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The Cause of Rickets.

So much has been heard in recent times of rickets as a disease due to a deficiency of the fat-soluble vitamin A which promotes growth, that it is a good corrective to examine again the position of those observers who do not agree that the disease is essentially an "avitaminosis," as the French would say. An interesting survey of the work of the Glasgow school from this point of view is given by Dr. Leonard Findlay in the *Lancet* (April 29, 1922, vol. i. p. 825). He there reviews the variety of investigations which have been carried on for some 15 years by himself and his collaborators—clinical, experimental, and sociological—and comes finally to the conclusion that "confinement and defective hygiene are the most potent causes in the production of rickets." While opinions will differ as to whether this summary may not be too comprehensive, no one can fairly say that the facts which he adduces are compatible with a positive conclusion that rickets is due to a deficiency of fat-soluble A. It is fortunately no longer necessary to try to decide which of these two views is correct for, as so often happens, it is now pretty clear that both are right, and, which deserves less notice, that both are wrong. The two propositions are indeed not contradictory but complementary.

In the same journal (July 1, 1922, vol. ii. p. 7) appears a preliminary account by Dr. Chick and her colleagues of their observations on children in Vienna which goes far to reconcile and harmonise the two points of view. By very careful experiments they show clearly that under certain conditions rickets can be controlled by cod-liver oil, and it is legitimate to assume for the present that the active factor is fat-soluble vitamin A. They also show (1) that the well-known seasonal prevalence of rickets in the winter and early spring finds a rational explanation in the preventive and curative action of sunlight, which can be duplicated by rays from a mercury vapour quartz lamp, and (2) that under equal conditions of diet and environment the disease develops much more readily in children under six months of age than in those a little older, presumably in correlation with the more rapid rate of growth, as Mellanby found in his experiments on dogs. The occurrence of rickets is evidently conditioned by a number of circumstances, of which one or another may in any given case be the "cause" in the pragmatical sense that attention to it may give satisfactory prophylaxis or cure.

From the vast amount of clinical and experimental work on the subject which has appeared in the last two or three years it seems possible to disentangle a certain number of definite data. If conditions are otherwise

favourable, rickets may be encouraged (*a*) by defective diet, the deficiency being in the sense of (i.) too little fat-soluble A, (ii.) too little calcium and phosphate, (iii.) too little meat and too much bread; (*b*) by bodily confinement and lack of exercise or by rapid growth; or (*c*) by the absence of sunlight. Conversely, rickets may be ameliorated or cured by (*a*) giving plenty of fat-soluble vitamin in cod-liver oil or butter, avoiding too much cereal food, and (which is of experimental rather than practical importance) having a reasonable amount of calcium and phosphorus in the diet; (*b*) by encouraging metabolism by massage and electricity, or, which comes to the same thing, by being careful that the total intake of energy in the food is no more than is necessary; or (*c*) by exposing the skin to open sunlight or to sources still richer in ultra-violet light, such as mercury vapour lamps or metallic arcs.

Dr. Findlay rightly objects to any superficial conclusion from this array of circumstances that rickets has many causes. A disease of so definite and isolated a species must be held *prima facie* to have but one cause. What that *vera causa* is we do not know, but evidently if the various contingencies that have been enumerated can be reduced to some common factor, some progress will have been made in its discovery. In the analogous case of beri-beri it is known that the quantity of vitamin B which is required to avert the onset of polyneuritis in experimental pigeons is proportional to the quantity of carbohydrate in the diet. It seems likely that the quantity of vitamin A necessary to prevent or cure rickets varies similarly with the intake of other food. A full diet and rapid growth encourage its onset: a meagre stunting allowance is to some extent a preventive. The quality of the food is evidently also of importance: it must contain an adequate and balanced supply of the materials necessary for bone formation, and, though this is still obscure, the right kinds of proteid (animal rather than vegetable) and no large excess of carbohydrate. It also makes a difference whether the food absorbed into the economy is used for energy production or for storage and growth. Exercise, even that brought about by the irritation of the itch, according to Dr. John Mayo (1674), is antagonistic to rickets, and if the child cannot take it in the ordinary way massage and electrical stimulation may supply it.

It appears, therefore, that the amount of vitamin B which is necessary varies with the proportion or quantity of food which is not used for energy production. If all other conditions are as favourable as possible, the vitamin may with some children be reduced without ill results to amounts which appear to be very small by the available method of testing on growing rats: from which comes the conclusion that the vitamin has not much to do with the ætiology of rickets. If, on the other hand, all or some of the other conditions are unfavourable, the quantity of vitamin—the abundance, *e.g.*, of butter or cod-liver oil—may make all the difference between a healthy and a sick child: hence the conclusion that vitamin B is the most important factor. Even in respect of the necessary components of bone, the vitamin is quantitatively important. Rickets may be induced in rats by a deficiency of vitamin A and of calcium, but not by a deficiency of either substance alone. The vitamin in this case enables the growing tissues to make use of a concentration of calcium which otherwise they would be unable to utilise for bone formation. Such observations may in time elucidate the relative weight of the various factors of which at present it is known only that they are quantitatively related to one another.

To bring the influence of ultra-violet rays on the skin into this conception of the causation, or rather the contingency, of rickets, it is not difficult to believe that it acts by increasing general metabolism, in other words by giving exercise. It is known that inflammatory and sub-inflammatory processes in the skin may lead to the generation of substances which are absorbed into the circulation and affect the whole body, *e.g.* by increasing the susceptibility of the whole skin to the action of some local irritant. By some similar process, metabolism might easily be affected. It is also possible that vitamin A is developed in the skin under this form of stimulation, though the nocturnal and crepuscular habits of our pigmented hairy predecessors make it difficult to explain the phylogenetic history of the mechanism. Whatever the solution, the observation that rickets may be cured by short exposures to the mercury vapour lamp in hospital wards provides a welcome experimental confirmation and partial analysis of the sociological finding that the conditions of life in the dreadful tenement flats of Glasgow are *per se* conducive to the disease.

The question therefore "What is the cause of rickets?" is at present as insoluble as the problem "Is the tubercle bacillus the cause of tuberculosis?" The answer in both cases is that it depends on circumstances. In the latter case we have, however, reached the stage when we can say that tuberculosis is impossible without the tubercle bacillus: the bacillus has been identified as the ultimate limiting factor. That absence or deficiency of vitamin A occupies the same position in respect of rickets has yet to be shown. It seems likely that it does, but the demonstration has not been made that cod-liver oil will avert rickets when all other germane circumstances have been arranged to provoke it.

The Border Land of Tibet and Nepal.

Mount Everest: The Reconnaissance, 1921. By Lieut.-Col. C. K. Howard Bury and other Members of the Mount Everest Expedition. Pp. xi+356+33 plates +3 maps. (London: E. Arnold and Co., 1922.) 25*s.* net.

THIS is a very attractive book with its wealth of beautiful illustrations, and the interest is great, whether told by Col. Howard Bury himself, or in the introduction by Col. Sir Francis Younghusband, by the surveyors—Major Morshead, Major Wheeler, and Dr. Heron—by other members, Dr. Wollaston and Mr. L. Mallory. The latter's knowledge of the Alps makes his portion a valuable contribution. The description of the monasteries, the beautiful type of their architecture shown in photographs, will be new to many. Of the Lamas themselves and their orderly system of government we find the same from one end of Tibet to the other. This will interest and prove instructive; readers will find they are not ignorant savages, but a people highly advanced in arts and education, and in many respects far more practical, united, and sensible than we are. Of course it is not new; much can be seen in Ladak and in the fine monastery of Himis near Leh, but what is new is the degree to which the tameness of wild animals and birds has been brought by the Buddhists living under the shadow of Mount Everest, markedly by those leading a hermit life in the Rongbuk Valley.

There are some striking lines in chapter 12, p. 183, where Mr. Mallory describes his feelings on the first good view of Everest, feelings shared in by Mr. G. H. Bullock, on their sighting it at 57 miles distance from Shiling, west of Tinki, their first impressions of what was before them. I was struck by, and like, what Col. Howard Bury says on "Back to Civilisation," p. 176. The right type of traveller is shown here:

"There was sorrow in our hearts, however, at parting with the friendly and hospitable folk whom we had encountered, and at leaving behind us the familiar landscapes with the transparent pale blue atmosphere that is so hard to describe and the distant views of range upon range of snowy mountains often reflected in the calm waters of some blue coloured lake. The attractions of Tibet may yet be strong enough to draw us back again once more."

It is very disappointing to read in the *Geographical Journal* for May, p. 380, that "No Survey of India party is to go this year, and that Dr. Heron of the Geological Survey has not been allowed by the political authorities to continue his geological work." This may possibly be got over, but I fear that what I said in my article in this journal last year on our successful entry into Tibet, quoting the president of the Royal Geographical Society, "Our geography of it must be complete," may not be realised.

These are investigations of true interest and value in connexion with the history of the Himalayan Range, the combining of accurate topography with knowledge of the rocks, so that a formation, say like that of the Ladak Range, can be traced mile after mile for a considerable distance, defining the age of the rocks both on the north and south of it.

The climbing of Mount Everest, on the other hand, is of secondary importance compared to what will be lost by political exigency, partly because "there was some little difficulty last year about the disturbance of the dragons that live under the sacred mountains" (quoting from the *Geographical Journal*, May 1922, p. 380). As a member of the Bhutan Mission in 1863–64, I remember what unreasonable, unexpected difficulties they will throw on the traveller going to any particular peak, or in any particular direction.

The past year's work, so well recorded in this book, has given us an insight into the geology and topography of the great peak. We know of the many valleys descending from it, towards the northern Tibetan side, and the type of the glaciers. It is lamentable to be told that Dr. Heron will not be able to complete his survey of the metamorphosed sedimentaries and associated granites, even on the limited slopes above the Chang La, which this year's expedition will reach, for there would be much detail for Dr. Heron to observe, and whether the "Daling Series" extends thus far.

I draw a line between climbing and mountaineering. There is a charm in the first, similar to that felt in the rigging of a ship by every sailor when he ascends to the main truck or lays out on a yard in a stiff breeze—there is a spice of danger in it. The second—and Mallory comes in here—demands a period of apprenticeship to gain that eye for ground which tells the surveyor where he can go, where he cannot, and the time it will take him to get over any particular section of country. Mountaineering is the highest form of athletic exercise that can be conceived; mind and knowledge enter into it.

I have long doubted the possibility of reaching the summit of Mount Everest by several thousand feet. What is the possible height attainable only those who have been on its side can guess. It is now being solved. I am guided by past experience at much lower elevations, less than 21,000 feet, but at a much higher latitude in Kashmir territory. There are so many uncertain factors, such as the impossibility of waiting for any length of time for a change of weather at the highest camp; strength of wind; cloud and snow and mountain sickness, which will prostrate a whole party at even 19,000 feet (Baltistan and Ladak).

A few remarks may be made on what there is to do. Accurate comparison should be made between the very typical glaciers of this far southern section of the Himalayan range and those in Kashmir territory and the Alps, on both of which much has been written. The accompanying illustration (Fig. 1) shows the rugged pinnacled surface, caused by difference in temperature between 28° latitude and that of Kashmir some 6° farther north, where the accumulation of both snow and moraine is so similar to that in the Alps. Around Bhutan and on the Assam Range, with the elevation of which Everest is closely connected. Since late Pliocene time enormous disturbance and crushing on the Tibetan plateau has taken place, disturbance well displayed in the Naga Hills, on the Burrail range, where the whole thickness of the Tertiary rocks, from the base upwards, is seen elevated to 10,000 feet, resting unconformably on a much older formation. How much and how often has the course of the Arun altered, and with it the Tsauspu, in that, geologically

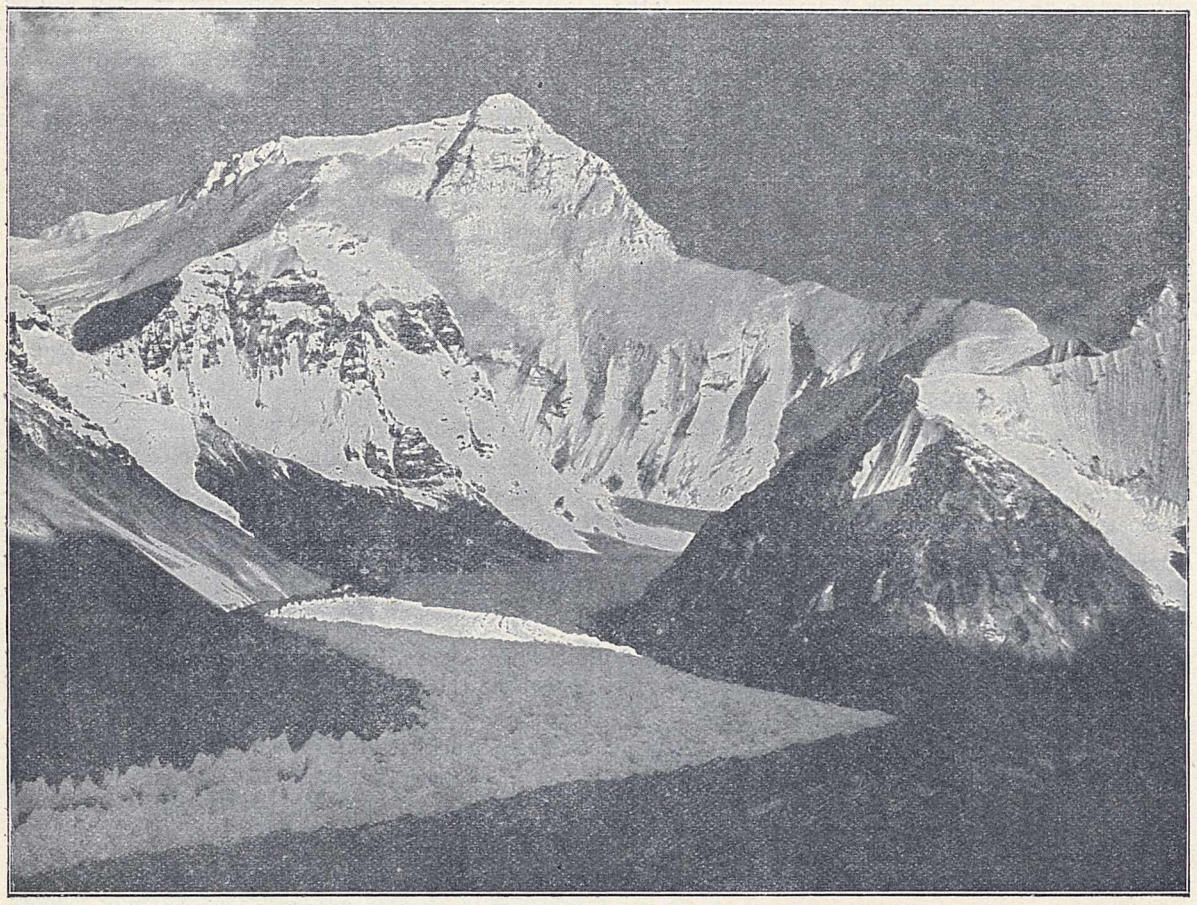


FIG. 1.—Mount Everest from the Rongbuk Glacier, nine miles north-west.
From "Mount Everest" (slightly reduced in width from the illustration facing p. 214).

Mount Everest all is changed; its height and isolation alter all the usual conditions, even those of denudation. It is desirable to know the thickness of the glaciers, the stratification, rate of motion, how far the moraines extend, and to what extent rocks *in situ* show the effects of past glaciation. Among the members of this very large expedition some should take such observations and fewer be engaged in finding what height a man can reach with or without oxygen.

The extent of the moraines at the base of Mount Everest tell something of its history. They would be the same age approximately as those I have observed farther east on the south face of the Himalaya in speaking, short lapse of time? Mr. Mallory describes this basal area and the surface of the Rongbuk Glacier, comparing it with his knowledge of the Alps. I am led to quote him (p. 192): "The glacier is prostrate, not a part of the mountain; not even a pediment, merely a floor footing the high walls. At the end of the valley and above the glacier Everest rises not so much a peak as a prodigious mountain mass." The party—put at 12 Europeans, 500 mule-loads, with number of coolies unknown—is to me, who worked long ago, huge, and out of all proportion to what has to be achieved, particularly as the first year's work has been so well told, the survey and geological work

so well done. The oxygen apparatus had much better have been left out, and experiments made on some more accessible peak. Never yet used under natural conditions at any elevation, it is complicated, and as four bottles weigh 32 lbs., impossible to work, for it seems to me the surveyor or climber carrying it would be unable to use his eyes or observe anything at the most critical time and under the most critical conditions.

I conclude with some remarks on the nomenclature of peaks. In the pages of the book and on Map 2, a large-scale one of Mt. Everest, constructed at the Royal Geographical Society, are the names Pumori, Ri-Ring, etc. In the May number of the *Alpine Journal* these, eleven in number, are explained (p. 228) in a contribution by Mr. Arthur R. Hinks, secretary of the R.G.S. They are all fictitious, and after all that has been written on the subject of nomenclatures I cannot too strongly condemn their creation, although they have had the criticism of Sir Charles Bell. Henceforward it will be no longer possible to distinguish between a *bona fide* Tibetan name and these inventions, unless as is adopted in natural history, the name of a species is followed by the name of its describer. The English names of Conway, Bullock Workman, and Dr. de Filippi, such as "Ogre Peak," "Mitre Peak," "The Bride," etc., are of a higher inoffensive order, and I for one see no reason why they should not be accepted. Will these new-coined names please the Tibetans, lay or sacerdotal? They may possibly give offence. Should we as a nation be pleased to see some foreign power mapping this country and giving names to our hills and valleys? I now come to the last name assigned to Mount Everest, "Chomo Lungma." It is not a happy one for a peak though quite correct in the passport issued by the Dalai Lama's Prime Minister, and very applicable to the country, a series of valleys round the great peak, which the Expedition was to work in. Lungma and Lungpa is a common name for a valley from Scardo eastward, and on Sheet 29A, N.E. of part of Baltistan and Little Tibet will be found a similar name, "Chogo Loongma," for the great glacier valley which ends at Arundo. Substitute "Chomo," feminine prefix (goddess) for "chogo" (large), there is a close resemblance, but neither is applicable to the summit of a mountain.

I am glad the Survey of India did not rush at the discovery of this name and adopt it. Mallory thus records on p. 225: "In the Sahib's tent that night there took place a long and fragmentary conversation with the headman, our sirdar acting as interpreter. We gained one piece of information: there were two chomolungmas," that is, valleys. Every valley has its name in Tibet, where they go with their flocks and herds, but peaks are not so universally noticed and distinguished. While the R.G.S. is publishing on maps new names for Himalayan peaks, I notice comparison with Peak K2 occurs on p. 309. This, the second highest peak in the Himalaya, received the name of Godwin-Austen. At a meeting of the Royal Geographical Society, when Lieut. Younghusband read his paper, "From China through Tibet to Kashmir," I was present, and pointed out, on a large-scale plan I had prepared, the great size of the Baltoro Glacier and the position of the great peak near the source. Then followed the proposal of General J. T. Walker, R.E., the late Surveyor-General of India, under whom I had served, seconded by Sir Henry Rawlinson, president, in the chair, put to the meeting and carried unanimously. It was a great honour, an unexpected recognition of my survey work, and was deemed worthy of notice, appearing in a short time in the "Times Atlas" and in a German one. By degrees the R.G.S. has discarded my name; this book does the same; geographical record is wiped out, and leaves me to regret I was present that evening. The Indian Survey, carrying out rules of their own, correctly recognise no other name than Mount Everest; for the rest they must be of true native origin. H. H. G.-A.

The Early Metal Ages in South America.

The Copper and Bronze Ages of South America. By Erland Nordenskiöld. (Comparative Ethnographical Studies, 4.) Pp. viii + 197. (London: Oxford University Press, 1921.) 18*s.* 6*d.* net.

THERE has long been felt the want of a general summary of information relative to the employment of copper and bronze in South America, and Dr. Erland Nordenskiöld's volume will be welcomed as, to a great extent, filling the gap. In about 200 pages he has brought together a considerable mass of detailed information derived from the historical record, from representations of metal objects on textiles, pottery, etc., and from the actual implements and ornaments of copper and bronze. He discusses the problem from a variety of points of view, each chapter dealing with a particular line of inquiry.

The chronological horizons of S. American antiquities are as yet, unfortunately, insufficiently defined, and much spade-work will be required before the sequence of cultures and their relationship to one another can satisfactorily be established. The author, in dealing with this aspect of the inquiry, has made use of such evidence as is to hand and offers deductions which are often very suggestive, especially when the chronological evidence is correlated with the data derived from the study of geographical distribution of types, to which Dr. Nordenskiöld has devoted special attention.

Perhaps the most valuable portion of the present volume is that which is concerned with the chemical analyses of the metal objects. A considerable number of analyses of implements, weapons, and ornaments, the basic material of which is copper, is now available, and comparisons can be made of the percentages of tin combined with copper to yield different qualities of bronze. From the data supplied it will be seen that in the New World bronze objects the proportion of tin to copper varies exceedingly. In some instances it is so small as to make it doubtful whether the alloy can be intentional; and, in such cases, it may, perhaps, be legitimate to include the objects in the category of "pure copper." In others an unusually high percentage of tin is revealed (55·60 per cent. having been recorded by Ambrosetti in one chisel), though frequently it is the ornamental objects which contain a high proportion of tin. As Dr. Nordenskiöld points out, from the results of experiment, copper with a *slight* admixture of tin can be hardened effectually by hammering. In fact, for the manufacture of implements designed for hard usage (cutting tools, etc.) a relatively low percentage of the alloy, combined with the process of compacting the metal by hammering, seems to give the most satisfactory results. The hardness of various objects of copper and bronze was tested experimentally with a Brinell press, and the tests were applied to different parts of the same implement, the results showing that the edge was hardened more than the rest, as might be expected.

It is clear from the capriciously variable percentages of tin that the alloying of copper with this metal was not fully understood, and that the metallurgy of bronze was still for the most part in an experimental stage in South America.

The author endeavours to prove that throughout the territory of the Inca empire the Bronze-age was preceded by an age of pure copper. He makes out an interesting case, but this point can be settled finally only by stratigraphical evidence. Much of the argument is based upon typological classification and geographical distribution of types, which, together with analyses of the metals, form a powerful combination in suggesting sequences, though they cannot prove actual chronological successions.

An interesting typological sequence is afforded by certain socket axe-blades of copper, in which the decorative treatment preserves the memory of an earlier method of hafting, by means of a collar of stitched raw-hide or leather. The form of the leather collar, which suggested the socket in this type of axe, and also the thong-stitches, are realistically represented on the later copper blades, although the latter were entirely of metal and cast in one piece.

The book has suffered somewhat at the hands of both translator and printer. Several sentences are very obscure in their meaning, and misprints and other blemishes are unduly abundant. Such an expression as "bronze (pure copper)" surely should not occur in a treatise which aims at differentiating between the alloyed and the pure metal. This expression occurs more than once and tends to obscure the issue and weaken the argument.

In spite, however, of the avoidable blemishes which occur in this translated version, the book is of real value and throws light upon a very interesting archæological problem. The volume is profusely illustrated, though the figures are of unequal merit, and contains maps and tables which are very helpful. There is also a bibliography. HENRY BALFOUR.

A Monument to a Master Chemist.

Untersuchungen über Kohlenhydrate und Fermente II. (1908–1919). Von Emil Fischer. Herausgegeben von M. Bergmann. Pp. ix+534. (Berlin: J. Springer, 1922.) Germany, 186 marks; England, 22*s.* 6*d.*

IT is an accepted fact in art and literature that, apart from the vagaries of fashion, only a future generation can properly assess the ultimate fame of artist or author. This is no doubt equally true in science, yet we are already sure that time will only serve to enhance the reputation of Emil Fischer. The remarkable official account of his life and work, written for the German Chemical Society by Kurt Hoesch, and the biographical fragment "Aus meinem Leben" left by Fischer himself, afford a unique store of material: when properly digested in this country by those competent to understand it, this should make it possible to obtain a clear view of his personality and attainments which will be free from the natural patriotic bias of his own countrymen.

During his lifetime Fischer, who was not without a characteristic strain of personal vanity, issued in book form reprints of his work on the sugars, proteins, purins, and tannins, including in the first papers published up to the end of 1908. Dr. M. Bergmann, a very loyal fellow-worker, has now collected the later sugar papers from 1908 onwards. To workers in this field, the advantage of possessing these volumes is very great, and science owes a debt of gratitude to Dr. Bergmann for completing them.

The sugars were Fischer's first love, though not the subject of his earliest work; to his work with phenylhydrazine he owed the chronic illness which had so great an effect on his daily life, causing him for a time to abandon their study, first for that of the de-

rivatives of purin—the mother substance of uric acid—and later of the proteins, thereby opening the door to almost a new branch of organic and physiological chemistry. Even in 1908, when he compiled the first set of reprints of his sugar work, he expressed the fear that this sensitiveness to phenylhydrazine would prevent him from taking any further active part in developing the chemistry of the sugars. Fortunately for posterity the old love proved too strong, and he returned again and again to the fray, the result being that forty-six additional essays chronicle the work achieved.

The writer had the good fortune to come under Fischer's tuition at the time of the opening of the new chemical laboratories in the Hessische Strasse in Berlin, and to be intimately associated with him during nearly three years, carrying out sugar inquiry under his inspiration, although at this time all other workers in the laboratory were busily engaged in the early stages of the great investigation on amino acids and proteins. Viewed from the perspective of twenty years later, it would seem that Fischer was already at that time a tired man, feeling both the strain of the work involved in obtaining and designing the new laboratory and the distraction caused by the heavy burden of official duties, which he never relished but could not avoid. Hoesch now throws much light on the events behind the scenes just before this period, as the provision of the new laboratory, made the first condition of Fischer's going from Wurzburg to Berlin, eventually took seven and a half years. His account includes the statement that at one time Fischer even seriously considered leaving Berlin and going to Bonn.

Apparently from the time he came to Berlin, as successor to Hoffmann, Fischer lived only for his work, and withdrew more and more within himself as the years passed. A widower, with his sons still young, he had no one to draw him out of himself in private life; he seemed to lose the power of unbending to his associates, although he was worshipped by his laboratory companions.

Having achieved the first synthesis of a natural sugar, glucose, Fischer's greatest ambition was to make ordinary cane sugar in the laboratory, and in 1900 this problem was again attacked with all the resources of the new laboratory. At first some measure of success was attained, as complex sugars (disaccharides) were obtained, identical or isomeric with some of the natural materials. The problem of the synthesis of cane sugar itself defied solution, however, and a measure of the difficulty of the subject is afforded by the fact that to-day, twenty years later, we are apparently no nearer success, in spite of the great progress made in other sections of carbohydrate chemistry.

The difficulties of synthesising natural and artificial glucosides were fully mastered, nearly half the papers published since 1908 dealing with this field of inquiry. These include the recognition of a third form of methyl-glucoside, the existence of which was concurrently demonstrated by Irvine in this country. This form, which apparently contains a γ-oxide ring, is highly active, and according to later work of Haworth, it may be the form in which the fructose molecule is present in cane sugar, for which Haworth accordingly suggested a new formula. The writer is not aware that Fischer expressed his views anywhere as to the correctness of Haworth's work; it cannot but have inspired him to renewed experimental effort to effect the much-desired synthesis.

In a dozen of the later papers are described results of the investigation of the acyl derivatives of the sugars, while a like number deal with mutations within the sugar molecule leading to the formation of substances such as glucal. The results serve to show that the chemist has still much to learn about this remarkable group; but they are too complex to be considered here.

Fischer's early work on enzymes is an acknowledged classic contribution to biological science. He returns to the subject in the last paper in this collection, dated July 14, 1919, a day before his death: this contains additional data for the discussion of the all-important question of the influence of the structure of β-glucosides on the activity of emulsin. It is written in Fischer's usual simple style—he used to dictate his papers while moving about the room in a very restless state—and shows how to the very end he retained his clarity of mind. A future generation alone can decide whether he should not be regarded as the greatest organic chemist the world has yet known.

E. F. ARMSTRONG.

American General and Economic Geology.

A Text-book of Geology. By Prof. A. W. Grabau. In two parts. Part I.: General Geology. Pp. xviii+864. Part II.: Historical Geology. Pp. viii+976. (London: G. G. Harrap and Co., Ltd., n.d.) 64*s.* net, two vols.

The Economic Aspects of Geology. By C. K. Leith. Pp. xvi+457. (London: Constable and Co., Ltd., 1922.) 18*s.*

(1) PROF. AMADEUS GRABAU, who is now professor of palæontology in the University of Peking and palæontologist to the Geological Survey of China, is the author of several excellent American geological text-books, and his new "Text-book of

Geology," in two volumes—one with the sub-title "General Geology," and the other with that of "Historical Geology"—supports his reputation. His work is marked by a logical arrangement of his material and a clear and interesting statement of the main problems. His teaching has been exceptionally wide in its range, as he was first lecturer in mineralogy at Tufts College, then professor of mineralogy and geology at the Rensselaer Institute, and afterwards professor of palæontology in Columbia University, New York. He has therefore had to teach both the physical and biological sides of geology, and he writes on both with sound knowledge and judgment.

The course of study Prof. Grabau recommends is to begin with the necessary elements of chemistry and mineralogy; then pass to the igneous rocks and volcanic action; next to take the "aqueous rocks"—which he limits to those formed as chemical precipitates, excluding those due to the mechanical action of water—and the organic rocks. Then follows the examination of the processes of erosion by wind, water, and ice, and by organic agencies; and after this work has been dealt with he proceeds to their products, the clastic rocks. The materials of the earth's crust having been studied, the course proceeds to the deformation of the rocks of the earth's crust by fold and fault, and to metamorphism and the rocks made by it, and concludes with the sculpturing of the earth's surface. This scheme, according to Prof. Grabau, is unusual in America, the physiographic section of the subject being usually taken first, but though that arrangement has no doubt great advantages in secondary schools, and in the popular presentation of geology, the author's course, beginning with the primary rocks and their constituents, seems to be the most logical for advanced students, and is adopted in some British universities.

The second volume deals with historical geology, and is the section in which the author's previous work renders his opinions of most interest and weight.

One striking feature of the book is its wealth of illustrations, which in the two volumes number 1980. Some of the most original are diagrammatic sections explaining the migrations of faunas, and they show that colonies have often played an important part, though not on the lines of the hypotheses which led to this process having been so long held in well-justified distrust.

One interest of such a general text-book is its evidence as to progress towards international agreement in terminology and theory. Prof. Grabau's classification of the pre-Cambrian rocks shows that their nomenclature is still chaotic. In the names of the geological systems he regretfully uses the adjectival ending of "ian," as in Cambrian, as a concession, but he thinks the ending in "ic," such as "Cambric" will ultimately be adopted. He quotes the use of the term *caldera* for an explosion crater like Krakatoa, and uses the term *sink* for a hollow due to subsidence for which *caldera*, the Spanish word, or its English equivalent, *cauldron*, has prior right. His chapter on vulcanism is illustrated by an excellent map of its distribution, but the Cameroons volcano should not be entered as extinct. The chapter on petrology makes no use of the American system, and the author's conservative classification will probably be found generally convenient for students of the standard for which the book is intended. The view that the temperature of the centre of the earth may be 200,000° or 350,000° F. is far in excess of the more moderate temperature suggested by the probable high thermal conductivity of the barysphere.

The author discusses the cause of former glaciations, and considers that none of the theories is wholly satisfactory. He objects to the theories based on variations in composition of the atmosphere, on the ground that their effects should be world-wide, whereas the glaciations have been local. Apparently he seems most disposed towards a theory of the shifting of the poles, though recognising the weight of the mathematical objections. He gives a diagram showing how the movements of the North Pole into Greenland would explain the glaciation in North America and north-western Europe combined with the contemporary freedom of Asia from ice. As a palæontologist taking especial interest in historical geology, his views on the changes and positions of the ocean are of weight. He admits great movements of the seas, but considers that in the Palæozoic period both the Atlantic and the Pacific were shallow oceans; he represents most of the Atlantic as having been occupied by sea in the Cambrian. He discusses at some length prehistoric man, and adopts dates in years for him as if they were well established; but he is more cautious in his reference to Piltdown man than some of his co-patriots when dealing with the possibility of the skull and the jaw belonging to the same individual.

(2) Mr. C. K. Leith's book on the economic aspects of geology contains many features of special interest. The central part of the book consists of brief descriptions of the chief ores and economic minerals, of their industrial uses, geological features, and mode of formation. The terseness of the descriptions makes them all the more convenient for those who desire a synopsis of the classification and formation of the chief economic minerals. The classification places pyrites amongst the group of fertilisers. This unusual arrangement is due to pyrites being largely used for

sulphuric acid in the manufacture of superphosphate. The book discusses some general problems which are not usually dealt with in geological text-books; thus there is a chapter on the world production of minerals, the capital value of the mineral reserves, and the political and commercial control of minerals. The last chapters deal with the relation of the geologist to the exploration and development of mineral deposits, the valuation and taxation of minerals, and mining law.

The discussion on this question includes the author's opinion of the much controverted Apex Law, wherein the mining laws of the United States and Rhodesia differ from those of the rest of the world. Mr. Leith says of the American geologists and engineers that "almost to a man they favour either modification or repeal of the law"; but he recognises that as it has been in force for 50 years, so large a body of vested interests has been established under it that it would now be difficult to make serious changes in it. He remarks on the objections to the present system of the use of expert evidence in law courts and the apparent advantage of selection of experts by the Court instead of by the contending parties; but he thinks the present system on the whole preferable, as the Court might find a sound selection impossible. The intense competition in such inquiries leads to the most intensive study of the problems. The author considers that few scientific treatises on economic geology contain facts better established than the reports of the great cases that have been rendered necessary in America by the imperfections of the Apex Law.

The author's conclusions as to the conservation of mineral resources are that little is to be feared from the actual shortage of supplies, but that the difficulties will arise in their extraction and distribution at a rate adequate to meet the future demand. He explains the use of geology in the late war and discusses the international problems based on mineral resources, which he represents as now in such confusion that it will take the combined efforts of the various governments many years to bring them into order. He says the entire European coal situation is in a state of chaos, and that, "unless there is a miraculous recovery and development of Germany's coal industry, impossible conditions have been imposed."

The volume concludes with chapters on the training of the economic geologist and on the ethics of his profession. The author recommends that the intensive study of geology should be a post-graduate course, that the universities should not give degrees in economic geology, but should leave the maintenance of a high standard, both of knowledge and conduct, to the professional societies connected with geology and mining.

Our Bookshelf.

British Labour: Replacement and Conciliation 1914-21: *Being the Result of Conferences and Investigations by Committees of Section F of the British Association.* Part 1, on Replacement, Co-ordinated and Revised by Miss L. Grier and Miss A. Ashley; Part 2, on Conciliation, Edited by A. W. Kirkaldy. Pp. xxxv+266. (London: Sir Isaac Pitman and Sons, Ltd., 1921.) 10*s.* 6*d.* net.

AN attempt has been made in the volume under notice to "sum up and co-ordinate" the various reports, issued between 1915 and 1920 by the Economic Section of the British Association, and relating to problems of labour during war-time.

In the first part of the volume, Miss Grier and Miss Ashley have succeeded admirably in their rather difficult work of collation, and the result is to present in small compass a concise history of the industrial adventure of women during the period of the war. The outlines of the story are by now sufficiently familiar: the value of the present contribution lies in the rich store of material, partly statistical, which it offers, and in the conclusions it reaches regarding the future of women in industry. The moral of the story is that while war-time experience has left women more ready to offer their services in production, there has been little permanent modification of industry which would make it possible to utilise those services.

Part 2 of the volume, dealing with conciliation in British Labour, 1914-1921, is somewhat inchoate. It is practically a reprint of reports on the promotion of industrial harmony and on industrial unrest, which had already been published elsewhere, and there is little evidence of selection from the papers and speeches which make up the original reports. Some excision and co-ordination would have added to the permanent value of this section.

The last forty pages of the volume contain a sympathetic discussion of works committees by Mr. C. G. Renold, who deals, with much breadth of vision, with the problems of industrial management involved in the growth of these committees.

Royal Society. Reports of the Grain Pests (War) Committee. Nos. 1 to 10 (in 1 volume). Pp. 23+48(+11 plates)+18+20+10+51+52+28(+11 plates)+52+16. (London: Harrison and Sons, 1918–1921.)

THE Grain Pests (War) Committee was appointed by the Council of the Royal Society in June 1916, as the result of correspondence with the Board of Agriculture, in which the Board requested the Royal Society to appoint a committee "in relation to the damage done to grain by insects." When established, the committee at once took very active measures to carry out the work allotted to it, and published the results of the investigations which it initiated in a series of valuable reports. Most of the latter have already been noticed in our pages and need no further comment. These reports have now been issued in book form, together with a final brochure (Oct. 1920), drawn up by the chairman, Prof. W. A. Herdman, who has summarised the results of the researches and puts forward certain

recommendations as to future work. The findings of the committee have shown clearly that the whole subject of grain pests is one of great importance to the Empire, and it is recommended that the State should assume a general responsibility for the continuance of the investigations. It is obvious that, if the work is to be placed on a permanent basis, it must be sufficiently provided for in order that it may be carried to its logical conclusion—the practical control of grain pests. The recommendations made for the provision of a nucleus organisation do not involve any large expenditure of money and, in view of the great importance of the conservation of food-stuffs, it is earnestly hoped that the Government will see its way to establish the work along lines suggested by this committee.

A. D. IMMS.

Among Primitive Peoples in Borneo: A Description of the Lives, Habits and Customs of the Piratical Head-Hunters of North Borneo. By I. H. Evans. Pp. 318. (London: Seeley, Service and Co., Ltd., 1922.) 21*s.* net.

THE part of Borneo described by Mr. Evans is that which is under the control of the British North Borneo Company, and the peoples with whom he deals are three in number: the Dusuns, an Indonesian people speaking a Malayo-Polynesian language, who inhabit the interior; and the Bajaus and Illanuns, immigrants of Proto-Malayan stock who live on the coast. Mr. Evans is a careful observer, and his experience as an official of the company enables him to speak with authority. On many points he is able to correct or supplement our previous information. The peoples he describes present marked contrasts, both in temperament and in culture. The Dusun is an agriculturist, in the main industrious, living in independent village-communities, each under a headman. In religious belief he is an animist, and has a strong and abiding faith in omens. The coastal peoples, on the other hand, are indolent and inveterate gamblers, who, now that their former chief industry—piracy—has been suppressed, earn their living from the sea. They are Mahommedans, but lax, and their religious beliefs embody many survivals of primitive beliefs, of which, unfortunately, Mr. Evans had opportunity to collect only a few examples.

The Island of Roses and her Eleven Sisters: or, the Dodecanese from the Earliest Time down to the Present Day. By Dr. Michael D. Volonakis. Pp. xxv+438. (London: Macmillan and Co. Ltd., 1922). 40*s.* net.

IN this volume the author gives an account, both historical and geographical, of the twelve islands lying off the western extremity of Asia Minor, for which the term "Dodecanese" has become current since the Italo-Turkish war. Of these, the most important is the island of Rhodes, but to English readers the names of others, notably Patmos, associated with St. John and the Book of Revelations, and Cos, the home of Hippocrates, will be equally familiar. The author, himself a native of the Dodecanese, relics mainly upon literary sources, but has supplemented these by the evidence of archæology and numismatics, while his intimate local knowledge has proved invaluable in elucidating his authorities. Owing to the isolation of their insular position, the inhabitants, while taking part in times of crisis in the affairs of mainland Greece, have kept their institutions practically intact from a remote period, notwithstanding successive waves of invasion, and subjection to the Knights of St. John, the Turk and the Italian. Hence this description of the islands has a peculiar value, and the author's fuller account of their archæology and culture here promised will be awaited with interest. The book is exceedingly well illustrated by numerous photographs.

The Machinery of the Mind. By Violet M. Firth. Pp. 95. (London: G. Allen and Unwin, Ltd., 1922.) 3*s.* 6*d.* net.

IT is stated by the author that this volume is for the edification of those who have neither the time nor the training necessary for the study of standard texts.

Whether such readers will be in the position, at the end of its perusal, to apply its generalisation to the interpretation of their own problems, or be inspired to continue the subject, is doubtful. In less than one hundred pages the author disposes of some of the most fundamental and debatable problems of modern psychology, but naturally there is no clue to their debatable character. It may be possible to compress the general truths of some sciences into a few pages, but none of the biological sciences are in that position, and psychology least of all. In a few lines the technical terms, sensation, percepts, concepts, images are used but not explained, while complex is used in two different senses. Analogy is useful in its place, but is very much over-used here; nor is it scientifically sound to give as evidence in a later chapter what has been merely asserted in an earlier one. In short this book is little more than an expanded dictionary of some frequently used psychological terms with the drawback that the order is not alphabetical.

Human Traits and their Social Significance. By Dr. Irwin Edman. Pp. xii+467. (London: Constable and Co., Ltd., n.d.) 15*s.*

THE work under notice is designed to serve as a general introduction to the problems of contemporary civilisation. The author feels that in attempting to interpret the conditions of life under which we live the psychological point of view is too frequently overlooked, and yet it is most important. Following Dr. McDougall and Prof. Thorndike, he describes the fundamental activities which are man's endowment, his primitive instincts, their environmental modification and development, the individual difference in endowment and the part played by language. While emphasising the innate character of many of man's actions and aims, the author realises that there is also in man the power to reason and to put before himself ideals which he considers desirable; such ideals when embodied in social customs, institutions, and speech become powerful motives.

The style is clear and the whole book is easy to read and should prove of value to the historian, economist, and the student interested in the complexities of life. The subdivision of each chapter, however, into paragraphs with a heading in heavy type seems unnecessary, and is a hindrance rather than a help.

Problèmes et exercises d'électricité générale. Par Prof. P. Janet. Pp. vii+254. (Paris: Gauthier-Villars et Cie, 1921.)

PROF. JANET gives an interesting collection of problems which have been set in the entrance examinations for the Higher School of Electricity in Paris. Many of the problems are novel, and in some cases it is shown how the solution can be obtained by several different mathematical methods. The examples are purely theoretical, so exact solutions can be given. They are expressed in nearly every case by algebraical formulæ, numerical illustrations being left to the student. The English reader will find the latter part of the book very instructive, as the author frames his problems so as to take into account mechanical as well as electrical considerations. For example, the instantaneous values of the currents depend on the moments of inertia of the moving parts of the machines as well as on the inductances of the circuits. We hope this innovation will be followed in English text-books. The students are supposed to have a thorough knowledge of electrical principles and to be familiar with the calculus. We can recommend this book to teachers. A. R.

Thought-Coin. By Bart Kennedy. Pp. x+219. (London: W. Rider and Son, Ltd., 1921.) 5*s*. net.

THE title gives no clue to the contents of this book. It is not, as might be imagined, one of those pseudo-scientific works urging a one-sided belief in the all potence of thought, nor is it a psychological treatise on thought-processes. It is an attempt to consider some of the problems of life, such as dreams, consciousness, grouping, sex, etc., not as abstractions but as living realities; it is a frank acceptance of facts as against the "oughts" and "ifs" of so many writers, and so far is more truly scientific than some of the more apparently scientific books. The author surveys the universe with the vision of the seer, and gives to problems which are so often treated in isolation the background of relation to the universe. All life is for him an ever provocative mystery. He writes with a penetrating imagination, but imagination controlled and vitalised by the teaching of science. It is interesting to read scientific problems expressed in terms of imaginative literature.

The Evolution of Consciousness. By A. W. Tilby. Pp. 256. (London: T. Fisher Unwin, Ltd., 1922.) 15*s*. net.

MR. TILBY writes with a vivacity and humour which make his book exceedingly pleasant reading. It contains no original research, but it is exceptionally well-informed. The idea is outwardly very like that of Bergson's creative evolution, and may have been suggested by it—that consciousness in every form, instinctive and intellectual, is a product of the evolution of life and utilitarian in its purpose. There is an essential difference, however, in the fact that Mr. Tilby recognises no interpretative principle such as that which, for Bergson, makes evolution creative. All that is, Mr. Tilby tells us, has emerged in a definite historical sequence, and we have merely to accept the fact and not ask why. The inert we are led to understand preceded the living, and even memory is a purely material fact.

F. C. Donders. *Reden gehalten bei der Enthüllung seines Denkmals in Utrecht, am 22. Juni* 1921. Von Prof. Dr. C. A. Pekelharing, Dr. Sikkel, Dr. A. F. Baron van Lijnden, Dr. J. P. Fockema Andreæ, aus dem Holländischen übersetzt von Paula Krais geb. Engelmann. Pp. 62. (Leipzig: W. Engelmann, 1922.) Fl. 1.

THE unveiling of a statue of F. C. Donders last summer at Utrecht was the occasion for the delivery of several addresses on his life and work. These have been collected, translated into German and issued as a small illustrated booklet. Donders was the founder of modern teaching on the accommodation and refraction of the eye, his great work on which was published in 1864. He was a prolific writer, and a list of his papers (1840–1883) is included: some of his latest contributions deal with colour-blindness.

The Microscope: A Simple Handbook. By Conrad Beck. Pp. 144. (London: R. and J. Beck, Ltd., 1921.) 2*s*. 6*d*. net.

MR. BECK has in this little book collected and set out in elementary form a considerable amount of information useful to the microscopist. The optics of the instrument are described in a simple manner, and a final chapter deals with pond-life as objects for the microscope. Published by Messrs. R. and J. Beck, the book avowedly deals with the products of that firm, but is none the worse for that so long as the reader is aware that other makers of microscopes exist. We can commend this account of the microscope to the beginner, who will find in it clear directions for use and explanations of many difficulties.

R. T. H.

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 6, 1921. Pp. 638. (London: Society of Chemical Industry, 46-47 Finsbury Square, n.d.) 7*s*. 6*d*. to Members; 12*s*. 6*d*. to Non-members.

REFERENCE has previously been made in NATURE to the very useful annual reports issued by the Society of Chemical Industry. This year the report is of the same high standard as its predecessors. A particularly noteworthy feature of the separate reviews of the progress made during the year, each written by a specialist, is that the matter is treated critically. The reports are essential to those who wish to follow the progress of chemical industry, and should be in the hands of technical chemists, teachers, and students, all of whom will find matter of interest in them.

Practical Polishing and Staining. By A. W. Parkhouse. Pp. viii+120. (London: Benn Bros., Ltd., 1922.) 8*s*. 6*d*. net.

MR. PARKHOUSE writes from practical experience, and his book is a very readable and well-informed account of the subject. He very properly lays stress on the importance of close co-operation between the polisher and the cabinet maker, and his book may be recommended to both.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Intensity of X-ray Reflection.

In a letter on "The Intensity of X-ray Reflection from Powdered Crystals" (NATURE, July 8, p. 38), Prof. A. H. Compton and Mr. N. L. Freeman have described some measurements which they have made on the reflection of X-rays by rock-salt, and have compared their results with figures published by us in the *Philosophical Magazine* for July 1921. Quantitative measurements of the amount of radiation reflected by the crystal are of great interest, since it is probable that an estimate of the way in which the electrons are distributed throughout the atom may be based on them.

In the case of the reflection by the (100) planes of rock-salt, they find a large discrepancy between our figures and theirs. The point at issue may be put as follows. By comparing the incident and reflected monochromatic X-ray beams, and applying formulæ calculated by Darwin and others, it is possible to estimate the amount of X-ray energy scattered by an atom in certain directions in terms of that scattered by a single electron under the same conditions. As the angle through which the rays are scattered is increased, the amplitude of the diffracted wave falls off, owing to interference between the waves scattered by the electrons distributed around the centre of the atom. In the case of the (100) reflection by rock-salt, we found that at the angle at which the reflection takes place the effect of the 28 electrons in a pair of sodium and chlorine atoms is reduced to an effect 20·1 times as great as that of a single electron (p. 7, *Phil. Mag., loc. cit.*). The ratio 20·1/28 is that indicated by ψ in this note by Prof. Compton and Mr. Freeman.

We obtained an estimate for ψ^2 by measurements made with a single rock-salt crystal. Prof. Compton and Mr. Freeman determined the quantity by the powder method, measuring the amount of radiation diffracted by a layer of powdered rock-salt spread on a plate, irradiated by an X-ray beam made homogeneous by previous reflection. They obtain a value of ψ^2, equal to 0·64, correct to 10 per cent., and quote our results as giving $\psi^2 = 0{\cdot}43$, a much lower value.

It may well be that our estimate is too low, for the reasons given by Prof. Compton in his note, which have been fully discussed recently by Darwin (*Phil. Mag.*, May 1922). By using the powder method, the extinction effect, which increases the absorption of the rays passing through at the reflecting angle, is partly or wholly eliminated. We believe, however, that an error has been made in quoting our value for ψ^2 as being 0·43. We obtained

$$\psi^2 = \frac{20{\cdot}1}{28} = 0{\cdot}718,$$

$$\psi^2 = 0{\cdot}515.$$

If this be the case, the discrepancy is not so great as Prof. Compton and Mr. Freeman believe. They used the molybdenum K_α line, of wave-length 0·708 Å.U., whereas we used the rhodium K_α line of wave-length 0·615 Å.U. The value of ψ^2, however, is independent of the wave-length for a spectrum of given order.

Their estimate for the value of ψ^2 in the case of the (100) reflection is of the very greatest interest. The measurements made with a single crystal are difficult to interpret for the strong reflections, on account of extinction, though they are probably accurate for the weaker ones. On the other hand, it is just these values for ψ^2 at small angles which are of the greatest importance, as indicating the distribution of electrons in the atom, particularly in its outer confines.

W. L. BRAGG.
R. W. JAMES.

Manchester University, July 13.

Geology and the Primitive State of the Earth.

I have no wish to depreciate the importance of the work of those geologists who have examined the older known rocks of the earth's crust and decided that all of them have been altered since they first became solid; but I question whether their results afford the evidence concerning the primitive state of the earth that is suggested by Prof. A. P. Coleman and Prof. G. A. J. Cole (NATURE, June 17 and July 8). The deepest boring yet made is one of 2·5 km., and there are few over a kilometre in depth; that is the extent of the crust accessible to geologists. Yet the average thickness of sediments over the continents is probably some kilometres, and in many places it is practically certain that the thickness reaches tens of kilometres. In addition, we have vast thicknesses of intrusive and eruptive rocks. Would it be surprising if all rocks in their primitive state have been denuded away or buried to an inaccessible depth?

Even if it is considered that a piece of primitive crust, still unaltered, has had an appreciable chance of being discovered and examined, I do not see that the results actually found afford any evidence for the cold earth theory as against the hot earth theory. The primitive rocks formed by slow accretion of solid planetesimals would be in a perfectly characteristic and recognisable condition; no such rock has, so far as I have heard, been discovered, and therefore Prof. Coleman's arguments, if they are sound, would be just as injurious to the planetesimal theory as to the hot earth theory.

The temperature of the surface of the earth is at present maintained almost wholly by solar radiation, and not by conduction from the interior. The rate of conduction of heat from the interior is of order 2×10^{-6} cals/cm.^{2} sec. The solar constant is about 3×10^{-2} cals/cm.^{2} sec. Even if the earth had a solid crust only a mile thick, the surface temperature would still depend wholly on the sun's radiation. Thus it would become cool at the surface at a very early stage in the solidification, and it is not surprising that the oldest rocks should show evidence of water at the surface.

I have published in the Monthly Notices of the Royal Astronomical Society, vol. 77, 1916, pp. 84-112, and in the Proceedings of the Royal Society, vol. 100, 1921, pp. 122-123, arguments that I believe to be fatal to the form of the planetesimal hypothesis that attributes to solid planetesimals any cosmogonical importance, and postulates an earth that has always been solid. No supporter of this hypothesis has yet published any reply to, or acknowledgment of, these criticisms.

HAROLD JEFFREYS.

St. John's College,
Cambridge, July 10.

α-Particles as Detonators.

The observation recorded by Mr. Henderson in a letter to NATURE of June 10, under the above heading, appears to involve possibilities of the greatest prac-

tical importance. Mr. Henderson found that under suitable conditions an α-particle may cause the detonation of nitrogen iodide, about one α-particle in 10^7 or 10^8 being effective. He suggests that other unstable substances may be similarly affected. The question naturally arises as to whether any of the explosives commonly used are sufficiently unstable to be detonated in this way. As they are all very much more stable than nitrogen iodide we would expect that the chance of an α-particle causing detonation would be much smaller, so that an explosion might only occur after a lengthy exposure to a copious source of α-particles. Still, in view of the almost universal presence of small traces of radioactive matter, it is possible that some unexplained explosions have been brought about in this way. It would appear to be worth while to conduct an investigation into the possible effect of α-particles on various explosives and detonators. If it is found that there is even the remotest possibility of detonation occurring, precautions should be taken in the manufacture of explosives to reduce the radioactive contamination to the lowest possible value.

HORACE H. POOLE.

Royal Dublin Society, July 11, 1922.

Occurrence of a Crystalline Style in the American Slipper Limpet (*Crepidula fornicata*) and its Allies.

DURING recent investigations, carried out with the aid of a Government grant, on the oyster beds in the river Blackwater, freshly caught specimens of the American slipper-limpet (*Crepidula fornicata*) were examined fresh microscopically, and the interesting fact was established that this species possesses a crystalline style. Individuals which have been out of water 24 hours or more still possess remains of the style, which has undergone partial solution. Crepidula differs therefore in this respect from the native oyster (*O. edulis*), the style of which is frequently completely dissolved within 3 to 5 hours after individuals are taken out of water, and is completely dissolved in all specimens after about 10 hours out of water.

In the style of Crepidula occasional Spirochætes (*Cristispira balbiani?*) were seen, but not identified. By analogy it was suggested that the allies of Crepidula should also possess a crystalline style, and an examination of fresh specimens at Plymouth at once proved the surmise correct in the case of the species *Calyptræa chinensis* and *Capulus hungaricus*. It is highly probable, therefore, that a crystalline style is present in the whole of the Calyptræidæ and the Capulidæ; it is also not improbable that a style may be present in all sedentary non-parasitic Streptoneura.

I have long suspected that a crystalline style—particularly in molluscs—is associated with a mode of feeding which consists essentially in the capture of planktonic organisms by mucus controlled by harmonised ciliary mechanisms. The discovery of a crystalline style in Crepidula and some of its allies, which all feed in the manner mentioned, lends some support to this idea; but too little is known of the habits of other gastropods which definitely possess a style, to permit of a general correlation of the presence of style with capture of food by means of mucus. Some indications have been obtained by rough hurried experiments that the style substance is a good solvent for mucus; and if this observation can be confirmed it may well be shown that the dissolving of the mucus enveloping food-masses is one of the most important functions of the crystalline style.

J. H. ORTON.

The Marine Biological Laboratory,
Plymouth, July 13.

Sense of Smell in Birds.

IN the issue of NATURE for June 17 there is a discussion on the inadequacy of present observations on the sense of smell in birds. Perhaps the following notes would be of interest. They are from an account of the habits of the birds of Trinidad which will be published shortly by the Department of Agriculture of that island.

On September 20, 1918, I observed large numbers of the black vulture (*Cathartes fœtens*) collected on and round a field which had recently been experimentally manured with liquid slaughter-house refuse and could be smelt a quarter of a mile away, although nothing was visible to the eye. A few red headed vultures (*Cathartes aura*) were also present. In Panama the same birds quickly found the body of an animal that I put close to the trunk of a thick tree, quite invisible from above.

Still more interesting is an observation by Hart (Bull. Dept. Agr. Trinidad II., p. 155), who records that *Cathartes fœtens* used to collect in the morning hours on trees near a plant of *Aristolochia gigas* v. *sturtevanti* which was flowering, and which has a particularly strong odour. There can be no doubt that these birds have an efficient sense of smell. At the same time I think that their congregation in numbers is due to watching the movements of their neighbours.

C. B. WILLIAMS.

Ministry of Agriculture, Cairo, Egypt,
June 29.

The Skull of Sir Thomas Browne.

IT may be known to some readers of NATURE that the skull of Sir Thomas Browne has recently been reinterred at Norwich, but that previously it came to London, where careful measurements, drawings, and tracings of it were made. It is proposed to publish a full account of the skull in *Biometrika*, but it would add much to the interest of the proposed monograph if it were accompanied by a series of reproductions of the portraits and engravings of one of the most noteworthy of Englishmen who have combined the study of medicine with the pursuit of literature.

The large number of plates required to illustrate adequately the relation of the skull to the portraits renders—under the present conditions of both printing and illustrative work—the appearance of a complete monograph, such as we desire to see issued, very difficult. We propose, therefore, to issue one hundred copies of the monograph at the price of one guinea each, if lovers of Sir Thomas Browne can be found in adequate numbers to subscribe for copies. Will you kindly permit us to appeal through your columns for the names of those who are willing to aid in this scheme for putting on permanent record the physical aspect of the author of the "Religio medici," who, by that and his other works, has won a unique position in the heart as well as in the mind of every cultured Englishman? Willingness to subscribe may be notified to either of the undersigned at the Royal College of Surgeons, Lincoln-Inn Fields, and University College, London, respectively.

ARTHUR KEITH.
KARL PEARSON.

London, July 12.

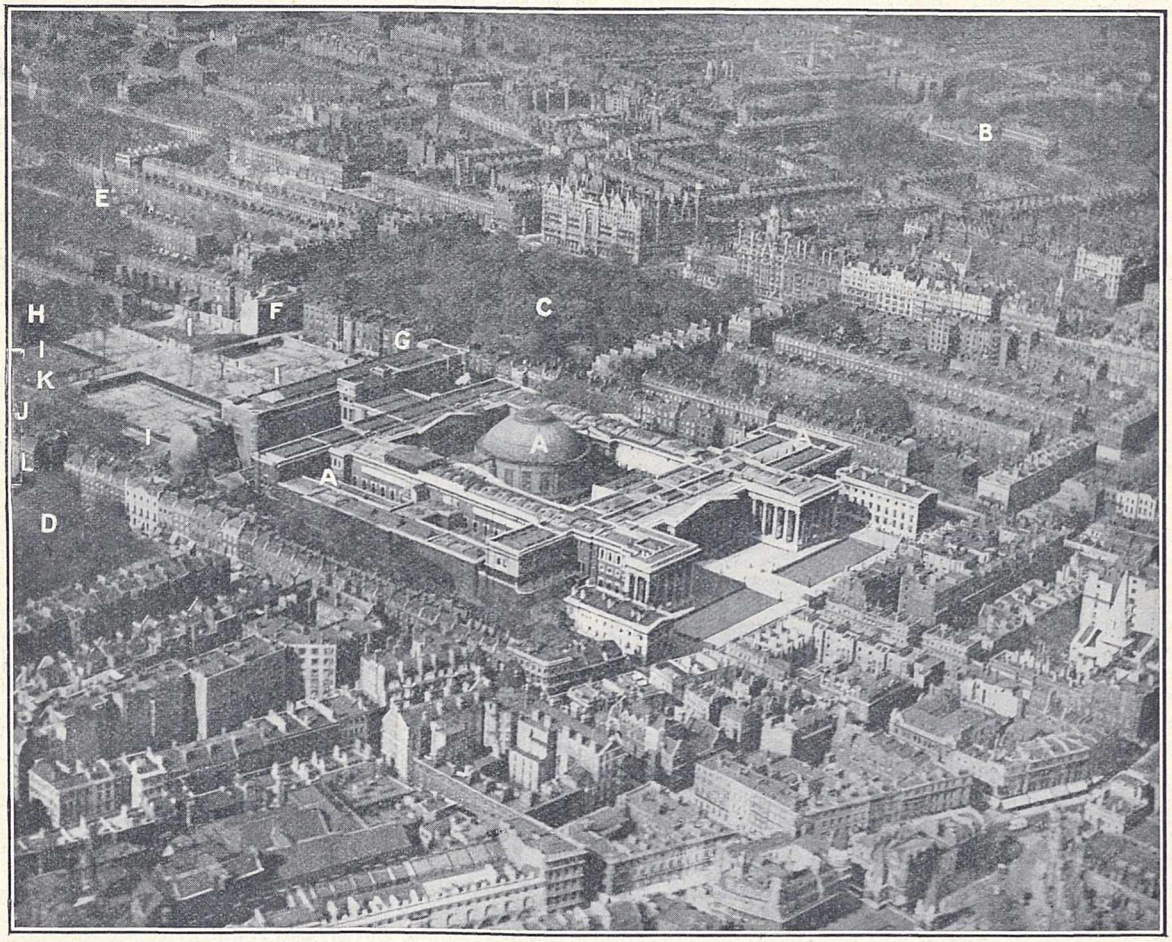
Bloomsbury and the University of London.

By T. LL. HUMBERSTONE.

BLOOMSBURY, originally Lomosbury, was in ancient days a retired village, renowned for its wholesome and pleasant air, situated with its manor near the present Bloomsbury Square. The Royal mews, established here, were burnt down in 1537, when the hawks and steeds were removed to Charing Cross. Two great houses were in the neighbourhood — Montagu House, which became the British Museum, and Southampton House, afterwards called Bedford House, near the present Russell Square. To the north, stretching towards Hampstead and Highgate, was open country with irregular patches, frequented by duellists, and the scene of robbery, murder, and every form of depravity.

Russell Square was built at the beginning of the nineteenth century, and became the resort of "gentlemen of the long robe." In those days, or somewhat earlier, Great Ormonde Street was a centre of fashion, but in course of time the district lost caste, and it was accounted a mark of high breeding not to know the locality. Croker inquired in the House of Commons, "Where *is* Russell Square?" It is recorded, however, that the dignity of this once patrician quarter of London was preserved by the ancient landladies, who still cherished the belief that Great Ormonde Street was the hub of the fashionable world.

The British Museum forms the natural centre of the district. Its establishment was due to a man of high scientific attainments, Sir Hans Sloane, a physician, who for a quarter of a century was president of the College of Physicians. He accumulated at his house in Chelsea a vast and varied collection of books and manuscripts, objects of natural history, and works of art, which he directed by his will should be offered to the nation on favourable terms. After his death, in 1753, an Act of Parliament was passed approving the acquisition of the collection, together with the Harleian Library of Manuscripts and the Cottonian Library; and to house the collections the Government purchased Montagu House, raising for this purpose, by means of a lottery, the sum of 100,000*l.*, of which 20,000*l.* was used for the purchase of the Sloane Collection. The museum was opened in 1759, and ever since has been available for "studious and curious persons," to quote the official regulations. In its gardens were encamped, in 1780, the troops who quelled the Gordon Riots.



[*Photo by Central Aerophoto Co.*

A=BRITISH MUSEUM. B=FOUNDLING HOSPITAL. C=RUSSELL SQUARE. D=BEDFORD SQUARE. E=WOBURN SQUARE. F=INSTITUTE OF CHEMISTRY. G=ROYAL INSTITUTE OF PUBLIC HEALTH. H=TORRINGTON SQUARE. I=SITE FOR UNIVERSITY OF LONDON. J=SITE FOR INSTITUTE OF PUBLIC HEALTH. K=UNIVERSITY OF LONDON UNION. L=CAVENDISH'S HOUSE.

George IV.'s Library was afterwards purchased, the *Quarterly Review* spitefully remarking that women's looks were the only books His Majesty required. The present building was designed by Sir Robert Smirke. It was commenced in 1846 and cost 800,000*l.*, an amount which is worth remembering in view of the fanciful estimates of the cost of housing the University of London on the adjoining site. The dome of the library is said to be the largest in the world, with the exception of the Pantheon at Rome. The north extension is a recent addition of great architectural dignity.

The next most important building in Bloomsbury is undoubtedly University College in Gower Street, founded in 1826 to afford "literary and scientific education at a moderate expense." Tom Campbell, the poet, and Lord Brougham share the credit for its foundation. Campbell, in his letter to the *Times*, suggested that a number of the "middling gentry" in London would be prepared to pay 50*l.* to furnish the inside of their skulls, that being the amount willingly paid for a full-bottomed periwig for external adornment. The College was nicknamed Brougham's "patent omnibus" as a play on the motto *Patens omnibus Scientia*. From the first, however, the ideals of the College were high and comprehensive. "May God," prayed H.R.H. the Duke of Sussex in laying the foundation stone on April 30, 1827—it should be noted that the centenary of this auspicious event is rapidly approaching—"bless the undertaking which we have so happily commenced, and make it prosper for the honour, happiness, and glory, not only of the metropolis, but of the whole country." This odour of sanctity was short-lived, for the Church party stigmatised the institution as the "Godless College," and established King's College in the Strand as an antidote. Nevertheless, the Duke's prayer has been answered; the bare fact of the inclusion of Lister's name in the list of distinguished *alumni* would be sufficient proof. After the ceremony the company dined together at the Freemasons' Tavern, thus establishing an early tradition of good-fellowship. The beautiful buildings, with the characteristic portico and graceful cupola, were designed by William Wilkins, the architect of the National Gallery.

The College is not included in the photograph, but to the north of the British Museum are to be seen the four plots recently purchased by the Government for the new headquarters of the University of London. The whole of Torrington Square and parts of Russell and Woburn Squares also belong to the University site of 11½ acres, to which it is proposed to move King's College also in the fulness of time. This is not the occasion to attempt even the briefest summary of the controversy which has raged round this question during the past eleven years. One point is, however, pertinent, as it is illustrated by the photograph. It has been charged against the site that its division into four plots is a great disadvantage. Could it not be urged with equal force that this is one of its greatest advantages? The four plots will permit of the construction of a group of well-lighted and ventilated buildings, with numerous entrances and appropriate purposes. The alternative of a mammoth single building would inevitably suffer from defects of lighting and ventilation, and would cause endless annoyance through the waste of time involved in pacing long corridors. The modern civic university must be, literally and figuratively, on the street rather than in some secluded grove. As will be seen, one of the plots is occupied by some wooden buildings, which have been acquired by the University Union Society from the Young Men's Christian Association as a temporary home. Immediately to the north is the University Institute of Historical Research, established last year for the benefit of students pursuing their investigations at the British Museum, the Public Record Office, and other archives. There they will come "to discuss their problems and results, and to receive that oral guidance for which they are properly debarred in libraries and manuscript departments." The Institute includes departments for English and Colonial history, naval and military history, the history of London, and of various foreign countries, and palæography. The plan is admittedly "opportunist rather than ideal," but the Institute may serve as a model and forerunner of numerous University Institutes for special studies. Between the wooden buildings and Gower Street is the site of the new Institute of Public Health to be established by the Rockefeller Foundation.

Bloomsbury has many interesting associations, as the plaques fixed to its houses testify. These are mostly literary or artistic, but occasionally scientific. At the Bedford Square end of Gower Street is the house where Cavendish, the chemist and philosopher, lived for some years. The house became packed with books and apparatus, and another in Dean Street, Soho, was taken as a library. When Cavendish wanted a book he signed a formal receipt. Enormously wealthy, he made no use of his money. His daily fare consisted of legs of mutton; and it is said that when his servant informed him that the one leg of mutton in the house would not be sufficient for the company, Cavendish instructed him to get another. Such simple direct answers to difficult questions are the acid test of greatness. We read also that Cavendish gave to Humphry Davy some bits of platinum for his experiments, and visited him to see the results of his experiments on the decomposition of the alkalis. He died in 1810.

While the Bloomsbury landlady, to whom respectful tribute has already been paid, remains extant, the district, as a whole, is rapidly changing in character. Russell Square and Bedford Square and the adjoining streets provide accommodation for a large number of learned and other societies of an academic character, and for several teaching institutions connected with the University of London, in addition to those already mentioned. The district is favoured by foreign consulates, the legal, architectural, and other professions, and by business concerns for administrative purposes. It certainly offers many attractions in its "wholesome and pleasant air," its nearness to the great railway termini, its dignity and traditions, its faint historical aroma, its spacious squares and wide streets. As London grows, a process which continues without rest or abatement, the importance of its central areas must be accentuated for all public and private purposes involving the visitation or meeting together of people from the environs of the city. Therefore, whatever its detractors may allege, the future of Bloomsbury is assured.

The Physiology of Life in the Andes.[1]

By J. BARCROFT, C.B.E., F.R.S.

THE recent expedition to Peru was initiated under the auspices of the Royal Society. So far as the British members were concerned, it was financed in part by a grant made by that body, in part by two substantial private subscriptions from Sir Robert Hadfield, then on the Council of the Royal Society, and Sir Peter Mackie, who has on previous occasions been a staunch supporter of anthropological research undertaken by the Royal Society. In part also its expenses were met by grants from the Moray and Carnegie funds in Edinburgh. These grants paid some of the expenses of the expedition as a whole, together with the personal expenses of three of its members—namely, Dr. J. C. Meakins, professor of therapeutics in Edinburgh; Mr. J. H. Doggart of King's College, Cambridge; and myself. The project was warmly supported by a number of institutions on the American continent, each of which sent a member of the party at its own expense. Harvard Medical School was represented by Dr. Bock, Dr. Forbes, and jointly with Toronto Medical School by Prof. Redfield; the Presbyterian Hospital, New York, by Dr. George Harrop; and the Rockefeller Institute by Dr. Carl Binger. The American and British parties sailed from New York and Liverpool respectively in the middle of November, the American section arriving in Peru a fortnight or more before we did.

I have perhaps given the impression that the party consisted of two sections from different continents, sharply marked off from one another, and neither of which had seen the other before. This impression is erroneous, for the whole idea of the expedition grew from the fertile soil of collaboration in the researches carried out under a single roof. Dr. Redfield and Dr. Bock had been working in Cambridge (England) throughout the previous year, and Dr. Harrop had been there for a short time. There the scheme had been hatched, the methods standardised, and a number of the controls carried out.

Why did we go to Peru, or, more precisely, to Cerro de Pasco? The question may most easily be answered by comparing Peru with some of the other localities to which we might have gone, and to which others have gone before us; for example, Monte Rosa, Pike's Peak in Colorado, the Peak of Teneriffe, and the Himalayas. Without going at length into the merits of each, the advantages of Peru will be sufficiently apparent if I compare it to one of the above, and I will select one of which I have personal experience, namely, the Peak of Teneriffe. Peru and Teneriffe have in common the merit of being close to the sea. In either case the baggage can be put on board at Liverpool or Southampton and taken to your mountain base without further transhipment. Peru, however, possesses the first necessity of laboratory equipment—an abundant supply of water—up to a height of 16,000 ft., *i.e.* 4000 ft. higher than the Peak. In the latter place the highest altitude at which I know of water is 7000 ft., while at 11,000 ft.—near the situation of the Alta Vista hut—there is an ice-cave from which water may be obtained by melting the ice.

Again, the conditions of transport are vastly different in Peru from what they are in Teneriffe. In Teneriffe everything goes up the mountains by mule. The amount of apparatus which can be taken up is therefore small; and if it arrives whole at its destination the worker is fortunate. If it arrives broken, there is little hope of mending it. We were very fortunate, at an early stage of our preparations, in getting in touch with Mr. Oliver Bury, the chairman of the Peruvian Corporation. The Peruvian Corporation owns, among other railways, the trunk line which goes directly inland from Lima, climbs the Andes to a height of almost 16,000 ft., and then drops down to Oroya (12,000 ft.), situated on the pampa between the two parallel ranges of the Cordilleras. From Oroya railways run north to Huancayo, and south to Cerro de Pasco (14,200 ft.), which place was to become our principal seat of operations. To the Peruvian Corporation we owe our laboratory. For the purpose we were assigned a luggage van, 45 ft. in length, together with a goods van which we used as a store; and these they offered to take to any locality on their system at which we desired to work. While the American members of the party awaited our arrival at Lima, they fitted up the luggage van and made a very fine laboratory of it. At one side the door was closed up and windows put in its place, benches and shelves were fitted, electrical wiring was installed, and ultimately we had electric light, power, and heat. What greater contrast in efficiency could exist than between our mobile laboratory at Cerro, jacked up off the bogies to prevent vibration, fitted with X-ray plant and apparatus for the measurements of hydrogen ions, on one hand, and the Alta Vista Hut in Teneriffe, with its paraffin stoves which emitted little but smuts and barely sufficed to melt a few handfuls of ice. Of more account, however, than all these advantages was the fact that, up to an altitude of 16,000 ft. in Peru there is a population most of which is connected with the mining industry. This population may be divided into two categories, namely, the Anglo-Saxon officials and the native labourers. The latter are of Indian descent, and as a race have lived at this altitude for many generations. In Cerro they are designated "Cholo," a name that has no exact anthropological significance, but I shall use it and so avoid an assumption of anthropological knowledge which I do not possess.

To judge from the customs which prevail in the outlying villages, the Cholo is not far removed from a very primitive civilisation. Within a mule-ride of Gollarisquisga there are communities in which private ownership of land does not exist; the land, as in some of the Russian communities which are, or were, on the Canadian prairie, belongs to the village. The produce, if the village is small, is placed in the church; in the larger villages there is a store for this purpose. If the stock of some commodity has run out, some person goes to such a market as Huancayo and buys some more, not for himself, but for the village. I said "buys"; but there are places to which money has scarcely penetrated, and where the exchange of commodities is still a process of barter. The condition of medical science in these villages may be gathered from the fact that such

[1] From a discourse delivered at the Royal Institution on Friday, June 9.

nostrums as horse-dung and well-kept human urine occupy an honourable place in the pharmacopœia, and that a custom appears to linger by which, when the practitioner has done his best—or worst—and failed, the services of another official are called in. He is the "despenador" or "putter out of pain." I need say no more of his or her duties than to give the following quotation from Bensley's "Spanish and English Dictionary": "Despenadora—a woman who is supposed to push her elbow into the stomach or breast of dying persons to relieve them from agony."[1]

It seems clear then that the Cholo, not the Cholo of Cerro de Pasco or Oroya, but of some of the far outlying districts, has been little touched by the Spanish or even the Inca civilisation, and that in him we have a subject for physiological research whose like has varied little for generations. In physique he is short in stature and sallow, or with some blood in his cheeks. That part of his anatomy which was principally of interest to our party was his chest. We made a considerable number of chest measurements. As regards the chest circumference the following statement sums up our findings. We based our measurements on Prof. Dreyer's tables, accepting his estimate of the normal ratio between the trunk length and the chest circumference. We ascertained that the average circumference of the Cholo chests which we measured would normally be 79 cm. It was, in point of fact, 92 cm. As a rough check we measured our own trunk chest ratios and those of the American and British engineers, a community of fine physical development. The circumference of the Anglo-Saxons was little in excess of Dreyer's estimate. The lowest level at which we came across one of these small people with chests which appeared out of proportion to the rest of his stature was at Matucana (8000 ft.), and on inquiry we found that he was a native of Huancayo (12,000 ft.).

To pass to the more strictly physiological aspects of the work of the expedition, one must reflect that the desire to investigate mountain sickness goes back at least to the middle of the last century. It is remarkable, when one comes to think of it, how recently our knowledge of the causation of disease has grown. The lure of mountain sickness to the physiologist lay originally in the fact that it was a disease to which a definite cause could be assigned. You go a certain height up the mountain—any mountain—and when your ascent corresponds to a given fall in the barometer you suffer from mountain sickness; when you descend, the malady leaves you. Mountain sickness, or as it is called in Peru, "seroche," seemed to form a sort of opening into the ætiology of disease.

In recent years the centre of interest has to some extent shifted. The cause of mountain sickness is universally regarded as insufficient oxygen supply to the tissues of the body, though there may still be some doubt as to the directness of the connexion between the deficiency of oxygen pressure in the blood and the activity of the nerve cells responsible for the continence of food in the stomach. Interest latterly has centred rather around the methods which the body has at its disposal for adapting itself to such a condition. But the same thread still runs through the fabric; this particular instance of adaptation to environment is studied because our knowledge of the conditions with which the body has to deal are so exact and the conditions themselves so easily produced or abolished.

Partly, of course, it has another interest, namely, that imperfect oxygenation of the blood is a factor in a number of pulmonary complaints and an analysis of those complaints demands an investigation of this particular factor. That is the definitely medical aspect, of which I shall say but little. Rather I shall turn my attention to the extent to which adaptation can take place, and the means by which it is brought about.

Some of the Cholos appear at first sight to have acquired an astonishing capacity for physical effort at high altitudes. An example may be cited. Near Cerro de Pasco there is a mine worked in the old Spanish way. The ore is raised from the bowels of the earth on the backs of porters, who carry their loads up a rude staircase. The mine is about 250 feet below the surface, and the staircase about 650 feet in length. It opens under a sort of hut. The first porter whom we saw emerge was a little fellow, who said that he was ten years old. We so far doubted his word as to place his age at thirteen or fourteen years. He had on his back a load of ore which I estimated at 40 lbs.—and that at an altitude at which the barometer stood at only 458 mm., or about 18 inches. Shortly a more mature boy appeared—perhaps seventeen or eighteen years of age—his load was about 100 lbs. To understand these feats, it must be remembered that exercise may be of two kinds, spasmodic or continuous. In the case of continuous exercise, such as that of long-distance running, the subject must maintain an approximate equilibrium between the oxygen which he uses and that which he absorbs. His oxygen account must, so to speak, balance approximately at any given time. In the case of spasmodic exercise it is otherwise. If the subject is prepared for the exercise to cease after a very short time, he may expend oxygen at a greater rate than he takes it in, and thus overdraw his oxygen account. A limit is, however, set to the overdraft, and when that limit is reached he must rest till his oxygen account has righted itself. This formed the subject of a most interesting investigation carried out by Dr. Lupton recently in the laboratory of Prof. A. V. Hill. The porters in the old Spanish mine raise their loads by a series of spasmodic efforts, each of which is followed by a rest of considerable length accompanied by great respiratory distress.

Of the means by which the body acclimatises itself to oxygen want, real or alleged, we investigated the following:

1. *Secretion of oxygen by the pulmonary epithelium.* Numerous direct estimations were made of the oxygen pressure in the arterial blood, and in the alveolar air. The two usually came out within two or three millimetres of one another, which is approximately the experimental error of the method. Such a coincidence can only mean that the oxygen passes into the blood by a process of diffusion through the very attenuated partition of epithelium which separates the air from the blood in the lung. Thus the view that the lung could enable the body gradually to overcome the effects of altitude by creating a sort of forced draught

[1] I am indebted for this quotation and much else to Mr. Murdock, manager of the coal mine at Quishuarcancha.

and maintaining the oxygen pressure in the blood at its sea-level value is unfounded.

However, the blood as it leaves the lung must contain appreciably less oxygen than its hæmoglobin would normally absorb. It is, to use the American phrase, *un*saturated to a considerable degree. Such blood, of course, would lack the bright scarlet colour of true arterial blood. The actual colour of the blood as withdrawn from the radial artery entirely bore out this view; as it flowed into the syringe it was of a dull red colour often verging on chocolate, and in the case of the natives was 82-86 per cent. saturated with oxygen, instead of 95-96 per cent. as at the sea level.

Curves giving the relation between the percentage saturation of the blood and the partial pressure of oxygen in lungs at Lima and Cerro de Pasca for different members of the party are shown in Fig. 1, from which

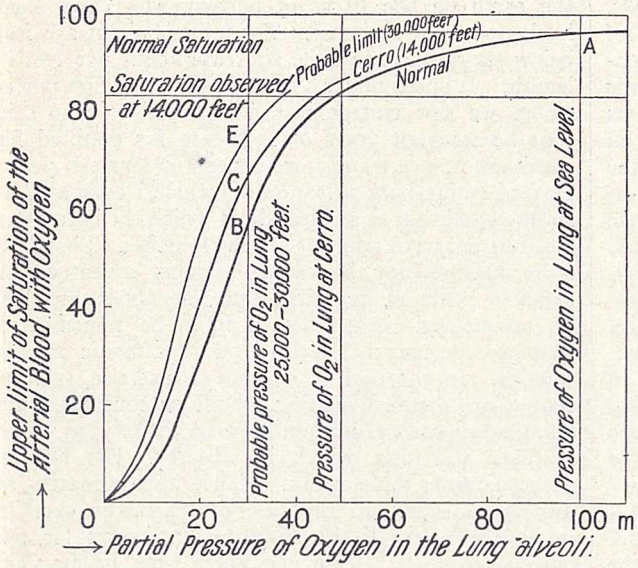


FIG. 1.

it is apparent that at high altitudes the partial pressure required to secure a percentage saturation sufficient for life decreases considerably.

The establishment of the fact that life can be supported with some degree of efficiency with the blood in this condition is of great importance, because in recent years there has been a tendency to assume that a small degree of unsaturation of the arterial blood must of necessity produce very grave results. Fig. 1 shows that there is some adjustment of the blood to the new conditions. At Cerro the unsaturation of the blood was written on the faces of the inhabitants. Any one who had any colour in his face was appreciably cyanosed.

2. *Increased pulmonary ventilation* has been shown by all recent observers to be of great importance as a factor in adaptation to high altitudes. In our case, had our respiration been the same in rate and depth at Cerro as it was at Lima we would have had about 40 pressure mm. of carbonic acid and 35 mm. pressure of oxygen in the air of our lungs. In fact, owing to increased respiratory effort, we reduced the carbonic acid to about 25 mm. and raised the oxygen to about 52 mm. The importance of these facts is enhanced by the certainty that it is the partial pressure of oxygen in the alveolar air which regulates the degree of saturation of the blood.

While the increased ventilation of the lung had been demonstrated by previous observers, the mechanism which was responsible for it had been much in dispute. This we investigated. The mechanism of hypernœa *at rest* seems to be that first suggested by Haldane, namely, that the want of oxygen heightens the activity respiratory of the respiratory centre, resulting in a mild degree of forced respiration—so mild as not to be apparent to the subject, yet sufficient to reduce the carbon dioxide content of his blood. Incidentally this process acting alone would make the blood more alkaline. The measurements of hydrogen ion concentration in the blood of persons at rest bore out this view; either the blood was more alkaline than at sea level, or it was of approximately the same reaction.

The effect of exercise on the blood has been more fully investigated, though for the most part by indirect methods. Our results support those already obtained, namely, that a given increment in the hydrogen ion concentration of the blood is produced by less exercise at high altitudes than at the sea level. Thus the dyspnœa of exercise is the cumulative effect of two factors—an increased response of the respiratory centre to a given stimulus, and an increase in the stimulus evoking the response.

3. I have already alluded to the size of the Cholos chest. With it appears to be associated an interesting modification of its configuration. Fig. 2 shows two X-ray photos of the left sides of two chests photographed from behind. Both pictures were made at Cerro de Pasco. That on the right is my own, and is fairly typical of our party; that on the left is a typical Cholo chest. There is a marked difference in the angle at which the ribs are carried; my own slope down from the vertebral column at a quite considerable angle, while those of the native are much more horizontal. It seems highly probable that this horizontal carriage of the ribs indicates a compensatory effort designed to increase the facility with which the blood obtains oxygen, for it is acquired at sea level by persons suffering from emphysema and other complaints in which there is shortness of breath. Several of the mining engineers, of whose chests we took radiograms, showed a similar tendency. At this point another peculiar physical conformation may be mentioned, namely, clubbing of the fingers, which, when found at sea level, is frequently associated with some trouble which prevents sufficient oxygen from reaching the extremities. Though they are not the rule, clubbed fingers are by no means unusual at Cerro de Pasco in persons without any circulatory or respiratory lesion.

4. An increase in the number of red blood corpuscles in each cubic mm. of blood has long been known to occur at high altitudes. Systematic researches carried out principally under the direction of Dr. Haldane have shown that the increase in the number of red blood corpuscles is associated with an increase in the quantity of hæmoglobin present. These two observa-

tions we have verified, and to them have added a third, namely, that the chemical conditions under which the hæmoglobin is held in the red blood corpuscle confer on it the peculiarly useful property of acquiring more oxygen when exposed to rare atmospheres than is the case with normal blood.

5. We sought in vain for any such form of acclimatisation as might be afforded by the driving of an increased volume of blood round the body in unit time. A rather natural supposition would be that, if the hæmoglobin of each cubic centimetre of blood were deficient in oxygen, the tissues might be fed with sufficient oxygen by the simple process of giving them more blood; but this is not so. It is true the heart quickened with exercise, but the quickening seems to have been rather a signal of distress than a compensatory mechanism.

Three principal forms of compensation have been described: they are increased total ventilation, increased expansion of the chest, increased hæmoglobin, and increased affinity of the blood for oxygen; their relative importance is a matter for future research. Jointly or severally they may mitigate the effects of oxygen want, but they cannot entirely abolish them; at some altitude the human frame must always succumb. We were naturally somewhat interested in the question of whether we could foretell which of our own party would succumb most quickly, and various members of the party worked out systems of prophecy which differed not only in character but in the prophetic order in which the various individuals would prove susceptible to altitude. One of these proved quite successful. It was based on the determination of Bohr's diffusion constant (the ratio of the quantity of oxygen absorbed per minute to the average difference of pressure between the oxygen in the alveolar spaces and alveolar capillaries) for the lung, and was suggested by Prof. Krogh. The members of the expedition could be divided into two distinct groups —those who had a constant for oxygen of more than 40 and those who had a constant less than that figure. One group with the higher diffusion constant suffered from obvious symptoms of mountain sickness, while the other did not. It is true that of the four who suffered the salient feature was different in each case: in one it was faintness, in another vomiting, in a third high temperature and intense headache, and in the fourth deafness and indistinct vision. Only further research can show whether the coincidence was fortuitous, or whether any causal relation exists between the diffusion constant and the tendency to "seroche." The hint, however, seemed to be worth taking, and in consequence an arrangement has been come to by which persons intending to go to the mining districts in the Andes are being tested in the Rockefeller Institute in New York.

I must also make some allusion to the goodwill which was extended to us by every one with whom we came in contact in Peru, from the President down to the humblest employee of the Cerro de Pasco Copper Corporation. Of the manager and the officials of this company we can only say that their kindness in placing themselves and their resources at our disposal was one of the most potent factors in enabling us to achieve such scientific results as we obtained. No less can be said of the officials of the Pacific Steam Navigation Company.

The problem of Everest from the point of view of physiology, upon which our work in the Andes throws some light, may be stated thus:

Every cubic centimetre of arterial blood which leaves the lung must contain a certain quantity of oxygen, expressed as a percentage of the maximum which the blood can hold, if life is to be maintained at a level consistent with any degree of efficiency. It is not known what this quantity of oxygen may be. The following considerations, however, give some clue to it:

(*a*) Let the maximum quantity of oxygen (shown on the ordinate of the graph in Fig. 1) which the blood can hold be called 100.

(*b*) There is a certain relation in the blood for normal persons between the amount of oxygen it can hold and the pressure of oxygen to which it is exposed; that relation is shown in the graph labelled "normal." (The partial pressure of oxygen forms the abscissa.) At the sea level the oxygen pressure in the lung is about 100 mm. and the quantity of oxygen in the blood 96 per cent. of the possible load. (See the point A on the graph.)

(*c*) Until recently it was supposed that the curve did not alter, and therefore the graph labelled "normal" stood for all altitudes.

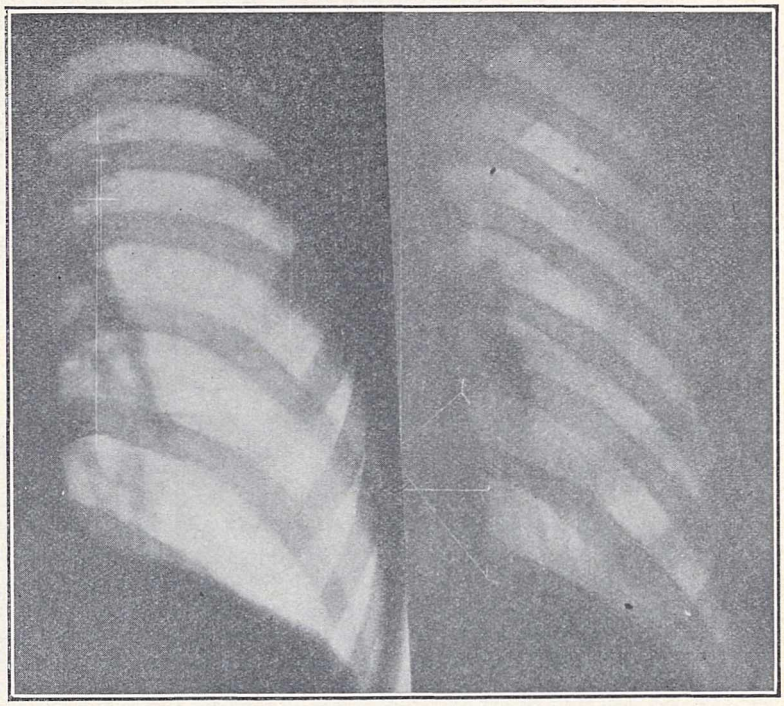


FIG. 2.

(*d*) Also the most competent authorities regarded an oxygen load of about 90 per cent. of the possible maximum as being required for the conduct of life—apart from short exposures.

(*e*) The probable partial pressure of oxygen in the lungs at 25,000-30,000 feet is calculated by a process of exterpolation to be about 30 mm. Combining *c*, *d*, and *e* above, the quantity of oxygen in the arterial blood on Everest would be 58 per cent. of the maximum—far below that necessary.

(*f*) The recent expedition to Cerro de Pasco has brought out two new points:

(1) That natives lead a reasonably normal existence with blood charged only up to 82 per cent. of the possible, and Europeans with 85 per cent. of the possible, load of oxygen.

(2) That the graph changes in position, and for natives and Anglo-Saxons approximates to that labelled Cerro (14,000).

(*g*) On this graph a partial pressure of 70 mm. of oxygen in the lung might saturate the blood up to 67 per cent. (*c*).

(*h*) It is scarcely likely that the curve moves further than that marked "Probable limit (30,000 ft.)." On that curve, however, the blood would be charged up to 76 per cent. — a figure within a reasonable distance of what has actually been observed in the Andes.

Obituary.

H.S.H. Prince Albert of Monaco.

NOT infrequently in the past have princes and nobles been munificent patrons of science and played a useful part in promoting the advancement of knowledge—would that we had more such at the present day—but it must be rare indeed for a reigning prince to attain recognition and distinction as a practical, working, man of science. The late Prince of Monaco, whose death took place recently, was both. He has given to France and the world of science at least three research institutions of first-rate importance, and throughout many years of his life, during the last half-century (since, in January 1873, on one of his early expeditions he met the *Challenger* at Lisbon), he has himself planned and carried out many notable investigations in both physical and biological oceanography.

His Serene Highness Prince Albert Honoré Charles, a descendant of the ancient House of Grimaldi, was born in 1848, and succeeded his father, Prince Charles III., as ruler of the principality of Monaco in 1889. In his early youth Prince Albert served as lieutenant in the Spanish Navy, and since then has shown a life-long devotion to the sea and a rare enthusiasm for its scientific exploration. Probably the most characteristic representation of the Prince is the statue in the entrance hall of the Museum of Oceanography at Monaco showing him in plain sailor's uniform standing at the rail on the bridge of his yacht. He must have spent a large portion of his life, and much of the ample funds at his disposal, in the many expeditions which he conducted in the successively larger and more perfectly equipped yachts *Hirondelle* (a 200-ton schooner) and the first and second *Princesse Alice*—the last a magnificent ocean-going steamer of 1420 tons, built by Lairds' on the Mersey in 1898, and fitted with all necessary machinery and apparatus for every form of modern oceanographic research, and for the capture of whales. By means of these vessels the "Gulf Stream" in its various parts, and its effect on the coast of France, the Azores, the seas around Spitsbergen, the Mediterranean, and much of the Atlantic from the equator to within the Arctic Circle, were systematically investigated in both their physical and their biological characters. Among his companions and assistants on these expeditions have been Baron Jules de Guerne, Dr. Jules Richard, and occasionally our own countrymen Mr. J. Y. Buchanan and Dr. W. S. Bruce; and the results of more than thirty annual cruises have been made known to science first by the Prince's preliminary reports in the *Comptes rendus*, and later, in full detail, in those beautifully illustrated, sumptuous memoirs in the series entitled "Résultats des Campagnes Scientifiques accomplies sur son Yacht par Albert Ier Prince Souverain de Monaco," dating from 1889, and the later series of the Bulletins and the "Annales de l'Institut Océanographique."

It is chiefly in connexion with the devising of apparatus for deep-sea research, and with the introduction of new methods of investigation, that the Prince's personal influence was felt on his expeditions. Among other new appliances which have yielded notable results may be mentioned his huge baited traps (the "Nasse"), his various types of trawls and nets for use in different zones of water, and his use of submarine electric lights to attract free-swimming animals with power of vision, such as fishes and Crustacea. There can be no doubt that his practical knowledge as an experienced sailor and as a mechanical engineer has added greatly to the efficiency and success of all his work on the yachts. His chief assistant, Dr. Jules Richard, who has charge of the museum and laboratories at Monaco, gave full descriptions and useful illustrations of many of these appliances for oceanographical investigation in a special volume of the Bulletin series that was published about 1900.

All the Prince's successive voyages have been very fruitful of scientific results, and biology owes its knowledge of many deep-sea Atlantic animals to the special memoirs issued from the Monaco Press; but none of these have been more remarkable, novel, and almost sensational, than the results of the Prince's whale-fishing expeditions, when he obtained the more or less perfect remains of various new, and in some cases gigantic, cuttlefishes (such as Lepidoteuthis and Cucioteuthis) from the stomachs of captured sperm whales. Some account of these discoveries and exploits, and of Homeric combats when, for example, three huge killer-whales attacked one of the boats and tried to crush it between their bodies, and again when a large Cachalot died under the keel of the yacht which

it had charged as an enemy, are given in one of the recently published volumes of "Accounts Rendered" by Mr. J. Y. Buchanan, who was a companion of the Prince on several of his expeditions.

There is another oceanographic investigation which will always be connected with the Prince of Monaco's name, and that is his distribution, commenced so far back as 1885, of floating or drift bottles over wide areas of the Atlantic, starting from the Azores as a centre, in order to determine the set of the currents. The knowledge acquired from such experiments extending over many years enabled the Prince to write what is probably the latest of his own personal contributions to science, a paper and map communicated to the French Academy, in 1919, on the future of the floating mines which, having gone adrift as the result of operations in the recent war, may be a danger to navigation in certain parts of the Atlantic for some years to come. He showed how mines from the European coasts will gradually be drawn into the various currents associated with the "Gulf Stream," and how some will, in all probability, continue to circulate in the great whirlpool of the Sargasso Sea, while others will eventually find their way to the Norwegian fjords and the Arctic Ocean and be destroyed ultimately in their encounter with the ice.

The inauguration of the Musée Océanographique, towards the end of March 1910, brought together at Monaco such an international gathering of men of science interested in the exploration of the sea as had never been seen before. Official representatives of many countries, delegates from the great Academies of the world, and others invited personally by the Prince, were united in celebrating the progress of oceanography and in launching an institution unique in character and of first-rate importance for science. This great museum with its laboratories and other workrooms rises sheer from the Mediterranean on the southern side of the rock of Monaco, the lower three stories facing towards the sea being below the level of the old town and palace, and the main entrance to the museum, from the streets, being half-way up the building. From the seaward side the appearance is especially striking, the masonry appearing to be almost a part of the rock and to grow up in a series of arches from the ledges of the cliff itself. This, the first Museum of Oceanography, demonstrates the methods of investigation and the results obtained. It contains the extensive collections made on the Prince's expeditions, and also shows the various types of dredges, trawls, tow-nets, deep-sea thermometers and water-bottles, current-meters, and other apparatus used by the different nations in their explorations of the ocean.

The museum at Monaco is, however, only one part of the foundation which the Prince has provided for the study of the sea. With the object of arousing interest in scientific marine studies in France, he instituted a series of lectures at the Sorbonne in 1903, and in 1906 he gave permanence to these by means of an endowment, and presented to the French nation a building specially devoted to university instruction in oceanography. In connexion with this "Institut Océanographique" at Paris three professorships have been established—one of physical oceanography, one of biological oceanography, and the third of the physiology of marine life. As was said of him at one of the inaugurations, "By his researches the Prince of Monaco has won for himself a distinguished place in the ranks of men of science, and by enshrining the results in the monumental buildings at Monaco and Paris he has invested his labours with permanent value for all time."

The third great scientific benefaction of the Prince is the Institut de Paléontologie Humaine at Paris, where again, as at Monaco, there is a museum and a laboratory with professors devoted entirely to the investigation and demonstration of one special subject —the early history of man. The Prince's personal interest in prehistoric archæology has been shown for many years by the explorations he has conducted or promoted at the Grimaldi caves near Monaco and at other caverns and important sites in France and Spain, with Prof. Boule, the Abbé Breuil, and others—and the results, as in the case of the oceanographic investigations, have been published at his expense in princely style. It has been reported in the daily press, since his death, that he has bequeathed a million francs, as further endowment, to each of these three research institutions. He has certainly put to a noble purpose for the advancement of science the ample funds which have come to him under the conditions of the concession granted many years ago to the proprietors of the Casino at Monte Carlo. It is well known that the Prince has expressed publicly his strong disapproval of the pigeon-shooting competitions at Monte Carlo; but considers that as he is not an autocrat, under the terms of the concession, he has no power to interfere with vested interests at the Casino except by the support his name and influence can give to public opinion.

None of those who were present at Monaco as the Prince's guests, during the four days of conferences and celebrations at the inauguration of the Musée Océanographique, will be likely to forget his gracious hospitality, his gravely courteous manner, his evident interest in all the scientific questions raised, and his keen desire to secure co-operation between the different nations in the further exploration of the oceans. In recent years, since the war, he has played a prominent and most helpful part in such international co-operation. He was appointed president of the "Commission internationale pour l'Exploration scientifique de la Mer Méditerranée" at the meeting in Madrid in 1919, and at the recent international conference in Rome he was chosen as president of both the physical and biological sections of oceanography. In all such meetings and in the subsequent work he was no mere figurehead, but took a prominent part in the proceedings. His death, in Paris, on June 26, will leave a great gap in many important organisations, and be felt as a real loss by all interested in the promotion of the science of the sea. He was a natural centre in organisation and a leader in work. In his independent position he stood apart from all international rivalries and showed only a single-minded devotion to the pursuit of truth. As he once said of himself, modestly and truthfully, in an address on his work at sea, in July 1891, to the Royal Society of Edinburgh, "I undertook the mission that lay before me because I was at once

a sailor and devoted to science." And that seems to express his attitude throughout all his work.

W. A. HERDMAN.

THE death is announced in the *Chemiker Zeitung* of June 24 of Prof. W. Hallwachs, of the Technische Hochschule, Dresden, on June 20. Prof. Hallwachs, who was sixty-three years of age, was known for his researches on electricity, particularly on the photo-electric effect. The same journal also records the death of Prof. Otto Lehmann, on June 20, at the age of sixty-seven. Prof. Lehmann, who has occupied the chair of physics at the Technische Hochschule at Karlsruhe since 1889, was best known for his work on liquid crystals. His first paper on this subject was published in 1890, and his further researches were embodied in two monographs published later. In addition, he carried out work of importance in connexion with discharge and cathode-ray phenomena.

Current Topics and Events.

COL. E. M. JACK has been appointed Director-General of the Ordnance Survey in succession to Sir Charles Close, who is retiring in August.

THE *Chemiker Zeitung* announces that Prof. H. Kamerlingh Onnes, director of the Physical Institute of the University of Leyden; Dr. P. Zeeman, professor of physics at the University of Amsterdam; and Dr. N. Bohr, professor of theoretical physics at the University of Copenhagen, have been elected corresponding members in the Physical-Mathematical Class of the Prussian Academy of Sciences, Berlin.

THE Charles P. Daly medal of the American Geographical Society has been presented on behalf of the society by the American Ambassador to Sir Francis Younghusband. The medal, which was instituted under the will of the late Charles P. Daly, sometime president of the American Geographical Society, is awarded for valuable or distinguished geographical services or labours, and that presented to Sir Francis Younghusband bears the inscription, "For explorations in Northern India and Tibet and for geographical publications on Asiatic and African borders of the Empire."

SOME appointments have recently been made on the scientific staff of the Field Museum of Natural History, Chicago. Mr. R. Linton has been attached to the department of anthropology as assistant curator of North American ethnology. Mr. Linton has carried out extensive investigations, principally archæological, in the eastern, central, and south-western United States, as well as in Central America and Polynesia. Recently he has returned from an expedition to the Marquesas Islands for ethnological and archæological researches, undertaken under the auspices of the Bishop Museum of Honolulu, Hawaii. A new division of taxonomy has been created in the department of botany, and Mr. J. F. Macbride, now in Peru at the head of a botanical expedition for the Field Museum, has been designated as assistant curator. In the department of zoology, Dr. C. E. Hellmayr, well known for his extensive work on Neotropical birds, has been appointed associate curator of birds. Dr. Hellmayr was formerly connected with the Rothschild Museum at Tring, and more recently has been with the Museum of the University of Munich. Mr. Heller, a former associate of Theodore Roosevelt, and Mr. J. T. Zimmer have been appointed assistant curator of mammals and assistant curator of birds respectively; they are at present engaged in field work in Central Peru. Mr. Karl P. Schmidt, formerly with the American Museum of Natural History, New York, has been appointed as assistant curator of reptiles and batrachians.

JUNIOR Beit Memorial Fellowships for medical research of the annual value of 350*l.*, and tenable for three years, have been awarded by the trustees to the following, the subject and place of research being given after each: Mr. E. B. Verney: The physiology and pathology of urinary secretion, at the Institute of Physiology, University College, London; Prof. F. Cook: A study of the neuro-muscular apparatus of the uterus, at Guy's Hospital; Dr. J. L. Rosedale: The chemistry of normal and pathological tissue with special reference to the protein and nuclein constituents, at St. Thomas's Hospital Medical School, London; Mr. R. Hilton: The study of the blood gases in various stages of pulmonary collapse produced by artificial pneumothorax; the condition of the circulation in the collapsed lung, at the Lænnec Hospital, Paris, and at St. Bartholomew's Hospital; Mr. A. St. G. J. M'C. Huggett: The investigation of the function of the placenta in relation to the passage of gases and other substances from the mother to the fœtus and the cause of fœtal apnœa, at the Sherrington School of Physiology, St. Thomas's Hospital, and at the Brown Animal Institution at Vauxhall; and Mr. V. D. Allison: The investigation of the nature and properties of a hitherto undescribed substance which has a strong bacterioidal, bacteriolytic and bacterio-inhibitory action—named lysozyme, at the Institute of Pathology and Research, St. Mary's Hospital. Fourth year Fellowships of the annual value of 400*l.* have been awarded to Dr. D. Keilin: The life-histories of protozoa pathogenic to insects; the life-history, anatomy and physiology of insects, at the Molteno Institute for Research in Parasitology, Cambridge; and Mr. I. de B. Daly: Auriculo-ventricular block, at the Institute of Physiology, University College, London. The trustees of the Beit Scientific Research Fellowships have re-elected Mr. H. L. Riley and Mr. W. A. P. Challenor to fellowships for the year commencing September 1922, and elected Mr. H. W. Buston to a fellowship for the same period. All the fellows are required to carry out their research at the Imperial College of Science and Technology. Mr. Riley will continue his research on "The

Atomic Weight of Silver, and the Dielectric Constants of Dry Gases" in the chemistry department, and Mr. Challenor will continue his work on "Ring Formation in the Aromatic and Aliphatic Series of Organic Chemistry" in the chemistry department, both under the direction of Prof. H. B. Baker. Mr. Buston will carry out investigations on "Nitrogenous Metabolism in Plants" in the biochemistry department under the supervision of Prof. J. B. Farmer.

THE final attempt, at least for this year, to reach the summit of Mount Everest was made on June 7. The party, according to General Bruce's despatch to the *Times*, consisted of Messrs. Mallory, Somervell, Finch, Wakefield and Crawford, with native coolies. From the outset bad weather was experienced. Captain Finch, feeling the result of his great exertions during the previous climb, had to give up and return. On the North Col the rest of the party were caught in an avalanche; Messrs. Mallory, Somervell and Crawford and one porter were able to extricate themselves unhurt, but the second party consisting of porters were overwhelmed. Three of them were rescued, but seven lost their lives. The attempt to gain the summit was then abandoned. General Bruce writes in terms of great praise of the loyalty and devotion of the native porters, whose loss the expedition felt keenly. Most of the Europeans with the expedition appear to be suffering from exposure at high altitudes; there are several cases of frostbite. It is not yet decided if a new attempt on Mount Everest is to be made next season. Several members of the exepedition, including Colonel Strutt, Dr. Longstaff and Captain Finch, have already reached England.

FOR some time past the practicability of measuring the depth of the ocean by means of sound waves reflected from the bottom has been discussed. A short explosive signal is made at the ship's hull and the time of this, and the echo from the bottom, are recorded. Apparently corrections are made for temperature effects on the velocity of transmission of the signal. Obviously the measurements can be repeated very quickly, or they may even be carried out automatically. It was announced in New York, on July 6, that extended trials had been made by Dr. Hayes, on board one of the U.S.A. destroyers, with much success. The outline of the sea bottom on a traverse between Rhode Island and Gibraltar is said to have been charted and minute records between Josephine and Tysburg Banks have been obtained. The bottom here is an extensive plain, bordered by mountains and tablelands rising to a height of 4000 feet above the plain, and containing several unrecorded deeps. Doubtless the apparent uniformity of level over vast areas of ocean bottom is to be explained partly by the paucity of deep soundings: this applies particularly to much of the Pacific Ocean. Should the new method prove trustworthy on critical investigation it will be possible to study the minor differences of depth with ease.

A MEMORANDUM regarding the probable amount of monsoon rainfall in 1922 was submitted to the Government of India in the early part of June by Dr. G. T. Walker, Director-General of Observatories. As frequently happens there are said to have been temporary advances of the monsoon in May, and in early June the rains began much earlier than usual in upper India, but the advance did not persist. The monsoon rainfall is affected by previous conditions over various parts of the earth, and a summary is given of the recent data which appear to be of importance. Among the factors stated as available are: a slight excess of snow in the mountain region of north-west India, a deficiency of rainfall over Java during the period of October to February, an excess of rain in Ceylon during May, and an excess of pressure at Mauritius in the same month. The data of Java, the Azores, and South America are decidedly favourable, of Iceland and the Cape scarcely appreciable, and of the east African coast decidedly unfavourable. The resulting indication shows that the Peninsula rainfall will be in excess, and for north-west India the rain is likely to be slightly deficient but not far from the normal. The establishment of the Arabian Sea monsoon will probably be delayed. For Upper Burma, north-east India, Mysore, and Malabar the indications are said to be conflicting and a useful forecast cannot be made.

THE Empire Forestry Association, which held its inaugural meeting in November last, was founded with the object of federating all the various societies interested in forestry throughout the Dominions overseas and India, as well as in the home countries. One of the functions of the Association is to disseminate information by means of a journal, *Empire Forestry*, the first number of which appeared in March. This contains about a dozen articles, the most important being a statement by Mr. R. L. Robinson, Forestry Commissioner, concerning forestry practice and available timber supplies throughout the Empire, based on the latest official information and statistics. Canada heads the list, as regards forest area, with 932,420 square miles of forest lands, of which, however, only 390,630 square miles are considered to be merchantable, the remainder being unprofitable or inaccessible. British India is second, with 126,310 square miles of merchantable forests; Nigeria is next, with 50,400 square miles; while Australia has 37,840 square miles. It is fortunate that 75 per cent. of the forest area of the Empire still belongs to the State. There is time yet to preserve the forests from ruthless destruction, by wise legislation aiming at effective regulations as regards felling, natural regeneration, and protection from fire. A useful feature in this number of *Empire Forestry* is a list of books, reports, and other publications on forestry and timbers, issued in 1920 and 1921.

REPORTS on lac, turpentine, and rosin have been issued by the Imperial Institute (London: J. Murray; 5*s*. net). Shellac is a characteristic Indian product, and indeed 94 per cent. of the world's supply comes from India and Burma. It is a resinous exudation produced by the lac insect, *Coccus lacca*, on various trees. In spite of the practical monopoly enjoyed,

the state of the industry in India is not satisfactory, and recommendations for improvement in the manufacture are given. The other reports deal with Indian turpentine and rosin. These have been produced on a small scale for some time past in the United Provinces and the Punjab, only one species of pine, *Pinus longifolia*, being tapped commercially. The turpentine of this tree is unfortunately inferior to that produced in the American and French forests. It appears that a much better turpentine could be obtained from *Pinus excelsa*, another species widely spread in the Himalayas, but the yield is small. *Pinus khasya* might also be tapped in Assam and Burma. The industry is at present merely in the experimental stage; but it is predicted that, with energetic business methods, the total annual yield, which is now trifling, might be increased in ten years to 120,000 cwts. of turpentine and 430,000 cwts. of rosin.

A CASE in which two cuckoos were apparently reared together in the same nest by a cock blackbird is recorded by Miss E. R. Saunders, Newnham College, Cambridge. A blackbird's nest containing four eggs on which the cock bird was sitting was found and observed. The fact that a dead hen blackbird was found close by afterwards may account for the continued presence of the cock bird on the nest. When the eggs hatched, two of the nestlings were blackbirds, the bodies of which were found on the ground, while in the nest was a young cuckoo. Another young cuckoo was perched on a stake within a hand's breadth of the nest. Cuckoos frequent a belt of trees nearby, and it seems in this case that two eggs were deposited in the one nest.

IN regard to the correspondence in NATURE of March 9 and June 3, under the title "A Rainbow Peculiarity," on the enhanced brightness of the sky within the primary bow, Mr. L. C. W. Bonacina writes to point out that the fact is splendidly illustrated, and duly commented upon, by Mr. G. A. Clarke in his book on "Clouds" published in 1920 (Plate 35*b*).

A NEW classified list of second-hand scientific instruments (No. 75) has been issued by Mr. C. Baker, 244 High Holborn, W.C.1. As is customary in these well-known catalogues, the instruments are arranged in groups and there are long sections dealing with microscopes, many by first-class makers, and telescopes and accessories. Among the electrical apparatus we notice a Marconi receiving instrument, and there is also a quantity of apparatus suitable for other departments of physics as well as surveying and drawing instruments. Most of the apparatus can be inspected at Mr. Baker's premises. A novel feature is the offer for hire, at very moderate charges, of field- and opera-glasses of various types.

Our Astronomical Column.

SKJELLERUP'S COMET.—The identity of this comet with 1902 II. (Grigg) is now very highly probable. Mr. G. Merton finds, with the aid of recent Greenwich photographs, that the period of Skjellerup is close to 5·13 years, the other elements being nearly the same as those recently given in this column. Further, the following new orbit has been deduced for 1902 II., which represents the observed places within a few minutes of arc, an amount well within their probable error:

$$T = 1902, \text{ July } 2{\cdot}52 \text{ G.M.T.}$$
$$\left.\begin{aligned} \omega &= 346^\circ\ 41' \\ \Omega &= 222^\circ\ 40' \\ i &= \ \ 9^\circ\ \ 4' \end{aligned}\right\} 1902{\cdot}0$$
$$\phi = 48^\circ\ 12'$$
$$\log a = 0{\cdot}4662$$
$$\text{Period} = 5{\cdot}004 \text{ years.}$$

The period was assumed, since the observations are not nearly precise enough to determine it. The other elements are fairly near those of Skjellerup. The differences are explicable by the fact that there was a very near approach to Jupiter at the beginning of 1905. By the above elements the comet was then in Longitude 29½°, N. Lat. 2°, log *r* 0·7081; Jupiter was in Longitude 32°, S. Lat. 1°, log *r* 0·6959.

THE PARIS ASTROGRAPHIC CATALOGUE.—M. Jules Baillaud notes in *Comptes rendus* for July 3 that this Catalogue, which extends from North Declination 18° to 24°, is approaching completion, and it is already possible to give data about the number of stars per plate in the different parts of the zone. He does this in two ways: (1) the uncorrected numbers, (2) the numbers after allowance has been made for variations due to imperfectly clear sky, less sensitive plates, etc. These have been estimated by comparing the overlapping portions of adjacent plates. Both sets of numbers are shown graphically. There are two steep peaks in the curve at 6ʰ and 21ʰ R.A., where the zone intersects the galaxy. The curve indicates 1100 stars per region of 6° × 6°·6 at 6ʰ R.A., and 1200 stars at 21ʰ R.A.

The minima are at 3ʰ and 14ʰ R.A., where the star numbers are 150 and 70 respectively per 6° × 6°·6. There is thus a 14-fold range in star-density. It will be noted that the minima do not fall symmetrically between the maxima.

OBSERVATIONS OF MARS AT SÉTIF, ALGERIA.—M. R. Jarry-Desloges has sent a report to the Paris Academy of Sciences of observations which he and M. G. Fournier have made this year (*Comptes rendus*, July 3). They have used two refractors, apertures 37 cm. and 26 cm.; it is noted that the smaller has practically no secondary spectrum, although there are only two lenses in the objective. While this is advantageous in most cases, M. Fournier finds that for the purpose of detecting slight colour-differences on the planets the former is preferable.

Some of the dusky regions in the southern hemisphere of Mars were seen to be covered with a misty veil, and M. Desloges notes that this was also seen in 1909 when the season on Mars was the same. He also directs attention to the difficulty of tracing the southern boundaries of these dusky regions: a similar difficulty was experienced in 1907, but in intermediate years these boundaries have been well defined. The misty veil is stated to be lifting, so that by June the boundaries could be traced. As a change that is probably not seasonal he adduces the present great development of the system Lacus Moeris, Nepenthes, Thoth, to the left of Syrtis Major. These features were not seen in 1907.

Lacus Phœnicis is large at present, and Lacus Solis is girdled by a system of dark streaks. Fons Juventæ has also been seen.

Research Items.

FOLKLORE AMONG THE ALGERIAN TRIBES.—In the June issue of *Folk-lore* (vol. xxxiii. No. 2) Mr. M. W. Hilton-Simpson publishes the result of a series of excursions among the hill and desert tribes of Algeria. In this hitherto practically unknown field he has found many curious usages. Among others, at a marriage firearms are discharged to scare the Jinn who are on the watch to possess the bride. On her arrival at her husband's house she is lifted into the house by a man, and as she reaches the door a female member of her family presents her with an egg, which she breaks on the lintel as she passes under it. This last usage is sometimes modified by the bride smearing the door-lintel with butter, the series of charms being probably fertility magic.

RELIGIOUS CEREMONIAL OF THE PARSIS.—An interesting collection of articles used in religious ceremonies by the Parsis of Bombay and preserved in the United States Museum is described by Mr. I. M. Casanowicz, the assistant curator, in Proceedings of the United States National Museum (vol. lxi. Art. 2), with a useful account of the origin and ritual of these people. The finest object is a brass nickel-plated fire-iron, with a ladle and tongs, used in making the sacred fire, and a similar tray on which offerings of fruit, flowers, milk, water, wine, or sherbet are made in remembrance of the souls of the departed, or with the object of invoking the help of protecting spirits.

FAR EASTERN ARCHÆOLOGY.—The July issue of the *Antiquaries' Journal* (vol. ii. No. 3) is devoted to the presidential address by Sir Hercules Read, who took as his subject the work of Sir Aurel Stein carried on for twenty years in exploring Eastern Turkestan. "The masterpieces of the earlier dynasties of China stand unchallenged in our museums and in private possession. Their value and interest are enhanced beyond words when we have in addition such a collection as that brought home by Sir Aurel Stein. By singular good fortune he has retrieved just the very objects that the earth can never yield to us. Pictures, embroideries, manuscripts, such as constitute his hoard, even if they had been buried in the graves, would have been destroyed by damp in much less than a thousand years. His finds in the bone-dry caves of the Thousand Buddhas form the necessary complement of what excavation has yielded from China itself, with the result that we have in England what is probably a unique mass of material for the study of Chinese archæology, religion, and art during the three centuries preceding the Norman Conquest."

THE PILTDOWN SKULL.—Since the discovery of fragments of a human cranium and jawbone at Piltdown in Sussex in 1912 a fierce controversy has raged over these interesting remains. The recent contributions to the discussion are reviewed by Mr. E. N. Fallaize in the July issue of *Discovery*. As regards the question of dating, he remarks that the claim of its identification as a specimen of Pliocene man must be held not to be proven. As to the character of the skull, a fresh reconstruction of it has recently been made by Profs. Elliot Smith and Hunter, generally confirmatory of earlier reconstructions of Dr. Smith Woodward and Mr. Pycraft. It is low and broad and of a capacity less than 1300 c.c. It differs, however, in one important respect. The occipital fragment, which determines the shape of the back of the skull, assumes a more vertical position, and produces a form more nearly resembling the anthropoid skull than that of modern man. The result is a skull like no other skull, but its similarity to the Simian skull brings it into complete harmony with the chimpanzee-like jaw. The difficulty of the discrepancy between cranium and jaw has thus been cleared up, while the endocranial cast, as might be expected, takes its place between that of *Pithecanthropus erectus*, the fossil skull from Java, and that of the recently discovered Rhodesian Man.

PALÆOZOIC BRACHIOPODA FROM EASTERN ASIA.—Two parts of a paper, which constitute a portion of the attempt of the Geological Institute in Sendai (Japan) to contribute to the knowledge of the geology of Eastern Asia, are contained in the Science Reports of the Tôhoku Imperial University, Sendai (Second Series: Geology, vol. vi. No. 1). In these, Ichirô Hayasaka discusses the palæozoic Brachiopoda from Japan, Korea, and China. The majority of forms are referred, although occasionally doubtfully, to species well known from the same strata in other parts of the world, but in one case the author has felt justified in establishing a new genus, Athyrisina, for two Middle Devonian species, also new. The seven photo-lithographic plates are good, but sometimes wanting in clarity; more exact illustration would have been especially acceptable in the case of the new genus and its species.

MIMICRY AMONG BIRDS.—Mr. G. T. Harris, Buckerell, East Devon, has sent us a description of a robin attacking a cuckoo. The latter species is frequently harassed by single small birds in this way, or is "mobbed" by a band of them. At first sight this might seem to indicate resentment of the cuckoo's parasitic habits, but it is probably going too far to credit the victimised species with so intelligent an awareness of the position: for although the chosen foster-parents will try to drive off a cuckoo about to lay in their nest, they will subsequently hatch the egg and rear the young parasite in a way which shows that they have indeed no understanding of the trick which is played upon them. A more credible explanation is to be found in the cuckoo's similarity to a hawk, for small birds will "mob" hawks and owls in much the same way when they can get these birds-of-prey at a disadvantage. The cuckoo is a comparatively weak bird, and its mimicry of a hawk is doubtless useful both in regard to its peculiar breeding habits and otherwise, although at times it entails the unwelcome attentions referred to above. This interesting mimicry is probably to be regarded as a definitely evolved adaptation: the alternative explanation of mere coincidence might perhaps be urged if there were not numerous other examples to show that such mimicry is quite possible. There is an Indian cuckoo, for example, which habitually victimises a drongo as a foster-parent and closely resembles that species in outward appearance. Again, there is the striking case of the friar-birds and orioles of the Malay Archipelago: here the weak orioles appear to gain an advantage in the struggle for existence by their close mimicry of the pugnacious friar-birds. Moreover, there are several species of friar-birds on different islands, and for each there is an appropriate oriole. Among insects, too, there are many good examples of the mimicry of one species by another and unrelated form.

EARTHQUAKES IN THE REGION AROUND TOKYO.—Prof. Omori contributes to the second number of the new journal, *Seismological Notes*, an interesting paper on the Tokyo earthquake of December 8, 1921, the strongest experienced in that city since 1894, though resulting in only slight damage to buildings. The shock was notable for its extraordinary duration, having been sensible for three minutes. The position of the epicentre, as determined by the duration of the preliminary tremors at Tokyo, Mito and Choshi, is 58 kms. N. 65° E. of Hongo (Tokyo). The actual distance of the focus from the latter place was, however, 65 kms., leading to the conclusion that the depth of the focus was about 29 kms. or 18 miles. Prof. Omori also considers the distribution of Tokyo earthquakes in space and time. Those of the eight years 1914–1921 originated for the most part in four regions, three of them at a mean distance of about 35 miles from Tokyo, the district surrounding the capital being at present immune, and the fourth a submarine zone off the eastern coast of the Main Island. The curve of annual frequency beginning with the year 1876 resembles so closely the curve of mean precipitation at Niigata and Akita (places in the Japan Sea region with an abundant snowfall) as to suggest the probability that the precipitation on the north-west side of the Main Island may be one of the secondary causes that determine the frequency of earthquakes felt in Tokyo.

AURORAL MEASUREMENTS.—In No. 8, vol. ii., *Geofysiske Publikationer* of the Norwegian Geophysical Commission, Prof. Karl Störmer gives further results of his auroral measurements. As a check on the accuracy of his methods, he deals with simultaneous observations taken on March 22, 1920, at Christiania, Kongsberg and Frederikstad. Combining the stations in pairs, he gets three sets of results derived from three differently oriented bases, having lengths of approximately 66, 79, and 89 kilometres. The heights of three selected auroral points are calculated in two different ways. As the accuracy seems much the same for the two methods, it will suffice to give the results of the first. The means of the heights calculated for the three points were 143, 177, and 214 km., and the differences between the highest and lowest of the three estimates from the three bases were respectively 5, 5, and 7 km. A second chapter deals with observations on the height and position of an auroral arc determined from observations with a base of 258·5 km. As seen from the southmost station, near Christiania, the arc was near the horizon. It was overhead at a point situated about 700 km. to the north-west. Besides diagrams in the text there are eight large plates, the first two referring to the cases described above. The others are selected as among the finest auroras which Prof. Störmer has yet photographed. In some cases difficulty may be experienced in deciding which is the top and which is the bottom of the picture. This might with advantage have been stated in words on the plates.

THE NEW MAGNETIC ATOM AND ITS PROPERTIES.—In order to improve his original theory of magnetic induction in ferromagnetic materials, Sir J. A. Ewing published in February his theory that the magnetic element is not the atom itself but something smaller which can rotate within the atom. It may be likened to a wheel with a number of like poles on its rim and the poles of opposite kind at its centre. Around it is a fixed ring provided with magnetic poles, under the action of which the wheel may take up a number of positions of equilibrium. Two months later, Prof. E. T. Whittaker showed that a model of this type when approached by an electron with kinetic energy exceeding a certain amount U, would take from it an amount U depending on the electronic charge and on the constants of the model, and that if n is the frequency of the oscillations of the model and of the radiation it emits, then $U = hn$ where h is the constant of the quantum theory. More recently Dr. H. S. Allen has pointed out that such a vibrator would not lead to the equipartition law, and Dr. R. A. Houston has shown that for the model to vibrate with the frequency of sodium light its diameter must be $2{\cdot}7 \times 10^{-8}$ cm. and with X-ray frequency $3{\cdot}5 \times 10^{-10}$ cm. which agree well with the known diameter, 2×10^{-8} cm. of the hydrogen atom. The four papers mentioned will be found in the Proceedings of the Royal Society of Edinburgh.

STRUCTURE OF ABRADED GLASS SURFACES.—A series of papers issued from the Research Department of Messrs. Taylor, Taylor and Hobson, Ltd., and published in the current number of the Transactions of the Optical Society, provide a valuable contribution to our knowledge of the physical nature of the processes involved in the workshop operations of cutting and grinding, particularly of hard brittle substances. Detailed photomicrographic studies of the structure of ground glass surfaces and of the flaws produced in glass by various means lead the author, Mr. F. W. Preston, to the conception of a flaw and fissure complex rather than the current view of a hill and hollow structure as characterising a ground surface in brittle materials. His experiments show that in polishing as well as in grinding, the forces of mechanical abrasion are active, although in the former case they tend to be obscured by surface tension effects. During polishing the whole of the flaw complex previously formed is broken away from the roots and a slight molecular rearrangement of the new surface then takes place, as observed by Beilby, who has demonstrated the existence on all polished surfaces of a flowed (surface tension) layer. The enhanced solubility of ground surfaces in hydrofluoric acid, and also the appearance of the structure of polished surfaces as developed by etching, suggest a low value for the thickness of this surface tension layer—in the case of glass some two or three millionths of an inch at the most.

REPEATING PATTERNS AS DECORATIONS.—The Journal of the Royal Society of Arts for June 30 contains an interesting paper by Major P. A. MacMahon on the design of repeating patterns for decorative work. Major MacMahon has recently investigated the modes of dividing flat space into identical figures without gaps or overlapping. Such divisions are familiar to every one in wall paper designs, which are generally formed by cutting up the plane first into identical parallelograms. More complex types of repeating pattern were designed in very early days and some of them still survive in ancient tessellated pavements. The method of classification obtained by Major MacMahon has proved wide enough to place every such design brought to his notice, and he has reasons for thinking that it is exhaustive. He reports that at least 90 per cent. of the few hundreds of categories have apparently never been drawn upon for practical application. The paper is illustrated by a few specimen patterns, some of which are sufficiently remarkable to merit close attention from those engaged in decorative work. An interesting fact, which does not appear to have been generally recognised before, is that a plane can be completely filled with congruent quadrilaterals of *any* shape.

Leicester Conference of the Museums Association.

THE thirty-third annual conference of the Museums Association, held on July 10-15 at Leicester, under the presidency of Mr. E. E. Lowe, director of the Museum, Art Gallery, and Libraries in that city, was attended by eighty-six members, comprising delegates from most of the leading museums, national and provincial, in the British Isles, as well as from Canada and the United States. The admirably organised hospitality of an influential reception committee rendered the meeting one of the most enjoyable in the history of the Association; and the devoted labours of its experienced president with his helpers, in their endeavours to make up for the regretted absence of the secretary, Dr. W. Tattersall, through illness, led to an unusual smoothness of working. Above all, the papers and discussions were thoroughly practical, and seemed likely to produce valuable results.

The president divided his address into a more popular part, for the benefit of the local dignitaries and other friends who attended the opening meeting, and a more technical part addressed to the members of the Association alone. This is an example that might sometimes be followed elsewhere. The first part showed how romance could be extracted from the objects in a museum and used to make more effective contact between the museum and the public. The second part suggested a means by which the Association might undertake more constructive work than it had previously been able to accomplish, and by which members other than the officers and council could take a more continuous and active share in the life and labours of the corporate body. This was the establishment of sub-committees, similar to those of the British Association, to conduct inquiries during the year and to report through the executive to the annual meeting. The proposal was taken up by the Council and welcomed by the meeting. Three such sub-committees were appointed to investigate matters already laid before the conference. Thus Mr. E. Rimbault Dibdin's paper on the organisation of picture exhibitions in the provinces led to the appointment of a committee to consider his proposals. A second committee, arising out of a demonstration by Mr. E. Howarth, is to report on the cleaning and restoration of pictures. The third committee is to investigate and report upon preservative solutions and upon cements for use with various preservatives. This committee, as at present constituted, comprises Dr. W. E. Hoyle (chairman), Dr. G. Hay Murray, and Dr. J. J. Simpson (secretary), and will doubtless welcome assistance from every quarter. The last two gentlemen presented to the meeting notes and demonstrations on cements and labelling for spirit specimens.

Other practical communications included a demonstration by Sir Sidney Harmer of his researches on the fading of museum specimens, illustrating his important paper published in a recent number of the *Museums Journal* and previously noticed in these columns; a paper and demonstration on taking squeezes of fossils by Dr. F. A. Bather; and a paper on museum labelling and printing, by Mr. A. T. Roberts, head of the Leicester School of Arts and Crafts. Leicester is famous for its printing and lettering, and the labels in the Leicester Museum admirably exemplify the influence of this school, while the exhibitions held there from time to time help the business community to improve the style of advertisement. Mr. Leney, of the Norwich Museum, recounted his success in obtaining money for museum purposes through an organisation known as "Friends of the Museum"; Mr. R. W. Brown, of Northampton, made sound suggestions on mutual co-operation between museums and public libraries; Mr. Williamson, of Derby, discussed the classification of Derby porcelain; Prof. Parks, of Toronto, described the constitution of the Royal Ontario Museum; and Mr. R. F. Martin reported on the Buffalo meeting of the American Museums Association which he had attended. Mr. J. Bailey urged the appointment of a Royal Commission "to investigate and report upon the work of museums of the United Kingdom in relation to industries and general culture" and his proposals, endorsed by a large meeting, were subsequently adopted by the council.

In connexion with the conference there were arranged at the museum an exhibition by the British Institute of Industrial Art, an exhibition of wood-grain panels, executed by Mr. A. J. Rowley, after designs by well-known artists, and a number of modern paintings lent by artists of international reputation. Bearing more directly on the work of the Association were two rooms filled with exhibits by members and by fifteen business firms, all of which attracted the constant attention of the delegates and other visitors throughout the week. But perhaps the most illuminating and inspiring exhibit was the Leicester Museum itself, not so much for the building or the specimens contained in it as for the prevailing sense of life and directing intelligence. The numbers that thronged the galleries on Sunday afternoon and the cordial assistance of the Mayor and many members of the corporation showed how highly the people of Leicester appreciate a museum and a director of whom they may well be proud. In doing so they prove how true are the principles for which the Museums Association and notably its retiring president have never ceased to strive.

The next conference will meet at Hull in July 1924, under the presidency of Mr. Thomas Sheppard.

The Arrangement and Motion of the Sidereal System.

THE above is the title of the late Prof. Kapteyn's last paper, which appeared in the *Astrophysical Journal* for May. In an earlier paper he had shown that the surfaces of equal stellar density are approximately ellipsoids of revolution, modified, however, by inflexions near the pole. In the present paper he assumes the exact ellipsoidal form, for convenience of computation, though admittedly not quite in accord with fact. He draws ten ellipsoids, embracing the known portion of the stellar system; the semi-minor axes (towards the galactic pole) range from 118 to 1660 parsecs, while the radii of the circular galactic sections are in each case 5·1 times the polar semi-axes. The logarithms of the star-density in the successive shells fall off from 9·80 in the inner to 8·00 in the outer, the density in the sun's neighbourhood being the unit. For simplicity the sun was taken as central; its most probable distance from the centre is given as 650 parsecs, the latter lying in R.A. $23^h\ 10^m$, N. Decl. 57°; this is not far from Kapteyn's 1893 position, which was R.A. 0^h, N. Decl. 42°. Kapteyn noted that his work would need correction for this eccentric position of the sun, and also for the fact that he combined stars of all spectral types together, though it is known that there are systematic differences in their motions.

The convenience of assuming that the successive shells are ellipsoids is that each shell exerts no attraction on the space within it, and if there are other similar shells outside the outermost one considered,

these will have no effect. Assuming that there are no dark stars or bodies the average masses of the stars are found to fall off from 2·2 near the sun to 1·4 in the outer regions. The mean is 1·6, practically the same as Jackson and Furner found from a study of binary stars. This seems to show that the amount of dark matter in the system is relatively small; we may infer that the duration of the system in the past is not greatly longer than the luminous period of individual stars. The two star-drifts are ascribed to rotational movements of the stars in opposite directions about the galactic polar axis, an idea that was also suggested by Eddington in the Jubilee Number of *Astronomische Nachrichten*.

Kapteyn shows that the supposition explains not only the observed directions of the drifts but also their numerical amounts, namely, 40 km./sec. for the relative velocity of the drifts. It is noted that if the drifts are really due to circular motion the more distant stars should give somewhat different apices from the nearer ones. This will afford a test of the theory.

Some preliminary statistics based on the study of the "Selected Areas" were used in the paper; when these data are fully available it will be possible to give improved values of the star-density in the outer regions. The paper is noteworthy as being one of the earliest attempts to explain dynamically all the star-movements in the system; while avowedly only approximate, it supplies a foundation on which more exact researches may be based.

The Oil Palm in French West Africa.[1]

THE resources of the French possessions in West Africa in oilseeds and nuts are practically inexhaustible, and considerable attention is now being given by the colonial authorities to the possibility of greatly increasing the supplies of these valuable products by scientific research, particularly in the direction of plant-breeding and selection, and the most up-to-date methods of cultivation. In collaboration with the Institut Colonial de Marseille the Governor-General of French West Africa is establishing research stations and experimental plantations in Dahomey and on the Ivory Coast, chiefly for oil-palm study, but work on the cotton plant and ground-nut (arachis) will also be included. It is estimated that, with proper methods, 300,000 tons of palm oil per annum could be obtained from the Ivory Coast alone. Two oil-palm experimental stations have been already planned, and a chemical and botanical staff is being engaged for the work under M. Teissonnier, Director of Agriculture of the Ivory Coast.

The programme of research both at Bingerville and at Dakar will include primarily the improvement of oil-palm varieties, and more particularly the evolution by selection of a variety which will give a maximum yield of palm oil. The aim therefore is to increase the pulp or pericarp at the expense of the kernel, since it is held that palm oil is of more value than palm kernel oil, and is likely to be still more so if the present research work on the production of an edible palm oil is completely successful. The best varieties at present known, *e.g.* Pisifera and Ceredia (A. Chevalier), will be used as a starting-point, and it is hoped by judicious selection, breeding, and proper cultivation in plantations, instead of happy-go-lucky native methods, to increase largely the yield of palm oil, and also improve its quality to such a degree that an edible grade can be obtained without the need of any subsequent chemical refining. Another important aim is to achieve a variety which will mature early. At present an oil palm in West Africa must be about five years old before commencing to bear fruit, although in the Dutch East Indies (east coast of Sumatra) they are reported to come into bearing at three years. On the other hand, in the East Indies, the seed takes much longer to germinate—six to nine months as compared with five or six weeks in West Africa.

The possibilities of plant research in connexion with many important economic products are now realised, and these experiments in French West Africa will be watched with interest, although, of course, some years must elapse before certain and definite results can be obtained.

Reference has been already made to the Dutch East Indies, where similar work has been undertaken both in Java and in Sumatra for many years. Doubtless also the big English firms interested in African palm oil are fully alive to the importance of this kind of research, and as a matter of fact they initiated experimental plantations years ago, but no results have been published, for obvious reasons.

The East Indies and also Malaysia have now entered the lists as serious rivals to West Africa in supplying the world with oil-palm products, and in some respects they seem to have an advantage over West Africa, but assuming that natural conditions of soil and climate are approximately equal, the deciding factor will be the success or otherwise of these plant-breeding experiments.

[1] Bull. des Matières Grasses de l'Inst. Col. de Marseille, 1921, 9 and 10, 145-158.

The French Dye Industry.

THE issue of *La Nature*, April 15, contains an interesting summary of the French dyestuff industry, particular attention being paid to progress made since 1914. In 1913, 2000 tons of dyes, of the value of seven million francs, were imported. Eighty-five per cent. came from Germany and ten per cent. from Switzerland. The balance of the consumption of 9000 tons represented French manufacture. It is pointed out, however, that the dyestuff factories of France, of which there were four, were almost completely dependent on Germany for intermediates, the home production of which represented scarcely ten per cent. of the requirements. There were in addition German works which received intermediates or even finished dyes from Germany. The article refers to the ready adaptation of the dye works in Germany to the manufacture of munitions during the war, and does not omit to point out that, without the means of obtaining synthetic nitric acid, which the enemy had also perfected, his dye works would not have been of the slightest use to him.

The French efforts during the war are described at length. In April 1916 the Syndicat National des Matières Colorantes was established, which had relations with the State and further arranged to take over after the war the national factories used in the manufacture of explosives. The Compagnie National des Matières Colorantes et de Produits Chimiques was constituted in January 1917 and at once set to work. Two factories rapidly grew up, the first at Nogent-

les-Vierges on a semi-technical scale, and a large factory at Villers-St-Paul, with a contemplated capacity of 4000 tons of synthetic indigo a year. This was abandoned during the German advance in 1918 and the material removed to Lyons, but it has again been set in operation, and as a result of intensive work, the total production of the French factories had grown from 175 tons in 1919 to 765 tons in 1920. Since that time the production has decreased on account of the economic crisis, although the capacity of production is now stated to exceed 13,000 tons. With a few exceptions, dyes of all the main types are manufactured and progress is being made.

The company has two large centres of production. The Oissel Works, installed at the old national factory, with an area of 39,000 sq. m. of buildings, is connected with the main line from Paris to Rouen. The power is generated by turbo-alternators of the most modern type, each of 1000 kilowatts. The factory is at present making intermediates, of which more than sixty are being produced, together with sulphur dyes and azo-dyes. These are produced directly from the intermediates without isolation of the latter from solution.

The second works is that at Villers-St-Paul, with an area of 35,000 sq. m. of buildings, on the main line from Paris to Compiègne. A very modern boiler plant is installed, which when complete will consume 300 tons of coal daily. In this works are made the dyes which require special apparatus, such as indigo and alizarine, phthalic acid and basic dyes derived from it, triphenyl and diphenylmethane dyes, pyrazolone dyes, etc. Vat dyes are also made, and there are large research laboratories.

At Saint-Denis the old works has been enlarged, while a new works at Isère grew up during the war. It is stated that prices are now high owing to high costs of raw materials, and the yields could also be improved by the further efforts of the chemists, and particularly of the engineers.

The Metallic State.

RECENT advances in our knowledge of the structure of the atom have added very little to the elucidation of the nature of the metallic state, and in this connexion a very suggestive paper by Prof. C. A. Kraus, in the June number of the Journal of the American Chemical Society, will be of interest. According to modern views the metals owe their characteristic properties to the presence of negative electrons free to move within the body of the metal. Electronegative elements, such as chlorine, owe their characteristic property of forming anions to the fact that they are capable of forming stable complexes (the ions) with one or more negative electrons. Metallic properties may be expected only in such substances as do not contain sufficient electronegative elements to engage the negative electrons supplied by the more electropositive constituents, or otherwise, in which electronegative elements are lacking. The smaller the affinity of an element or group for the negative electron, the more electropositive will it appear, and the more readily will it enter into reaction with more electronegative elements.

The association of negative electrons with positive metallions, which is supposed to make up the structure of a metal, has some resemblance to a salt. At very low concentrations the negative electron may no longer possess the freedom of motion characteristic of the metallic state, and it is known, for instance, that mercury vapour is a very poor conductor. The metal may under such conditions exhibit salt-like properties, and intermetallic compounds may also show resemblances to salts. There are many such compounds which have properties in harmony with this view. The more electronegative elements in such compounds are supposed to have a negative charge. The compound Na_3Sb is then similar to Na_3N or Na_3P. The question is raised whether the apparent deviations of intermetallic compounds from the valency relations may not be due to the tendency of electronegative elements to form complexes. This is shown in the compounds NaN_3, KI_3, etc., and it is suggested that something of the kind occurs in such compounds as Na_4Sn, Na_2Sn, Na_4Sn_3, NaSn, and $NaSn_2$. The atoms in such complexes, however, may not all function in the same manner. The property of metallicity is not an atomic one; it is due to the negative electron, and the rôle of the positive constituent is a secondary one.

Many reactions in liquid ammonia solution, and the existence of substituted ammonium amalgams and substituted ammonium radicals in liquid ammonia solution, support the views expressed. As an example it is stated that tellurium reacts with a solution of sodium in liquid ammonia to form a white crystalline precipitate of the typical salt-like compound Na_2Te. On further addition of tellurium this goes into solution with the production of complex tellurides, Na_2Te_2 and Na_2Te_4, which form strongly coloured solutions, similar to those of alkali-metals, and when precipitated from solution exhibit metallic properties.

University and Educational Intelligence.

LONDON.—At a meeting of the Senate on July 19, Dr. J. C. Drummond was appointed to the University chair of biochemistry tenable at University College. Dr. Drummond graduated from East London College with first-class honours in chemistry, and has been research assistant in the Physiological Laboratory at King's College and assistant analyst in the Government Laboratory (Foods Department). He has also conducted research work at the Cancer Hospital, and has been since 1920 University reader in physiological chemistry at University College.

PROF. ADRIAN STOKES was appointed to the Sir William Dunn chair of pathology tenable at Guy's Hospital Medical School. Prof. Stokes has held the posts of assistant to the professor of pathology at Dublin University and pathologist to the Royal City of Dublin Hospital, while since 1919 he has been professor of bacteriology and preventive medicine at Dublin University. Two years ago he worked with the Rockefeller Commission on Yellow Fever in Nigeria.

The following doctorates were conferred:—*D.Lit.*: Mr. W. I. Moore, King's College, for a thesis entitled "Education and Social Systems, English and French: A Study of Educational Effort and Opinion 1750–1810"; *D.Sc., in Botany*: Miss Dorothy Haynes, King's College and the Imperial College—Royal College of Science, for a thesis entitled "(1) Electrical Conductivity as a Measure of the Content of Electrolytes of Vegetable Saps, and (2) the Action of Salts and Non-electrolytes upon Buffer Solutions and Amphoteric Electrolytes and the Relations of these Effects to the Permeability of the Cell"; *D.Sc., in Physics*: Mr. W. E. Curtis, King's College, for a thesis entitled "The Structure of the Band Spectrum of Helium"; Mr. B. A. Keen, University College, for a thesis entitled "The Physical Properties of Soil"; Mr. F. H. Newman, for publications entitled "Active Modification of Hydrogen and Nitrogen produced by

X-rays," "A New Form of Wehnelt Interrupter," and other papers; Mr. H. R. Nettleton, for a thesis entitled "On the Absolute Measurement of the Thomson Effect," and other papers. *D.Sc.* (*Engineering*): Mr. Herbert Moss, the Imperial College—Royal College of Science, for a thesis entitled "Air Consumption and B.H.P. of Aero-Engines."

MR. H. G. WELLS has accepted the invitation of the Labour Party of the University of London to offer himself as the candidate of the Party at the election for a representative of the University in the House of Commons to be held after the retirement of Sir Philip Magnus at the end of the present session of Parliament. Mr. Wells occupies such a distinguished position in the world of literature and among leaders of thought to-day that his early work in science and education is often overlooked. He was a student at the Royal College of Science, South Kensington, in 1884–87, and was the first president of the Old Students' Association of the College. He took his B.Sc. degree with honours in zoology in 1890, and his first book was a "Text-book of Zoology," written particularly for London University students while he was a teacher of the subject. He is a fellow of the College of Preceptors, and for a short time edited the *Educational Times*. Throughout his career he has been a steadfast supporter of scientific methods in schools and government, and in his books has pleaded the cause of scientific education and research with eloquence and conviction. It is not too much to say that no graduate of the University of London possesses such a rare combination of brilliant literary power and scientific thought or has used these gifts with greater effect than has Mr. Wells in his many and various works.

IT is announced in *Science* that by the will of Seymour Coman, of Chicago, the University of Chicago is made trustee of his residuary estate, about 29,000*l.*, the net income from which is to be used for scientific research with special reference to preventive medicine and the cause, prevention and cure of diseases. The bequest is to be known as the Seymour Coman Research Fund. By the will of Alexander D. Thomson, of Duluth, Minnesota, the sum of 20,000*l.* is bequeathed to the University of Minnesota for use in the medical department. It is also stated that Wake Forest College School of Medicine, North Carolina, is entitled to receive the principal of a trust fund, amounting to 275,000*l.*, which was created in 1892 by Jabez A. Bostwick, a director of the Standard Oil Company.

A SUMMER course in the Austrian Tirol of unusually wide interest is being organised by the directors of Leplay House, 65 Belgrave Road, Westminster, S.W.1. The course will be of the nature of a civic and rustic survey, and for this purpose the party will be divided into groups each of which will take one particular aspect of the work. Mr. H. J. E. Peake, president-elect of the Anthropological Section of the British Association for the Advancement of Science, has undertaken to direct the group studying the anthropological aspects; Dr. M. Hardy will organise a survey of plant life and agriculture, while other sections will deal with the geology, physiography, history and sociology of the district. Group meetings and gatherings of the whole party will frequently be held for the purpose of discussing and comparing results, which when assembled and collated should provide a valuable record of natural conditions and life in the Tirol. The tour will commence on August 4 and will last four weeks, although it is possible to arrange for a shorter course of two weeks.

Calendar of Industrial Pioneers.

July 31, 1884. Charles Manby died.—The eldest son of Aaron Manby, one of the pioneers of iron shipbuilding, Charles Manby was engineer of the first iron steamer which crossed the English Channel, and after gaining experience in his father's gas and iron works in France returned to England, and from 1839 to 1856 rendered valuable services to the engineering world as secretary to the Institution of Civil Engineers.

August 2, 1910. Oscar Guttmann died.—Hungarian by birth, Guttmann became editor of an Austrian mining journal, practised on the continent as a chemical engineer, and eventually settled in England, where he erected several works for the manufacture of explosives. He wrote and lectured on explosives, on which he was a recognised authority, and was elected a vice-president of the Institute of Chemistry.

August 3, 1792. Sir Richard Arkwright died.—Born at Preston, December 23, 1732, four years before Watt, Arkwright was responsible with Watt for the great industrial developments in England in the latter part of the eighteenth century which enabled this country to withstand the tremendous drain on her resources due to the Napoleonic wars. Starting life as a barber, Arkwright became a hair merchant, and about 1767 gave himself up to inventions in cotton spinning. Two years later he patented his "spinning frame," "the first adequate example of those beautiful and intricate mechanical contrivances which have transformed the whole character of the manufacturing industry." He is also regarded as the founder of our factory system.

August 3, 1880. Mungo Ponton died.—A Writer to the Signet and a founder of the National Bank of Scotland, Ponton through ill-health retired from business and devoted himself to science. In 1839 he made the important discovery that the action of the sun renders bichromate of mercury insoluble.

August 3, 1906. Sir Alexander Moncrieff died.—Educated at the universities of Edinburgh and Aberdeen, Moncrieff became an officer in the Forfarshire Militia and saw active serve in the Crimean war. He afterwards became known as the inventor of the Moncrieff disappearing gun-carriage and the hydropneumatic system of recoil.

August 4, 1921. Samuel Alfred Varley died.—A member of a famous family of electricians and one of the pioneers of the dynamo, Varley made numerous experiments on submarine telegraph cables. In 1866 he made a self-exciting dynamo with soft iron magnets, and ten years later patented the compound-wound dynamo.

August 5, 1729. Thomas Newcomen died.—A native of Dartmouth and born in 1663, Newcomen is believed to have been a blacksmith. He became associated with Thomas Savery in his attempts to use steam for pumping, but it was Newcomen's own great invention of the atmospheric steam-engine which furnished the model for pumping engines during the eighteenth century. His first engine appears to have been erected at Dudley Castle in 1712. Newcomen died in London and was buried in Bunhill Fields.

August 5, 1876. James Freeburn died.—Freeburn enlisted in the artillery in 1825 when seventeen years of age, and rose to the rank of sergeant-major. Turning his attention to the exploding of shell he brought out a series of metal and wood fuses for time or percussion which, after various improvements, were adopted. Freeburn after thirty years' service was retired with the rank of honorary captain.

E. C. S.

Societies and Academies.

LONDON.

Geological Society, June 28.—Prof. A. C. Seward, president, in the chair.—C. E. **Tilley**: The petrology of the metamorphosed rocks of the Start Area (South Devon). The rocks of the Start area comprise a group of mica- and quartz-mica-schists, together with a great development of green schists of basic composition. They can be divided into lower mica- and quartz-mica-schists, green schists, and an upper group of mica- and quartz-mica-schists. The field relations of these rocks show that the dominant feature of the area is an anticlinorium with an axis plunging westwards. The rocks are sharply differentiated from the slates and phyllites of Devonian age in the Kingsbridge area immediately to the north; the two areas are probably separated by an important boundary of dislocation. The aluminous sediments are typically quartz-muscovite-chlorite types, the grade of metamorphism corresponding to the formation of biotite not being reached. In the composite type of sediment, where tufaceous material is included, the highest stage of metamorphism is reached in the muscovite-chlorite-garnet-albite-schists. The garnet is rich in the spessartine molecule, and the reversal of the normal biotite-garnet order in an increasing grade of metamorphism is ascribed to the presence of manganese.—A. R. **Dwerryhouse**: The glaciation of the counties of Antrim, Down, and parts of Armagh, Londonderry, Tyrone, Monaghan, and Louth in Ireland. The deposits consist of boulder-clay, gravel, and sand, and are divided into two groups according to their direction of transport: those derived from the north-east and carried by a glacier which flowed by way of the Firth of Clyde from Scotland; and those the source of which lay to the west, carried by an Irish ice-sheet having its origin in Donegal. The former are characterised by the riebeckite-bearing rock of Ailsa Crag with granites, quartz-porphyry, and pitchstone from Arran; the latter contain boulders of igneous rocks from County Tyrone. Delta-terraces and overflow-channels show that ice-dammed lakes existed in the district. Moraines occur, the most conspicuous being those near Armoy in Antrim and near Garvagh in Londonderry. The earlier glaciation was effected by the ice from Scotland, which reached south-west to the town of Monaghan and the eastern flank of Slieve Beagh. The Scottish ice was then gradually replaced by that from Donegal. The latest phase of the glaciation was a second advance of the Scottish ice, which formed definite frontal moraines in the neighbourhood of Ballymoney and Armoy, and the establishment of a small local centre of glaciation in the neighbourhood of Trostan, the highest mountain in County Antrim. Glaciation was probably continuous.

DUBLIN.

Royal Dublin Society, June 27.—Dr. J. A. Scott in the chair.—H. H. **Jeffcott**: The electrical design of A.C. high tension transmission lines. A method is given for calculating the performance of high tension transmission lines, based on direct evaluation by complex quantities. The process can be systematised into an arithmetical routine. Examples of its application to specific problems are given.—T. **Dillon**, Rosalind **Clarke**, and V. M. **Hinchy**: Preliminary experiments on a chemical method of separating the isotopes of lead. Lead chloride containing thorite lead was treated with magnesium ethiodide and the resulting lead tetraethyl and metallic lead were re-converted into lead chloride. This material was treated with magnesium ethiodide and comparative atomic weight determinations of the lead from the two fractions of lead chloride obtained showed a difference of atomic weight of 0·2 to 0·3.—T. **Johnson** and J. G. **Gilmore**: (1) The lignite of Washing Bay, Co. Tyrone. Lignite was found at various depths, but especially at 1000 ft., in the Washing Bay core. It is all coniferous in nature and is referred to *Sequoia Couttsiae*, Heer, of which cones, seeds and foliage have been previously described from the same beds. The Lough Neagh lignite originally described by Unger as *Peuce Pritchardi* may prove to be a Sequoia also. (2) Libocedrus and its cone in the Irish Tertiary. A foliage impression of *Libocedrus salicornioides* showing characteristic stomata and epidermal papillæ is described. The specimen was found at a depth of 904 ft. in the clay core of the coal-bore at Washing Bay, Lough Neagh. The foliage shoots and cones of the same species from the interbasaltic beds of Ballypalady, Co. Antrim, are also described, the specimens being preserved in the Belfast Museum. Restorations of the wood show agreement between the Irish material and that from Leoben in Styria and with recent Libocedrus, of which *L. decurrens* (California) and *L. chilensis* are the nearest living representatives.

PARIS.

Academy of Sciences, June 26.—M. Emile Bertin in the chair.—P. A. **Dangeard**: Researches on the structure of the cell in the iris. In an earlier communication the author has suggested that the term chondriome really comprises three different types of elements named vacuome, plastidome and spherome. This is confirmed by a study of the leaf of *Iris germanica*. The structure is best observed on unstained specimens. Fixing and staining methods are liable to cause distortion, and have, in the author's opinion, led to erroneous interpretations of the cell structure in the past.—J. **Costantin**: Acquired heredity. The wild potato is a mountain species, growing in the Andes up to 4000 metres, and the formation of tubercles is caused by a fungus. In the absence of this fungus, the hereditary characters can be maintained intact only if the plant is maintained under the climatic conditions which it requires. Thus the variety "Up to date" degenerates in Algeria, but has been maintained without change for twenty-five years in Scotland.—Pierre and Louis **Bazy**: Vaccination before operation. Preventive auto-vaccination is suggested as preferable, except in cases requiring immediate operation, to preventive serotherapy.—Maurice **d'Ocagne**: Transparent nomograms.—A. **Rateau**: Calculation of the variations of the level of an aeroplane due to a variation of its weight or to the use of a turbo-compressor.—Henri **Jumelle**: The group of *Chrysalidocarpus lutescens*.—M. Amé Pictet was elected correspondant for the section of chemistry in the place of the late Prof. Ph. A. Guye.—H. **Mineur**: Certain functional algebraical equations.—Torsten **Carleman**: The problem of moments.—Paul **Lévy**: The law of Gauss. Correction of an error in an earlier note (March 27).—W. **Margoulis**: Transparent abacus with orientation.—Gaston **Bertrand**: The law of Riemann, the perihelion of Mercury, and the deviation of light. Measurements of high precision are necessary to decide between the formulæ of Einstein and Riemann.—Charles **Nordmann** and Le **Morvan**: Observations of stars of the N type and especially of a star with a very low effective temperature, by means of the heterochrome photometer of the University (Paris). One of the three stars examined (112, 559, Henry Draper Memorial Catalogue) has an effective temperature of 2160° absolute (1887° C.), the lowest temperature of any star measured.—N. Vasilesco **Karpen**: A new evaluation of the internal

pressure of liquids. The criterion of the association of the molecules in a liquid.—B. **Szilard**: The direct estimation of very small quantities of radium by the penetrating rays. An application of the portable electrometer described in a previous paper (June 19). Using 500 grams of material containing 10^{-9} grams of radium per gram, the error of estimation is within 2·5 per cent.—Paul **Pascal**: Magnetochemical research on the constitution in mineral chemistry. Acids containing arsenic.—G. **Gire**: The dissociation of barium chloroplatinate. The dissociation pressures of this salt were measured at temperatures ranging between 428° C. and 665° C., and the heat of reaction calculated.—A. **Demolon**: The accessory elements in Thomas slag. Besides phosphate, basic slag contains lime, magnesia and manganese. Determinations of the solubility of the slag in various solvents (water, sugar-solution, carbolic acid, etc.) have been made and the results given as curves with time as abscissæ.—L. J. **Simon**: Oxidation by mixtures of sulphuric acid and chromates. The use of silver chromate with sulphuric acid gives a more complete combustion of organic compounds than alkali chromates and sulphuric acid. The modification is especially useful in the analysis of bodies containing the acetyl group.—Mlle. Hélène **Billon**: The action of trimethylene chlorobromide on some ketones of the fatty series.—R. **Locquin** and Sung **Wouseng**: The transformation of the tertiary ethylenic alcohols (linalool type) into primary ethylenic alcohols (geraniol type).—F. **Kerforne** and L. **Dangeard**: The palæozoic rocks brought up by the dredge of the *Pourquoi-Pas?* in 1921 in the western English Channel.—F. **Ehrmann**: The discovery of the Silurian with graptoliths and the Devonian with tentaculites at Beni-Afeur (south of Djidjelli, Algeria).—Ch. **Gorceix**: The distribution of temperature in Lake Bourget.—Pierre **Nobécourt**: The mechanism of the parasitic action of *Penicillium glaucum* and of *Mucor stolonifer*. Experiments on the artificial ripening of sterilised fruits by inoculation with the two moulds named above. The action appears to be due to a secretion of enzymes, and the action takes place only in acid media.—Joseph **Bouget**: Observations on the most favourable altitude for the coloration of flowers.—Jean **Dufrenoy**: Tumefaction and tuberisation (in plants).—W. **Mestrézat**, Pierre **Girard**, and V. **Morax**: The elective ionic permeability of the cellular elements. Experiments on the cornea of the dog and rabbit prove that the permeability of the cells to electrolytes is an ionic permeability and that it is elective.—M. **Doyon**: Comparison of the effects of the nucleic acids and of the antithrombine of peptone plasma on the coagulability of the blood circulating in the frog.—L. **Panisset** and J. **Verge**: Idiosyncrasy and anaphylaxy.—Maurice **Nicloux** and Georges **Welter**: Does cyanic acid exist in the blood? Attempts to show the presence of cyanic acid in the blood and lymph gave negative results.—A. **Weber**: Influence on the development of the eggs of a batrachian of a substance extracted from the fertilisine of the eggs of a fish.—A. **Lécaillon**: Variability of the species and the experimental creation of new races in the silk-worm of the mulberry tree.—R. **de La Vaulx**: The appearance of intersexual forms in a strain of *Daphnia magna*, and on the probable determinism of the phenomenon.—A. **Vandel**: Geographical spanandria in a terrestrial isopod.—R. **Hovasse**: A Peridinian, an intracellular parasite of the Vellela.

MELBOURNE

Royal Society of Victoria, April 8.—Mr. F. Wisewould, president, in the chair.—F. **Chapman**: New or little-known Victorian fossils in the National Museum. Pt. XXVI. Some Tertiary Mollusca. Fourteen new species of Pelecypoda and Gasteropoda are described and the distribution and diagnoses of eight other forms are discussed. So far back as Oligocene and Miocene times there existed many species of Mollusca which are so closely related to living forms that they are evidently the direct ancestors of present molluscan types. Others have migrated from the Bassian area and are now found only as varietal offshoots in warmer Australian waters. Certain species dating back to the older Tertiary are now found living in lower latitudes of the Southern Ocean.—H. B. **Williamson**: An addition to the flora of Victoria. A new species of Helichrysum, *H. Gatesii*, has been found growing on dry hillsides a few miles from Lorne by the Rev. A. C. F. Gates. The plant resembles a Leptorrhynchus, but approaches very closely to *Helichrysum podolepideum*, a Central Australian species. It is probably a connecting link between sections Oxylepis and Chrysocephalum of the genus.—J. **Shirley** and C. A. **Lambert**: *Coprosma Baueri*, End. The leaf pits were examined, but no acarids were found. The pits are of teratological interest only, as the plant no longer lives under xerophytic conditions.—G. H. **Hardy**: Notes on some Australian Asilidæ (Diptera) in the collection in the National Museum. A new species of Neoitamus is described, and notes and new descriptions on the remaining fifty-four species and one subspecies in the collection are given.—A. J. **Turner**: Studies in Australian Lepidoptera. A number of species obtained on the Claudie River in the Cape York Peninsula, N. Queensland, in the National Park, Queensland, and in Tasmania are described. Revisions of orders previously described are given, together with descriptions of some new forms.

SYDNEY

Royal Society of New South Wales, May 3.—Mr. E. C. Andrews, president, in the chair.—E. C. **Andrews**: Presidential Address. The coral-bearing limestones of the Cainozoic within the Pacific are of two types, namely, Tertiary and Pleistocene. The Tertiary consist of sediments deposited unconformably upon sinking surfaces of submarine erosion, whereas the Pleistocene, although deposited unconformably along the Cainozoic, have grown in clear water away from the influence of silt-laden streams. No signs of bedding occur in them, and they are amorphous, massive, and homogeneous. Cliffs one thousand feet in height exist, which reveal no sign of structure. To understand the origin of coral reefs, it must be remembered that the continents bordering the Pacific have grown mainly towards that ocean in the form of land waves or undulations commencing at the continental nuclei, such as South-Western Australia, the Canadian Shield, Brazil, and Siberia. Island groups such as Japan, New Zealand, Fiji, and Tonga represent extensions of earth waves of this type. These earth undulations have grown as oscillatory vibrations with a progressive but slow radial movement of the major wave axes. Each island group forms a compound earth wave. Generally, the western islands and the larger individual groups, such as New Caledonia and Fiji, have been stable during the later Pleistocene, whereas the eastern satellitic islands and islets have moved up and down in vibratory undulations during the same period. The true coral reefs of the Pacific indicate the peculiar vibrations and undulations of movement in these relatively unstable masses of the island groups and also the growth of great barriers and fringing reefs, such as the Great Australian Barrier, on submerged areas of submarine erosion. Generally, Pleistocene coral reefs are amorphous and non-bedded, and have been formed on submerged surfaces of submarine erosion at various stages.