the first parent, but the mass is reduced four units because a helium atom, or rather nucleus, has been expelled as an α particle. The mass depends on the *gross* number of + charges in the nucleus, chemical properties on the difference between the gross numbers of + and − charges. But the radio-active properties depend not only on the gross number of charges, but on the constitution of the nucleus. We can have isotopes with identity of atomic weight, as well as of chemical character, which are different in their stability and mode of breaking up. Hence we can infer that this finer degree of isotopy may also exist among the stable elements, in which case it would be completely beyond our present means to detect. But when transmutation becomes possible such a difference would be at once revealed.

The case is not one entirely of academic interest, because it is probable that the reconciliation of the conflicting views of the geologists and chemists who concluded that lead was not the ultimate product of thorium, and those who by atomic weight determinations on the lead have shown that it is, depends probably on this point.

As has long been known, thorium-C, an isotope of bismuth, disintegrates dually. For 35 per cent. of the atoms disintegrating, an α ray is expelled, followed by a β ray. For the remaining 65 per cent. the β ray is first expelled, and is followed by the α ray. The two products are both isotopes of lead, and both have the same atomic weight, but they are not the same. More energy is expelled in the changes of the 65 per cent. fraction than in those of the 35 per cent. Unless they are both completely stable a difference of period of change is to be anticipated.

The same thing is true for radium-C, though here all but a very minute proportion of the atoms disintegrating follow the mode followed by the 65 per cent. in the case of thorium-C. The product in this case, radium-D, which, of course, is also an isotope of lead, with atomic weight 210, is *not* permanently stable, though it has a fairly long period, twenty-four years. The other product is not known to change further, but then, even if it did, it is in such small quantity that it is doubtful whether the change would have been detected. But, so far as is known, it forms a stable isotope of lead of atomic weight 210, formed in the proportion of only 0·03 per cent. of the whole.

Now the atomic weight evidence merely shows that *one* of the two isotopes of lead formed from thorium is stable enough to accumulate over geological epochs, and it does not necessarily follow that both are. Dr. Arthur Holmes has pointed out to me that the analysis I gave of the Ceylon thorite leads to a curiously anomalous value for the age of the mineral. The quantity of thorium lead per gram of thorium is 0·0062, and this, divided by the rate at which the lead is being produced, $4{\cdot}72 \times 10^{-11}$ grams of lead per gram of thorium per year, gives the age as 131 million years. But a Ceylon pitchblende, with uranium 72·88 per cent., and lead 4·65 per cent., and ratio of lead to uranium as 0·064, gives the age as 512 million years. Dr. Holmes regards the two minerals as likely to be of the same age, and the pitchblende to be, of all the Ceylon results, the one most trustworthy for age measurement.

If we suppose that, as in the case of radium-D, the 65 per cent. isotope of lead derived from thorium is *not* stable, and that only the 35 per cent. isotope accumulates, the age of the mineral would be 375 million years, which the geologists are likely to consider much nearer the truth. But the most interesting point is that, if we take the atomic weight of the lead isotope derived from uranium as 206·0, and that derived from thorium as 208·0, and calculate the atomic weight of the lead in Ceylon thorite, assuming it to consist entirely of uranium lead and of only the 35 per cent. isotope from thorium, we get the value 207·74, which is exactly what I found from the density, and what Prof. Hönigschmid determined (207·77) (compare NATURE, May 24, p. 244).

The question remains: If this is what occurs, what does this unstable lead change into? If an α particle were expelled mercury would result, or if a β particle bismuth, two elements of which I could find no trace in the lead group separated from the whole 20 kilos of mineral. But if an α and a β particle were both expelled, the product would be thallium, which is present in amount small, but sufficient for chemical as well as spectroscopic characterisation. If the process of disintegration does proceed as suggested, it should be possible to trace it, for this particular lead should give a feeble specific α or β radiation, in addition, of course, to that due to other lead isotopes. So far it has not been possible to test this. In the meantime, the explanation offered is put forward provisionally as being consistent with all the known evidence.

Looking for a moment, in conclusion, at the broader aspects of the new ideas of atomic structure, it seems that though a sound basis for further development has been roughed out, almost all the detail remains to be supplied. We have got to know the nucleus, but, beyond the fact that it is constituted, in heavy atoms, of nuclei of helium and electrons, nothing is known; whilst, as regards the separate shells or rings of electrons which neutralise its charge and are supposed to surround it like the shells of an onion, we really know nothing yet at all. The original explanation, in terms of the electron, of the periodicity of properties displayed by the elements still remains all that has been attempted. We may suppose that as we pass through the successive elements in the table one more electron is added to the outermost ring for each unit increase in the charge on the nucleus, or atomic number, and that when a certain number, 8 in the early part of the table, and 18 in the later, has been added, a complete new shell or ring forms, which no longer participates directly in the chemical activities of the atom. Thanks, however, to Moseley's work, this, now, is not sufficiently precise. For we know the exact number of the elements and the various atomic numbers at which the remarkable changes, in the nature of the periodicity displayed, occur. Any real knowledge in this field will account not only for the two short initial periods, but also for the curious double periodicity later on, in which the abrupt changes of properties in the neighbourhood of the zero family alternate with the gradual changes in the neighbourhood of the eighth groups. The extraordinary exception to the principle of the whole scheme presented by the rare-earth elements remains a complete enigma, none the less impressive because, beyond them in the table, the normal course is again resumed and continues to the end. This latter, highly significant, feature of the periodic table is one of the definite conclusions following from the chemical characterisations of the numerous radio-elements.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—Mr. C. O. Blagden has been appointed as from September 1 next to the new University readership in Malay, tenable at the School of Oriental Studies.

The cordial thanks of the Senate have been voted to Sir Ratan Tata for a further donation of 1400*l.* a year for five years in continuation of his previous benefaction for the promotion of the study of the principles and methods of preventing and relieving destitution and poverty. This will be expended on behalf of the Ratan Tata Department of Social Science and Administration in the London School of Economics, which will be controlled by a joint committee appointed partly by the Senate and partly by the school.

The following doctorates in science have been conferred:—*D.Sc. in Botany*, Miss F. A. Mockeridge, an internal student, of King's College, for a thesis entitled "Some Effects of Organic Growth-promoting Substances (Auximones) on the Soil Organisms concerned in the Nitrogen Cycle." *D.Sc. in Geology*, Mr. Arthur Holmes, an internal student, of the Imperial College (Royal College of Science), for a thesis entitled "Contributions to the Geology of Mozambique." *D.Sc. in Mathematics*, Mr. G. N. Watson, an internal student, of University College, for a thesis entitled "Various Methods of Approximation, with Special Reference to Bessel Functions and Gamma Functions." *D.Sc. in Physics*, Mr. W. Wilson, an internal student, of King's College, for a thesis entitled "The Complete Photo-electric Emission and the Emission of Electrons from Hot Bodies." *D.Sc. in Zoology*, Miss K. M. Parker, an internal student, of University College, for a thesis entitled "The Development of the Hypophysis Cerebri, the Pre-oral Gut, and Related Structures in the Marsupialia." *D.Sc. (Economics)*, Miss Kate Hotblack, an internal student, of the London School of Economics, for a thesis entitled "Chatham's Colonial Policy."

Grants have been made out of the Dixon fund for the year 1917–18 as follows:—25*l*., Mr. Nilratan Dhar, for research on temperature coefficients of chemical reactions; 30*l*., Mr. H. R. Nettleton, for researches on the measurement of the Thomson effect in wires; 20*l*., Dr. D. Ellis, towards the cost of publication of a book on "Iron Bacteria"; 100*l*., Mr. Birbal Sahni, to enable him to carry out botanical investigations at Cambridge.

Regulations have been adopted for the degree of B.Sc. in horticulture for external students.

THE appointment is announced of Mr. G. Gerald Stoney to be professor of mechanical engineering in the Manchester School of Technology. Mr. Stoney has had a seat on the Board of Inventions and Research under Lord Fisher, and on the Engineering Committee of the Advisory Council for Scientific and Industrial Research. Prospectuses of the university courses in the School of Technology for the session 1917–18 are now available, and provide full particulars of the work expected from students proceeding to the degrees of Bachelor of Technical Science and Master of Technical Science.

THE report of the conference convened by the Workers' Educational Association, held on May 3 last in the Central Hall, Westminster, has just been published. The findings of the conference are the more impressive since they represent the conclusions of a widely representative body of delegates, numbering between 700 and 800, not only from labour organisations and co-operative societies, but from educational associations, teachers' organisations, local authorities, and the universities. The resolutions call for the establishment of small and easily accessible nursery schools for the due care and nurture of young children from two years of age until six; the abolition of all exemptions from school attendance up to fourteen; the raising of the school age up to fifteen within five years, and to sixteen within three further years; the provision of maintenance allowance over the age of fourteen, and the abolition of all child labour for wages during compulsory full-time attendance; the immediate reduction of the size of classes to forty pupils, and ultimately to thirty; the establishment of adequate medical inspection and treatment of all scholars and improvement in school meals; better facilities for games, swimming, and open-air teaching, together with means of conveyance where children reside more than a mile from school. The policy of the conference was declared to be the establishment of a broad highway so as to ensure the highest facilities of education to all capable scholars. To this end it is proposed to limit the hours of labour for all young persons under eighteen years of age to twenty-five hours per week, and to establish compulsory part-time education for such persons of not fewer than twenty hours per week, and that such education shall be directed to the full development of the bodies, minds, and characters of the pupils. Further, it is demanded that free, full-time secondary education shall be provided, together with an adequate supply of scholarships to enable scholars of ability to enter a university. In order to secure the necessary supply of good teachers of both sexes, it is claimed that adequate salaries shall be paid and pensions provided with equal pay for equal service. Each local education authority is to be required to submit a complete scheme for its area to the Board of Education, 75 per cent. of the total cost of which shall be met from the National Exchequer, and where the conditions are inadequately fulfilled there shall be a reduced percentage.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, June 18.—M. A. d'Arsonval in the chair.—J. **Boussinesq**: The limiting equilibrium of a sandy mass under given conditions.—C. **Guichard**: Surfaces such that the Laplace equation of the network formed by the lines of curvature is integrable.—A. **Righi**: The ionisation of the X-rays in a magnetic field. Earlier work by the author on the influence exerted by the magnetic field on the phenomena of discharge pointed to the existence of a new action of the field on gases tending to increase their ionisation. This effect, to which the name magneto-ionisation is given, may be explained on the assumption that the electromagnetic force acting upon a satellite electron in the atom causes a variation in the energy necessary to separate the electron from the atom. In the present paper a direct experimental proof of this effect is given.—R. Bourgeois was elected a member of the section of geography and navigation in succession to the late M. Hatt, and E. Solvay a correspondant for the section of chemistry in the place of the late Sir Henry Roscoe.—G. D. **Birkhoff**: A generalisation of Taylor's series.—H. **Duport**: The law of universal attraction.—Ed. **Chauvenet**: The zirconyl sulphates. The six combinations of zirconia and sulphuric acid described in a previous paper are considered from the points of view of modes of formation and probable composition. All are represented as zirconyl salts containing the group ZrO.—J. **Bougault**: The action of iodine on alkalies. A study of the oxidising powers of iodine in presence of caustic soda, sodium carbonate, and sodium bicarbonate.—M. **Guerbet**: The condensation, under the action of potash, of *cyclo*hexanol with *iso*propyl alcohol. The synthesis of *cyclo*hexyl*iso*propyl alcohol.—M. **Sauger**: The time of fall of a stone to the centre of the earth. The problem is considered, taking into account the variation of the density of the globe with the depth. The time found is 19m. 15s.; on the assumption of a density equal to the mean density the time found is 79s. greater.—L. **Daniel**: The preservation of our oaks. The spread of the fungus causing the *Blanc du Chêne* is shown to be connected with the method of lopping the trees. The usual practice is a drastic lopping every seven years. This destroys the normal moisture equilibrium of the tree; the absorptive apparatus remains intact, but the reduction in the leaf surface causes the retention of an excess of moisture in the tissues, a condition favourable to the spread of the fungus. It has been proved that trees just lopped are more easily attacked than those lopped the preceding year; the latter are more easily attacked than those trees lopped several years earlier. A modified system of lopping is proposed, but it is pointed out that State action will probably be necessary, since the interests of the farmers and owners are opposed, and it is not likely that the cultivators will willingly change their present system of working.—Mme. Marie **Phisalix**: The parotid poison gland of the Colubridæ.—W. **Kopaczewski**: Researches on the serum of *Muraena helena*. The serum of this species is very toxic. A dose of 0·05 c.c. is fatal to a guinea-pig, an amount corresponding to 4·19 mgr. of dry substance. 0·4 c.c. of serum killed a rabbit in four minutes, and 1·5 c.c. killed a dog (5 kilograms) in seventy minutes.—A. **Krempf**: A new endoglobular hematozoa in man (*Haemogregarina hominis*). The organism was isolated from the hypertrophied spleen of a Chinese from the neighbourhood of Tientsin. Only one case is described, but it would appear that the disease caused by this organism is common in some parts of China.

June 25.—M. A. d'Arsonval in the chair.—A. **Lacroix**: The transformation of some basic eruptive rocks into amphibolites.—G. **Bigourdan**: The observations attributed to Prince Louis of Valois; and on the astronomer, Jacques Valois. The observations attributed to Prince Emmanuel of Valois (1596 to 1663) were really due to Jacques Valois (or de Valois), whose life is only known through his correspondence.—L. **Maquenne** and E. **Demoussy**: The influence of water and mineral matter on the germination of peas. The presence of traces of mineral matter derived from glass favours the germination of seeds, and if it is required to study the process of germination in distilled water, it is necessary to use a quartz condenser in making the distilled water and to store the water in quartz or platinum vessels. Comparative experiments, germinating peas in quartz and glass vessels, always gave a better development of roots in the glass than in the quartz vessels. The magnitude of the effects observed was unexpected, and it is pointed out that in botanical and physiological experiments attention must always be paid to the possible intervention of soluble products derived from the glass.—A. **Gautier**: An artificial soil, nearly free from all mineral or organic material, suitable for the study of plant cultures and for the examination of the influence of various chemical manures. The medium proposed is powdered charcoal (*braise de boulanger*) first heated to redness, then boiled with hydrochloric acid, and extracted with distilled water. This may advantageously replace glass powder, cotton, or sand media for botanical cultures. It has been especially useful in studying the effects of traces of fluorides on vegetation.—E. **Ariès**: The specific heats of fluids maintained in the saturated state.—G. **Julia**: Binary indeterminate conjugated forms remaining invariant by a group of linear substitutions.—W. **Sierpinski**: An extension of the notion of the density of ensembles.—E. **Jablonski**: Contribution to the study of the most general case of shock in a system of material points submitted to Newton's law.—E. **Belot**: Some principles applicable to comparative planetography.—P. Th. **Dufour**: Experimental researches on the terrestrial tetrahedron and the distribution of land and sea. Globules of liquid paraffin wax are immersed in methyl alcohol of the same density as the paraffin, and carried to a temperature slightly above the melting point of the wax. On allowing to cool slowly, the liquid globule remains perfectly spherical. If the bath is kept in motion, so as to produce a regular solidification, symmetrical tetrahedral globules are obtained, with convex faces and rounded points. The effect of variations in the density of the earth's crust on the form assumed by slow cooling is discussed in connection with these experiments.—A. **Leduc**: The expansion of argon and neon. Internal pressure in the monatomic gases. The coefficient of expansion of argon between 5·47° C. and 29·07° C. is 0·003664; of neon between 11·95° C. and 31·87° C., 0·003669, with a possible error of 2 in the last figure.—P. **Chevenard**: An anomaly of cementite in carbon steels, annealed, tempered, or half-tempered.—J. **Bougault**: A new method of estimating aldehydic sugars. The method is based on the oxidation to the corresponding acid by iodine and sodium carbonate, the iodine used being determined. A small correction is required on account of a secondary reaction.—Ph. **Glangeaud**: The ancient glaciers of the Monts-Dore volcanic massif.—L. **Moreau**: Radiological researches on the angle of inclination of the human heart. The angle of inclination of the normal human heart is usually given in the treatises on anatomy as between 55° and 60°. One hundred subjects examined by a radiological method gave a figure which, in 74 per cent. of the cases examined, was between 65° and 78°.—L. G. **Seurat**: The evolution of *Maupasina Weissi*.—H. **Vallée** and L. **Bazy**: The active vaccination of man against tetanus. The liquid injected consisted of a tetanotoxin neutralised with a solution of iodine in potassium iodide. Vaccinated rabbits resisted the effect of a quantity of toxin sufficient to kill 2000 kilograms of living substance. The vaccination treatment is more especially proposed to combat latent tetanus.

BOOKS RECEIVED.

A Bibliography of Fishes. By B. Dean. Enlarged and edited by C. R. Eastman. Vol. i. Pp. x+718. (New York: American Museum of Natural History.)

Bibliography of the Published Writings of H. Fairfield Osborn for the Years 1877–1915. Second edition. Part i., Classified by Subject. Part ii., Chronologic. Bibliography. Pp. 74. (New York: American Museum of Natural History.)

A Chemical Sign of Life. By S. Tashiro. Pp. ix+142. (Chicago: University of Chicago Press; London: Cambridge University Press.) 1 dollar, or 4*s*. net.

Manuals of Health. I., Food. By Dr. A. Hill. Pp. 64. (London: S.P.C.K.) 9*d*.

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