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THE FACE OF THE EARTH.

Das Antlitz der Erde. By Prof. E. Suess. Vol. iii., pt. ii. Pp. iv+789; 3 plates, 5 maps. (Vienna: F. Tempsky; Leipzig: G. Freytag, 1909.)

Namens und Sachregister für Sämtliche Bände. By Dr. L. Waagen. Pp. 158. (Vienna: F. Tempsky; Leipzig: G. Freytag, 1909.) Price, including index vol., 50 marks.

The Face of the Earth. Vol. IV. Translated by H. B. C. Sollas, under the direction of Prof. W. J. Sollas. Pp. viii+673. (Oxford: Clarendon Press, 1909.) Price 25*s.* net.

ALL geologists will join in hearty congratulations to Prof. Suess on the completion of his great work, the influence of which has been spreading steadily since the appearance of its first part in 1883. Prof. Suess's views were opposed to such cherished traditions that they were naturally at first regarded with suspicion; but *many* of his conclusions have been now generally accepted, and his illuminating suggestions have stimulated much fertile research. The last section of the work (vol. iii., part ii.) is accompanied by a series of most valuable maps and a detailed locality index of 158 pages, prepared by Dr. Lukas Waagen. The concluding part shows Prof. Suess's wide acquaintance with the whole literature of stratigraphical geology, which he interprets with characteristic insight and originality. The summary of recent geological work on various remote regions would alone ensure this volume a warm welcome from its usefulness as a work of reference, apart from its place as the completion of one of the standard works in geological literature.

The conclusion has been awaited in the hope that it would be largely devoted to a general summary of Prof. Suess's results and his explanation of the existing plan of the earth. This expectation has, however, not been fulfilled. This part includes the tenth to twenty-seventh chapters of the third volume, and thirteen of the eighteen chapters continue a revision of the mountain systems of the world, dealing with those of Europe, America, Africa, and Oceania. The remaining five chapters discuss various general problems, including the three zones of the earth's crust, which, from the chemical symbols of their leading constituents, Prof. Suess calls Nife, Sima, and Sal, the trend of mountain folds, isostacy, the process of igneous intrusion, the structure of the moon, and a final chapter on some lessons from the distribution of life. There is no attempt at a complete general theory of the distribution of land and water on the earth, as Prof. Suess apparently holds that none such is yet possible. He recognises on the earth several superposed plans, but makes no suggestion as to their causes. Thus the reason for the difference between the Atlantic and Pacific types of coast structure he describes as still unknown, and he leaves "to the future" (p. 724) the explanation of the great marine transgressions, the fundamental importance of which he was the first to appreciate correctly. The explanation that they are due to the shallowing of the ocean basins by the spheroidal recovery of the earth after periods of deformation is not mentioned, though it may once be vaguely alluded to.

The first impression made by a perusal of this volume is the greatness of the changes between it and its predecessors. Prof. Suess's essential principle that the face of the earth owes its expression to dimples and wrinkles due to the earth having shrivelled with age is maintained; but the view that all vertical movements are necessarily downward is abandoned. The ingenious explanations by which Prof. Suess endeavoured to explain away Darwin's evidence as to the vertical uplift of the coast of Chile after the earthquake of 1822 are resigned, in face of the well-established vertical uplifts along the western coasts of North America. Prof. Suess, however, does not admit uniform regional elevation, and he therefore necessarily rejects the principle of isostacy. He discusses this question in one of his final chapters, and expresses his strong distrust of mathematical evidence on such problems. Its uncertainty is illustrated by his proposal to alter the widely accepted conclusions by simply modifying the formula by which they were reached. Suess points out (p. 703) that the omission, as suggested by Faye, of the second factor in the formula used in deducing the weight of the earth's crust from gravity observations would remove the evidence obtained in some cases that the weight of mountains is compensated by a deficiency in material underneath. As the factor in question is a correction for the weight of the material between the point of observation and sea-level, its inclusion seems reasonable. Prof. Suess's further statement that deficiencies in mass beneath mountains "would be contradictory to all geological knowledge" (p. 708) is unexpected, as it is the weight of the geological evidence for the action of isostacy that has induced so many geologists to accept the mathematical arguments in its favour. Less stress is laid in this volume upon variations of the shore line in consequence of local disturbances of sea-level; and Prof. Suess remarks (p. 694) that there is no precise knowledge of the effect of continental attraction upon it. He also changes the meaning of the term batholite, which he proposed for masses of plutonic rocks injected into cavities due to radial contraction; he now attributes the formation of batholites to the replacement of the original rock by absorption and assimilation. Though most geologists are prepared to admit that igneous absorption takes place to some extent, many will probably hesitate before accepting it on so vast a scale.

Some modification was expected in the definition of the Atlantic and Pacific coast types, the establishment of which was one of the great contributions of Prof. Suess's earlier volumes. The Pacific coast type was originally characterised as bounded by mountain chains folded towards the ocean; this view has proved untenable without considerable modifications, and Prof. Suess now accepts (p. 577) the absence of mountain-making activity on the Atlantic coasts as the essential difference; he seems, however, disposed to regard the structural basis of this classification as

less important than the petrographic; he retains the terms for Harker, Becke, and Prior's two petrographic regions, of which the Atlantic is characterised by igneous rocks rich in alkalies, and the Pacific by those rich in lime and magnesia. Both the characters of recent mountain formation and the chemical composition of the lavas can only be applied with numerous exceptions; and we cannot but think it would be regrettable if the great geographical truth in Suess's original view were abandoned, and his two terms retained with a meaning so changed and inappropriate as to be misleading.

Though no general theory is advanced in this volume, Prof. Suess gives in an appendix (pp. 783–5) his final classification of the lands of the earth. He arranges them in the following ten divisions:—

(1) Eurasia, including part of North America; (2) Laurentia; (3) Gondwanaland; (4) Australia, Oceania, and parts of Antarctica; (5) South America and the western mountains of North America; (6) the British Isles, excluding the southern counties, but including part of Norway and the mountains of the western Sahara; (7) the volcanic islands of the Atlantic type, with which are grouped some of the islands of the eastern Pacific, Indian and Southern Oceans; (8–10) the Cape Mountains, the north-western peninsula of New Guinea, and the Fiji Archipelago are each independent elements.

This classification, embodying the conclusions that have been reached by Prof. Suess after thirty years of most careful research, must command respectful consideration from all geographers, though objection may be taken to some parts of it.

The first seven chapters (Nos. x. to xvi.) describe the mountains of western Eurasia, of which the most important are referred to two groups, the Altaids, including the Hercynian Mountains of Bertrand, and the Alpids, formed by Cainozoic foldings in areas that had foundered in the frame of the older Altaids. The Caucasus are now transferred from the Alpine to the Altaid system. There are unquestionably important differences between the Alps and the Caucasus, but these two chains and the Pyrenees were all due to earth movements that probably had a connected origin, though they affected western earlier than eastern Europe. Thus the Pyrenees were folded at the end of the Eocene; the Alps in the Upper Miocene, and the Caucasus in post-Sarmatian times. No doubt the Caucasus has a foundation of older mountains; but so also have the Pyreness, which have indeed a more typical Altaid basis than the Caucasus.

No one can differ from Prof. Suess on mountain classification without great hesitation. But a classification which correlates the Caucasus with the hills of Devonshire instead of with the Pyrenees is obviously not intended for general geographical use. The geological evidence still seems consistent with the conclusion of Fournier, who, in his monograph on the Central Caucasus, reports "que la Caucase, par sa direction, par l'âge et le sens de son dernier plissement, par le parallélisme même des stades de sa formation, est le prolongement direct de la grande châine Alpine."

The African representatives of the Altaids include the Atlas Mountains, to the south of which is a mountain band composed of Archean rocks with a north to south strike. From this fact Prof. Suess identifies them as a section of the Caledonian mountains. In Scotland the general trend of the foliation in the gneiss and crystalline schists is not from north to south, which is the direction characteristic of the Archean rocks of equatorial and northern Africa; there seems no very convincing reason for correlating these mountains of the western Sahara with the British rather than with the African Archeans.

The discussion of the Eurasian Mountains closes with an especially valuable chapter, in which Prof. Suess traces the Altaid system through the Appalachians and across the United States as far west as Texas and the frontiers of Mexico. Then follow two chapters, one on the African fractures and the other on the Oceanids, the island festoons of Australasia. In dealing with Australia, Prof. Suess's most important proposal is its separation from Gondwanaland, on the ground that not enough is known of the intervening area to show their relations. The evidence, however, of the fossil flora and fauna of Australia seems conclusive of the former land connection of Australia and Gondwanaland.

Prof. Suess next discusses the western mountains of America, and traces the Asiatic structure into America through Alaska. He re-classifies the mountains of North America, and again, as with the correlation of the Caucasus, appears to attach undue weight to the early history and materials of the mountains in comparison with the movements to which they owe their existing forms and geographic importance. He divides the western mountains of North America into three groups. The eastern group is that of the Rocky Mountains, which Suess shows, by a masterly study of Alaska, belong to the Asiatic Structure. The westernmost group is the Mount St. Elias chain, which passes out into the Pacific through the Alexander Archipelago. All the mountains between the Rockies on the east and the chain of Mount St. Elias, and the Coast Range of California on the west he calls the Intermediate Mountains; they reach the Pacific coast in British Columbia and the northern part of the United States. On the strength, mainly, of these "Intermediate Mountains," Prof. Suess now maintains the essential unity in structure between North and South America, though of the four chief mountain elements in the former only the Intermediate Mountains occur in both. The view of the unity of the two Americas is based partly on these Intermediate Mountains and partly on the Andes, of which the low Archean Coast Range of California is regarded as the northernmost representative. Prof. Suess represents the Andes as formed by pressure from west to east, so that where the movement was not obstructed by the great mass of the Eastern Highlands of South America the Andean line projected eastward in two great loops, the northern Antilles in the West Indian area, and the "Southern Antilles," including Tierra del Fuego, the South Shetlands, and Graham Land. In both these "Antilles" the Pacific is represented as having advanced into the Atlantic region. The writer once

visited the West Indies to investigate this problem, and, in spite of the nature of the lavas, felt bound to reject the conclusion owing to the palæontological and tectonic evidence.

South America itself, according to Prof. Suess's interpretation, has a uniform structure without any trace of the earlier geographical plans which he admits in other continents. The mountains trending from north-west to south-east in the Argentine he explains as connected with the Andes, an opinion different from that of some Argentine geologists; and as it is conceded that the Sierra de Tandil does not belong to the Andes, there seems evidence for the existence of an older mountain system.

The English translation has been issued as vol. iv., without the plates, maps, appendices, and index, which are to follow. The translation shows evidence of haste, and it has missed the revision by several distinguished geologists of which the preceding volume had the benefit. Miss Sollas has done her part of the work well, as the translation reads easily; but in a work of such geographical importance it is a pity that the geographical terms were not more carefully revised. Thus the depressions on the oceanic floors known in German as "Rinnen" are translated as "channels" (p. 294), a term which connotes the idea of flow, so that the term "trench," recommended by the International Geographical Congress, is preferable. "Die Stauung der ersten Welle" (p. 438) is translated (p. 382) as "the stowing of the first wave," whatever that may mean. More serious objection can be taken to the translation of "Das Zwischen Gebirge," in which Prof. Suess includes all the mountains in Canada and the United States west of the Rockies with the exception of the Mount St. Elias chain, as the Intermediate "Range." The term range is so unsuitable to a vast area of mountain country, which includes many mountain ranges, that the translation cannot always adopt it; so when Prof. Suess says (p. 479), "Das Zwischengebirge in ein Meer von submeridionalen Zügen aufgelöst," the English version reads, "The Intermediate *Chain*, broken up into a sea of submeridional *ranges*."

As an illustration of the inconsistency in the translation of geographical terms, it may be remarked that Gebirge, Züg, and Kette are all sometimes translated as range; while Gebirge and Kette are also both sometimes translated as chain. British students will find the irregular treatment of place-names inconvenient and puzzling. Such variations as Brazilia and Brasilia are unimportant, though hardly to be expected in a work issued by a University Press; but many of the variations introduced are confusing. Thus, Prof. Suess speaks of the Sea of Ochot'sch, and calls some adjacent mountains the Ochitiden. The translation, by adopting Okhotsk (p. 328) for the sea and Ochotides for the mountains, obscures their connection; the latter name is once spelt Okhotides. The Yana of p. 331 is the Jana of p. 332; and the Chuchki Peninsula of p. 358 is the Chukchi of p. 377. The Chaja of Suess is sometimes repeated in that form (p. 334), sometimes as Khaja (p. 335), and as Chaya (p. 337). Kegyl (p. 334) is Kygyl on p. 339.

Many of the names in the translation appear in German forms, and are difficult to find in British atlases; thus the lake, which in the *Times* atlas appears as Yege—a reasonable transliteration—is spelt Eche or Esse. Yezo appears as Hokkaido, and Gilolo as Halmahera. The Vistula is mentioned thrice, but its identity is each time concealed by the retention of its German name, Weichsel; "from the Weichsel to Dakota" (p. 88) does not give much information to a student limited to British atlases or gazetteers. Further confusion is added by the differences between the text and the figures; thus Werchne in Fig. 28 is the Verkhne of the text, and Werchojanskij in the same figure occurs as Verkhoiansk in the text.

In the French edition the original technical terms are often quoted in brackets after the translation, and as that excellent precedent has not been followed it would be convenient if, in the index-volume, a list were given of Prof. Suess's geographical terms with the translations adopted. J. W. GREGORY.

EXPLORATIONS OF INDIA.

The Gates of India. Being an Historical Narrative. By Colonel Sir Thomas Holdich, K.C.M.G. Pp. xv+555. (London: Macmillan and Co., Ltd., 1910.) Price 10*s.* net.

THESE "Gates of India" are the gates beyond the Indus, the difficult tracks through which all the great historic invaders of the country made their way prior to the days of oceanic exploration. There are few men more competent to write about them than Sir Thomas Holdich, who knows them from the Pamirs to Makran, though he hardly refers to his own achievements as a geographer, but treats the matter mainly from the historic standpoint, beginning with the Medes and Persians, and ending with Pottinger and Burnes and their contemporaries.

For the purposes of review we may divide the book into three parts. The first part—a quarter of the whole—deals mainly with what may be called the conjectural period of Assyrian and Persian and Greek. The second part—another quarter—is taken up by the Arabs; here the observer, describing country as wonderful as it is inaccessible to ordinary people, keeps conjecture subordinate to facts of observation. The third part, occupying nearly half the book, reviews the explorations and adventures of the modern European period; here facts predominate, and the romance of the story is of an individual kind.

We propose to give precedence to the second or Arab period, as this part of the book is the most original and certainly the most novel.

Everyone, of course, knows in a general way that Arab merchants and slave-dealers went everywhere—their footprints have been left all over Africa; Algerian slave-hunters even raided the coasts of Iceland once upon a time—but amid the alarums and excursions of historians and archæologists intent on Macedonian and Mogul invaders and Buddhist monuments, most people nowadays need to be told that "the whole of the Indian north-west frontier was much traversed by and thoroughly well known to the Arab trader."

Sir Thomas Holdich has much to say about these

old Arab caravan-routes and trade-centres, and much that is surprising to tell of the oblivion that has overwhelmed them. In Sind he has stood upon the site of an Arab city of which nothing whatever is left but traces of its cemetery. In the Helmund valley he has seen broken pottery "literally in tons"—the only remaining evidence of a vanished polity. In Central Afghanistan one may follow in the footsteps of the old Arab traders, with the story of their travels in hand, and may recognise the physical features of the road, but of the flourishing market towns that they mention there may be nowhere discernible "the faintest outward indication"—everything is now by Time's fell hand defaced. Only in southern Baluchistan did the author find, besides pottery and graves, undoubted ruins of cities and huge masonry dams that once held water-supplies.

The mediæval Arab traders used two main systems of communication, one through Herat and Afghanistan to Kabul and Afghan Turkestan, the other through southern Baluchistan (Makran) to the lower Indus valley. The routes of both systems are followed out by the author, and are illustrated by most excellent maps. In the account of the northern routes there are some short but interesting descriptions of those parts of the country that are least generally known. Something is said of Seistan, "the great central basin of Afghanistan, where the Helmund and other Afghan rivers run to a finish in vast swamps, or lagoons." The author speaks of it as a flat, unwholesome country, with remains of a really fine system of irrigation, and thinks that it does not justify its olden reputation as the granary of Asia. It must be remembered, however, that the Babylonian country, which in the time of Herodotus was by far the most fruitful known, and where the millet grew to such a height that Herodotus, though he well knew it, would not mention it lest it should appear incredible, does not at the present time justify its ancient reputation. Incidentally we also learn that Zamindawar, to the north-east of Seistan, and also watered by the Helmund, is a prolific region; that in northern Afghanistan the economic value of the Murghab river is still great; and that much of Afghan Turkestan is rich in agricultural possibilities. The author thinks that some of these "roads of the old khafila travellers may again be the roads of modern progress"; and he extols the route from Kabul and Ghazni to the Helmund as one of the "grandest high-roads in Asia, from the days of Alexander to those of Roberts."

The chapter on the "strange land of Makran"—the land of Gedrosia, where Alexander discovered that a trackless and waterless desert under a burning sun was an enemy against which even his unconquerable energy was impotent—is perhaps the most interesting and novel of the whole interesting story.

In days contemporaneous with the Heptarchy, the Arabs ruled Makran, and it was through Makran that they invaded India and conquered Sind.

"For three centuries there existed through Makran one of the great highways of the world, a link west and east such as has never existed elsewhere on the Indian border, save, perhaps, through the valley of the Kabul river and it affluents."

This highway ran about fifty miles north of the Makran coast that proved so disastrous to the Macedonian army, and behind the successive ranges of hills that face that coast. The author thinks that it may yet develop into a line of railway between India and Europe, particularly as it would enjoy the unique advantage, from a British point of view, of command and protection from the sea.

We get glimpses of some of the natural wonders of the Makran coast that almost remind us of pages of Hakluyt; submarine mud volcanoes, weird and fantastic strata, piles of sea-shells on upraised mud-flats, desiccated forests with the trees waiting to be fossilised as they stand; stiff, straight, spurless ranges of hills lying east and west like parallel lines of ramparts, with long, narrow, flat-bottomed valleys between them; and the curiosity of the archæologist will be whetted by allusions to ruined cities and tombs and gigantic irrigation works.

The interest of the latter half of the book is of quite a different kind. We now shake off the fascination of a dim storied past, and come face to face with the facts and political intrigues of the nineteenth century. Here we find an abstract and brief chronicle of the adventures of Christie and Pottinger, of the extraordinary Masson, of Lord and Wood, of the ill-fated Moorcroft, of Burnes, of Vigne, of Broadfoot, and of Ferrier.

The author remarks, as a strange fact, that we are indirectly indebted to Napoleon Buonaparte and his nefarious designs on India for these early explorations of Afghanistan. On the same chain of causes, we may note in passing, hang the discovery of the Rosetta stone and the key to the arcana of ancient Egypt. Thus do we by indirections find directions out, and thus he that increaseth sorrow sometimes increaseth knowledge.

The author thinks nobly of his predecessors in the exploration of the gates of India. As explorers he calls them "magnificent." He in no way approves the opinion that their work is superseded, and he is inclined to doubt whether the superior mechanical equipment of the modern explorer altogether balances the superior methods of the pioneers who lived among the people, adopted their dress, ate their salt, and talked their "shop."

A few words may be said about the first part of the book, which contains, *inter alia*, an introduction, and an account of Alexander's invasion of India. Here we think that the author hardly does himself justice; there is too much conjecture, not always relevant, and there are some statements and rather airy assertions that are hard to accept. For instance, the delightful history of Herodotus, which was written to the pious intent that the great and wondrous deeds of men might not be effaced by time, is referred to, almost barbarously, as a "geographical treatise," and, worse still, as a "gazetteer." Again, on p. 13, there is an extraordinary assertion about sailors and geography. If we have not misinterpreted it, it implies, if it does not actually assert, that sailors are not of much account as geographers. Now, among the things that we have kept from our youth up—and we fancy we are not singular in this respect—is a firm belief

that the greatest of all geographers were sailors, and we venture to adduce the names of Magellan, Columbus, Drake, Baffin, Davis, Hudson, Cook, Franklin, Ross, and McClintock in support of it, not to mention any names of those now living. Once more we demur to the use, in any literal sense, of such metaphorical expressions as "early Persian Department for geographical intelligence." The early Persian expeditions that we know anything about—namely, those against Greece—relied on spies and on guides picked up at the moment. Finally, where so much is said about Greeks and Alexander one is disappointed to find the famous Macedonian pike (sarissa) disguised as "sarina"; and ballistæ and catapeltæ (did Macedonians use the Roman ballista?) translated as "mounted infantry and artillery"; and Nearchus appearing now (correctly enough for those who like that fashion) as Nearkhos, and now (to suit no fashion) as Nearkos. In the case of a name like Nearchus, the free and easy fashion approved by Mr. Tony Weller is hardly to be commended. These things are blemishes which we should not care to remark if the book were not so good and so fresh in its essentials.

GENERAL BIOLOGY.

Allgemeine Biologie. By Oscar Hertwig. Dritte Auflage. Pp. xviii+728. (Jena: Gustav Fischer, 1909.) Price 16 marks.

IN the review of the second edition of this work, which appeared in this journal in 1906, it was pointed out that for any single man to undertake to give a circumstantial and critical account of the numerous problems of modern biology, and to support the conclusions arrived at by a sufficient record of the facts on which they are founded, is too stupendous a task, and one which certainly cannot be adequately carried out in a single volume. The third edition of Dr. Oscar Hertwig's book follows soon after the second, and it is to be inferred that it has been useful to a large circle of readers in Germany and elsewhere, though it has not attracted so much attention in England. It is doubtful whether the third edition will be more successful in this country than its predecessor. It is enlarged by the addition of eighty pages, and the illustrations in the text, which are well chosen and for the most part admirably executed, have been increased in number from 371 to 435.

Dr. Hertwig is a lucid writer, and has a style which attracts the reader and carries him easily through many difficult places, but in almost every chapter he leaves a certain sense of disappointment. There is a vast amount of information, and the argument is clear, and in many places convincing, but the detail is insufficiently worked out. This, perhaps, is no great fault in a text-book, if such information as is given is founded on the best and most recent authorities, and the references to literature are sufficiently full and up-to-date. But it cannot be said that this is always the case. To take some examples, the author informs us in the preface that the sections on the maturation divisions of the germ-cells, on natural and artificial parthenogenesis, on hybridism and the biogenetic law, have been largely re-written and revised in this edition.

In the section on the maturation divisions we are disappointed in finding that the discussion turns mainly on the phenomena observed in Ascaris. The work of vom Rath, Rückert, and Korschelt is also dealt with, but there is no mention of Farmer and Moore's important papers on the Maiotic phase in animals and plants, and their papers, which surely are old enough to be incorporated in a text-book published in 1909, are not even quoted in the list of literature. The section on natural and artificial parthenogenesis is more satisfactory, as a fair summary is given of the more important experimental researches on this subject up to the year 1908. The discussion of the results is, however, somewhat unconvincing.

Mendel's law, which was ignored in the second edition, is concisely dealt with in the latter half of chapter xiii. Here only a few simple cases are quoted to illustrate Mendelian principles, and no discussion of more complicated and unconformable cases is attempted. As in many other parts of the book, the experiments of Continental authors are quoted, but the large amount of English work on the subject is not taken into account.

Dr. Hertwig is quick to take advantage of the results of Mendelian work in support of his own theories of inheritance, but it is not always easy to understand in this connection, as in many others, what his real opinion is. It might be described, in Mendelian terms, as a polyhybrid of several theories promulgated by different authors; and sometimes one is inclined to think that, under stress of argument, his system resolves itself, by a process of segregation, into its original elements. He maintains, as he was one of the first to assert, that the chromosomes are the bearers of the heritable qualities of the organism, and it may be said in this connection that he disposes too easily of the evidence furnished by Crampton, E. B. Wilson, and others, that specific organ-forming materials are located in the cytoplasm of the egg. But while admitting the existence of a nuclear idioplasm, he will have nothing to do with Weismann's theory of biophors and determinants, but holds with Nägeli that the idioplasm has a micellar structure, and that it is distributed equally to every product of cell-division. None the less, he speaks of particles (Teilchen) which are bearers of inheritable qualities, and comments on the fact that Mendelian experiments show that these particles must be mobile and capable of forming new combinations. Hence, he says, it is clear that the chromosomes cannot retain their individuality, but must be regarded as tactical combinations of smaller units. Few will be disposed to quarrel with this conclusion, but it is not obvious wherein these "smaller units," capable of entering into tactical combinations, and representative of the specific or racial characters (Merkmale) of the adults, differ from Weismann's determinants.

Here, as in several other places, Dr. O. Hertwig appears to be inconsistent, but it would be an injustice to press this charge of inconsistency too closely. He is a champion of an epigenetic theory of development, and argues with admirable clearness in favour of the view promulgated at the same time by Driesch and himself, that the destiny of any given cell in a developing organism is a function of its position. At the same time, he brings into account the indisputable fact that the characters of the organism, and therefore of the cells composing it, are determined beforehand by the constitution of the fertilised ovum from which it is derived. In other words, he admits preformation, but preformation tempered by the mutual interaction of parts and the influence of external conditions.

There are many indications that the impartial position adopted by Dr. O. Hertwig is the right one, and, after all, it is the position taken up by Darwin, who wrote that "there are two factors, the nature of the organism, which is much the more important of the two, and the nature of the conditions." But latterly opinion has been sharply divided on these questions, and to partisans of the preformationary or epigenetic schools any attempt to reconcile such apparently irreconcilable theories exposes the author to the charge of inconsistency. In truth, it is very difficult to draw certain conclusions from the available evidence, much of which appears to be contradictory. It is the chief merit of Dr. Hertwig's work that he refuses to take extreme views, and no better exposition of the middle position can be found than is contained in this volume.

COMMERCIAL ORGANIC ANALYSIS.

Allen's Commercial Organic Analysis. A Treatise on the Properties, Modes of Assaying, and Proximate Analytical Examination of the Various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine, &c. Fourth edition, vol. i. Edited by Dr. H. Leffmann and W. A. Davis. Pp. x+576. (London: J. and A. Churchill, 1909.) Price 21*s.* net.

THE first volume of the last edition of this well-known treatise was issued in 1898, and was remarkable for the introduction of two features, which have become the most striking characteristics of this first volume of the new edition. These are the recognition of the fact that the subjects to be dealt with are so numerous and important that a single compiler can no longer cope with them, and that in publishing a large and important work of this kind in English it is desirable to endeavour to meet the needs both of readers in this country and in the United States. This latter consideration is a very important one, and it is to be hoped that its recognition will facilitate the re-publication of other large works of reference in English.

This volume is divided into ten sections, and each of these is written by an expert in that branch. It will be a matter of satisfaction to those familiar with "Allen" to find that in bringing the subject-matter up to date it has been possible to retain the old arrangement. The introduction is written by the English editor, Mr. Davis, and shows perhaps less change than most of the other sections, the most important additions being useful chapters on (1) refractometers, (2) spectrometers and spectrographs, and (3) the determination of moisture, "crude fibre," and ash, all these being of sufficient general importance to warrant their discussion in the introduction. This section is, on the whole, a very satisfactory piece of work, though it is rather doubtful whether it was worth while to devote about three pages (53–6) to an illustrated description of an arrangement for maintaining a temperature constant to within a few thousandths of a degree, since the commercial analyst is not likely to want refinements of this description in practice. Further, the space devoted to the "Employment of Immiscible Solvents" (pp. 79–82) might have been much curtailed, as the present-day analyst is probably perfectly familiar with the separating funnel and its use. The table at the end of this section is reprinted from the third edition, and should have been omitted, as it is too general to be of any value, and, moreover, contains the inaccurate statement that cantharidin, picrotoxin, and santonin are glucosides. It is also a mistake to refer to "saponin" as if this were a single definite substance.

Dr. Leffmann, the American editor, contributes two sections, the one entitled "Neutral Alcoholic Derivatives," and the other, not very happily named, "Acid Derivatives of the Alcohols."

Notable additions are the very useful article on "Yeast" by Mr. Emil Schlichting, and the excellent section on "Papers and Paper-making Materials by Mr. Sindall. Mr. G. C. Jones contributes the sections on "Alcohols" and "Wines and Potable Spirits." Both these seem to contain all the data an analyst is likely to need, but in the second section something might have been said regarding the analytical work on rum carried out in recent years in Jamaica and British Guiana.

The remaining sections are those on "Sugars" and "Starch and its Isomerides," both written by Dr. E. F. Armstrong. In the main, these are excellent *résumés* of the present position of the chemistry of these subjects, and the omissions are of a trifling character. In the first some reference should have been made to the detection and estimation of such glucosides as salicin and strophanthin, used in medicine, but possibly it is intended to deal with these under "Drugs" in a later volume. Under "Starch" no mention is made of the analytical characters of the "sago substitutes" that are now prevalent in commerce. The article on gums in this section is little more than a replica of that in the third edition, and it is unfortunate that the author did not take the opportunity of correcting the errors in it.

The book as a whole is very well edited, but there are a few curious mistakes; thus in three places the name of one of the authors is written "Schlichting," and in the fourth and most important place, viz. at the head of his contribution, it is given as "Schlighting." The heading of one section is printed

as "Starch and Isomers" in the list of contents, and as "Starch and its Isomerides" above the text of the section itself. Finally, the book is described as "printed in America." Printers in the United States do not apparently believe that "the whole is greater than its part." T. A. H.

TROPICAL CLIMATOLOGY.

Handbuch der Klimatologie. By Prof. Julius Hann. Band ii., Klimatographie. 1 Teil, Klima der Tropenzone. Dritte, wesentlich umgearbeitete und vermehrte Auflage. Pp. xii+426. (Stuttgart: J. Engelhorn, 1910.) Price 14 marks.

THIS is the first part of vol. ii. of the third edition of Prof. Hann's "Handbuch der Klimatologie." Vol. i. dealt with general principles, and we now come to the detailed consideration of the climates of different parts of the world. The volume before us concerns itself with the tropics, the consideration of temperate and polar regions being reserved for subsequent volumes. The author has not confined himself strictly to the area lying between 23½° north and south of the Equator. When desirable he has gone outside this region. Roughly speaking, he discusses that portion of the earth's surface which has an annual mean temperature of 20° C. or above. The isotherm of this value may be taken as marking the polar limits of the trade winds, when definable, and of the palm tree.

A great part of the book is taken up with tables, interspersed with descriptive paragraphs taken from the writings of travellers or residents in the regions under review. The tables refer for the most part to the elements, temperature, and rainfall, but where the data are available, tables of wind direction frequency, humidity, cloud amount, and pressure are added. The additional matter incorporated since the second edition appeared in 1897 is considerable. For some areas the author has had the advantage of consulting works such as Captain Lyons's "Physiography of the Nile Basin," but for others he has had to go into the byways of meteorological literature. The labour involved in collecting and working up the scattered fragments must have been prodigious even for so indefatigable a worker as Prof. Hann, and we can but admire and marvel at the thoroughness with which the task has been completed. Much time has been expended over the calculation of true means of temperature from daily extremes or from readings at fixed hours. Even so, Prof. Hann regards many of the values as still uncertain, but in the absence of adequate knowledge of the course of the diurnal variation, no more can be done at present.

The introductory chapter discusses the general characteristics of tropical climate. A special section is devoted to its physiological action on the human organism, particularly that of the white man, and affords an opportunity of referring to the recent advances in the domain of tropical medicine. After that we are introduced successively to West Africa and the Congo, East Africa with the Sudan, the monsoonal area of Asia and northern Australia, the Pacific islands, and finally to tropical America.

OUR BOOK SHELF.

The Fourth Dimension Simply Explained. Edited by Prof. H. P. Manning. Pp. 251. (New York: Munn and Co., Ltd., 1910.) Price 1.50 dollars net.

THERE are few fallacies which have done more to mislead the unscientific public than the misconception known as *the fourth* dimension. The use of this term is calculated to convey the false impressions, first, that hypergeometry is limited to space of four dimensions instead of being extended to space of n dimensions where n is any positive integer; second, that even not going beyond four dimensions, there is one particular coordinate called the fourth dimension which stands out from the rest, and alone is worth considering.

Now so long as we regard four-dimensional space as a geometrical conception, there is no difference between its fourth dimension and its first, second, and third dimensions, just as in ordinary solid geometry there is no third dimension distinguishable in any respect from a first and second dimension. On the other hand, as soon as we introduce the concept of a fourth coordinate differing essentially from the other three, this coordinate ceases to be a geometrical conception, and may be taken to represent time, density, or anything else we like.

Some American who had some money to get rid of and had no better use for it offered, in the *Scientific American*, a prize of 25*l.* for the best popular explanation of *the fourth* dimension, and the present volume is a collection of selected essays that were submitted in the competition, with an introduction by Dr. Henry P. Manning. It must be admitted that what the authors have written is mostly sensible and reasonable enough, and in no way contradicts the remarks that have been made above. If the book had been brought out under the title "Hyperspace Simply Explained," and the titles of those essays where the words occur had been altered by the substitution of "four" for "the fourth," the utility of the book would have been considerably increased. It contains very little that can be described as ***unscientific.***

Diagram showing the Classification of the Elements: Periodic Arrangement. Size 44×68 inches. (London: Baird and Tatlock, Ltd.) Price, mounted on cloth, rollers, and varnished, 25*s.*

THE "periodic" classification of the elements plays such an important part in courses of inorganic chemistry for students that a large wall diagram illustrating this classification has now become a prominent feature in the equipment of the chemical lecture theatres of colleges and technical institutions. Such diagrams have usually had to be prepared by the staff of the department concerned. Many teachers of chemistry will therefore welcome the issue of a large printed chart, suitably mounted on stout linen, giving the usual periodic classification of the elements with their names and atomic weights. The lettering is bold and clear, although, perhaps, a little wider spacing might have been allowed with advantage.

The chart fails to show, however, the differentiation of each vertical group into "odd" and "even" series. From a teaching point of view there is much to be said for placing the helium and argon group of elements before the alkali group and not after the halogens. The method of classification used for the iron-platinum group is perhaps not quite the most satisfactory one, though this is, of course, at present largely a matter of individual opinion. The chart as a whole would probably gain in clearness by replacing in future issues the names of the elements by their customary symbols.

Apart from the relatively minor points just mentioned, the chart will probably prove of considerable service to lecturers of chemistry by relieving them of the necessity of preparing the large diagram illustrating the periodic classification which is now essential for class teaching of chemistry.

Leitfaden der Biologie für die Oberklassen höherer Lehranstalten. By Dr. O. Rabes and Prof. E. Löwenhardt. Pp. x+248. (Leipzig: Quelle and Meyer, 1910.) Price 3 marks.

THIS book is intended for the use of pupils who have already had a certain amount of biological training in school. It covers a very great deal of ground in a very superficial manner, but in the hands of a capable teacher it should serve as a good foundation for an extremely interesting course of general biology. It commences, in what we conceive to be a very logical manner, with a general account of the cell, but the fact that this occupies less than one page is typical of the superficial method of treatment. A few unicellular organisms are then dealt with, chiefly from the physiological point of view.

The general physiology of multicellular organisms comes next, and the first part concludes with a description of seventeen types of plants and animals, ranging from bacteria to the bean in the vegetable series, and from Paramœcium to the rabbit amongst animals. The descriptions and illustrations of these seventeen types occupy twenty-six pages! The type system has become almost vestigial.

The second part of the book is devoted to the dependence of organisms upon their environment (œcology), including geographical distribution and an appendix on the geological history of plants and animals and the theory of descent. The third part deals with man, mainly from the physiological, ethnological, and palæontological points of view.

The book is very copiously and admirably illustrated, but four or five volumes of its size would be required to do justice to the subject-matter.

Tarr and McMurry's Geographies. The Five Book Series. First part, Home Geography. Pp. xi+112. Price 2*s.* 6*d.* Second part, The Earth as a Whole. Pp. ix+168. Price 2*s.* 6*d.* Third part, North America. Pp. xix+469. Price 4*s.* 6*d.* Fourth part, General Geography, South America and Europe. Pp. xvii+378. Price 3*s.* Fifth part, Asia and Africa. Pp. ix+214. Price 2*s.* 6*d.* By Prof. Ralph S. Tarr and Prof. Frank M. McMurry. (New York: The Macmillan Co., 1908, 1909, 1910.)

THE authors, who are well-known writers on geographical subjects from the point of view of the school, have evidently taken great pains to adapt themselves to the needs and capabilities of young pupils. On the whole, they have been successful in producing a good, workable course of school geography. Written primarily for American boys and girls, great prominence is given to the geography of the United States and less importance to that of the British Isles. When it is pointed out, however, that while 230 pages are devoted to the United States, the British Isles are disposed of in 35 pages, it will be seen that the volumes are hardly suitable for adoption as class-books in our schools. But they should prove of great assistance to our teachers in showing how geography may be taught in a way to arouse interest and develop thought. Every part is well and profusely illustrated with views, diagrams, and photo-relief maps. In addition there are numerous coloured political maps, but no use appears to be made of coloured orographical maps.

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.*]

Koch's Discovery of the Method of Plate-culture of Micro-organisms.

READING the interesting notice of Robert Koch which appeared in NATURE of June 2, I was reminded of an incident mentioned concerning his early scientific career in the preface to Cohnheim's "Gesammelte Abhandlungen." Cohnheim, the pioneer of what has been sometimes termed physiological pathology, died in 1884 at the early age of forty-five. The preface to his collected works, published in the following year, contains a charmingly written memoir of him from the pen of his friend W. Kühne, the accomplished Heidelberg physiologist. The obituary notice of Koch in NATURE rightly stressed the immense value to bacteriology of his invention of the plate-method for obtaining pure cultures of micro-organisms. The incident reported by Kühne in his memoir of Cohnheim has reference to that, and to Cohnheim's contact with Koch in consequence of it in the year 1875. At that time Cohnheim was already full professor of pathology in the University of Breslau, and his brilliance as an investigator was already attracting to his laboratory men of promise from all parts. Koch, on the other hand, was in country practice in Silesia, and quite unknown to the scientific world. Koch's discovery of the plate-method led to Cohnheim's discovery of Koch, and the enthusiasm and remarkable prevision at once shown by the young professor of pathology regarding his unknown compeer, only two years younger than himself, are strikingly told by Kühne. His words run:—

"In November, 1875, Robert Koch wrote begging Cohn, the celebrated botanist, Professor of Botany in the University, to look at cultures of anthrax bacilli which he (Koch) had prepared pure; and for that purpose Koch went to Breslau to see him. Cohn had had many tiresome and disappointing experiences of cultures of pathogenic organisms brought to him with the assertion that they were of pure and isolated species; in the present instance he naturally felt at first little confidence, but after interviewing Koch he sent a messenger to the Pathological Institute asking someone to come over because a visitor, Dr. Koch, had something to show which was 'quite right and very interesting.' In the Pathological Institute, Weigert, Cohnheim's assistant, was about to perform an autopsy; Cohnheim himself therefore went across to the Botanical Laboratory, and when he returned he said, 'Now leave off everything here and go over to Koch. The man has made a tremendous discovery, which for its simplicity and its accuracy of method deserves admiration all the more because Koch himself is living entirely remote from scientific intercourse, and has done it all by himself and finished it right out. There is nothing whatever to add to it. I regard it as the greatest discovery in the whole field of bacteriology, and I believe Koch will surprise us all in times to come with further discoveries and put us all to the blush for our laurels.'"

Perhaps this picturesque reference to a turning point in Koch's earlier career, being contained in a volume little likely to be sought for information about him, might escape the notice of some whom it would interest, especially at the present time.

C. S. SHERRINGTON.

The University, Liverpool.

Crocodiles and Sleeping Sickness.

IN the obituary notice of Prof. Robert Koch in NATURE of June 2 (p. 404), it is stated that "Koch suggested that the crocodile might be the reservoir host of the trypanosome that gives rise . . . to sleeping sickness." This is a statement that has been made very often, especially in the daily Press, but which I, for my part, have never been able to verify, although I have some acquaintance with Koch's writings on the subject of sleeping sickness. Since this idea has been attributed so often to Koch, it is doubt-

less safe to assume that there is some foundation for doing so, and I should be very glad to learn when and where Koch made the suggestion that the crocodile is a reservoir host for sleeping sickness. The point is merely one of historical and bibliographical interest, since in his latest writings Koch expressly repudiated the idea of any such connection between crocodiles and sleeping sickness (see NATURE, February 18, 1909, p. 458, and May 5, 1910, p. 279; also the Bulletin of the Sleeping Sickness Bureau, No. 11, November 5, 1909, p. 421, footnote).

E. A. MINCHIN.

Lister Institute of Preventive Medicine, Chelsea Gardens, S.W., June 8.

PROF. MINCHIN'S letter comes as a reminder, so often repeated, and apparently not too often, that one should verify one's references. I had read a leading article in the *Lancet* of October 30, 1909, on the work of the German Commission, but I had not referred to the original report, and I am afraid that the statement that the *Glossina palpalis*, on occasion, takes its nutriment from the unprotected parts of the crocodile led me somewhat astray as to the exact significance of Koch's observations and recommendations. I am glad that Prof. Minchin has directed attention to the matter. *My* excuse must be that the article had to be in the hands of the editor within a few hours of my receipt of a re-directed telegram, and that I had to depend upon my memory for almost everything but a few dates and data which appear in "Wer ist's."

THE WRITER OF THE ARTICLE.

The Earth and Comets' Tails.

IN spite of the unreserved predictions of astronomers, the earth did not pass through the tail of Halley's comet on May 18–19, nor subsequently. The tail as seen in the morning sky, previous to the transit of the comet across the sun's disc, appeared like a long and straight beam of light stretching from the horizon to Aquila. It was noticed from day to day that the tail was practically fixed in position in the sky. We rather expected the tail to get nearer to Venus and Saturn as the comet approached the ecliptic, but it remained stationary. On the morning of transit, May 18–19, the tail was unchanged, but a second branch to the south was now noticed. It joined the northern branch to the east of the Square of Pegasus. Unfortunately, this southern branch was near the zodiacal light, and only distinguished from it with difficulty.

Both these tails were seen morning by morning, including this morning (May 22, Civil day), but they have diminished in brightness, and were difficult to see. Further observation of these will be impossible, because of the moon remaining above the horizon until after dawn during the next ten days. The whole eastern horizon where the tails meet and where the zodiacal light is was suffused with a dim and indefinite glow, which was particularly noticeable on May 18–19 and 20–21. This glow was not so definite in boundary as the zodiacal light. When the comet was seen on the evening of May 20 we were surprised to see it had the ordinary tail pointing away from the sun as usual. It had been noticed for several days that in the neighbourhood of the sun the sky was not so blue as usual, but this was the case even a week before the transit, and is probably merely a meteorological phenomenon. This brief summary of the facts will suffice here; the observations in detail will be published elsewhere.

We have now to explain the reason why the earth did not pass through the tail of the comet, and why the tail broke up so that some of it was left in the morning sky, where it remains, and is slowly losing its luminosity, and some (or another tail) appeared in the evening sky. It is well known that a comet under the sun's radiant action (I do not attempt to define it more closely) expels corpuscles towards the sun which the sun repels, and these luminous corpuscles form the tail. This process goes on even when (as in the case of Halley's comet) the distance between the comet and the sun exceeds the distance of the earth from the sun. If the nearer planets do not show tails it is because these corpuscles have been shed by the planets ages ago. In short, a comet and a planet under the radiant action of the sun, and the sun itself, all repel these corpuscles. This being so, it is impossible for the earth to go through the tail of a comet—it simply repels the tail, and, as a consequence, instead of a passage through it, a disruption near the time of passage must occur, one part being left in the (in this case) morning sky, whilst a new one is developed in the evening sky. Here I may remark that on the evening of May 20 the measured length of the new tail was 19°, on May 21 32°, and on May 22 it was 40°.

Again, the earth is bombarded with meteorites, which are also throwing off corpuscles. These will be repelled by both earth and sun, so that if we look at the part of the sky opposite to the sun we should, and do, see the faint tail thus formed which is known as the Gegenschein. This simple theory explains all the facts of observation, and, if it is correct, will save nervous individuals some worry when the next near approach of a comet's tail is imminent.

R. T. A. INNES.

Transvaal Observatory, May 22.

P.S.—Mr. H. C. Reeve, of Lorentzville, under date May 22, has sent me a letter conveying the same idea. He says:—"Whatsoever nature the stress between the sun and the comet may be which causes the repulsion of the tail . . . the same stress must also exist between the earth and the comet . . . under these circumstances the earth could not possibly pass through the comet's tail."

ON the morning of May 19, at between 4 and 4.30 a.m. standard Indian time (5½ hours from Greenwich), the tail of Halley's comet could be seen stretching as far as the Milky Way near Sagittarius, if not beyond. The tail was much fainter than it had been two or three days previously, but was still quite distinct.

In the constellation Sagittarius, however, a dark band, like a shadow, stretched diagonally right across the tail upwards from east to south at an acute angle of about 20° to 30° with the direction of the tail. The edges of the band were approximately straight and parallel, and the width of the band was perhaps two or three degrees.

No luminosity could be noticed within the band.

If, as seems probable, the tail was then entering into the shadow of the earth, it would appear that at any rate the major portion of the light of the tail was light reflected from the sun.

A. S. HEMMY.

Government College, Lahore, Punjab, May 26.

The Term "Radian" in Trigonometry.

NATURE of April 21, containing Mr. Thomson's letter, has just reached me, and I hasten to say that, had I known that his father had ever claimed to have originated the word "radian" I should, of course, have mentioned the claim in my communication to NATURE of April 7. As a matter of fact, Prof. Thomson never did so in my presence, and he certainly knew shortly after he came to Glasgow that I had on my own initiative proposed the word, and had made use of it for some years. One day when I met him accidentally he told me that he had found a college student who had been a pupil of mine using the word "radial" for a unit-angle, and that, while agreeing with me as to the need of such a word, he had doubts as to the suitability of the terminal syllable. My reply, as may be guessed from my recent communication, was that "radial," "radian," "rad," had all something to be said for them, and I referred him to my letter to NATURE dated April 4, 1870. On at least two subsequent occasions we spoke of such things, and he supported the termination *-an* in this particular case, because of a supposed analogy with the geometrical term "median." All this, you will see, does not preclude the possibility of an independent origination of the term by him in July, 1871, as stated by Mr. Thomson, and I therefore regret that here there is no chance of me having the satisfaction of seeing the printed word in the Calendar of Queen's College, Belfast, for 1873–4.

May I direct attention to the fact that in justification of his letter Mr. Thomson unfortunately represents me as saying that it was in 1874 that "the word was finally adopted"? This is quite incorrect. If he will kindly

glance at my letter again, he will see that, speaking of the various forms which I had used or had under consideration during the preceding five years, I said that in that year (1874) "the form *radian* was definitely adopted by me." It is the words *form* and *by me* that here make all the difference.

The same mail steamer which brought Mr. Thomson's letter brought for delivery a few hours later a tattered copy of the third edition of Todhunter's "Plane Trigonometry," sent to me as evidence of a still earlier use of the word "radial" to denote the unit-angle in question. This text-book was the property of a pupil of mine in 1867, and it contains in my handwriting of that date the words "1 radial $= 180°/\pi$, 1 degree $= \pi/180$ rad." When next in England I shall offer it for your own and Mr. Thomson's inspection.

THOS. MUIR.

Cape Town, South Africa, May 11.

I SHALL be very pleased to send Dr. Muir a copy of my father's examination questions of June, 1873, containing the word *radian*; and when Dr. Muir returns to England I should like to show him my father's copy of the "Imperial Dictionary" containing a note in his own hand saying that he had proposed the word in July, 1871. So far as I know, he did not meet Dr. Muir until he came to Glasgow in October, 1873.

It thus appears that *radian* was thought of independently by Dr. Muir and my father, and, what is really more important than the exact form of the name, they both independently thought of the necessity of giving a name to the unit-angle.

JAMES THOMSON.

22 Wentworth Place, Newcastle-on-Tyne, June 1.

The Nutritive Value of Black Bread.

IN the issue of NATURE for June 2 (p. 398) there is a letter from a correspondent in reply to the article on "The Nutritive Value of Black Bread." The correspondent points out that the writer of the article overlooked one all-important question, viz. how much of the nitrogen present in each form of bread is actually digested? In the original article the writer complained that misleading statements were made by some politicians during the last Parliamentary General Election with regard to German black bread. No doubt some of your readers expected to see a letter or two in reply to this complaint. There has not been one.

Now what are the facts with regard to German black bread? What the people of the United Kingdom care about is what their bread will cost. They do not care whether that bread, which the Germans themselves call "black bread," is black, or brown, or grey. The following are the prices obtained from a large bakery in the town of Elberfeld last December:—

Flour.

Description	Price per 14 lbs. s.	d.
Finest wheat flour	2	8
Wheat flour	2	5½
Best rye flour	2	1½
Ammunition flour	1	10
Coarse rye flour	1	9½

Bread.

Description	Price per 4 lb. loaf d.
White bread, made with milk and wheat flour	9½
Fine bread, made of wheat and water	8¾
Rye bread, pure	6
Rye + wheat (¼ wheat + ¾ rye)	6
Rye + wheat (⅛ wheat + ⅞ rye)	6
Ammunition bread	5¾
Black bread	5

From the above figures, which have never been challenged, your readers can draw their own conclusions.

Protectionists are most anxious to prove that rye bread is good, and they suggest that it is preferred to wheat bread. Free Traders never denied that rye bread was good. They stated that it was an inferior bread to wheat, and that the chief reason for its use in Germany was its lower price in comparison with wheat bread. Rye costs less than wheat in Germany, and this is a proof that it is an inferior grain. The bread which is reckoned the finest bread is wheat bread, all the world over, and in the best hotels in Germany it is regularly served with all meals. On account of the duty the price of wheat bread is too high in Germany for working-class people, and they buy breads made from mixtures of cheaper grains, according to price. The "black bread" in Elberfeld is made from a very coarsely ground rye flour, and it is sold and spoken of as "black bread," although it is a very dark brown in colour.

FRED SMITH.

92 Halsbury Road, Fairfield, Liverpool, June 4.

IT is assumed in the letter that the whole difference in price is due to the duty on wheat. But an examination of the figures given shows that the cost of the various breads is not closely proportionate to the price of the flours, and it would seem that the bakers take a much larger profit on the wheaten bread. Indeed, this must certainly be so unless the yield in bread from a given weight of rye flour is much larger than from a similar weight of wheaten flour, a point upon which no information is to hand.

THE WRITER OF THE ARTICLE.

The Recoil of Radium B from Radium A.

WHEN radium A is transformed into radium B, the process is accompanied by the expulsion of an α particle. It has been shown that in these circumstances the atom of radium B recoils from the α particle with considerable velocity, as is to be expected from a consideration of the momentum of the system.

Some experiments have recently been made to determine whether radium B is charged when it recoils, and, if so, to ascertain the sign of the charge carried by it. Measurements to determine whether the radium B was deflected when passing through an electrostatic field revealed the fact that at least some of the atoms of this product, on formation from radium A, carried with them a positive charge when projected through a high vacuum. Experiments were therefore made to measure the magnitude of the deflection suffered by the atoms of radium B when projected through an electric field at right angles to the direction of motion of the particles.

Now, since the α particles from radium A travel with a velocity of $1{\cdot}77 \times 10^9$ centimetres per second, the recoiling atoms of radium B should have a velocity of $3{\cdot}3 \times 10^7$ centimetres per second, on the assumption that the atomic weight of radium B is 214 and that of the α particle 4. The deflection to be expected when subjecting the recoil particles to a field of known strength can easily be calculated if it be assumed that each particle carries one atomic charge, or half that carried by an α particle. The results of the experiments to deflect the radium B in an electrostatic field were consistent with this theory of the phenomena, but the experimental difficulties were such as to prevent us, so far, from making very accurate determinations.

Before attempting to make these measurements with greater accuracy, it was thought of interest to investigate the deflection of radium B in a magnetic field. This has been done by Mr. E. J. Evans and one of us, and the results obtained show that when radium B recoils through a magnetic field the deflection suffered by the particles is of the size to be expected from theory.

Taken together, the results of the electrostatic and magnetic deflections of the atoms of radium B after recoil leave little doubt that the atomic weight of radium B is in the neighbourhood of 200, that this product carries with it on recoil a single positive atomic charge, and that the velocity of the particles is of the order of magnitude to be expected from considerations of momentum. It is, however, hoped that subsequent experiments may lead to a determination of these important quantities with accuracy.

W. MAKOWER.
S. RUSS.

Physical Laboratory, The University,
Manchester, June 10.

Curve Tracing and Curve Analysis.

THE review of a book on practical curve tracing in NATURE of June 9 is tantalising to one who is not in the least interested in drawing the graph of an equation, but who is frequently plotting curves from experiment, and who would like to find formulæ, not only to fit them, but to explain them. I look through most of the reviews of mathematical books in NATURE in the hope of discovering one that deals with the practical analysis of curves, and I am continually disappointed.

Can no mathematician be induced to recognise that for some of us an equation is the end, and not the beginning, of a piece of work? In innumerable cases experimental work ends with a curve, such, for example, as a hysteresis curve, and no attempt is made to find an equation to fit it.

Half a dozen rules exist, the uses of log. and semi-log. paper can easily be explained, but nobody has gathered them together with explanation of the difference between empirical formulæ and rational equations, of interpolation, smoothing, and of the legitimacy of extrapolation.

London, June 9. A. P. TROTTER.

A Brush for Collecting Mercury.

SINCE more or less mercury is always spilled around the laboratory, a simple and efficient mercury collector is of great use. I have found a very good one, and, since I have not seen it in use before, I will describe how it is made.

It is made like a paint-brush, with the difference that #40 copper wire is used instead of camel's hair in the brush part. The fine copper wire is then amalgamated with mercury. Use the brush as though painting with it. It will take up large globules and go into cracks and collect the smallest particles, so that none need be lost. Use a cup when collecting, and when the brush is full shake the mercury into the cup.

GEORGE WINCHESTER.

Washington and Jefferson College, Physical Laboratory, Washington, Pa., May 28.

LIGHT ALLOYS.

THE problem of producing an alloy which shall combine great strength with a low specific weight has been before metallurgists ever since the commercial manufacture of aluminium became an accomplished fact; more recently, however, the requirements, in the first place, of racing yachts, then of motor cars and of motor cycles, and, finally, the pressing problems of aërial navigation, have added a rapidly increasing importance to the whole question. At the present moment German manufacturers particularly are putting forth claims in regard to achievements in this direction which appear startling at first sight, and it is interesting to examine the whole state of the question.

The need for a light alloy lies in the fact that pure or nearly pure aluminium is, unfortunately, very weak mechanically. Its low specific gravity (2·71) is more than counterbalanced by the fact that its tensile strength, even in the form of rolled bars, does not exceed 7 tons per square inch. If these figures are compared with those of the best special alloy steels suitable for structural purposes, we find that some of these show tenacities up to 64 tons per square inch, with a density of approximately 7·9. Consequently, a bar of aluminium, to bear the same ultimate load as a bar of such steel having a cross-sectional area of one inch, must have a sectional area of approximately 9 square inches, and would therefore weigh about three times as much as the steel bar. A light alloy which is to compete successfully with such special steels, therefore, must either be much lighter than pure aluminium or it must combine with the density of aluminium a tensile strength of 21 tons per square inch.

So far as alloys consisting principally of aluminium are concerned, it does not appear that this tensile strength has ever been attained, except in the case of hard-drawn wires the ductility of which has been reduced to an excessively low value. It must, however, be borne in mind that the high-tension steels referred to above cannot be employed in excessively thin sections, so that in many special cases, where the scantling of structural parts cannot be reduced to minute dimensions, while the strength required is not very great, light alloys may be employed with advantage as compared with alloy steel. The same argument applies, however, to a comparison made on similar lines between light alloys and the stronger kinds of wood. These woods are all considerably weaker, per square inch of sectional area, than the light alloys now available, but when their much lower density is taken into account, as well as the advantage of larger scantlings, the result must in many cases be favourable to the employment of wood. It is for this reason that the frames of most aëroplanes are constructed of wood. When, however, an alloy of density less than 3, and possessing a tensile strength of more than 20 tons per square inch under conditions allowing of a ductility equivalent to an extension of not less than 15 per cent. on a 2-inch test-piece, becomes available, its employment will become advantageous as compared both with the best alloy steel and the best wood.

The light alloys available at the present time are somewhat numerous, and, as regards those of them which are patented or otherwise proprietary articles, it is difficult to obtain satisfactory data; it is certain, however, that extravagant claims are often advanced for such alloys, and these are not verified when samples are tried in a testing machine.

The claims of those advertising or selling such alloys must therefore be looked upon with much reserve.

Among the earlier alloys of aluminium which found a certain amount of practical application were those with iron and with nickel. One of the racing yachts engaged in one of the later races for the America Cup was built of plates rolled from one of these alloys, but the metal suffered from excessively rapid corrosion, and the presence of iron in aluminium alloys, although it undoubtedly confers considerable strength upon them, is rightly regarded as extremely undesirable. At the present time, the most completely studied of the light alloys are those in which copper is incorporated with the aluminium, either alone or with the addition of other elements, such as manganese. In the form of rolled bars and sheets, these alloys attain a tensile strength of slightly more than 17 tons per square inch, with an elongation of 15 per cent. on 2 inches; these figures apply almost equally to alloys containing about 4 per cent. of copper alone, or to those containing 3 per cent. of copper and 1 per cent. of manganese, or 2 per cent. of copper and 2 per cent. of manganese, the specific gravities of all these alloys lying close to 2·8. So far as trustworthy data are available, these figures probably represent the best available alloys of this character. Alloys of aluminium with from 15 to 20 per cent. of zinc may possibly yield somewhat higher figures, but, owing to the presence of a considerable proportion of zinc, their density is also much higher, so that they can hardly be classed among the light alloys.

The light alloys at present employed in practice are principally used in the form of more or less complicated castings, such as motor-car engine crank-cases, the corresponding parts of aërial motors, and similar purposes. When thus used the alloys cannot be compared with special alloy steels, and still less with wood, and they hold the field quite easily against cast-iron, brass or bronze of any kind. For these

purposes, hardness rather than ductility is desired, and alloys containing rather more than 4 per cent. of copper, or the corresponding amount of manganese, can be employed. The casting of these alloys presents some difficulty, but a considerable number of founders are able to produce castings of this kind with regularity; the secret of their success lies largely in casting the alloy at a suitable temperature, and in the preparation of a mould having a hard and very dry surface. All the alloys of this class undergo a comparatively enormous amount of shrinkage in passing from the totally liquid to the totally solid condition, and unless due allowance is made for this contraction, faulty castings always result.

In the case of the aluminium-zinc alloys, a difficulty of another kind arises; while these alloys are less viscous when molten, and flow into the moulds more freely than the aluminium-copper alloys, they are very weak and brittle while hot, and castings made of these alloys are very apt to crack while cooling if their contraction is opposed to any considerable extent; it is probably on this account that these alloys have acquired the reputation of being "treacherous." They have, on the other hand, been employed with some success for the production of so-called "die castings." These castings are produced by means of metallic moulds, and can be made so accurate that no machining is required even for such objects as screw-threads and certain parts of instruments. On the other hand, these alloys are said to be weak under vibration, but this statement as yet requires confirmation by systematic investigation.

The question of the power of light alloys to resist corrosive influences is one of considerable importance; it has been generally accepted by those accustomed to deal with aluminium and its alloys that the pure metal is much more resistant to corrosion than any of its alloys, and, as regards some of these, this view is undoubtedly correct. The numerous "solders" which have been advocated for jointing aluminium and its alloys all suffer very seriously from this point of view. It must, of course, be borne in mind that aluminium itself has a powerful affinity for oxygen, and only protects itself from rapid atmospheric oxidation by the formation of a very thin coating of oxide on all exposed surfaces; if this coating is ruptured, as, for instance, by friction, continuous oxidation results, and the presence of an alloyed element in the form of a distinct constituent may cause such interruption. Again, the contact of aluminium with another metal, in the case of all those metals usually met with in engineering construction, leads to the formation of galvanic couples, and the consequent rapid corrosion of the aluminium. In this way also an alloyed element may intensify corrosion. On the other hand, it is equally possible that the presence of an alloyed metal may improve the protective coating of oxide formed on the surfaces of the metal, and there is good reason to believe that the presence of copper produces this effect to some extent, while the presence of manganese—as has recently been shown—facilitates the formation of a surface "patina" containing manganese oxide as well as alumina.

Even in the best circumstances, however, the protection of light alloys from corrosion is a most important matter, and this is accentuated by the difficulty of finding a suitable paint or varnish the constituents of which do not act upon aluminium—an action which generally takes the form of an interchange of oxygen between the pigment and the metal. Processes for coating the light alloys with a less corrodible metal, such as copper, tin, zinc, &c., have been tried, but these modes of protection are accompanied by the risk of an increased amount of local corrosion owing to galvanic action, if the metallic coating is anywhere broken through. A more hopeful line of thought is to be found in the development of processes for coating the alloys with an adherent layer of some inert compound of aluminium, much as iron and steel are coated with a layer of phosphate of iron in the "Coslettising" process.

Finally, some reference may be made to the possibilities of the use of magnesium and its alloys for the production of light and strong materials of construction. The fact that magnesium has a specific gravity of only 1·74 at once suggests its use for such a purpose, but the fundamental objection lies in the fact that it is much more corrodible than aluminium, and that therefore the attainment of even moderate durability in its alloys must be a problem of much difficulty. That some solution of this problem may have been found is suggested by the statement recently made that the newest German Zeppelin airship is to be constructed of an alloy known as "Elektron," said to be an alloy of aluminium and magnesium. Its density is stated as being close to 1·7, so that it must clearly consist of magnesium alloyed with only 1 or 2 per cent. of aluminium. No data as to the strength of such an alloy are available, but from the known constitution of the alloys of the aluminium-magnesium system, it appears probable that the addition of aluminium to magnesium in proportions up to 7 or 8 per cent. will materially increase the strength of pure magnesium, but the actual results cannot be predicted; it is, however, probable that pure magnesium is rather weaker than pure aluminium, so that it would be surprising to find in this group an alloy having a density less than 1·8, with a tensile strength above 10 or 12 tons per square inch. Alloys of aluminium with small proportions of magnesium are, it may be mentioned, in somewhat extensive use, particularly for certain parts of scientific instruments, under the name of "magnalium," but these alloys, although somewhat lighter, are not so strong as the best of the aluminium-copper and aluminium-copper-manganese series.

From the foregoing review of the question it will be seen that the problem of light alloys is still far from a satisfactory solution, and that there is a need for further systematic study of the alloys of the lighter metals.

WALTER ROSENHAIN.

GREEK ARCHÆOLOGY.[1]

THE "Annual of the British School at Athens" still remains of the somewhat unwieldy size that it has assumed of late years. A return to the more convenient bulk of, say, vol. viii. would be welcomed by the reader; yet it cannot be said of any of the articles in vol. xiv. that any part of them might profitably have been excised. Only the fourth instalment of Dr. Mackenzie's work on "Cretan Palaces" seems rather too long. Still, no doubt the various questions raised by Dr. Dörpfeld's criticism of Dr. Mackenzie's former articles, Dr. Noack's work on Cretan buildings, and the discoveries of Neolithic prototypes of the "Homeric" palace in Thessaly, needed exhaustive treatment. So we are compelled to postpone reading Dr. Mackenzie's views on the relations of the Homeric house to the Cretan palaces until next year.

The director of the school and his assistants continue their account of the discoveries at Sparta, which have conferred such lustre upon British archæological work during the last three years. Few believed that excavations at Sparta would prove so interesting.

[1] "The Annual of the British School at Athens." Vol. xiv. (Session 1907–8.) Pp. x+468; 15 plates. (London: Macmillan and Co., Ltd., 1909.) Price 25s. net.

We assumed too hastily that the rude, countrified Lacedæmon of the prejudiced and tendencious Athenian historians whom we are taught at school to accept as infallible would yield little or nothing of interest to our spades. Yet the excavations of Messrs. Bosanquet and Dawkins and their helpers have shown that early Sparta was in no way behind other Greek cities in art and civilisation; and we remember that in Homeric days Lacedæmon was a lordly house of princes, while Athens was nothing at all. The excavations of 1909, which are not treated in this volume of the "Annual," have revealed to us the scanty remains of the old Mycenæan civilisation of Sparta, at the Menelaïon, the heroön of Menelaos, on a hill some two miles distant from Sparta itself, on the opposite bank of the Eurotas. We await with interest the publication in the next "Annual" of these discoveries. The volume before us deals chiefly with the continued excavations of the temple of Artemis Orthia, which have resulted in the discovery of the most primitive shrine on the site, which dates from the eighth century B.C. Geometric pottery found beneath its floor shows that the place was sacred at an earlier date, but no Mycenæan sherds prove a history going back into the Bronze age. The geometric sherds lie on virgin soil, and the sanctuary was evidently a new one, established by the Dorians.

The great quantity of pottery found has enabled Mr. Droop to construct a scheme of the development of Laconian pottery from its first stage, immediately succeeding the Geometric, to its latest. The identity of the Laconian style with that hitherto known as "Cyrenian" is proved.

Prehistoric archæology is represented in this volume by two articles by authors who disagree with one another. M. Vassits, the curator of the Belgrade Museum, writes a somewhat inconclusive article on "South-eastern Elements in Prehistoric Servia," in which he claims, reasonably enough, that the Ægean culture must have sent forth a stream of influence which passed up the Vardar valley into the Danubian basin, but does not bring forward much positive evidence of importance to confirm this probability. Messrs. Wace, Droop, and Thompson contribute an account of their very important excavations in Thessaly, which have put into their proper perspective the previous discoveries of Sotiriadis in Bœotia, and Tsountas in Thessaly, and have shown that in early times northern Greece possessed a peculiar art and culture of its own which was very little affected by Ægean influence. We say "very little"; the authors would say "not at all," but without much probability. Mr. Wace and his colleagues have discovered that in northern Greece a Neolithic culture continued to exist until long after the Ægean had reached the full flower of the Bronze age, and that the Thessalian contemporaries of the Minoan Cretans were stone-using barbarians. Then, brushing aside the few traces of Ægean influence on this barbaric culture (such as the rude spiral ornament in the Dimini pottery), they assume that the North-Greek and Ægean contemporary cultures had no connection with one another, and were absolutely independent, not only in origin, but until suddenly the higher culture broke down the lower in the latest Minoan age. It is obvious, however, that this is impossible. The Ægeans were active seamen, and it is incredible that Ægean influence should not have affected the Thessalians, conservative though they were, from the beginning; and, at the same time, that the Ægean influence should not have affected the north coast of the Ægean Sea and have penetrated up the Vardar valley, as M. Vassits says it did, and have greatly influenced the Danubian Bronze-Age civilisation. We believe that the independent North-Greek Neolithic and Chalcolithic "culture" was no bar to this, and that itself it was much more affected by the Minoan culture than its discoverers believe. For us, then, M. Vassits and Mr. Wace are both right.

The great importance of the Thessalian discoveries for the history of the origin of European civilisations is evident. It has never seemed to the present writer probable that the changes from the age of Stone to that of Metal, and from the age of Bronze to that of Iron, each necessarily took place at about the same time all over the European and Mediterranean world; iron, for instance, seems certainly to have been used sporadically by the Egyptians as early as the time of the fourth and sixth dynasties, about 3000 B.C., whereas even in southern Europe it does not appear much before 1000 B.C.; and now we see the same thing in this case of the continued use of stone, for long exclusively, by a large community in northern Greece down nearly to 1300 or 1200 B.C., and contemporaneously with the existence, but two hundred miles off, of the head centre of the splendid Bronze-age civilisation of Minoan Crete. We are again reminded that, though nature *nihil facit per saltum*, human activity does progress in precisely this haphazard way. Our archæologists, too much under the influence of the professors of natural science, have assumed that the evolution of human progress was far more even and equable than actually was the case.

The Greek sculpture of the later period takes up less space in this year's "Annual" than in that of last year; there is only one short article by Mr. Wace on an interesting Pergamene head found at Sparta.

Prof. Burrows and Mr. Ure contribute an account of their excavations in tombs at Rhitsóna (Mykalessos), which have produced large quantities of pottery of the classical period; and there are interesting articles by Mr. Hasluck on the topography of Laconia, and by Mr. Hogarth on Hierapolis Syriæ, the ancient sanctuary between Aleppo and the Euphrates, otherwise called Bambyke or Mabog, the modern Mambij. Mr. Hogarth publishes several fragmentary Greek and Latin inscriptions and graffiti of Roman days from this ancient holy place. H. R. HALL.

GOATS AND MALTA FEVER.

A QUESTION asked in the House of Commons on June 13 illustrates the desirability of members of Parliament becoming familiar to some extent with scientific facts before concerning themselves with subjects in which such facts are involved.

The question was in regard to the part played by the goat in the spread of Malta fever, and arose out of a misreading of the evidence given before the Royal Commission on Vivisection (Q. 14,242). The question asked was to the effect that, seeing no goats had been infected by the alleged Malta-fever germ, and that it did not give rise to any ill-health or fever in these animals, why spend money on any inquiry regarding the part played by goats in Malta fever?

The evidence given before the Royal Commission was that the goats did suffer from this disease, that the micro-organism did multiply in their bodies, but that it did not give rise to any appearance of ill-health or rise in temperature. It is this that makes the goat so dangerous. If Malta fever caused high fever and the other symptoms of a severe disease in the goat, as it does in man, the goat would probably cease to be a danger. The animal would be confined to its stable, and its milk would run dry. As it is, the goat which acts as a source of the virus of Malta fever continues to accompany the herd into the town or village, appears the picture of health, and secretes quite as much milk as its harmless neighbours.

This is a matter of great practical importance, since the Maltese themselves refuse to believe that Malta fever is milk-borne, although the Commission sent out in 1904–5–6 to investigate the disease proved this up to the hilt. Since then the Maltese have been exporting their Malta-fever-carrier goats, and spreading this serious human disease far and near. That this should be permitted would seem to be beyond belief, but, looking nearer home, we must remember that our own milk supply is not quite free from the tubercle bacillus.

The American Government attempted to import Maltese goats in 1906. The drinking of the milk of these gave rise to an epidemic of Malta fever on board the vessel which conveyed them from Malta, and a woman in the quarantine station in America became infected. The sequel to this story is told in a recent report of the Board of Agriculture of America. The goats remained under strict quarantine and inspection for some two years, those showing marked infection with Malta fever being slaughtered from time to time. The result is that all the animals imported have been slaughtered—even the kids born in America—not a single animal could be saved, on account of Malta-fever infection.

This disease is becoming more widespread every year. Last year the Sleeping Sickness Commission of the Royal Society discovered an epidemic of it affecting a large part of the native population round the shores of Lake Albert Edward, in the south-west corner of Uganda, and the native goats in that out-of-the-way place were found to be the carriers, just as in Malta.

In regard to the result of forbidding the use of goats' milk to the sailors and soldiers in Malta, it cannot be too often repeated that this simple order at once led to the extinction of the fever in the garrison. This does not, of course, refer to the native population, among whom the incidence of the disease is as great as ever. In 1905, before the preventive measures came into operation, there were 643 cases in the Army alone; in 1906, 147; in 1907, 11; in 1908, 5; in 1909, 1; in 1910, 0.

THE KING AND THE ROYAL SOCIETY.

AMONG the addresses received by the King at St. James's Palace on June 9 was one from the Royal Society, which was presented by a deputation consisting of Sir Archibald Geikie (president), Sir Andrew Noble (vice-president), Mr. A. B. Kempe (treasurer and vice-president), Sir Joseph Larmor and Prof. J. R. Bradford (secretaries), and Sir William Crookes (foreign secretary), with Mr. R. Harrison (assistant secretary) bearing the mace.

In the course of the address it was stated :—

We are proud to remember that no less than forty-seven years ago King Edward was graciously pleased to enter the Fellowship of the Royal Society, and later, on his accession to the Throne, to become our Patron.

Your Majesty enters upon the duties of your high station with a wider personal knowledge of the Empire and its various peoples than was ever possessed by any previous Sovereign of this country. Your subjects have had many proofs that this extended knowledge has been accompanied by an active sympathy with every cause and movement that will promote their welfare and happiness. The interest which your Majesty has shown in the progress of discovery and invention assures us that these elements of national greatness will continue to receive your favour and protection.

His Majesty replied as follows :—

I thank you for the loyal address of condolence from the president, council, and Fellows of the Royal Society on the death of my beloved father. It is a consolation to feel that your society, numbering amongst its fellows the most distinguished men of science of this country, sympathises with me in my terrible bereavement.

Your words of appreciation of the character of the late King are very welcome to me. He always regarded with the deepest interest those scientific discoveries, and those applications of discoveries already made, which have been of such supreme importance in the advancement of civilisation. I also have watched with close attention the work of your society, and it is my sincere hope that its prosperity will continue, and that a Fellowship of the Royal Society will always be esteemed one of the highest honours which can be earned by devotion to the cause of science.

I desire to thank you most cordially for your congratulations on my accession to the Throne, and to assure you of my sympathy and support in your beneficent efforts for the promotion of natural knowledge. I gladly accede to your request that I should inscribe my name as Patron in your charter book.

PROF. GEORGE F. BARKER.

PROF. BARKER, whose death was announced last week, was one of the most genial men of science on the other side of the Atlantic. He was a frequent visitor in London, and invariably of recent years, during the period of his stay, he was made an honorary member of the Athenæum. He was born in Charlestown, Mass., in 1835, and died on May 25 last. He was educated in the Boston public schools, finishing at Yale, where he graduated in 1858.

The American system of education is continuous and methodical, and whatever line of pursuit an American boy is prepared for, he is ultimately turned out well drilled for his future career. Barker commenced in the Albany Medical College, where he received the degree of Doctor of Medicine in 1863, and was appointed professor of chemistry at Wheaton College, Illinois. Thence he proceeded to the Western University of Pennsylvania in the same capacity, but later he became professor of physiological chemistry and toxicology. In 1872 he was appointed professor of physics at the University of Pennsylvania, in Philadelphia, and there he taught until 1900, when he retired on account of ill-health.

Prof. Barker was an admirable teacher and expounder, but he did not undertake much research, and therefore his name is not so well known in the scientific world as that of many of his countrymen. He was much engaged as an expert witness, especially in patent cases. He acted as United States Commissioner to the Paris Electrical Exhibition of 1881, to the Electrical Exhibition held in Philadelphia in 1884, and he took a very prominent part on the jury of the electrical department of the great exhibition in Chicago in 1893. He was a past president of the American Chemical Society and of the American Association for the Advancement of Science. He had served as vice-president of the American Philosophical Society, the headquarters of which are in Philadelphia, since 1899. His English friends will miss him very much when they visit America.

NOTES.

SIR JOHN GAVEY, C.B., will deliver the James Forrest lecture at the Institution of Civil Engineers on June 22. The subject will be "Recent Developments of Telegraphy and Telephony."

A CONVERSAZIONE of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, on Tuesday, June 28.

PROF. T. W. RICHARDS has accepted the invitation of the council of the Chemical Society to deliver the Faraday lecture of the society next session.

THE death is announced, at the age of eighty-four years, of Prof. W. P. Blake, emeritus professor of metallurgy, geology, and mining, and director of the School of Mines of the University of Arizona.

A CORRESPONDENT says he "would like to ask Messrs. Cowell and Crommelin whether it is not highly probable that the Star of Bethlehem was, after all, nothing else than Halley's comet"? We submitted the inquiry to Dr. Cowell, who has been good enough to reply that he does not consider it "highly probable" that the two objects are identical.

IT is proposed to establish, under the title of the India Society, an association to promote the study and appreciation of Indian culture in its æsthetic aspects. The new society will publish, for distribution to its members, works showing the best examples of Indian architecture, sculpture, and painting, and will assist in the preservation of the traditional arts and handicrafts of the Empire. The honorary secretary is Mr. T. W. Rolleston, Ardeevin, Christ Church Road, Hampstead, N.W.

THE National Association for the Prevention of Consumption is inaugurating an educational campaign against tuberculosis. So great has been the success of the Travelling Tuberculosis Exhibition that the council is convinced that the time has come for a vigorous and widespread effort. A special appeal committee has been appointed, over which the Earl of Derby will preside, to raise funds. Its object is to raise an annual income of 5000*l.* for the purpose of spreading information on the question of the cure and prevention of consumption. This campaign is to be carried out by means of travelling tuberculosis exhibitions; caravans, with lantern-slides, for small towns and villages; popular lectures; an information bureau; and the distribution of literature. The cooperation of all persons is solicited to aid in raising the fund, which will be applied entirely to educational purposes, as the committee feels that if the country can be aroused to a comprehension of the loss in life and money occasioned by tuberculosis, and the methods by which the disease can be controlled, ultimate conquest is assured.

THE Italian earthquake of June 7, referred to last week, occurred in a district which is frequently disturbed by shocks from more or less distant centres, but in which they rarely originate. Avellino, where the recent shock was strongly felt, is thirty miles east of Naples. The epicentre of the earthquake was, however, about thirty miles still farther to the east, including the villages of Calitri and San Fele, at both of which there was much damage to property and some loss of life. The only important earthquake which is known to have occurred in the same centre is that of September 8, 1694, when more than four thousand lives were lost. Calitri was then entirely destroyed, and at least 700 persons were killed. The epicentre of both earthquakes lies only a few miles to the north-west of that of the great Neapolitan earthquake of 1857, and not far from the continuation of the isoseismal lines drawn by Mallet in his well-known report.

PROF. RONALD ROSS, in an address to representatives of the missionary societies of the world meeting at Livingstone College on Commemoration Day, June 11, urged that missionaries, like the priests of old, should be healers both of the mind and of the body. He suggested that missionaries might ascertain, by the examination of the spleen, whether children in the tropics were affected by malaria, and that this would give a rough indication of the amount of malaria in the district. He suggested that quinine might then be administered to the children in the district, and that this would tend to check the spread of the disease. He also hoped that they would be able to assist in drainage schemes, so that the breeding places of mosquitoes might be eradicated. He thought all missionaries should have such training as that given at Livingstone College, in order to be enabled to share in these sanitary precautions.

MANY meteorologists will be glad to learn that the activity of the British Rainfall Organisation, founded some fifty years ago by the late Mr. G. J. Symons, has been placed upon a permanent footing by the transfer of the management by the director, Dr. H. R. Mill, to a strong representative board of trustees interested in rainfall work. The board will consist of Dr. Mill (as chairman), Mr. F. Druce (treasurer), Mr. R. M. Barrington, Sir Alexander Binnie, Mr. C. L. Brook, Mr. C. J. P. Cave, Mr. D. W. Freshfield, Dr. H. Mellish, Sir John Murray, and Mr. J. G. Wood. The board, with the aid of other obeservers, will form an endowment fund for the continuance of the work, which hitherto has been dependent on the efforts of its promoters and voluntary contributions. The observers now number nearly 5000, and the accumulated records are quite unique. Dr. Mill now makes over the whole of the documents and the lease of the headquarters in Camden Square to the board of trustees as a free gift for the benefit of meteorological science.

THE fifteenth annual congress of the South-eastern Union of Scientific Societies was held at Guildford from June 8 to 11. Dr. D. H. Scott, F.R.S., was succeeded as president by Prof. Ernest Gardner, who delivered a discourse on the evolution of classical art. Some of the papers read were of much local interest, notably one by Mr. H. Bury on the relation of the River Wey to the Blackwater and the Arun—a study of river-development on the lines laid down by Prof. W. M. Davis. Another local paper dealt with the Pilgrims' Way between Farnham and Albury, in which Mr. J. G. N. Clift discussed the question whether the route was along the higher or the lower road. Mr. E. A. Martin explained his experiments on dew-ponds, made with the view of determining the way in which the supply of water was maintained. Dr. W. Martin showed in a learned paper how the bird's-eye views and maps of the sixteenth and seventeenth centuries should be interpreted. A lecture on colour in insects was given by Mr. J. W. Tutt, in which he pointed out the need of obtaining definite information respecting the changes which bring about differences of coloration. Dr. Vaughan Cornish lectured on waves in sand and snow, and Mr. A. R. Horwood, of Leicester, referred to the extinction of cryptogams. The Rev. R. Ashington Bullen is succeeded as honorary secretary of the union by Dr. William Martin, who will be assisted by Mr. Norman Gray. Next year's congress will be held at St. Albans, under Sir David Gill, K.C.B.

THE University of California, continuing the investigation of the numerous shell-mounds on the shores of San Francisco Bay, publishes in the fifth part of vol. vii. of its Proceedings a report on that at Ellis Landing, by Mr. N. C. Nelson. This is one of the largest of the series, and the period required for its accumulation is estimated at more than three thousand years. From the very beginning it was used both as a dwelling site and place of burial, and it was occupied by the Californian aborigines up to a time not long antecedent to the European discovery and occupation of the country. The earliest occupants were not savages of the lowest grade, and there is throughout the strata distinct evidence of the evolu-

tion of culture. The later inhabitants were skilled in various industries, and made journeys to, or had trade relations with, distant tribes. Even if it was from time to time occupied by migrants or enemies, these people were all essentially of the same type, and the last were Indians similar to the inhabitants of Middle California within historic times.

MESSRS. DULAU AND CO. have published part iv. of the "Treasury of Human Inheritance," the publication containing pedigrees, illustrative of the inheritance of various defects or other characters, issued by the Galton Laboratory for National Eugenics. The present part contains pedigrees of a large number of cases of hare-lip and cleft palate, with introductory explanation and bibliography by Dr. H. Rischbieth; pedigrees of hereditary deaf-mutism collected by the Eugenics Laboratory; and pedigrees of congenital cataract, collected and annotated by Mr. N. Bishop Harman. The pedigrees are given in the same general style as in previous parts, and the first and third articles are illustrated by a number of plates, which are exceedingly well reproduced.

MR. M. OSHIMA, of the Bureau of Scientific Researches at Taihoku, has been enabled to add twelve species to the twenty-nine recorded in Stejneger's "Herpetology of Japan, &c.," as indigenous to Formosa. Of these twelve additions, four species and one subspecies are regarded as new to science. Mr. Oshima's paper appears in vol. vii., part iii., of *Annotationes Zoologicae Japonensis*, which also includes four articles on as many groups of Japanese invertebrates.

To the June issue of Witherby's *British Birds* Mr. H. Wormald contributes an exquisitely illustrated article on the attitudes assumed by the mallard and certain other drakes during the period of courtship. The performance generally commences by four or five mallards swimming round a duck with their necks drawn in, and then suddenly lowering their beaks, and at the same time raising themselves nearly upright in the water and drawing the beak up the breast. For the other actions we must refer the readers to the paper itself, as they are difficult to describe.

IN their thirty-eighth report (1909–10) the directors of the Zoological Society of Philadelphia state that in December last a large number of animals collected by the Smithsonian Institution expedition to East Africa, under Mr. Roosevelt, were temporarily accommodated in the gardens previous to their transport to the National Zoological Park at Washington. Specimens of Thomson's gazelle, waterbuck, Coke's hartebeest, and wart-hog became, however, the property of the society. The last-named species, we regret to see, figures in the list as Macrocephalus in place of Phacochœrus. When a name fits an animal so admirably as the latter does the wart-hog, it ought in no circumstances to be changed.

WE have to acknowledge the receipt of the report of the director of the Zoological Gardens at Giza, near Cairo, for 1909, in which it is stated that the season under review was unusually favourable to the animals, although the number of visitors was 26,239 less than in the previous year. To the late and present Governors of Senar the gardens were indebted for a large and representative collection of animals fom the Blue Nile, while a feature of the year was the large number of species which bred in the menagerie. Jungle-cats and foxes were responsible for the deaths of several animals, while to rats, owls, &c., may probably be attributed the disappearance of many others.

IN past years locusts have caused enormous losses in South Africa to the farmers, who have usually, on religious grounds, taken no steps to destroy them. Since agricultural departments have been formed, locust officers have been appointed whose duty it is to collect information about the swarms and the places where eggs are laid, and to take such destructive measures as may be necessary. The report of the chief officer for Cape Colony for the past season has recently been issued in the *Agricultural Journal of the Cape of Good Hope* (No. 2, 1910). The most successful method of destruction is to spray the veldt with a dilute solution of sodium arsenite and treacle, or, if the grass is too short, to scatter some finely chopped green vegetation, bran, or even "voetgangers" themselves, previously soaked in the solution. When the swarm comes along it is immediately attracted by the treacle, and eats with great voracity, so that the insects soon begin to sicken and die. It is even recorded that a second swarm has come up and devoured the first, two swarms thus perishing through one spraying. At an earlier stage the destruction is a simpler matter—the insects are sprayed immediately they hatch out. Wherever these methods are adopted damage from locusts becomes comparatively small, and as soon as the religious scruples of the farmers can be overcome and adequate help is rendered, the locust plague will cease to be formidable because it can be controlled.

MR. E. HERON-ALLEN, writing from Large Acres, Selsey, sends an account of the extraction of several colours by him from purple iris flowers. The petals of from twenty to thirty flowers of the deep purple iris, which were either quite withered (shrivelled, but still moist) or just beginning to wither, were put into a jar and just covered with alcohol. At the end of ten minutes, (1) a bright and typically iris reddish purple solution was produced; (2) these soaked (in alcohol) blossoms, squeezed fairly dry and steeped in plain cold water for ten minutes, gave a bright ultramarine-blue solution, with no trace of purple or red; (3) these alcohol-soaked blossoms, left in the water for an hour, gave a deep (almost indigo) blue solution, with no trace of purple or red. Another similar lot of blossoms, cut just above the seed pod, were steeped in enough alcohol to cover them, for three hours, and gave a rich crimson solution with no trace of blue or purple. Several other brilliant and distinctive colours were obtained by various treatments of blossoms and residues. Mr. Heron-Allen's interesting observations remind us that while we have in this country a wide range of blue and red, as well as of yellow flowers, there is not, with the exception of woad (*Isatis tinctoria*), a single indigenous blue, or even red, colouring matter which has ever been of any importance as a dye-stuff. Many years ago woad was used to some extent as a source of indigo, while weld (*Reseda luteola*), dyer's-broom (*Genista tinctoria*), and many other yellow dyes were also employed, but we were dependent upon foreign countries for our colouring matters even when natural dye-stuffs were used. The chemical constitution of the colouring matter of the purple iris does not appear to have been investigated, but the results obtained by Mr. Heron-Allen may probably be explained by the extraction of traces of acid and alkaline bodies by the solvents used.

MR. JOHS SCHMIDT, head of the recent Danish expedition in the *Thor* for the investigation of physical conditions in the Mediterranean, has sent us a reprint of a preliminary report on the work of the expedition, published in *La Géographie*. The *Thor* cruised in the Straits of Gibraltar and along the north coast of Africa to Sardinia, then

explored the western Italian coast, and made some observations further east in the southern Adriatic and off the coast of Greece. The results are of great value and interest. Special attention may perhaps be directed to the section of the region west of the Straits of Gibraltar made between February 20 and 28, 1909, which may be compared with a similar section based on Dr. Wolfenden's observations made in the *Silver Belle* in 1904.

IN the *Sitzungsberichte* of the Vienna Academy of Sciences of December 9, 1909, Prof. W. Trabert discusses the connection between the temperature conditions of the atmosphere and the pressure at the surface of the earth. The inquiry is based upon observations of the temperature of the upper air during 1903–8 made by the aëronautical observatory at Lindenberg, and on the simultaneous behaviour of the barometer at the ground level. For this purpose those days were selected on which the air-column over Lindenberg was colder than the previous and following days, and *vice versa*. The results show, *inter alia*, that the barometer rises during the existence of cold air-columns; the minimum of pressure occurs generally on the day before, and the maximum on the day following. With warm columns of air the reverse holds good. After an extreme of pressure a column of extreme temperature occurs as a rule on the first or second day afterwards, viz. a warm column follows a high pressure, and *vice versa*. There is, at all events, an intimate connection between temperature conditions in the free air and pressure at the ground level, from which fact the author agrees with the opinion generally obtaining at the present time, that "the hope of meteorology lies in the upper regions."

AN extended series of tidal observations on the Pacific coast was obtained by the Canadian Tidal Survey during the summer of 1909, under the supervision of Dr. W. Bell Dawson, the superintendent of the Survey. There were in all a series of twenty recording tide-gauges in simultaneous operation along the coast of British Columbia. One noteworthy result obtained is that the time of high and low water at the head of the long inlets on the coast is very little later than at the mouth. For instance, at the head of Bute inlet high water is only seven minutes later and low water fourteen minutes later than at Lund, sixty-six miles below. The range of the tide at the head of the other inlets is only from 2 to 12 per cent. greater than at their mouth. This rapid progress of the tidal undulation must be due to the great depth of such inlets. Where the depth is so great, the whole surface of the inlet rises and falls simultaneously, in correspondence with the impulse at its mouth given by the rise and fall of the tide in the open. It would also appear that there is little current except in the mouth of the inlet, where the pulsation takes place. The results obtained by Dr. Dawson provide valuable information upon the subject of the progress of the tide in ordinary shallow estuaries and in deep inlets. They are in no sense, therefore, of merely local interest or local application, but they illustrate the general question of the rate of progress of the tide relatively to the depth of the channel or inlet.

THE velocities of certain reactions between metals and the halogens in solution form the subject of a paper by Messrs. R. G. van Name and Graham Edgar in the current number of the *Zeitschrift für physikalische Chemie* (May 24). Solutions of iodine and bromine in potassium iodide and bromide solution respectively were allowed to react with mercury, cadmium, zinc, copper, and silver at 25° C. and 35° C., and the velocities of solution of the metal measured. With iodine the velocity of solution was found to be practically independent of the nature of the metal. The temperature coefficient of the reaction was found to be unusually low, about 1·3 for 10° rise, instead of 2·0 generally found for reactions in homogeneous systems.

SPECIAL interest attaches to a paper by the late Dr. Ludwig Mond on "Some New Metallic Carbonyls," which appears (with an introduction by Dr. R. L. Mond) in the Journal of the Chemical Society. A description is given of the apparatus, by means of which the action of carbonic oxide on metals could be tested at temperatures up to 450°, and at pressures up to 500 atmospheres. An account is also given of a new black cobalt carbonyl, $Co(CO)_3$, prepared by the decomposition of the red tetracarbonyl, $Co(CO)_4$, recently described, of a ruthenium carbonyl, of which only a small quantity was obtained as an orange-yellow deposit, and of a molybdenum carbonyl, $Mo(CO)_6$, forming highly refractive white crystals which sublime without melting in an atmosphere of hydrogen or carbon monoxide at 30° to 40°.

PROF. H. B. DIXON'S presidential address to the Chemical Society, reproduced in the Society's Journal, deals with the "Union of Hydrogen and Oxygen in Flames." He considers that the explosion of the two gases is a direct action, (1) because well-dried mixtures of electrolytic gas always explode with a spark; (2) because the velocity of explosion in a well-dried mixture is greater than when steam is added; and (3) because the explosion-wave is propagated exactly in the same way as a pressure-wave in the gas. In the case of the combustion of the gases at moderate temperatures, he agrees with Dr. Baker that steam plays an important part in the interaction of the two gases, but suggests that if once a flame is started the presence of moisture is not necessary for its propagation. During the combustion small amounts of hydrogen peroxide are formed, which can be preserved by allowing the jet to impinge on ice or on solid carbon dioxide. It has been suggested that hydrogen peroxide is the first product of the interaction, and this view has been supported on various grounds, as, for instance, on the ground that the primary interaction in a gaseous mixture must be between two molecules only. For these views no sufficient support appears to be forthcoming, and many of the arguments used in its favour are shown to be fallacious.

THE idea first expressed by Lord Rayleigh, and afterwards by Prof. Liebenow, that the high electrical resistivity of alloys was due to thermo-electric forces set up at the points of contact of the constituents of the alloys, has been taken up by several physicists, but no attempts to establish its truth experimentally have succeeded. In the *Physikalische Zeitschrift* for May 15 there is a communication from Mr. K. P. Brooks which appears to prove definitely that the idea is untenable. Mr. Brooks has measured the resistivity at different temperatures of columns consisting of a large number of thin gold and silver discs, and of sticks of compressed gold and silver dust, and has found that their resistivity and their temperature coefficient of resistivity lie between those of their constituents, and vary with composition according to the ordinary law of mixtures. Alloys of the two have, on the contrary, higher resistivities and lower temperature coefficients than have their constituents.

IN the *Revue générale des Sciences* of April 30 Prof. E. Cohen, of the University of Utrecht, writes of what he terms the "infectious diseases of metals." Under this heading he describes systematic observations on the allo-

tropic transformation which metallic tin undergoes at moderately low temperatures. More interesting, because of far wider importance, however, are his observations and views on what he terms the "maladie d'écrouissage"; this is, in reality, simply a process of spontaneous annealing or re-crystallisation which occurs in certain circumstances in metals which have been severely hardened by plastic strain. So long ago as 1900 Ewing and Rosenhain showed that when pure lead has been freshly crushed or rolled, the minute crystals commence to grow, even at the ordinary temperature, at a rate which produces visible changes in a few weeks. Prof. Cohen's observations show that processes of this kind are not confined to lead, but occur also in harder materials, especially in hard-drawn brass, thus accounting for the spontaneous cracking of cartridge-cases which occasionally occurs in practice after a lapse of several years from the date of manufacture, on the view that the re-crystallisation process is accompanied by a change in volume. The whole process is favoured by any rise of temperature, so that the phenomena are more readily observed in hot climates. Whether such action takes place at possibly a still slower rate in iron and steel is a problem still to be investigated. An important fact brought out by Prof. Cohen's experiments, however, is that the process of re-crystallisation is initiated and accelerated by intimate contact with a piece of the same metal in the stable or "annealed" condition; it is, indeed, this phenomenon which leads Prof. Cohen to describe the whole process as an "infectious disease" of metals.

THE *Engineer* for June 3 contains a description of the Druitt Halpin system of thermal storage recently installed at the King's Road works of the St. Pancras Borough Council Electricity and Public Lighting Department. Each of four water-tube boilers has been fitted with a storage vessel, and some figures regarding the performance of the plant are certified by Mr. Baynes, the borough electrical engineer. Each boiler, as originally installed, had a maximum normal evaporation of about 11,000 lb. per hour. One boiler fitted with a thermal storage drum was run for 2h. 51m., the storage drum being full at the start and empty at the finish. During this time the average evaporation per hour was found to be 17,542 lb., or an increase of 59·5 per cent. more than the normal. During this test the average working pressure was 185 lb. per square inch, the temperature in the drum 360° F., and the draught at the boiler exit 0·5 inch by water-gauge. With this system it is found that deposits from hard water are found in the storage drum rather than in the boiler, and are therefore not subjected to the heat of the furnace, which would bake them to a hard scale. Such deposits are very easily blown off from the storage drum in a soft powdery state.

MESSRS. LONGMANS, GREEN AND CO. have published a third edition of Dr. F. Mollwo Perkin's "Qualitative Chemical Analysis: Organic and Inorganic." The first edition of the work was reviewed in our issue of August 22, 1901 (vol. lxiv., p. 397), and it is sufficient to point out that to the present issue has been added a short section dealing with some of the rarer elements and a new chapter on ethereal salts.

A THIRD edition of Mr. Walter B. Priest's "Scheme for the Promotion of Scientific Research" has been published by Messrs. Stevens and Sons, Ltd. We dealt with the second edition somewhat fully in our issue of January 21, 1909 (vol. lxxix., p. 345). In the present edition the administration of grants has been further explained, and the author of the book proposes terms of allocations of grants in relation especially to electrical science. The author hopes that the advantages to be gained by legislating for the promotion of scientific research, where it affects purposes of general utility and advantage, will receive serious consideration.

OUR ASTRONOMICAL COLUMN.

THE METEOR OF JUNE 1.—Further observations of the large meteor of June 1 9h. 40m. have been received by Mr. Denning from various parts, and they are in very fair agreement with each other and with the values given by him for the height, radiant, &c., in NATURE for June 9.

The meteor was seen from Clapham Common passing from a few degrees below the pointers in Ursa Major to a place just north of "The Twins." The trail was a reddish-yellow colour, while the nucleus was a brilliant electric-blue. At Loughton, Essex, the meteor was viewed during a portion of its flight over the western sky. The object appeared extraordinarily brilliant, with a blue head and red tail.

As an instance of the erroneous impressions of nearness occasioned by the startling lustre of fireballs of this kind, it may be mentioned that the observer at Loughton estimated it as seventy yards distant, and thought it must have fallen behind a house near him. Search was made for fragments, but without avail. As a matter of fact, the meteor was more than 100 miles distant. The shower of Scorpiids to which it owed its origin is singularly rich in fireballs in June, and they form probably the débris of some dissevered, periodic comet the materials of which are now distributed into a wide stream.

COMING TOTAL ECLIPSES OF THE SUN.—From Dr. Pio Emanuelli we have received an abstract from the *Rivista di Astronomia e Scienze affini* (April) in which he discusses in detail the conditions of the total solar eclipses of the sun on May 9, 1910, April 28–29, 1911, and April 17, 1912. The eclipse of 1911 will have a period of totality of nearly five minutes, and the line of totality will completely traverse the Pacific Ocean; commencing on the east coast of Australia, it will terminate at a short distance from the west coast of Central America. A small chart given by Dr. Emanuelli shows the path of the shadow touching the islands of Nassau, Samoa, and Tonga. Vavau Island will probably afford the best *locale* for observations, and at the port of Neiafu, on the south-west coast, totality will last for 3m. 36·8s. with the sun at an altitude of 43°. At Tau, in the Samoan archipelago, totality will endure for 2m. 13s., the altitude being 51°. The last island to be traversed by the shadow will be Nassau, which is practically an uninhabited desert 1280 metres long and 914 metres across; but here the duration of totality will be 4m. 10s., and the altitude of the sun 57°.

THE NEW CANALS ON MARS.—In No. 422 of the *Observatory* (p. 215) M. Jonckheere states that, from observations made at Hem, there can be no doubt as to the reality of the two new canals recently described by Prof. Lowell. Independent observations by M. Jarry Desloges and himself disclosed these features, which were carefully studied at the Hem Observatory.

THE OBJECTIVE-PRISM DETERMINATION OF STELLAR VELOCITIES.—In No. 4, vol. xxxi., of the *Astrophysical Journal* Prof. R. W. Wood reports further progress in the preparation of light-filters for use in the objective-prism, radial-velocity work recently described by Prof. E. C. Pickering. It will be remembered that by employing a neodymium-chloride filter, Prof. Pickering introduced a fine absorption line into the spectra to which the stellar lines could be referred for measurements of velocity in the line of sight. Prof. Wood now finds that the addition of erbium chloride introduces another good reference line at λ 382, whilst, with isochromatic plates, the narrow interspace between two neodymium bands at λ 5220 might be employed. With vapours he believes better results could be obtained, and he is also experimenting on the manufacture of solid screens by using a solvent which would solidify, such as styrol. The success attained so far is very promising for the final application of this method.

EXPLORATION OF THE KARAKORAM RANGE.[1]

IN the communication referred to below H.R.H. the Duke of the Abruzzi gives a very interesting account of his expedition last summer to Baltistan, in Kashmir territory, undertaken with the object of ascending K2, the highest peak in the N.W. Himalaya, as well as to investigate the physical features of that range, which his previous mountain work in North America and Africa would render so valuable by comparison.

FIG. 1.—The Peak K2 from Windy Gap.

The rapidity and facility of modern-day travel compared with that of fifty years ago is remarkable. From Srinagar to the foot of the Baltoro occupied only fifteen days, which in 1861 took me twenty-nine. The Duke proceeded *via* the Indus Valley and the Braldoh River, and returned by the Skoro La and the Deosai Plains, all now well known and constantly travelled over.

The Baltoro Glacier has since 1861 been made famous by the visits of no fewer than three exploring parties, commencing in 1892, who have added to the topographical detail of its furthest sources. This last expedition was large and well equipped; besides its leader, there were the Marquis F. Negrotto, Messrs. Vittorio Sella, F. De Filippi, three Italian guides, G. Petigrew and A. and E. Brocherel, four porters and an assistant photographer, and Mr. Baines, who joined the party in Kashmir to look after the transport arrangements, so that the number of porters proceeding from Askolay was about 360. On May 18 they began the ascent of the great glacier, the first camp being at Liligo, on the right bank, where the marginal ice cliff is mentioned as being 196 feet high. The next day Rdokas, on the same side, was reached, where the party were detained three days by bad weather, snow falling and covering the surface of the glacier. This was made the base-camp. The magnificence of the view to the north from this point of the gigantic peaks and spurs of the main range, of which one, now known as Mustakh Tower, is the most striking feature, is described.

Beyond this camp reference is made to, and a hypothesis ventured on, a very conspicuous feature (mentioned in my paper, "The Glaciers of the Mustakh Range," R. G. Soc., January, 1864)—the long line of white ice in masses more or less detached, and distinct in structure from that of the ice on either side. I was unable to follow this ice-flow to its source. I venture yet another hypothesis. Its position is central; it appeared to originate from the precipitous western face of Gusherbrum, and to be glacial ice quite free from any morainic matter drawn into the flow of the main northern and southern branches, but had never been subjected to the pressure and formed under the same conditions as the ice which carried and partly held it in position. This is only one of the phenomena connected with these great glaciers awaiting elucidation and calling for that closer investigation which the first explorers had not the time to solve.

On reaching the base of K2 a close examination of the peak was made, first on the western side up the tributary glacier named Savoia, leading to the saddle at its head, 21,863 feet. It was a stiff climb; steps in the ice had to be cut all the way up to the summit. The Tibetan side presented a precipitous wall of rock; beneath was a glacier flowing west to the Oprang Valley, probably a tributary of the glacier descending from the Mustakh Pass. As the Duke describes it, the northern flank of K2 seen from that side must form a gigantic wall nearly 10,000 feet in height. Seen well from here, K2 was deemed impracticable for the Alpine climber. The explorers next attacked the eastern side, and reached the points attained by the Anglo-Austrian expedition. From this splendid Alpine basin, as it is described, K2, with its precipices and snow cone, shows itself in all its splendour; the difficulties of its ascent were apparent, and they had to declare themselves conquered—that only in an aëroplane could the summit be reached. From the

FIG. 2.—The Bride Peak.

[1] *Bollettino della Società Geografica Italiana*, April, 1910. Explorazione nei monti del Karakoram. By S. A. R. Luigi Amedeo di Savoja, duca degli Abruzzi. Con due carte e 5 illustrazioni fuore testo.

water parting on this side they saw a precipitous slope on the Tibetan side, not vertical as at the Sella Savoia, but a very crevassed glacier. The Italian guides and porters might have descended, but returning was the difficulty. The Duke was under the impression they would see from here the Oprang Valley; however, he was surprised to find a great glacier flowing south-east, separating Windy Gap from a great mountain chain which appeared to connect with Staircase Peak on the north; this glacier received numerous tributaries from the eastern face of the Staircase and mountains south of Windy Gap. The Duke says that here are two important geographical problems to be resolved—how the chain is attached to Staircase Peak and where the glacier the travellers saw emerges. From Windy Gap and Sella Vittoria Sella the eastern peaks of Gusherbrum were seen, and the Duke suggests that the glacier from there and the Staircase was the one seen by Younghusband from the Oprang Valley. A most plucky attempt was made by the Duke and two porters to reach the top of Staircase Peak, but after a night at 21,650 feet they were baffled by a *bergschrund*, which they failed to work round. From here K2 appeared more than ever inaccessible; it is recorded, also, that its northern face is precipitous, also that towards the east chains and mountains were lost in the distance.

Rejoining his party on June 28, the Duke determined to make a final effort to ascend the Bride Peak (K6), 25,119 feet. Ascending the main Baltoro glacier, from Footstool Camp of Conway, on July 3, he and Sella started for the Kondus Saddle; the view they obtained from this point, 20,772 feet, compensated them for all they had gone through. To the south it lay over the Kondus Glacier, embracing Peaks K7, K8, and K9; he noted that this valley trends to the east, then bends to the north, coming round Golden Throne and Hidden Peak, and perhaps joins the pass at the head of the Ordoch Glacier of Younghusband.

Although the work was most severe and many camps were in exposed and trying sites, great praise is due to all, and the account is written in a most natural, unpretentious way. The value of the Italian guides on work of this nature is well exemplified, for when they were on the Chogolisa Saddle, and Sella had left for Rdokas, they prevailed on the Duke to wait for fine weather and attack the "Bride Peak," and the little party actually stayed three weeks on this exposed ridge of 21,000 feet.

The ascent was finally made, and a point 24,577 feet reached, close below the summit, when, dense mist coming on, and the remaining 500 feet being of a dangerous nature, they reluctantly had to descend, having attained the highest altitude yet reached by man. More it was impossible to do. The Duke trusts some future traveller, profiting by his labours, may some day reach the magnificent summit of the Bride Peak (Fig. 2). The future surveyor who may be sent there is taught a valuable lesson by these most capable mountaineers towards the securing of an accurate plane-table survey of the wonderful unknown country lying to the eastward. With the numerous peaks fixed by the triangulation, it is shown conclusively that the area occupied by the Terim Gangrhi and glacier, together with the Snowy Range from which the Remo Glacier descends, could all be mapped and dozens of peaks fixed from points already visited by the Duke of the Abruzzi and Dr. Longstaff, supplemented by a few others at the head of the Kondus Valley and those seen from the Mustakh Pass crossed by Younghusband.

H. H. GODWIN-AUSTEN.

FURTHER OBSERVATIONS OF HALLEY'S COMET.

A NUMBER of further observations of Halley's comet are recorded in Nos. 4415–8 of the *Astronomische Nachrichten*. In No. 4416 (p. 401) Prof. Max Wolf gives a sketch showing the position of the tail on May 12 at 14h. 15m. (Königstuhl M.T.). A slight curvature was noted, the convex side being towards the north, and the extremity of the tail lay on a line joining α Equulei and β Aquarii. From this observation it was deduced that the actual length of the tail was about 45 million kilometres (28 million miles), whilst that part through which the earth would pass, if passage took place, was at least 3° broad. Observations extending from May 17 to 24 indicate that the halos observed at the Königstuhl Observatory on May 19 were more than twice as strong as those observed on the other days. Dr. Cerulli directs attention to an apparent shortening of the tail towards 15h. (M.E.T.) on May 18, which he ascribes rather to the alteration of direction, in regard to the line of vision, than to the approach of daylight.

Herr A. Miethe records that, at the photographic observatory of the Royal Technical High School, Berlin, on May 24, the nucleus of the comet was seen to occult the 8·5 magnitude star A.G. Lpz. I. 4615; for 28·1 seconds the star was lost in the brightness of the nucleus, but at 9h. 0m. 40·5s. (M.E.T.) it was again seen amongst the matter streaming out from the nucleus. It then appeared as an absolutely sharp, bluish point of light, and suffered no apparent alteration beyond a slight twinkling. Herr Osthoff records some cloud observations made at Cologne on May 19, but found nothing which might be ascribed to the action of the comet's tail; the 22° halo around the sun is accepted as the natural result of the presence of the cirrus clouds observed.

Observations made at Warsaw on May 26 indicated that the axis of the tail, in the plane of the comet's orbit, made an angle of 11° with the radius vector at distance 0·18 from the head. Computations by Dr. Banschiewicz show that this would mean a delay of 0·6–0·7d. in the passage of the earth through the tail after the conjunction of the comet with the sun.

No. 23 of the *Comptes rendus*, for June 6, contains several further reports of observations of the comet.

MM. Luizet and Guillaume (p. 1492) give a *résumé* of their observations since early in December, 1909, directing special attention to the changes which took place in the form of the nucleus, the structure of the various parts of the head, and the extent of the tail after the beginning of March. On May 15 it was noted that the pronounced flattening of the nucleus was in a direction perpendicular to that observed on May 14.

MM. Cirera and Ubach give the results obtained at the Observatoire de l'Ébre (Spain), during the period May 11–26, from observations of terrestrial, atmospheric, magnetic, and electrical phenomena. Some disturbances were recorded on May 18 and 19, but the authors believe that they were not connected in any way with the comet, although they hesitate to pronounce definitely on the subject until the results have been more fully considered.

M. Comas Sola, of the Fabra Observatory, describes (p. 1496) a very brilliant projection of gas from the nucleus on May 31. A photograph, exposed for eighty-three minutes, showed that this projection extended some million kilometres from the nucleus, in the direction opposed to that of the sun. A condensation in this projection gave the appearance of a second nucleus, which, on June 2, was about 40″ from the primary nucleus, and was some three magnitudes fainter. Between these two nuclei there appeared to be an alignment of very feeble stellar points, but these were so faint as to be doubtfully seen. A photograph taken, with ninety minutes' exposure, on this date showed, among other interesting details, a long aigrette emerging from the nucleus and forming a medial line in the tail. On June 4 the secondary nucleus was invisible, but the primary was accompanied by four condensations, which travelled rapidly away from it. In 110 minutes the principal one of these was displaced 5·9″, in regard to the primary, in the direction of the tail.

M. Giacobini also directs attention (p. 1496) to the breaking up of the nucleus on June 2. To him it appeared that the comet had split into two nebulosities, each having a nucleus, the only difference between their aspects being that one was considerably fainter than the other. He also remarks on the rapid alteration of the form of the nucleus since May 24. Prior to that date it had been distinctly nebulous and elliptical, but since then it has appeared as a sharply defined point.

As mentioned previously in NATURE, M. Jean Mascart travelled to Teneriffe to observe the comet, and set up his instruments on the spot occupied by Piazzi Smith in 1858. He now describes (p. 1497) the instruments and the observing conditions during his two months' sojourn at the station. At an altitude of 2715 metres he was well above

the usual clouds, and only on one night was the sky obscured. Further, he gives a detailed account of his observations of the sky on the night of May 18–19, but beyond an exceptionally fine display of the zodiacal light no special phenomena were remarked.

Photographs of the comet taken at Helwân, Kodaikanal, Johannesburg, &c., were shown at the meeting of the Royal Astronomical Society on Friday last, and all of them show plainly what a striking object the comet was in more favourable latitudes and in clearer skies. The long straight tail is seen to have a very complicated structure of fine filaments and waves.

Several observers have forwarded to us accounts of recent observations of the comet. Mr. Leach, of Malta University, states, on June 8, that the comet had been seen every evening since May 20, and, although fainter, the tail still extended some 20° or 30°. It was best seen on June 1, when the tail extended nearly to Jupiter. He also remarks on the change in the appearance of the nucleus, which, latterly, was quite stellar in character and of about the second magnitude.

Mr. J. W. Scholes, of Grimscar, Huddersfield, sends an account of observations made at Morecambe Bay. A sketch, made at 11.10 p.m. on May 31, in a clear, cloudless sky, shows three plumes, or tails, two shorter ones lying beneath, and separate from, the main tail. The lowest, and shortest, is quite near to Castor and Pollux, and nearly parallel to a line joining them. No simple, definite explanation of this apparition is yet forthcoming.

PAPERS ON INVERTEBRATES.

IN the May number of the *Entomologist's Monthly Magazine*, Dr. D. Sharp records the history of the discovery in the New Forest of a new species of arboreal beetle of the genus Corticaria. One species of this genus, *C. similata*, was for thirty-seven years known as British only by a single specimen. In 1908 beetles of this genus were taken on an oak-tree in the New Forest and identified with that species, which they seemed to indicate to be sexually dimorphic. Other specimens procured, both in the Forest and at Woking, demonstrated, however, that not only was *C. similata* re-discovered in Britain, but that the former area is the home of a new species, for which the name *C. lambiana* is proposed. *C. similata* has been subsequently taken in Scotland.

To the Proceedings of the Academy of Philadelphia for December, 1909, Mr. T. H. Montgomery contributes the second part of his observations on the habits of spiders. Particular interest attaches to his account of the breeding habits of Pisaurina, the species of which closely resemble the Lycosidæ in structure, but differ by being arboreal instead of terrestrial during the cocooning season, and in carrying the cocoons by means of the chelicera instead of suspended from the spinnerets. The large white cocoons of one species are usually found on poison-ivy (*Rhus toxicodendron*); and from observations on specimens kept in confinement it appears that the female carries the cocoon about with her until a few days before the young are ready to hatch. As they emerge, she commences to enclose them with a network of lines, she herself remaining on the outside of the nest thus formed. In this manner the old cocoon and the young spiders are eventually enclosed in a complete nest, which may take as much as three days to construct.

The January and February issues of the same serial for the current year are occupied by papers on molluscs—for the most part American land and fresh-water forms—among which the longest is one by Messrs. Pilsbry and Ferriss, on the land-snails of the south-western States. As the result of their study of Arizona snails, the authors have been led to doubt the power of environment as a main factor in the differentiation of species, and to regard this as capable of explanation only on the hypothesis of variations in the egg, leading to modifications of the organism, for the most part not affecting the well-being of the race. Such adaptation as exists is probably due to selection, and the isolation of colonies would favour the perpetuation of mutations.

Fresh-water gastropods of the genera Limnea and Physa progress, it is well known, by crawling, back-downwards, on the surface-film of the water. On p. 42 of the serial just cited Mr. H. S. Cotton shows that the same mode of progression occurs in the case of a marine bivalve of the genus Modiolaria, the remarkable feature in this instance being the small size of the area of adherence.

To the May number of the *American Naturalist* Dr. H. A. Pilsbry communicates a note on a new type of barnacle (*Stomatolepas praegustator*) inhabiting the mucous membrane of the throat of the loggerhead turtle. Although sessile barnacles are well known to infest the external surface of turtles and whales, while certain parasitic forms penetrate the integument of their crustacean hosts, no commensural thoracic type appears to have been previously described. Stomatolepas belongs to the subfamily Coronulinæ, and is nearly related to Tubicinella, which lives on the skin of whales, and Stephanolepas, a barnacle found imbedded in the horny plates of the shell of the hawksbill turtle.

SOME BIOLOGICAL SERIALS.

THE frequency with which the successive numbers of the *Quarterly Journal of Microscopical Science* make their appearance may be taken as an index of the activity in research—of a particular kind—on the part of British biologists, and the editor is to be congratulated on the issue of seven parts of what used to be literally a quarterly journal during the last twelve months. The April number (vol. lv., part i.) maintains the usual high standard of this publication. It opens with a detailed description, by Prof. G. C. Bourne, of the anatomy of a remarkable New Zealand mollusc, *Incisura* (*Scissurella*) *lytteltonensis*, illustrated by five carefully drawn plates. Mr. W. J. Dakin gives a very full description and discussion of the eye of the scallop—Pecten—an organ which, on account of a certain resemblance to the vertebrate type of eye, has for a long time past attracted a large share of attention from biologists, and which lately, we believe, has played a not unimportant part in the theories of philosophers. Mr. Dakin concludes that "there is no ground whatever for placing the Pecten eye in the same class as the vertebrate eye, for the resemblance is very superficial, and though the retina is inverted in both cases, this has been produced in very different ways." Prof. E. A. Minchin and Dr. H. M. Woodcock have a paper on the blood-parasites of certain fishes, accompanied by three of those remarkably beautiful plates which we have learnt to expect from protozoologists. A special welcome should be extended to another protozoological paper, the first, we believe, from the pen of Mr. Julian S. Huxley, grandson of Prof. T. H. Huxley, which deals in a very thorough manner with a new genus and species of gregarine from the digestive tract of that remarkable crustacean *Anaspides tasmaniae*. Both this memoir and that by Prof. Bourne, already referred to, are based on material obtained by Mr. Geoffrey Smith on his recent trip to Australasia. The number concludes with a reprint of Prof. Hubrecht's address to the Boston meeting of the International Zoological Congress on the fœtal membranes of the vertebrates, in which the author elaborates his remarkable views on the interpretation of mammalian development.

In the second volume of the *Zeitschrift für induktive Abstammungs- und Vererbungslehre* Prof. G. Steinmann further elaborates his theory of the extreme polygenetic origin of the Mammalia. This is a new and somewhat startling hypothesis which does not seem, as yet, to have attracted much attention in this country; its acceptance would involve a far-reaching modification of generally adopted views as to the phylogeny of the Vertebrata. The reptiles, which are themselves supposed by Prof. Steinmann to have arisen polyphyletically from the Amphibia, are divided into two groups, the Orthoreptilia, which include the existing crocodiles, chelonians, lizards, and snakes, and the Metareptilia, which include extinct forms which have no reptilian representatives at the present day. The Metareptilia are again divided into Avireptilia, which are supposed to be the ancestors of the birds, and Mammoreptilia, from different groups of which the various lines of mammalian descent are traced. Thus the Ichthyosauria are regarded as the ancestors of the Delphinoidea, the Plesiosauria of the Physeteroidea, the Thalattosauria of the Mystacocœti, the Pterosauria of the Chiroptera, the

Theriodontia of the Carnivora, and so on. The author bases his theory mainly upon palæontological evidence, but the ordinary zoologist will find it difficult to believe that such highly specialised mammalian features as the development of hair, the allantoic placenta, and the habit of suckling the young have been evolved many times over, and yet always in conjunction with one another.

The third part of the second volume of Dr. J. W. Spengel's "Ergebnisse und Fortschritte der Zoologie" contains two useful summaries. The first, by Mr. H. F. Nierstrasz, deals with recent additions to our knowledge of the Chitons, which has enormously increased during recent years. The second, on the physiology of the facetted eye, by Mr. Reinhard Demoll, is based almost entirely on Exner's classical, but no longer very recent, work on the compound eyes of crustaceans and insects. The problem presented by these eyes is an extremely complex one, and really lies in the domain of the student of physical optics rather than that of the zoologist. On the whole, it appears that the Müllerian theory as to their mode of action still holds the field, but that this theory is not equally applicable to all cases.

REPORTS ON ICE IN SEAS AND OCEANS.

THE report on the state of the ice in the Arctic seas during 1909, published by the Danish Meteorological Institute, possesses more than usual interest on account of Admiral Peary's remarkable sledge journeys in the spring of that year. It summarises the conditions for each month, so far as known from reports supplied by traders to those parts, with maps for April–August inclusive. The state of the ice was unfavourable in Barents Sea and round Spitsbergen, while in the Greenland Sea and Denmark Strait the ice boundary was much more westerly than usual. The coasts of Iceland were almost free of ice, but much was observed off Newfoundland and on the Transatlantic steamer routes. On the south-east of Greenland and in the North American archipelago conditions were very favourable; in the Bering Sea they were about normal, and in the Beaufort Sea rather favourable, especially towards the middle of the summer. It is inferred that the amount of ice along the south-east of Greenland will be somewhat small in 1910, and that favourable conditions along the south-west coast of Greenland may result during the summer of this year.

From statements made on the useful monthly meteorological charts for the North Atlantic and Indian Oceans for April last, issued by authority of the Meteorological Committee, it appears that ice was scarce in the Southern Ocean during 1909. Up to about the middle of March last reports of only forty bergs passed in that year were received by the Meteorological Office; half these related to a position midway between New Zealand and Cape Horn. A later chart, however, states that from December, 1909, they commenced to be rather frequently reported. Tables referring to the bergs met with in previous years show that lengths of six to thirty miles are not uncommon, while some thirty of those sighted in that ocean in the last quarter of a century were 800 feet or above in height. Up to the present time, the report states, the birthplace of the largest of the bergs (1000 to 1500 feet in height) has not been definitely settled.

THE INTERNATIONAL HORTICULTURAL CONGRESS.

THE International Horticultural Congress at Brussels, April 30 to May 3, was attended by a large number of representatives, including delegates from the important horticultural societies. The meetings took place in the Salle des Fêtes in the grounds of the Great Exposition, at that time in a very incomplete state. Among the various subjects discussed was that of horticultural nomenclature. While there has been a general desire on the part of the more scientific horticulturists to conform to the rules of botanical nomenclature agreed upon at the International Botanical Congress at Vienna in 1905, it was felt that certain details which were not discussed at Vienna, but which were of special interest to horticulturists, should be definitely settled. The congress was unanimous in agreeing to adopt the Vienna rules of nomenclature, with necessary additions in the case of horticultural varieties and hybrids. It was agreed that the names of horticultural varieties, expressed, in accordance with the rules, in the vulgar tongue, must remain fixed when used in other languages than the one in which they were originally employed. When possible, the name should consist of a single word, and never of more than two, or at most three, words. To ensure valid publication a description of the variety must be drawn up in Latin, English, French, German, or Italian.

As regards garden hybrids, it was agreed that the specific name may be expressed in Latin, or in a vulgar tongue and written in Roman characters; if possible it should be a single word, but, at any rate, not more than three words. Various suggestions had been made as to the system of nomenclature for artificial hybrids in which two, three, or more genera are involved. In the case of bigeneric hybrids, the general custom was confirmed of forming a Latin generic name by the combination of the names of the parents; the specific name, also in Latin form, is to be separated from the generic by the sign of hybridity, thus, *Laeliocattleya* × *Smithii*. For plurigeneric hybrids the recommendation of the Royal Horticultural Society of London was adopted, namely, the use of a conventional generic name, derived from that of some person of distinction, with the termination *ara*, *e.g.* Lawrenceara.

The programme of the congress also included a visit to the Royal park and conservatories at Laeken, and to the new colonial gardens and plant-houses. The latter contain many plants of interest from the Congo.

LOWELL OBSERVATORY PHOTOGRAPHS OF THE PLANETS.[1]

THE pictures which I have the honour of showing tonight represent the results of the new planetary photography originated at Flagstaff in 1903–5, and now beginning to be successfully copied elsewhere, notably this last summer by M. le Comte de la Baume Pluvinel and M. Baldet in France, who from the summit of the Pic du Midi de Bigorre succeeded themselves in getting imprints of the canals of Mars. Although the method was originally designed to exhibit the markings of what is practically our nearest neighbour in space, it has since been applied to the other planets with an outcome as surprising as it is satisfactory. Little details which one would not have supposed could sit still long enough for their pictures to be taken stand out unmistakably on the plates, the faint equatorial wisps of Jupiter offering a good example of such tractability, though by no means the most remarkable.

That the canals of Mars should be made to write their own signatures on a photographic plate was the occasion of the invention of the process, which, after long and patient study by my assistant, Mr. Lampland, they were finally induced to do. To his marvellous feat the best tribute was that of Schiaparelli, who, after recognising the canals on the print sent him, wrote me in wonder that photography could be made to do such work, "I would never have believed it possible." Since then further improvement has been reached, to which almost every member of the staff has contributed. The process is based upon what our visual study of the planets has taught us to be the crux in the matter—the all-importance of definition. For this reason the older celestial photography, which furnishes such beautiful pictures of the stars and nebulæ, was here impotent. This will be realised when one considers that the whole disc of a planet could be put inside the image of a single star. For a like cause reflectors cannot be employed, for with them all faults, instrumental or atmospheric, are magnified three-fold over those of a lens. They may give imposing-looking pictures, but the finer detail is lost, a fact which is evident at once to an expert. Now it is in the registration of this finer detail that the accomplishment lies, and which from a scientific point of view marks its importance.

Study of the conditions leading to definition has made these photographs possible, just as lack of such study alone makes possible the scepticism one sometimes hears.

[1] A discourse delivered at the Royal Institution on April 8 by Prof. Percival Lowell.

Thus it is a well-known fact with us that the main markings of a disc may come out sharp, while the delicate ones are obliterated by a blur which otherwise eludes detection. This applies as much to photographic as to visual results, and it is this defect that a reflector introduces. Another optical mistake, which has latterly been hailed as showing that the lines are not lines, but a series of dots, was made the other day in France. The observer saw perfectly correctly, but one with knowledge of the optics of a telescope in our air should have known that the effect observed was the inevitable result of using an aperture which the seeing did not warrant, as he could easily have assured himself by looking at the shattered rings in the synchronous image of a star. Even in our far better Flagstaff atmosphere the best results are got by diaphragming the aperture down.

In photography we cannot diaphragm down to advantage because we need the light, and this is one reason why photographs cannot rival an expert eye. Visual observations conducted by an eye fitted by nature, and trained by experience, must always surpass the best the camera can do.

One reason for this resides in the fact that the eye registers its impression in the twentieth of a second, while the plate takes forty times as long. The result is that the planet's presentments in its bad moments are superposed upon its good ones to a composite photograph of the whole, not unlike that got from a similarly merged company of doctors where all individuality is lost in one inane smile. As such well-meaning imbecility does not do justice to the planet, its exposure-time must be shortened to the limit of effect.

For a like reason the out-of-focus images of what by courtesy is called the achromatic telescope must be suppressed. So what the new process does is to monochromatise the light as nearly as possible. This is accomplished by a colour-screen, and a plate sensitised in accord with it. Then at the moment of exposure every precaution is taken that all movement shall be as nearly nil as can be secured within the instrument itself, and in the air without it. Lastly, he who would photograph the canals most successfully must first have seen them, that he may know when his opportunity arrives.

Planetary photography is not intended, nor is it destined, to supersede visual observation. Research on the planets must rest in future, as in the past, on the ultimate power of the eye and of the brain behind it, a useful adjunct in such investigation, whether this take the form of telescopic, spectroscopic, or other perhaps new line of inquiry. But in certain ways the sensitive plate may supplement the retina. Position is one of these, contrast another. For the eye to place in their proper posts all the markings of a multi-featured disc in the short time at its disposal is a well-nigh impossible task. The film registers them at once *in situ*. Values are another thing the photographs bring out clearly. They exaggerate contrast, it is true, as compared with the eye; but this is no detriment. Rather the reverse, for it furnishes a greater scale for measurement.

In looking at the photographs two things must be borne in mind. One is that the irregularities due to the grain of the plate must not be attributed to the images. Thus, within the limits set by the grain, the lines on Mars show as lines, not as a patchwork. This is perfectly apparent when they are carefully scanned. When we consider that the original images are only 5 mm. in diameter we realise the strain of lantern exhibition. Even so they are magnified 200 times in the taking. They are then further enlarged on the slide, and lastly thrown greatly increased upon the screen. The wonder is that they stand this limelight publicity at all.

The second point is that we are not dependent on them for our minute knowledge of the planet. A good eye trained to the subject sees at least ten times as delicately as the film; but it must be an eye suited to planetary work, which is quite a different eye from that good at faint satellite or nebula detection. It is very important to remember this, for not only is there a physiologic reason for it, but mistake of it is often made in high quarters. When an observer records a polar flattening as twice and four times what hydrodynamics permit, his forte lies elsewhere than in planetary research.

Three planets will now show you their presentments, Mars, Jupiter, and Saturn. I was minded at first to omit Mars, passing by this old acquaintance with a nod, but so great have I found the interest in him here as elsewhere that he has been put beside the others.

As an example of the delicacy of the detail to be described on him, not only by the eye, but in the photographs, may be instanced the sight of one of the many vicissitudes of his changeful year, which suddenly appeared one day when least expected. The event was the first frost of the season in the Antarctic regions of Mars, detected visually at Flagstaff on November 16. The patch was at once photographed, and is plainly apparent on the plate. To chronicle thus the very weather on our neighbour will convince anyone that interplanetary communication has already begun, and that, too, after the usual conventional manner of ordinary mundane greetings.

My next mention shall show you the pitch of precision to which measurements of these little prints can attain. It is well known that the south polar cap of Mars is not centred on the pole, but lies some 6° off it, in longitude 20° or thereabouts. When the images showing the cap at two different longitudes were measured, the measures revealed distinctly the excentring of the cap, and even registered with some accuracy its amount and position. When we reflect what this means, it looks as if Mr. Crommelin's belief that areology would stand indebted to the photographs for help in its geodetic survey is in a fair way to be realised.

It would be possible in these photographs to take you on many a journey to that other world, but one such interplanetary voyage must suffice. This shall give you sight of the great new canals that appeared last September in a region of the planet where no canals had ever showed before. To begin with, you should know that the lines you will see are certainties, not matters admitting of the slightest question for all their strange regularity, and so seen by all those who, from the most prolonged and careful study, are qualified to speak. Schiaparelli described them as looking as if they had been laid down with rule and compass, and not only I, but all of my assistants, have seen them thousands of times the same. Nor are they near the limit of vision in our air, which sometimes sets the planet against the sky as if etched in a steel engraving.

In the second place, the technical word "canals" does not mean ditches dug, but artificially fertilised strips of country to which the water from the polar cap is led by some mechanical means. We have proof of their artificiality from the fact that they develop latitudinally down the disc from pole to equator after the cap begins to melt, for on a body the surface of which is in equilibrium, as with Mars, neither water nor any other substance could take this equatorward course unless it were intelligently conducted. What the conduits that lead it may be like we ignore, for all we see is their effect on vegetation.

Lastly, the organisms of Mars can hardly resemble men, which opens up for them unknown possibilities of intelligence and renders them really interesting.

On September 30 last, when the region to the east of the Syrtis Major came round into view again after its periodic hiding of six weeks, due to the unequal days of the earth and Mars, two imposing canals were seen leading up from the Syrtis to the south-east, which had not been there at the preceding presentation. Research showed that not only had they never previously been seen, but that they could never have existed as such before. The long and full records of the observatory, extending over fifteen years, made it possible to be absolutely sure of this. Yet these canals, with several subsidiary ones, fitted into the general canal system as if they had always made part of it.

Not only was their coming into existence established by the drawings, but the photographs of previous years testified to the same unheralded advent. By comparing the drawings and photographs made at the same epoch the oneness of the two becomes evident, while the change of both with the Martian seasons is clearly portrayed. Thus we have actually witnessed a "canal" called into being by the life existent at this moment on the surface of Mars.

Turning now to Jupiter, we find a completely different

set of features registered on the plates, no less corroborative of the drawings made of him at Flagstaff, but utterly unlike those of Mars. Their symmetry is immediately striking, and then no less is its purely latitudinal character. They are belts, bright and dark, banding the disc halfway to the poles. Their behaviour, however, indicates in them no regard for the sun, as they are quite oblivious both to the planet's day and to his year. They last indifferently through both, and disappear at their own good time. That the brighter are clouds and the darker the gaps between seems inferable; but they are not as our clouds. With us the heat that causes cloud comes from without, with Jupiter from within. Sun-occasioned the one, self-evolved the other. We have visual evidence of this internal heat of Jupiter in the cherry-red that tinges his darker belts, as if we there looked down into the seething cauldron below. We have theoretic proof of it, too, in the oblateness the disc presents taken in connection with what we know to be the planet's mean density. In two articles shortly to appear in the *Philosophical Magazine*, those who care for mathematics will find that his own fire alone enables Jupiter to keep his youthful figure, and, furthermore, that his shape shows him to consist of a comparatively small kernel wrapped in a huge husk of cloud. Even those who do not care for the oldest of the sciences must admit a certain grandeur in it when theory can thus plumb depths experiment may never fathom.

These belts have another peculiarity. Their several parts are travelling at idiosyncratic rates. With them it is a go-as-you-please race, in which each outruns or falls behind its neighbour. On this interesting subject we owe most to your fellow countryman, Mr. Stanley Williams, who for some years has acted as timekeeper and referee of this Jovian family contest. In future he will have no mean rival in the photographic plate. Not that it sees as well, but that it may be measured at leisure by any investigator who likes.

There is one feature in the photographs which has had a long and eventful history. I refer to the Great Red Spot. Detected in 1879, it lasted as such to within a few years. Rather a long life for a hole in the clouds! Now, properly speaking, we see only the grave in which it lies buried, the oval shell it once occupied; but these same photographs were, in a sense, the means of bringing its cradle also to light. Sixty years ago, a cycle of Cathay, Sir William Huggins made a fine series of drawings of the planet, and on receiving the present pictures was struck by the resemblance of the two. In consequence he sent me prints of his. On scanning them my eye was caught by an oval placed as the present one lies. Clearly it was the cradle prepared already for the Great Red Spot twenty years in advance. He had been present before its birth, as he is still, happily, present after its demise.

In the next set of images we envisage a Jovian event of some interest, in spite of the frequency with which it occurs—the transit both of a satellite and of its shadow across the planet's disc. For this means to Jupiter the occasion of a total eclipse of the sun, an impressive phenomenon were there anyone there to see. In the left-hand images the satellite itself may be descried just passing off the disc, while in their complete procession the shadow, which is the eclipse, may successively be followed in its travels from one side toward the other of the planet's face. The swiftness of its traverse may be marked in the displacement it undergoes, not only directly, but with regard to the Jovian cloud-belts, which are themselves whirling round at the rate of 25,000 miles an hour. To witness thus the progress of a total solar eclipse on the great planet gives one, perhaps, his most vivid experience of Jovian affairs.

The third point we may mention in these photographs is their revelation of the equatorial wisps. Some years ago Mr. Scriven Bolton detected a most curious set of markings lacing Jupiter's bright equatorial belt. His discovery met with the usual approved disapprobation which has been the orthodox reception of astronomical advance since Galileo's time. Were a discovery to be hospitably hailed it would prove disconcerting to the discoverer, who would instantly suspect something wrong. Eventually the subject was referred to us for corroboration. This we were able, fortunately, to secure. A singular phenomenon they proved to be, criss-cross filaments of shading traversing the belt from triangular spots at its edges, for all the world like the lacings of a sail that hold the bolt-rope to its spar. Though perfectly evident to the eye, we hardly hoped to catch them on a plate. Nevertheless, Mr. E. C. Slipher did, and innumerable other images of them have since been got by us; their pictures you will presently see for yourselves upon the screen. Why such peculiar rents should be torn in the planet's great cloud envelope we cannot yet explain, but further news about them has still more lately come to us from the planet to which we now pass in our journey outward from the sun, the great ringed planet Saturn.

In some respects Saturn is the most difficult of the three planets to photograph, certainly the most tiring. So faintly is it illuminated that what takes but two seconds for Mars takes twenty or more for Saturn. To keep the image of the planet upon its guiding cross-wires for that length of time, with the nervous knowledge that any slip will be

Reproduction of a photograph of the planet Saturn taken on November 4, 1909, by Prof. Lowell.

fatal, seems an eternity. Since sensations measure existence, it may be commended as a sure, though not happy, way to prolong one's life.

On the resultant images may be seen abundant detail. Cassini's division is there as large as life, and somewhat broader, due to the difficulty of keeping it still; so also is the shading of the inner side of ring B, and the tones of the several portions of ring A. The ball appears finely, its belts standing out even more than to the eye, and the duskiness of its polar hoods being peculiarly pronounced. The shadow of the ball upon the rings is, of course, salient, and so is the shadow of the rings upon the ball. This much is evident at a glance, but there is more to be made out by him who examines closely.

If we consider the images of November 4, which happen to be mine, we shall notice a dark band below the rings where they cross the ball, and one which is but dusky above them. Now at this date both the sun and the earth were above the plane of the rings, as we see the image, the sun the higher, the sun's relative latitude being $-12^\circ\ 18'$, that of earth $-11^\circ\ 4'$.

We saw, in consequence, the shadow of the rings A and B underneath the rings themselves. This accounts for the dark band below. What, then, was the dusky band above? It could not be the shadow of these rings, for the shadow could not fall on both sides of them at once, nor could it be seen above. A little consideration will reveal to us what this band was. Inside of ring B toward the planet lies the crêpe-ring C. It is a semi-transparent ring, because its particles are widely scattered, instead of seeming solid like the outer rings, where the particles lie closer together. Their constitution we owe to perhaps the greatest mind of the last century, your own Clerk-Maxwell. This, then, was the explanation: in the dusky band we were looking through the crêpe-ring on to its own shadow thrown upon the ball. Thus the crêpe-ring revealed its presence unmistakably, not by being seen, but by being seen through.

When we compare these images of November 4 with those taken by Mr. E. C. Slipher on September 9, we note

a marked contrast in the two fringes of shadow. This corroborates what we have just deduced, for at this time the relative positions of the sun and earth were reversed.

In the case of Saturn we have, as another interesting detail, the excellent instance it affords of contrast. From the bright equatorial belt, the most brilliant part of the whole picture, we notice a regular gradation of tints down to the faintest parts of the rings, for it is noteworthy that the dark belts of the planet are not so dark as these. This grading is particularly serviceable for being practically that of the eye, for the colour screen and plate used were such as to give us the light from that portion of the spectrum of which the eye takes greatest cognisance. The relative effect, therefore, on the plate is the same as on the retina.

Lastly, we come to what is one of the greatest triumphs of the whole process, the self-recording of the wisps of Saturn. It was in September that these wisps were first detected visually, independently, by my assistant, Mr. E. C. Slipher, and myself. Curiously enough, they were suspected synchronously on the photographic images, and on later ones were definitely seen. They counterpart almost precisely those of Jupiter, though, of course, in very faint replica. Here comes in the beauty of the photographic method. Instead of taking but a single image, twenty or more are taken one after the other on a single plate. Meanwhile, the colour-screen is moved. Thus any detail in the image due to defect on the plate proclaims its origin by its singularity, and in the same manner the colour-screen betrays its self-written markings. If a detail is repeated on several images in place it must be real, however faint.

As we take our leave of Saturn let me point out the beautiful elliptical figures of the rings thus shown, a symmetrical correctness wonderfully pleasing to the eye, and which the best of drawings fails to reproduce.

From the detail these photographs have thus proved themselves able to depict, they mark a new departure in planetary research. While, on the one hand, they exhibit to the world at large something of the advance recently achieved in our knowledge of the solar system, on the other they constitute in themselves the beginning of a set of records in which the future of the planets may be confronted with its archived past, and which shall endure after those who first conceived such registry shall have long since passed away. They can never take the place of first-rate visual observation, but they will form a firm foundation for whatever shall subsequently be seen, and will enable such changes as must inevitably ensue to be the better collated and compared. They are the histories of the planets written by themselves, their autobiographies penned by light; and in their grand historical portrait gallery, where the planets' pasts live on for ever in immortal youth, astronomers yet to come may see the earlier stages of the great cosmic drama which is slowly but surely working itself out.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Mr. E. M. Holmes, whose magnificent collection of seaweeds and algæ was purchased for the University some time ago, has now presented to the botanical department another series of about 2000 beautifully preserved specimens, together with a number of valuable books on algology. The possession of this collection, the finest of the kind in the world, places the University in a unique position for the study of this branch of botany.

Prof. Sidney S. Dawson has resigned the chair of accounting.

An official degree of M.Sc. is to be conferred on Prof. F. W. Gamble.

Dr. Arthur Francis Bashford, director of the Imperial Cancer Research, has been appointed to deliver the Ingleby lectures for 1911.

Prof. Charles Lapworth, F.R.S., has been appointed to represent the University at the International Geological Congress at Stockholm in August next.

CAMBRIDGE.—The general board of studies has appointed the following university lecturers:—Dr. Marr, geology; Dr. Shore, physiology; Dr. Baker and Mr. J. H. Grace, mathematics; Mr. G. F. C. Searle and Mr. C. T. R. Wilson, experimental physics; and Mr. H. O. Meredith, economics.

The special board for biology and geology has nominated Prof. I. Ikeda to occupy the university table at the laboratory of the Marine Biological Association at Plymouth for three weeks between July 15 and August 30.

GLASGOW.—Among the recipients of the honorary degree of Doctor of Laws on Thursday, June 9, were Dr. H. Dyer, C.E., first principal of the Imperial College of Engineering, Tokyo, now honorary principal of the college, and emeritus professor of the University of Tokyo; and Prof. G. O. A. Montelius, royal antiquary of Sweden and professor at the National Archæological Museum, Stockholm.

LEEDS.—On Saturday, June 11, the University held a Congregation for the purpose of installing the Duke of Devonshire as Chancellor in succession to the late Marquis of Ripon. The gathering, which included the Mayor and Corporation of the City, a large representation of Yorkshire civic and educational authorities, as well as the Court, Senate, and Convocation of the University, was held in the Town Hall. After the ceremony of installation a band of one hundred and fifty students sang a chorus from Bach's "Dramma per Musica." The Chancellor delivered a short address, in which he alluded to the hereditary interest of his family in the fortunes of the Yorkshire College and the Leeds University, and expressed himself anxious to maintain the tradition to the utmost of his power. He commended the work of tutorial university extension and the prosecution of research, especially in connection with the prevention of disease. In connection with the ceremony, honorary degrees were conferred on a number of distinguished public men, including the Prime Minister (who was born near Leeds), the Earl of Crewe, Lord Lansdowne, and the Speaker. The degree of D.Sc. was conferred on Lord Rayleigh, Sir Clements Markham, K.C.B., and Prof. Osler. Sir Hugh Bell, Bart., received the degree of LL.D. On behalf of the honorary graduates, Mr. Asquith congratulated the University upon the installation of its new Chancellor. He expressed the opinion that the new universities had justified the faith and fulfilled the high hopes of their founders, and he passed a warm eulogium upon the work of the University of Leeds. The ceremonial of the proceedings, which was picturesque without being archaic, excited great interest, and the part taken by the students met with general approbation.

ON Thursday, June 23, Dr. H. A. Miers, F.R.S., principal of the University of London, will present the prizes at the London (Royal Free Hospital) School of Medicine for Women. Mrs. Garrett-Anderson, president of the school, will occupy the chair.

WE learn from *Science* that an announcement has been made of the receipt by Western Reserve University of a gift of 50,000*l.* by Mr. H. M. Hanna, as an addition to the endowment of the medical department, and that Mr. J. Ogden Armour has made a gift of 14,000*l.* to the Armour Institute of Technology.

ACCORDING to a Reuter message from Peking, the Throne of China, approving a recommendation of its Board of Education, decrees that English shall be the official language for scientific and technical education. The study of English is made compulsory in all provincial scientific and technical high schools.

THE annual conference of the Association of Teachers in Technical Institutions, which was postponed on account of the death of King Edward VII., will be held at Birmingham on Friday and Saturday, June 17 and 18. Mr. J. Wilson, president of the association, will deliver his address on the latter day, and a paper will be read by Dr. T. Slater Price on the relations of technical institutions to the universities.

THE late Prof. J. Campbell Brown, professor of chemistry for thirty-two years in Liverpool University, left estate of the gross value of 43,101*l.*, of which the net personalty has been sworn at 42,740*l.* We learn from the *Times* that he bequeathed to the professors of chemistry of the University

of Liverpool and their successors his collection of old alchemical and similar books, to be kept together as the nucleus of a collection for the professors' private room. He left a sum sufficient to produce an annual income of 50*l.* to Liverpool University to found an advanced chemical scholarship to be called "The Campbell Brown Scholarship," and a sum sufficient to produce an annual income of 800*l.* to the University of Liverpool upon trust for the endowment of a chair of chemistry in addition to existing chairs, to be called the Campbell Brown chair, or if a chair shall have been endowed, then either for a chair for the teaching of agricultural chemistry or a chair of some other branch of industrial chemistry. He also left 5000*l.* to the University upon trust to place the income at the disposal of the Campbell Brown professor for the time being towards the cost of his apparatus and material. If the University of Liverpool shall not accept the bequest for the endowment of the chair on these conditions, the whole sums are to be given to the University of Manchester to endow a Campbell Brown chair of music. The residue of his property he left upon trust to found a series of entrance scholarships each of the value of 60*l.* per annum, to be held at the University of Liverpool, tenable for three years and renewable for a fourth. The value of the bequest for the proposed professorship is from 25,000*l.* to 28,000*l.*, of that for the advanced chemical scholarship 1500*l.*, and for the entrance scholarships 5000*l.* to 8000*l.*

AT one of the meetings of the Women's Congress held at the Japan-British Exhibition on June 8, the question of a university standard in home science was discussed. Mrs. St. Loe Strachey read a paper on the ideals of home science, and defined a university standard as meaning the attainment by a student of such a standard of knowledge as could be rewarded by the grant of a degree if it had been attained in a subject in which our universities examine for a degree. In the special courses in home science being held at King's College for Women, the teaching claims to attain to a university standard. The students are not allowed to be content with merely acquiring a knowledge of the technical processes carried on in the practice of domestic science, but are required to study at first hand the various scientific principles which underlie the proper conduct of a house or institution and the bringing up of the young. It is true, she said, that women in our universities have for many years past studied physics, chemistry, biology, bacteriology, and, indeed, the whole list of sciences mentioned in the King's College syllabus, but the point is that these subjects should be studied in a definite, coordinated course, having for its object "to provide a scientific education in the principles which underlie the whole organisation of home life." Miss Oakeley, warden of King's College Women's Department, said the new movement met the spirit of the age in its insistence that science should be everywhere, that reason should occupy all spheres, that there should be no dark corners left. The meeting seemed hardly to realise that to be thoroughly effective in improving the conditions of home-life the science teaching received by women must be begun in the school, and that many women will have few opportunities for further study after school days are over. The conditions in the schools must be improved. First, a course of practical work in science suitable for girls, and having the needs of the home before it at every stage, must be forthcoming; and, secondly, there must be a supply of well-educated mistresses who, in addition to their laboratory practice and general knowledge of science, have gained a first-hand acquaintance with household needs and difficulties, and have become experts in such arts as are required in the kitchen and laundry.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 9.—Sir Archibald Geikie, K.C.B., president, in the chair.—J. A. **Gray**: The distribution of velocity in the β rays from a radio-active substance. The β rays from some radio-active substances have been deflected in a magnetic field, and the detection of sets of homogeneous β rays attempted by the photographic method. Radium emanation was the substance first used. It was placed in a very narrow thin-walled tube, drawn out from capillary tubing, so thin that the α rays from the emanation escaped. Enough black paper was placed over the tube to absorb the α rays and to protect the photographic film from phosphorescence caused by the α rays. The β rays from the active deposit had thus to pass through very little absorbing material. If the β rays from a simple radio-active substance are emitted at an identical speed, we should therefore expect to find evidence of such, even if β rays do change slightly in velocity in passing through matter. Although several photographs were taken, no sign was found of sets of homogeneous β rays from Ra B and Ra C. Experiments were then tried with Ra E as radiating substance. Here we have β rays which are very nearly absorbed according to an exponential law, and if, as many writers have assumed, absorption according to an exponential law signifies homogeneous β rays, these rays should be practically homogeneous. It was found, however, that the velocities of the rays were distributed over a wide range. The results of the experiments may be summarised as follows:—(1) β rays which are absorbed according to an exponential law are not homogeneous; (2) β rays must fall in velocity in passing through matter, for, if not, the absorption coefficient of any mixture of rays must decrease as the rays pass through matter.—W. **Wilson**: The decrease of velocity of the β particles on passing through matter. In a previous paper it was shown that the velocity of β particles suffers an appreciable decrease on passing through matter. The present experiments were undertaken with the view of directly confirming this result. Homogeneous beams of rays were separated by means of a magnetic field from a heterogeneous beam given out by the active deposit from radium. These homogeneous rays passed into another magnetic field, where their velocity was measured. Sheets of aluminium were then placed in the path of the rays between the two fields, and the velocity of the emergent rays was found to have decreased by an appreciable amount. From considerations of the law of absorption found to hold for homogeneous rays, the decrease of velocity of the rays as they pass through matter could be calculated, and was found to agree with the results obtained experimentally. The results obtained are in agreement with the equations $E=k(a-x)$ and $E^2=k'(a'-x)$, where E is the energy of the rays, x the thickness of matter traversed, and k and a constants. The agreement is rather better in the former case than in the latter, but the range of velocities considered was not sufficient to differentiate sharply between them. Although the change in velocity observed was only from $2{\cdot}85\times10^{10}$ to $2{\cdot}25\times10^{10}$ cm. per sec., yet the change of the properties of the rays with respect to absorption is very large, the absorption coefficient of the former being 4·9 cm.$^{-1}$, while that of the latter is 35·2 cm.$^{-1}$.—J. N. **Brown**: The rate of emission of α particles from uranium and its products. The object of the experiments was to estimate the number of α particles emitted per second per gram of uranium in equilibrium with all its products (*i.e.* as it occurs in pitchblende). The pitchblende was prepared as a thin film, over which was placed a zinc sulphide screen. The scintillations produced on the screen by the α particles were observed through a microscope. Each scintillation corresponded to the emission of one α particle from the pitchblende. The weight of pitchblende sending particles to the portion of screen viewed by the microscope was readily obtained, and since the screen was very close to the film the number observed could be taken as half the total quantity emitted by this weight of pitchblende so long as the thickness of the film was less than the distance of penetration of α rays into pitchblende. This point was ensured by making observations on films of various thicknesses and plotting a curve between number of scintillations per minute and weight of film, the result being calculated from a film for which the curve showed the rate of production of scintillations to be proportional to the thickness. The percentage of uranium in the pitchblende was estimated, and the result finally expressed as number of α particles per second per gram of uranium in equilibrium with its products, the figure obtained being $7{\cdot}36\times10^4$. From Rutherford's result for radium the value for uranium can be obtained through a series of calculations, each of which may involve a 5 per cent. error. The value obtained in this way is $9{\cdot}1\times10^4$.—Hon. R. J. **Strutt**: The accumulation of helium in geological time, iv.

This paper gives further determinations of the ratio of helium to radio-active matter in minerals, chiefly those occurring in Archæan rocks. Very large relative quantities of helium are found, in one instance (a sphene from Renfrew Co., Ontario) indicating an antiquity of at least 700 million years, even if no helium has escaped. The unique case of beryl, which, as shown in a former paper, contains much helium with hardly any radio-active matter, is discussed. An explanation, suggested by Dr. Boltwood, is put forward. It is supposed that beryl, in crystallising, has separated from the parent magma one of the longer-lived products of the uranium or thorium series, such, for example, as radium, ionium, or radio-thorium, without the parent element. This product would decay, leaving no trace of its presence except the helium generated. Reasons are given for believing that nothing of this kind has happened in the cases relied on for measuring time.—R. T. **Lattey**: The effect of small traces of moisture on the velocities of ions generated by Röntgen rays in air. Some experiments of Prof. J. S. Townsend (Proc. Roy. Soc., vol. lxxxi., A, 1908, 464) on lateral diffusion of a narrow stream of ions moving in an electric field led to the conclusion that negative ions are much smaller in perfectly dry air than in air containing a small quantity of moisture. It was consequently to be expected that complete removal of water vapour would cause an increase in the velocity with which negative ions move under the influence of an electric field of force. At his suggestion an investigation of the velocities of ions in air at low pressures was undertaken, and it was found that, while the complete removal of water vapour had only a small effect on the velocities of positive ions, yet the same cause increased the velocities of negative ions by a factor rising to as much as thirty for some of the forces that were used, and this factor appeared to be much larger for larger forces. The velocities of positive ions are known to vary directly with the potential gradient (X) and inversely with the pressure (p) of the gas in which they are travelling; in other words, vp/X is a constant where v is the velocity. Between 14 and 29 mm. pressure the following values of vp/X were obtained:—dry air, $vp/X=1121$; moist air, $vp/X=780$. In the case of negative ions it is known that when air is moist v is not a linear function of X/p, but that vp/X increases slightly as X/p increases. The velocity is, however, a function of X/p, and is independent of actual values of either X or p. In dry air it was found that while v is still a function of X/p, yet the rate of increase of v with increase of X/p is considerably more rapid than in moist air. This is illustrated by the following table:—

Velocities of Negative Ions in Dry Air in Centimetres per Second.

p (mm.)	X/p=0·04	0·05	0·06	0·07	0·08	0·09	0·10
14·3 ...	107	175·5	310	580	1126	2200	4210
18·4 ...	103	163	279	514·5	1006	2050	4170
24·5 ...	110·5	172·5	286	509	936·5	1799	3480
28·8 ...	116	180	208·5	519·5	926	1652	—
Mean ...	112·5	173·2	287·8	510·5	953·5	1845	3635

Thus when pressure remains constant at 14·3 mm. and force varies from 0·56 volt per centimetre to 1·43 volts per centimetre, velocity increases from 107 centimetres per second to about 4000 centimetres per second. When the gas is slightly moist the corresponding velocities would be about 32 centimetres per second and 90 centimetres per second. Thus in air containing about 11·5 per cent. (by pressure) of water vapour the velocities observed were:—

(mm.)					X/p=0·09	0·10
18·0	...	...	...	...	80	89
19·3	...	...	...	...	83	92
Mean	...	...	...	...	81·6	91·7

—Dr. A. O. **Rankine**: The variation with temperature of the viscosities of the gases of the argon group. The ratio of the viscosity at the temperature of steam to that at atmospheric temperature has been determined for each of the five gases. Taking Sutherland's equation $\eta=\frac{KT^{\frac{1}{2}}}{1+C/T}$, the values of C have been calculated, and are shown in the following table. C is least in the case of neon; in fact, this is the lowest value yet recorded for any gas. This suggests that neon is the most nearly perfect gas known. A further interesting point is that C is, in the cases of argon, krypton, and xenon, proportional to the critical temperature:—

	He	Ne	A	Kr	X
C	70	56	142	188	252
T_c	—	[63]	155·6	210·5	288
T_c/C ...	—	[1·12]	1·10	1·12	1·14

The critical temperatures of helium and neon are not definitely known, but it is certain that T_c for helium is much too low to conform with the above rule. With regard to neon, however, T_c is known to be less than 68° absolute, and this does not exclude the value 63° absolute calculated by means of this rule. It has also been noticed that, with the exception of hydrogen, the same rule holds good for all other gases the data for which are available.—Dr. W. G. **Duffield**: The effect of pressure upon arc spectra. Part ii. No. 4.—Gold.—Prof. B. **Hopkinson**: Radiation in a gaseous explosion. The pressures produced by the explosion of a mixture of coal-gas and air in a vessel plated with silver on the inside have been recorded, first with the walls highly polished, and second when the walls are blackened. The mixture contained 15 per cent. coal-gas, and was at atmospheric pressure and temperature before firing. The maximum pressure reached in the explosion was about 110 lb. per square inch above atmosphere, corresponding to a temperature of about 2200° C. It was found that when the walls were polished the maximum pressure was about 3 per cent. higher, and the rate of cooling for the first half-second about 35 per cent. less, than when the walls were blackened. The state of polish of the walls had a great effect on the rate of cooling, differences hardly appreciable to the eye making a marked difference in the rate of fall of pressure. The heat received by polished and blackened surfaces, respectively, was determined by means of a bolometer of silver strip fixed to the walls, the remainder of which was black. The change of resistance of this strip during explosion and cooling was recorded by means of a reflecting galvanometer on a moving film simultaneously with the pressure. From the rise of temperature of the strip and its capacity for heat the heat-flow into it could be deduced. It was found that when the strip was polished the heat received during the first quarter of a second after firing was three-fourths of that received by blackened strip in the same period, the pressure records being the same. Relative rates of heat loss to completely blackened and completely polished walls deduced from pressure records, during 0·25 second, varied from 0·6 to 0·7. Direct measurement of radiation from the gas was made by means of a recording bolometer placed outside the vessel, and exposed to the radiation through a fluorite window. At the end of half a second after ignition the total quantity of heat radiated and recorded by the bolometer amounted to 22 per cent. of the heat of combustion of the gas. At this period the gas was still radiating heat to a perceptible amount, its temperature being then 1000° C. At the moment of maximum pressure (1/20 second after ignition) 3 per cent. of the heat of combustion had been radiated away. The radiation recorded by the external bolometer exceeds by about 50 per cent. the difference between the heat absorptions by the blackened and polished silver respectively. The estimate of the latter difference is, however, subject to a good deal of uncertainty on account of the large correction for heat lost to the backing to which the bolometer strip is fixed. Moreover, there are reasons for supposing that it does not represent the whole of the radiated heat.

Royal Microscopical Society, May 25.—Mr. A. N. Disney, vice-president, in the chair.—Dr. M. D. **Ewell**: Comparative micrometric measurements.—E. **Heron-Allen** and A. **Earland**: The recent and fossil Foraminifera of the shore sands of Selsey Bill, Sussex, part v., the Cretaceous Foraminifera.

Physical Society, May 27.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Dr. W. H. **Eccles**: An oscillation detector actuated solely by resistance-temperature variations. Experiments are offered as additional support for the hypothesis of the mode of action of certain types of electrical oscillation detectors. This hypothesis suggests that in detectors constituted of a loose contact, the

energy of the oscillatory current through the contact is transformed into heat at the contact and warms the matter there sufficiently to change its electrical resistance, and, consequently, the steady current through the indicating instrument. The experiments are on a detector of the so-called "crystal rectifier" type, from which, however, the possibility of thermoelectric effects has been eliminated.—S. W. J. **Smith**: The limitations of the Weston cell as a standard of electromotive force. The experiments of Mr. F. E. Smith on cadmium amalgams are discussed. Theory and experiment suggest that there is no range at any temperature over which the E.M.F. of a Weston cell is absolutely independent of the percentage of Cd in the amalgam. Even if the materials are pure, the existence of surface energy must cause some variation. Within the range over which the E.M.F. is usually taken as constant the E.M.F. appears to rise, very slowly, with increase in the cadmium content. The rate varies, but is never more than a few millionths of a volt for 1 per cent. Cd. From the data it seems possible also to discover the precise way in which the use of the richer two-phase amalgams may lead to variability of the E.M.F. of the Weston cell. The interpretation advocated is that the irregularities are due to electrolytic skin effects arising out of want of uniformity of composition of the surface grains. The probable reason why the temperature coefficient of E.M.F. of a Weston cell, always small, actually vanishes near 0° C. is indicated.

Geological Society, May 25.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. F. H. **Hatch** and R. H. **Rastall**: Dedolomitisation in the marble of Port Shepstone (Natal). The Port Shepstone marble is shown by chemical analysis to be a dolomite. It owes its marmorisation to thermal metamorphism by an intrusion of granite, which surrounds it and penetrates it in broad dykes. This intrusion took place at some time prior to the deposition of the Table Mountain or Waterberg Sandstone, and is therefore pre-Devonian. The metamorphism of the dolomite under normal conditions produced a saccharoidal marble of coarse texture, consisting of carbonates; and the fact that neither periclase nor brucite has been produced in the normal marble is taken to indicate that the high-pressure conditions obtaining during the metamorphism precluded dedolomitisation.—E. B. **Bailey**: Recumbent folds in the Highland schists. A description is presented of the stratigraphy and structure of a portion of the Inverness-shire and Argyllshire Highlands. The district considered lies south-east of Loch Linnhe, and extends from the River Spean in the north to Loch Creran in the south. The following conclusions are arrived at:—(1) The schists of the district are disposed in a succession of recumbent folds of enormous amplitude—proved in one case to be more than twelve miles in extent. (2) The limbs of these recumbent folds are frequently replaced by fold-faults, or "slips," which have given freedom of development to the folds themselves. (3) The slipping is not confined to the lower limbs of recumbent anticlines, and is due to something more than mere overthrusting. It is a complex accommodation phenomenon. The cores of some of the recumbent folds have been squeezed forward, so that they have virtually reacted as intrusive masses. (4) In the growth of these structures many of the earlier formed cores and slips have suffered extensive secondary corrugation of isoclinal type.

Linnean Society, June 2.—Dr. D. H. Scott, F.R.S., president, in the chair.—Dr. A. B. **Rendle** and others: A contribution to our knowledge of the flora of Gazaland: an account of collections made by Mr. Swynnerton, by members of the Department of Botany, British Museum, with notes by Mr. Swynnerton. The collections which form the subject of this paper were made by Mr. C. F. M. Swynnerton chiefly in the high country which forms the boundary between eastern Rhodesia and Portuguese territory. It consists of a number of detached masses of highland separated by river valleys which ultimately unite to form the Buzi, an important river running eastwards through the lower-lying Portuguese territory to enter the Indian Ocean near Beira. Mr. Swynnerton has supplied an interesting account of the phyto-geographical character of the district. There is evidence that it was once covered with dense forest, which has, however, been largely destroyed by the annual forest fires during some former period of dense population. At present the forest occupies the more protected uplands, forming great patches; such are the great forests in the Chimanimani mountains in the north, a rugged range reaching a height of 8000 feet, and the Chirinda and Chipete forest patches closely adjoining each other in the south. Chirinda is described as a virgin forest of enormous, and mostly evergreen, trees, covering about 12,000 acres of the higher portions of the hill. Its larger trees range from 80 to 170 feet in height, and the undergrowth, with mosses, ferns, epiphytes, and lianas, is of a thoroughly tropical character. As was to be expected from the geographical position, the botany of these highlands shows a strong South African affinity, and several of the genera and a considerable number of the species have not been hitherto recorded beyond South Africa. A large proportion of the plants are identical with those previously known from Nyasaland. There is also a well-marked Angolan element. An interesting novelty is *Pseudocalyx africanus*; Pseudocalyx is a Malagasy genus not hitherto known from tropical Africa.

Mathematical Society, June 9.—Sir Wm. Niven, president, in the chair.—G. T. **Bennett**: The composition of finite screw displacements.—Prof. M. J. M. **Hill**: Differential equations with fixed branch points.—Miss M. **Long**: Geiser's method of generating a plane quartic curve.—W. P. **Milne**: The generation of cubic curves by apolar pencils of lines.—E. **Cunningham**: The constitutive equations of material media in electrodynamics.—Dr. W. H. **Young**: (1) A new method in the theory of integration; (2) semi-integrals and oscillating successions of functions.—H. R. **Hassé**: The transformation of the equations of the theory of electrons for quasi-stationary motion.

EDINBURGH.

Royal Society, May 2.—Prof. Hudson Beare, vice-president, in the chair.—Sir Joseph **Larmor**: Address on the dynamics of molecular diffusion, with extension to suspended particles. After referring to the remarkable parallelism between the phenomena of a free gas, of sparse molecules constituting a dilute solution in water or other fluid, and of the Brownian movements, Sir Joseph proceeded to emphasise the distinction between osmotic pressure and gas pressure. The former depended on the frictional pull of moving particles, and the latter on the momentum of the free motion. The zigzag paths of particles suspended in water, photographs of which were projected on the screen, suggested that here also, as in gases, there was an average free path and an average speed to which the power of diffusion stood in definite relations. In this discussion the unexpected result emerged that, at the same temperature, the mean speed was proportional to the number of particles in suspension. Recent observations under the ultra-microscope, by which we can detect particles of a size more minute than can be seen by direct optical methods, have not contradicted this conclusion. The analogy between free gases and dilute solutions must not therefore be pressed too far. There was ground for thinking that we were approaching a great advance in the interpretation of phenomena of this kind, namely, the average phenomenon of a great crowd of molecules as they affect *en masse* our senses of perception. The main interest and fascination of science lay in its growing points where new knowledge was gaining ground on the unknown; and to consider some of the recent achievements and the outstanding problems in a field now rapidly undergoing development seemed more suitable to such an audience as the Royal Society of Edinburgh than to pass under review once more some harvest already definitely won and safely garnered in the stores of human knowledge.

May 16.—Prof. Crum Brown, F.R.S., in the chair.—J. W. **M'David**: Equilibrium in the ternary system, water, potassium carbonate, potassium ethyl di-propylmalonate. Crichton had observed that when a concentrated aqueous solution of this last-named salt was shaken up with a concentrated solution of potassium carbonate, two distinct layers were formed. The object of the present paper was to show how the miscibility of the two solutions depended on their concentration, temperature, &c. Various solutions

of the two salts in approximately equal proportions were mixed together and left to settle, and one mixture was made with quite different weights. Analysis showed that there was always a considerable quantity of potassium carbonate in the upper layer, but that the amount of potassium ethyl di-propyl-malonate present in the lower layer was scarcely appreciable until the solutions were comparatively dilute. When water was added drop by drop, the liquid being kept well stirred, the two layers ultimately disappeared, and one homogeneous solution was left. This disappearance of the two layers was quite well marked, and was due to the potassium carbonate passing into the other layer.—Profs. Alex. **Smith** and A. W. C. **Menzies**: A method for determining boiling points under constant conditions. The apparatus consisted of a small bulb with a bent capillary, the whole being attached to a thermometer suspended in a beaker which contained water, sulphuric acid, melted paraffin, &c., according to the temperature to be measured. The method was especially useful when only small quantities of the material could be used. The apparatus was also found to be very serviceable in measuring vapour pressures. The authors gave illustrations of its adaptability in a second paper, entitled "A Simple Dynamical Method for determining Vapour Pressures." In a third communication by the same authors attention was directed to a common thermometric error in the determination of boiling points under reduced pressure. It was found that appreciable corrections had to be applied when the bulb of the thermometer was enclosed in an evacuated vessel. This was due to the dilatation or deformation of the bulb. The error might be as much as one-fifth of a degree.—Dr. J. **Brownlee**: The mathematical theory of random migration, and epidemic distribution; and the inheritance of complex forms, such as stature, on Mendel's theory. In the former paper, which was a continuation of an earlier communication, equations were formed which represented closely epidemic distribution, and the distribution which small animals, such as small crustaceans, took up experimentally. The theory led to the exponential curve as an approximate solution, and the facts were in good accord with the theory. Experiments were made with Daphnia, Pulex, Littorina, &c. In the second paper it was shown that the distribution of such a complex as stature when the dominant elements were equally derived from both sides may be represented by the terms of the trinomial $(1+n+1)^p$. In the case of random mating and of equal fertility, $n=3{\cdot}3$. This point binomial was in Pearson's terminology leptokurtic, that is, the apex had a smaller radius of curvature than the normal curve fitted to the same sets of figures.—Prof. R. J. A. **Berry**, Dr. A. W. D. **Robertson**, and K. S. **Cross**: (1) Craniological observations on the lengths, breadths, and heights of 100 Australian aboriginal crania; (2) a biometrical study of the relative degree of purity of race of the Tasmanian, Australian, and Papuan; (3) the place in nature of the Tasmanian aboriginal as deduced from a study of his cranium. These three papers formed a connected series of anthropomorphic investigations, leading up to the determination of the Tasmanian race affinities. The statistics throughout were treated in the recognised modern method, in which variability about the mean, correlation between pairs of dimensions, and the estimation of deviations were discussed by rigorous mathematical analysis. Dr. Robertson in the first paper concluded that the difficulty of separating the skulls into sexes rendered it advisable to have resulting values obtained for crania for races without reference to sex, and that the Australians, though less heterogeneous than some other races, were not as homogeneous or pure as some series which were regarded as homogeneous, and that the relationship of their cranial measurements, as indicated by the coefficient of correlation, was low, but was higher than most modern, though lower than primitive, races. In the second paper, after a general account of the many conflicting views expressed by various writers, an elaborate comparison was instituted between the cranial characteristics of 86 Tasmanian, 191 Papuan, and the hundred Australian skulls of the first paper. The coefficients of correlation for length-breadth, breadth-height, and height-length showed that, as already recognised by other investigators, the greatest stress must be laid on the length-breadth coefficient and the least on the breadth-height. The whole investigation proved that, of the three types considered, the Tasmanian was the purest and the Papuan the least pure. The result supplied a link in the chain of evidence concerning the heterogeneity of the Australian as contrasted with the homogeneity of the Tasmanian. Of the third paper, part i. only had been presented. In this, on the basis of a large number of cranial measurements, the relations of the Tasmanian to the anthropoid apes, Pithecanthropus, *Homo primigenius*, *H. fossilis*, and *H. sapiens* were considered. In part ii. the relations to the Australian aboriginals will be discussed in similar fashion. Twenty distinct measurements of the skulls of fourteen groups were made and tabulated side by side, and from the comparison among these important conclusions were drawn as to the relative evolutionary value of certain measurements. The general results were that, of recent man, the Tasmanian stood nearest to *Homo fossilis* (Brüx and Galley Hill remains), but morphologically had progressed a very long way from *Homo primigenius* (Spy and Neanderthal skulls) and the anthropoid apes, and that Pithecanthropus stood nearer to the anthropoid apes than to *Homo primigenius*.

PARIS.

Academy of Sciences, June 6.—M. Émile Picard in the chair.—H. **Poincaré**: Time signals intended for ships. An account of the system adopted for sending wireless time signals from the installation at the Eiffel Tower. A simple form of receiving apparatus has been designed for the ship, the cost of which is less than that of a chronometer. Signals are sent at midnight and at two and four minutes past midnight, each signal being preceded by an introductory signal.—A. **Haller** and Ed. **Bauer**: The preparation and properties of the β-alkyl-α-hydrindones or the 22-dialkyl-1-indanones. The chloride of the dialkylbenzylacetic acid is obtained from the acid by the use of thionyl chloride. Benzyldimethylacetyl chloride in suspension in petroleum ether is treated with aluminium chloride; the dimethylindanone is readily isolated in good yield from the reaction product. Indanone can be methylated directly by the sodium amide reaction previously described by the authors.—A. **Chauveau** and M. **Contejean**: The formation and elimination of nitrogenous waste in subjects in the state of youth.—Pierre **Termier** and Jacques **de Lapparent**: The monzonite of Fontaine-du-Genie, near Cherchel, Algeria, and on the micromonzonites of the neighbouring region.—R. **Zeiller**: Some Wealdian plants of Peru.—M. **Luizet** and J. **Guillaume**: The appearances of Halley's comet. A detailed account of the varying aspects of the comet from March 1 to May 26.—P. **Cirera** and M. **Urbach**: Observations on the passage of Halley's comet made at the Observatory of Ebra, Spain (see p. 470).—J. Comas **Sola**: Halley's comet. Photographs taken on May 31 and June 1 showed a double nucleus.—M. **Giacobini**: Halley's comet. On June 2 the comet appeared doubled, with two nuclei. Before its passage over the sun the nucleus was sensibly elliptical; after the passage the nucleus became reduced to a point.—Jean **Mascart**: Photograph of Halley's comet. An account of work done at Teneriffe at a height of 2715 metres.—Joseph **Marty**: Singular values of an equation of Fredholm.—A. **Chatelet**: The classification of a system of tables equivalent among themselves.—L. **Zoretti**: The properties of Cantorian lines.—M. **Saltykow**: The generalisation of the theorem of S. Lie.—E. **Barre**: A series of solutions of Lamé's equations of elasticity in a homogeneous and isotropic medium.—Th. **Rosset**: A new sound-recording instrument. A record on a wax cylinder is copied directly on to another wax cylinder by a system of levers. Mirrors are fixed to the levers, and a photographic enlargement of the phonograph trace thus obtained. If the second wax cylinder gives sounds identical with the first, then the photographed record is necessarily a true one.—P. **Pascal**: The accuracy of the methods of measuring magnetic susceptibilities. The methods which have been proposed by the author have about double the accuracy of methods utilising a torsion balance.—A. **Perot**: The mercury arc in a vacuum. The effects produced by varying the conditions of working are described.—Daniel **Berthelot** and Henri **Gaudechon**: The oxidising effects of the ultra-violet rays on gaseous bodies. The peroxidation of the

oxygen compounds of nitrogen and of sulphur. All experiments to cause the combination of oxygen and nitrogen by the action of the ultra-violet rays gave negative results. Nitrous oxide under these conditions gave nitrogen and some of the higher oxides, and nitric oxide behaved similarly. Sulphur dioxide in the presence of mercury gave sulphate of mercury and sulphur, a considerable proportion of the sulphur dioxide remaining unchanged. Sulphur is produced in this reaction even if oxygen is added in excess.—J. O. **Serpek**: The nitrides and oxides extracted from aluminium heated in air. Commenting on a recent note by M. Kohn-Abrest, the author points out that the fact of the production of oxide and nitride of aluminium simultaneously by the combustion of aluminium in air has been known for a long time.—P. **Mahler**: The action of air on coal. Data are given for the amounts of carbon monoxide and dioxide produced by the action of air on coal maintained at temperatures varying between 25° C. and 105° C. This action takes place slowly at the ordinary temperature, and from this it follows that the traces of carbon monoxide which have been found in the air of mines are not accidental, but normal.—Georges **Dupont**: The oxidation of the acetylene γ-glycols. Synthesis of the α-acid alcohols.—A. **Arnaud** and S. **Posternak**: The isomerisation of oleic acid by the displacement of the double linkage. A repetition of the work of Saytzeff on the addition of hydriodic acid to oleic acid, and the subsequent removal of this acid by the action of alcoholic potash, has shown that a very complicated mixture of isomeric acids is obtained. The *iso*-oleic acid of Saytzeff is not a single substance.—Léon **Brunel**: The passage of some aromatic hydroalcohols to the corresponding phenols. The best of the methods examined was found to be that of Sabatier and Senderens, the catalytic dehydrogenation of the aromatic hydroalcohols by passing over hot reduced copper.—MM. **Stœcklin** and **Crochetelle**: The accidental presence of sulphocyanides in milk and their origin. Sulphocyanides may be introduced into milk when certain Cruciferæ enter into the food of the cow.—Raoul **Combes**: The simultaneous production of oxygen and carbon dioxide in the course of the disappearance of the anthocyanic pigments in plants. It is shown that the simultaneous evolution of oxygen and carbon dioxide is more general than has been hitherto supposed, and always occurs when the acid pigments are disappearing.—H. Jacob **de Cordemoy**: The influence of the medium on the variations of the secreting apparatus of the Clusiaceæ.—A. **Contamin**: The resorption of experimental tumours of mice under the influence of the X-rays. The results of a histological study of the resorption of a glandular epithelioma under the influence of the X-rays.—Mlle. Boleslawa **Stawska**: Studies on cobra venom and the anti-venom serum.—M. **Fougerat**: The homologies of the muscles of the posterior member of reptiles.—M. **Rose**: Some tropisms.—G. **Seliber**: The symbiosis of the butyric bacillus in culture with other anaërobic micro-organisms.—Jean **Bielecki**: The variability of the proteolytic power of anthrax bacteria.—V. **Roussanof**: The Palæozoic strata of Nova Zembla.—A. **Doby**: A fossil-bearing horizon in the *Muschelkalk* of Bourbonne-les-Bains (Haute-Marne).—Jean **Boussac**: The Helvetian Nummulitic and the pre-Alpine Nummulitic in central and eastern Switzerland.—M. **Roman**: The Rhinoceri of the European Oligocene, and their connection.—M. **Fournier**: The nodules (Septaria) of the Triassic ammonites of Madagascar, and on the development of Ammonea.

DIARY OF SOCIETIES.

THURSDAY, JUNE 16.

ROYAL SOCIETY, at 4.30.—Experimental Researches on Vegetable Assimilation and Respiration. VI. Some Experiments on Assimilation in the Open Air: D. Thoday.—A Case of Sleeping Sickness studied by Precise Enumerative Methods: Regular Periodical Increase of the Parasites Disclosed: Major R. Ross, F.R.S., and David Thomson.—The Recognition of the Individual by Hæmolytic Methods (Preliminary Communication): Dr. Charles Todd and R. G. White.—Receptors and Afferents of the Third, Fourth, and Sixth Cranial Nerves: Miss F. M. Tozer and Prof. C. S. Sherrington, F.R.S.—(*a*) Trypanosome Diseases of Domestic Animals in Uganda: (1) *Trypanosoma pecorum*; (*b*) Experiments to ascertain if Cattle may act as a Reservoir of the Virus of Sleeping Sickness (*Trypanosoma gambiense*): Colonel Sir D. Bruce, F.R.S., and others.—The Lignite of Bovey Tracey: Clement Reid, F.R.S., and Eleanor M. Reid.

LINNEAN SOCIETY, at 8.—Inheritance of Sterility in Potatoes, with Remarks on the Shapes of the Pollen: Dr. Redcliffe N. Salaman.

MONDAY, JUNE 20.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Features of Alpine Scenery due to Glacial Protection: Prof. E. J. Garwood.

TUESDAY, JUNE 21.

ROYAL STATISTICAL SOCIETY, at 5.

FARADAY SOCIETY, at 8.—Studies in the Electrometallurgy of Ferro-alloys and Steel: P. Girod.—The Failure of the Light Engineering Alloys, particularly the Aluminium Alloys: E. F. Law.—New Types of Mercury Vapour Lamps: Dr. F. Mollwo Perkin.

THURSDAY, JUNE 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Damping of Sound by Frothy Liquids: A. Mallock, F.R.S.—Dispersion of Light by Potassium Vapour: Prof. P. V. Bevan.—Additional Refractive Indices of Quartz, Vitreous Silica, Calcite and Fluorite: J. W. Gifford.—The Absorption Spectra of Sulphur Vapour at Different Temperatures and Pressures and their Relation to the Molecular Complexity of this Element: J. I. Graham.—The Wave-making Resistance of Ships; a Study of certain Series of Model Experiments: Dr. T. H. Havelock.

FRIDAY, JUNE 24.

PHYSICAL SOCIETY, at 5.

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