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British Fine Chemicals.

DURING the period of twenty years preceding the war, it was a frequent complaint among organic chemists that there did not exist in this country a firm resembling Kahlbaum or Schuchardt, from which it would be possible to obtain, at short notice, large or small quantities of those organic compounds, both common and obscure, required for the prosecution of research. The absence of such a domestic source of supply was deplorable for several reasons, but there was always said to be "no money in it," and various ingenious theories were necessarily devised to explain the survival of the German firms, which certainly did not remain in business on philanthropic grounds alone. The shock of war galvanised this branch of industry along with many others, and it was widely declared that the gradually increasing supply of these materials should be augmented to the volume essential for the brisk practice of research, and should be maintained on a self-supporting basis even when free communication with Germany had become restored.

Encouraged by these patriotic pronouncements, the industry in this country has grown to respectable dimensions, and it does not seem fair, now that the famine in German products is over, to withdraw support from those manufacturers who have expended money and thought in meeting a national need at a critical period. That, nevertheless, is the logical outcome of present complaints. At the moment, it is possible to buy these materials much more cheaply in Germany, but that is due principally to the depreciated mark, and should not be allowed to weigh with those who have permanent national interests at heart. Moreover, comparison of current British and German prices is not the test which should be applied. It is more just and reasonable to compare current British prices with those of German materials prevailing in this country before the war. On this basis we have taken at random fifty typical substances and have found that in fifteen cases the present British quotations are lower. Furthermore, dividing the British (1922) by the German (1913) price, and averaging the factor for the fifty examples, an over-all factor of 1·4 ensues. Remembering that the corresponding factors given by the Ministry of Labour for April 1922 as compared with July 1914 are: Food 1·73, rent 1·55, clothing .2·40, fuel and light 2·15, other items 1·95, it will be seen that the foregoing factor, 1·4, is astonishingly moderate, bearing in mind the difficulties which attend the enterprise.

Another feature of the price question deserves appreciative recognition. While the Safeguarding of Industries Bill was under discussion, it was freely stated that the measure would lead to enhanced prices for the

domestic products involved. If, however, the quotations in April 1922 are compared with those in September 1921 for the same fifty typical materials it is found that, of the forty-six listed in the earlier catalogue, the price of twenty-four is unchanged, the price of twenty is reduced, whilst in two cases only has it been increased.

The question of quality obviously does not admit of discussion on a quantitative basis, but it will be recalled that even the long-established German firms were obliged to acknowledge sporadic blunders, and only the chemist who himself has never failed in preparing an organic material of the highest grade is entitled to withhold mercy, not to mention justice, from those manufacturers who have endeavoured to meet domestic requirements by covering a wide range as rapidly as possible. Surveyed generally, the British quality reaches a high standard.

Moreover, the range now offered is commendable. The organic chemist, particularly in the opening phases of an investigation, sometimes requires relatively obscure compounds in quantities of a few grams at a time, and the convenience of a British price-list comprising 2500 individual substances for use in research or analysis approaches, within a praiseworthy distance, the advantages offered by Kahlbaum and Schuchardt. There is no finality to such a list, which can receive additions when requirements are made known. Even the research chemist who has been mesmerised by the multitude and cheapness of German products, and by pre-war facilities for obtaining them must, on reflection, realise the burden which would be placed on a new industry by stocking every conceivable material, a large proportion of which would not be wanted for years to come. Finally, it should be represented that if the spell of German chemical superiority is ever to be broken, one factor in its dispersal is the demonstration, to successive relays of native students, that it is possible to produce in this country chemical materials of good quality and at reasonable prices. Moderate self-denial and exercise of fair-play during the next few years appear to be the principal equipment required in achieving this most desirable end. M. O. F.

Northernmost Greenland.

Greenland by the Polar Sea: The Story of the Thule Expedition from Melville Bay to Cape Morris Jesup. By Knud Rasmussen. Translated from the Danish by A. and R. Kenney. Pp. xxiv + 327 + pls. and maps. (London: W. Heinemann, 1921.) 36*s*. net.

MR. KNUD RASMUSSEN occupies a unique place amongst polar explorers because, as the son of a Danish pastor in Greenland, he spent the first fourteen years of his life amongst the Eskimo, knowing their language like his own and entering into their modes of life as to the manner born. There was thus nothing strange or repulsive to him in the diet, the clothing, or the housing of the Eskimo, and after his education at the University of Copenhagen, he turned to the exploration of Greenland and the study of its people as naturally as a seal takes to the water.

In 1903–4 Mr. Rasmussen sojourned as a member of the Danish Literary Expedition among the "Arctic Highlanders," first discovered by Sir John Ross in 1818 and made familiar to English readers by Peary's repeated winterings. In 1910 Rasmussen established a station named Thule on the shore of Wolstenholme Sound, nearly in 77° N., and from this centre he made his "First Thule Expedition" in 1912–13; he crossed the inland-ice to the north-east, and proved that Peary was in error when he supposed that his Independence Bay was on a channel which cut off northernmost Greenland as an island. Rasmussen's intention had been to return to Thule along the west coast of Greenland from its most northerly point, but circumstances compelled him to go back by the way he came. An attempt to repeat the journey in 1914 failed, and the purpose of the book now under review is to describe the journey northward along the west coast which was carried out in 1917. The motive of the expedition was ethnographical—the discovery of the route by which the great Eskimo migration entered Greenland, and it was only preliminary to a greater journey, not yet completed, along the north coast of America.

The range of the journey is stated on the title-page as "from Melville Bay to Cape Morris Jesup," but was really less, as De Long Fjord was its termination. None of the ground traversed on the outward journey was new in the sense of first discovery, for the whole coast had been charted from the sea by expeditions which had forced their way through Smith Sound and the channels to the polar ocean, while sledge parties from Nares' expedition onwards had skirted much of the coast.

The interest of Rasmussen's journey lies in its methods as much as in its results. He was accompanied by two Scandinavian men of science—Dr. Koch, a Danish geologist, and Dr. Wulff, a Swedish botanist. There were also four Eskimos, and when the expedition started from Thule on April 6, 1917, it had 6 sledges and 185 dogs. The expedition carried a minimum of European stores and equipment so as to travel quickly, and beyond luxuries such as cocoa, tea, sugar, prepared oats, biscuits, and pemmican, all food was to be obtained by hunting.

The first day's journey was 94 kilometres, accomplished in ten hours, a magnificent performance on the sea-ice, which was never equalled afterwards; as

the distance is inadvertently given as "94 miles," the casual reader might suspect the author of romancing; but no explorer ever recorded his exploits more modestly. In many particulars it is a little difficult to follow the narrative, for the author is frequently obscure and discursive in his general statements, and the translator has been sorely troubled by the rendering of scientific terms. The reader may indeed feel a glow of justifiable satisfaction when he reasons out that the piece of apparatus designated a "cooking barometer" must be neither more nor less than a boiling-point thermometer! Also it takes time to accustom oneself to the one word "mountain," applied equally to mean mountain, hill, or knoll.

One has not to read far, however, before the narrative grips the attention, and the difficulties of style and terminology do not disguise the fact that Rasmussen travelled with the inherited skill and resourcefulness of the Eskimo and the insight of a man of science.

A series of helpful sketch-maps for each section of the journey is provided as well as an excellent general map. The route of the expedition ran north through Smith Sound, Kane Basin, Kennedy Channel, Hall Basin, and Robeson Channel on the sea-ice or the ice-foot, closely following the Greenland coast, stopping to hunt and gorge on seals, reindeer, musk-oxen, hares, or ptarmigan where game abounded, pushing forward desperately over the barren country, where the dogs had to be fed on their weakest comrades. At length on June 21, 1917, they reached the entrance to De Long Fjord in 83° N. and faced the problem of the return. The easy travelling of spring was past. It was impossible to move quickly over the thawing sea-ice; the sledges could not be dragged across the bare, stony coastlands with their sparse growth of the brilliant Arctic flora, and it was necessary to find a way up to the distant inland ice and to lay in a store of food for the long march over the empty snowfields. A find of 24 tins, each containing 9 lb. of New Zealand mutton, left by the Nares expedition in 1875, before any of Rasmussen's party was born, had given occasion to much feasting on the way north, for the meat was as good after 42 years as if freshly tinned. One cannot help thinking that such a windfall of portable food might have been saved for the inland-ice journey; but the Eskimo rule of unlimited feeding when food is available appears to have been faithfully carried out.

It was the end of July before the party had got back to St. George's Fjord in 82° N. with all the fresh meat they could collect, and on August 4 they succeeded in ascending the glacier at the head of the fjord on to the inland-ice, with only 17 dogs remaining. Their supplies allowed only 12 days for making the journey to Cape Agassiz, south of the Humboldt Glacier. There they hoped to replenish their food supplies by hunting. One of the Eskimos had been lost in St. George's Fjord, they were all weak, and Wulff was very ill. It was 20 days before they reached the sea in a starving condition, all the dogs having been eaten. Rasmussen, with the strongest Eskimo, left the others and hurried southward along the coast, but by the time he met the native hunters and could send back supplies, Wulff had died. It is impossible to read of the hardships all had undergone without realising that the dangers of following Eskimo practice are very nearly equal to the advantages. It was October 22, 1917, when the survivors returned to Thule.

The scientific results of the expedition were substantial, and may to some extent be gathered from the narrative and the appendices. The map has been rectified in many particulars and the outlines of several fjords laid down for the first time. The extent of the ice-free land where life is possible has also been mapped in considerable detail. This lies between the sea-ice which never leaves the coast and the inland-ice which occupies the high land of the interior. The geology has been studied, and Koch is of opinion that the folded mountain system of the extreme north of Greenland is an extension of the Caledonian fold, which curves westward from Norway through Spitsbergen and continues westward of Greenland into Grinnell Land. Some interesting notes on air temperature are also given.

Dr. Wulff left valuable notes on the flora, including the observation that flowers formed one summer survived the cold of winter and matured in the second summer. The habits of the musk-ox are further elucidated and illustrated by excellent photographs, while there are many notes on insect life, the most curious being the appearance of enormous swarms of bluebottles, which make it almost impossible to keep meat killed in summer for more than a day or two in 82° N. The most important result, however, is the light thrown on the migrations of the Eskimo. Mr. Rasmussen has satisfied himself that they came from America, passed through Ellesmere Land, crossed Smith Sound, and moved down the west coast of Greenland, round Cape Farewell, and up the east coast. He is certain that they could not have reached the east coast by the shorter route along the north coast of Peary Land, which he thinks was never inhabited, and can never support human life.

The author refers in terms of generous appreciation to his predecessors of all nationalities, and amongst the most interesting illustrations are facsimiles of the letters deposited in cairns by parties of the Nares and Greely expeditions. The English version of the book

is appropriately prefaced by an appreciation of the author's work by Sir Lewis Beaumont, who himself did heroic service in leading one of the sledge parties from the *Discovery* nearly half a century ago.

HUGH ROBERT MILL.

Modern Tendencies in Physiology.

(1) *Practical Physiological Chemistry*. By Dr. J. A. Milroy and Prof. J. H. Milroy. Third edition. Pp. ix+449+ii pls. (Edinburgh: W. Green and Sons, Ltd., 1921.) 21*s*. net.

(2) *Biological Chemistry*. By Dr. H. E. Roaf. Pp. xvi+216. (London: Methuen and Co., Ltd., 1921.) 10*s*. 6*d*. net.

(3) *An Introduction to Biophysics*. By Dr. D. Burns. Pp. xiii+435. (London: J. and A. Churchill, 1921.) 21*s*. net.

THE curricula of most universities represent Natural Science as being made up of a number of subjects: geology, mineralogy, chemistry, physics, zoology, botany, human anatomy, and physiology, astronomy being grouped rather with mathematics than with natural science. Twenty years ago such a classification represented not only the scaffold on which the standard of departmental teaching and examination was erected, but it also represented the current conception of the limits between subject and subject. Where will these limits be twenty years hence? Everywhere the boundaries are disappearing; the physicist has made far-reaching additions to the basal conceptions of chemistry, the zoologist has largely forsaken animal morphology for fatherless frogs and the inheritance of sex characteristics. Of no department of science have the boundaries become less distinct than they have of physiology. One phase of the change which is taking place is emphasised by the publication of the three books, the titles of which stand at the head of the present article.

(1) "Practical Physiological Chemistry" written jointly by Prof. J. H. and Dr. J. A. Milroy, has already had a long and honourable career, and is now in its third edition. It represents the first phase in the change—that in which organic chemistry commenced to play a prominent part in physiology. In the present edition considerable additions have been made, especially in the direction of physical chemistry, but the book essentially stands for what it always did, namely, for physiology seen from the angle of the organic chemist, and as such its value is fully maintained.

(2) Dr. Roaf's book, "Biological Chemistry," represents a much more fundamental change. It deals with something wider than the mere chemical aspect of vertebrate physiology. As its title suggests, it embraces the chemical aspect of life generally, hence it includes not only invertebrate physiology, but botany in its bracket. The subject-matter of the book, therefore, covers parts of what formerly were regarded as three biological subjects, namely, physiology, zoology, and botany. It inevitably raises the question, "What are the real boundaries of physiology?" The question is a vital one in the teaching of science and medicine. Concrete instances of the transition which is taking place may be found in the organising of any medical school, and that of Cambridge may be cited as an example. Just before the war, the department of physiology was reorganised, a new laboratory was erected with much greater accommodation than the old one, yet at the same time experimental psychology and biochemistry were both recognised as new subjects and given laboratories of their own. In Manchester, where the subject of physiology has also been reorganised, the cleavage has taken place at a different point. Biochemistry remains a part of the subject, but histology has been handed over to the department of anatomy. What then remains as the essence of physiology? If it is to lose histology, experimental psychology, including a large part of the study of the organs of special sense, and biochemistry, what is to remain? What justification is there for a department of physiology at all?

In discussing this matter a couple of years ago, a well-known physiologist took up the position that what remained was biophysics. Turning then to Dr. Burns's volume (3), "An Introduction to Biophysics," it was a matter of peculiar interest to ascertain the extent to which it bore out the definition of being what remained of physiology after that subject had parted with biochemistry and experimental psychology.

Dr. Burns's book—incidentally we would remark that it is very nicely got up, being pleasant both to hold and to read—will well repay perusal, and should be read by both teachers and the more reflective class of students. The title of the book, however, seems to embrace less than the covers, but even granting that there is more in the book than is legitimately covered by the term biophysics, there still remains much of physiology which is not there.

The question then, what is left of physiology after biochemistry, biophysics, and experimental psychology have been taken from it, remains unanswered. The answer in our view is simply this—physiology remains. Biochemistry and biophysics are the apparatus of physiology, but they are not physiology. To the physiologist they are all-important, for to him every advance which is made in biochemistry is vital, because it gives him a new machine with which to explore his own department of knowledge.

To take a concrete example, nothing could be more truly in the domains of biochemistry and biophysics than are the chemical and physical properties of hæmoglobin. When our knowledge of these properties is complete—and it is now only commencing to open up—we shall be but in a position to commence the study of the red corpuscle—its birth, its fate, the extent to which it may be regarded as a living entity, and its relationship to other tissues in the body. These are physiology—physiology surely remains; and indeed these reflections apply not only to physiology but to pathology and medicine. It is only a matter of time till corresponding books on these subjects appear. There are chemical and physical aspects of pathology and medicine as truly as of physiology, but when pathological chemistry and the chemistry of medicine have said all that they should say, they too will be rather the necessary apparatus of pathology and medicine than the subjects themselves. Pathology and medicine will consist in the application of the chemical facts to the human subject as a whole—jointly with many other kinds of facts which are not chemical.

In the future of medical schools it would look as though chemistry and physics would be taught all along the line by persons specially qualified for the task, not merely as at present for the first M.B., or as in some cases organic chemistry for the second M.B. is now taught, not as side issues or luxuries or as the affairs of specialists, but as the necessary groundwork from which medical science grows—soil necessary to the tree. The line between the ground and the tree may be artificial and may be movable, but the distinction between the ground and the tree does not lack reality on that account.

Early Chinese Pottery.

The Early Ceramic Wares of China. By A. L. Hetherington. Pp. xviii + 160 + 44 plates. (London: Benn Bros., Ltd., 1922.) 3*l.* 3*s.* net.

THIS excellent and trustworthy piece of work, obviously the fruit of prolonged research and consideration of the available evidence, is precisely the book one would recommend to the student or collector who was about to enter upon a serious study of the earlier Chinese pottery and porcelain with a view of forming a collection for his personal delight and study; for it is conceived and carried through in such a fine vein of reasoned enthusiasm that one could scarcely wish for a saner yet more inspiriting guide. Though our knowledge and understanding of the progressive steps by which the early pottery and porcelain of that vast territory were slowly brought to perfection are still incomplete, and must probably always remain so, really competent works such as this are of great value, if further progress is to be made in the task of elucidation, because they focus attention so clearly on what is known and, at the same time, remind us of the most important points that are still unknown or, at best, imperfectly understood.

European knowledge of the earlier centuries of Chinese ceramic history is a plant of slow and comparatively recent growth. There is all the more reason, therefore, to welcome a volume of this scope and style—illustrated by an abundance of choice examples which have been carefully selected from the most famous English collections, especially from those which are still in private keeping—which describes, in a connected narrative with copious references to the standard authorities, those delightful and alluring examples of the potter's skill which are anterior in date (many of them long anterior), to the foundation of that important masterful dynasty known as "The Ming" (the chiefs of a western warrior race which seized the Imperial throne in A.D. 1368, and held it in the most brilliant fashion for close on three hundred years).

Although the Chinese potters of Sung times, under their native rulers, had made an abundance of fine porcelains of superb artistic quality for some centuries before the advent of the Ming rulers and overlords, it was only during the sway of the latter that the mysterious substance, Chinese porcelain, found its way into the treasure-cabinets of European princes in any appreciable quantity. For centuries after its first sporadic appearance in Europe, the novelty of its substance, together with the matchless skill displayed in its fabrication and decoration, gave rise to a crop of the wildest legends and guesses as to its nature and composition. This is especially shown in the writings of our medieval European naturalists and alchemists, who, while groping in the dark among things old and new, were laying the foundations of modern scientific methods and knowledge. The era that saw the Ming emperors firmly seated on the throne of China was of great moment in the history of civilisation, for all over the old world a spirit of keen intellectual activity and enterprise worked like a new leaven, manifesting itself in eager inquiry into all the things of heaven and earth no less than in the accomplished production of fine material things. It seems like one of nature's own revenges that a period of time which was once a chosen domain for the historians of the drum and trumpet school is now seen to have been pregnant with discoveries and inventions which were to revolutionise the subsequent progress and prospects of mankind.

In a work of this class the reader will always consider

the sources to which an author attaches most weight, and here Mr. Hetherington proves himself at once catholic and discriminating. The older European authorities like Dr. Bushell, Sir A. Wollaston Franks, and his successors in the famous school of the British Museum have naturally been used to great advantage, while the writings of Mr. Berthold Laufer and other special workers in the history of early Chinese art have been drawn upon with discrimination. One would say off-hand that no modern opinion of value has been overlooked, while each, in turn, is supported or refuted from authoritative sources. This piece of patient toil has been carried out with much discrimination, as is especially manifest in the author's appraisement of the information that is to be obtained only from Chinese sources. The valuable original sources are set out in a select bibliography, where a list of the most important English and French works on the subject is also given.

The illustrations of the ancient wares, gathered from many sources, are worthy of the book and really illustrate it, while they have been chosen in a truly commendable way. Mr. Hetherington explains the manner of his choice in a few words which deserve to be quoted: "In selecting the illustrations I have followed a somewhat unusual course. The specimens chosen are not the rarest and most costly examples, nor are they taken from the great National Museums. I have illustrated typical pieces of good quality in the possession of private collectors. The ordinary person, in my opinion, wants to see the kind of thing he may hope to acquire for himself; not specimens worth a king's ransom which are never likely to adorn his cabinet."

WILLIAM BURTON.

Optical Theories.

(1) *Die Prinzipien der physikalischen Optik. Historisch und erkenntnispsychologisch entwickelt.* Von Ernst Mach. Pp. x+444. (Leipzig: J. A. Barth, 1921.) 48 marks.

(2) *Optical Theories: Based on Lectures delivered before the Calcutta University.* By Prof. D. N. Mallik. Second edition, revised. Pp. vii+202. (Cambridge: At the University Press, 1921.) 16*s*. net.

(1) ERNST MACH died in February 1917, at a time when civilised humanity was too busy to notice the passing of one who had made his influence felt wherever interest existed for the understanding of the fundamentals of mechanical and physical knowledge. The present work was published in 1921, but it is not a posthumous work, for it was ready before the war, and in fact the preface is dated July 1913. Although it went to press in 1916, the war and other causes delayed its issue.

As the title indicates, the book is an historical and epistemological account of the development of the principles of physical optics, the writer's aim being similar to that in his famous book on Mechanics. The book is thus not really a history, but rather a statement of the progress of ideas and of the manner in which they arose in the minds of their originators. Nobody who has read other books by Mach will need to be told that this volume is interesting and instructive: the description of the way in which the fundamental notions such as periodicity and asymmetry of the light ray emerged, is as fascinating as any romance.

The present volume was intended as a first part of a larger work: subjects like theories of the ether and relativity were reserved for the second volume. But the author's foreboding that this second volume would not be written by himself was unhappily justified.

Many points of interest emerge in the course of this history. Full tribute is paid to Newton's genius—it was Newton who first realised clearly the periodic nature of the light ray, later worked up into the wave theory, and its asymmetry, which became the theory of polarisation and the notion of the transverse light-vector. When Fresnel first reached the conclusion that light oscillations are transverse, the revolution in ideas was too great for even Arago, who refused to be associated with Fresnel's idea, and in fact, although Fresnel and Arago collaborated in many pieces of work, the transverse vibration theory was put forward in a paper bearing only Fresnel's name. Young's experiments did not at once receive the recognition they deserved, owing to the mistaken and reactionary servitude to all that was supposed to have emanated from Newton. The author has not much good to say about Schopenhauer's attempt at a theory of colours, while faint praise is all that is allotted to Goethe.

As already remarked, relativity as such is not discussed in this book, and even when Michelson's interferometer is described nothing is said about the 1887 experiment. Nevertheless the author felt it incumbent upon him to decline the honour of having been the herald (*Wegbereiter*) of relativity. On various grounds he refuses to accept the theory—presumably this refers to the restricted theory—and, while acknowledging the value of the relativist researches, he doubts whether the theory itself will find a lasting place in the physical *Weltbild* of the future. Mach asks: "Will the theory of relativity be more than an ingenious *aperçu* in the history of this science?" Would Mach's opinion have been affected by the events of 1919?

(2) The lectures delivered by Prof. Mallik at Calcutta in 1912 were published in book form in 1917, and the

book has been reissued in a second edition. It offers a brief technical *résumé* of the optical theories since Descartes and Fermat till the present day, a little being also said about ancient European and Indian ideas on the subject. The elastic solid theories, the electromagnetic theory, and the electron theory are passed in review, each treated briefly in mathematical manner, with its virtues and its imperfections exposed. In the second edition there are a few additions, notably on the theory of relativity in so far as it affects optics, and the opinion is expressed that this theory will not "dispose of the physical existence of the *etherial model*, until a better one can be found, which shall explain the intimate nature of the various concepts of modern physics, corpuscles and negative particles, electric charge and magnetic force, gross matter and gravitation, in one comprehensive scheme."

S. BRODETSKY.

Notes on Inorganic Chemistry.

Notes on Inorganic Chemistry for First Year University Students. By Prof. F. Francis. Pp. viii+244. (Bristol: J. W. Arrowsmith, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1921.) 8*s*. 6*d*. net.

THE reputation which Prof. Francis has gained as a teacher is so firmly established that a book written by him on the lines that he has adopted for his lectures may be expected to be of much interest and value. Although the "Notes" have been written primarily for students of Bristol University they will, no doubt, be found useful by many others.

The book commences with a few interesting extracts of a philosophical nature from the works of various authors and a brief note on the indestructibility of matter; the subject of errors is then fully discussed, and the laws relating to gases are considered at length. The properties of hydrogen and oxygen are next described together with those methods of preparation which are of practical or theoretical importance. Opportunity is thus afforded for reference to catalysis, autoxidation, and the methods of determining the relative atomic weights of these two elements. The next three chapters are devoted to a discussion of the chemical atom, energy, thermochemistry, and to a fuller account of catalysis. In the chapters on the physical properties of water, a variety of subjects are discussed, such as vapour pressures and boiling points, the phase rule, solutions, osmotic pressure, electrolysis, dissociation, and the electron theory. The utilisation of atmospheric nitrogen in the preparation of ammonia and nitric acid is considered in some detail and the natural sources of these substances are mentioned. Reference to the action of sulphuretted hydrogen on arsenious acid serves as an introduction to a brief discussion of the chemistry of colloids, and in the remaining chapters Dulong and Petit's law, the periodic law, the laws of constant composition and of multiple proportions, the law of isomorphism, and the subject of valency are discussed.

The book is for the most part very clearly written, but typographical errors are rather numerous: for example (p. 9), $3{\cdot}1415^{10}=93{,}621$, not $93{\cdot}621$; (p. 21) ρ' should read ρ; (p. 36) for Nitrogemn read Nitrogen; (p. 44) Lavoisier's name appears in place of Scheele's; (p. 56) for "proportional now" read "proportional. Now"; (p. 97) ·62%, etc., should be 62%, etc.; (p. 110) for Ladenberg read Ladenburg; (p. 179) for $HClO_4$ read $HClO_3$; (p. 205) the formulæ for apatite and vanadinite require correction; (p. 207) in the italicised sentence, "of" should read "or" and "methods" should read "molecule"; (p. 226) the constant m does not appear in the formula.

No doubt these mistakes will be corrected when a second edition is required.

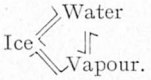
There are a few statements which appear to be open to objection: On p. 23 Dalton's law of Partial Pressures is stated thus: "If P=total pressure and V=total volume,

$$P=p_1+p_2+p_3\ \ldots$$
$$V=v_1+v_2+v_3\ \ldots"$$

It is not stated, however, that the second equality only holds if the volumes are all calculated at pressure P.

In the thermochemical equations on p. 57 it would perhaps be better to write $\frac{1}{2}H_2$ rather than H where molecular and not atomic hydrogen is meant.

On p. 65 there is the statement that "at 0° C. and 4 mm. pressure, Ice⇌Water⇌Vapour." Presumably "⇌Vapour" is intended, but, in any case, the triple point pressure of water is 4·6 mm., and at 0° C. and 4 mm. pressure water could only exist as vapour. A correct statement would be: "at 0·0075° and 4·6 mm. pressure



It is stated on p. 88 that "one gm. molecular weight of Methyl Alcohol, 32·03 gms., dissolved in 1000 gm. of water raises the Boiling Point to 100°·52"; but, of course, all mixtures of methyl alcohol and water boil at a lower temperature than pure water. It is evidently assumed that methyl alcohol is practically non-volatile.

The following sentence occurs on p. 204: "atomic weight of Sulphur: atomic weight of Selenium=18·39: 45·34 of Sulphur=32." Presumably the words "of Sulphur=32" should be deleted. There is also a

discrepancy between the value 45·34 and that (45·40) given previously as the weight of selenium equivalent to 18·39 of sulphur.

Students who read this book carefully in conjunction with their lectures and laboratory work will be in a position to continue their studies in theoretical and practical chemistry with great advantage.

The Origins of Disease.

Organic Dependence and Disease: Their Origin and Significance. By Dr. J. M. Clarke. Pp. 113. (New Haven: Yale University Press; London: Oxford University Press, 1921.) 12*s.* 6*d.* net.

THE distinguished palæontologist who directs the New York State Museum at Albany has here brought together a number of instances of dependent life, tending to or attaining a parasitic habit, as presented by fossils mostly of palæozoic age. Some of these have long been known, others are due to Dr. Clarke's own skilled observation, but it is useful to have them all assembled. On this foundation is reared an edifice of philosophic conclusions, imposing in its dimensions and decorated with much verbal ornament. But, as in all great architecture, the main lines of the structure are few and simple, nor do they diverge unduly from accepted tradition. "Disease is any departure from normal living." "Normal living means full activity of an unimpaired physiology inclusive of the function of locomotion or mobility." Those who consider the lilies of the field will protest that these definitions are scarcely traditional. True; but, if they be accepted as interpretations of terminology, the actual theses will not appear so revolutionary.

The main conclusions are these. Among animals, at any rate, evolutionary progress has been always through those races that have retained full powers of locomotion. The assumption of a stationary mode of life is a step on the primrose path, and that one false step is ne'er retrieved. (Clearly Dr. Clarke does not believe in the fixed ancestor of the echinoderms.) The proportion of forms that retained their freedom was greater in the earliest known faunas. These statements are even more applicable to animals that have adopted a life of dependence on others. Simple association precedes either symbiosis or parasitism, and the evolution of a parasitic habit was gradual, extending it may be through many geological periods. This is well exemplified by the history of those simple sea-snails that took up their quarters near the vent of a certain species of crinoid and subsisted on the issuing stream—a history traced from Ordovician to Middle Carboniferous times. In treating of the oldest faunas, Dr. Clarke perhaps trusts too much to negative evidence, but his main lines of argument are reasonable enough.

It is of the host we speak as suffering from disease; but the parasite also lives a life that Dr. Clarke calls "abnormal" or even "unrighteous." Neither sin nor disease was "original" with life as a whole. Even the bacterium of the Precambrian was a free and independent organism. As for man, "it is safe to say that none of his physical ancestors have ever surrendered their physical independence or suffered essential modification through perturbation of their normal activities." Holding such views, Dr. Clarke naturally does not sympathise with some recent attempts to base evolution on pathology. He does not agree, for example, with Eccles that "The path of evolution is the path of past disease." He might, however, have discussed the further philosophical (or theological) question, whether sin and disease in a part of creation may not be a necessary condition for the evolution and salvation of the other part. Such lofty subjects may seem remote from the humble invertebrates of palæozoic seas, but Dr. Clarke is justified in his claim that a study of life-relations in their simple beginnings may furnish clues to our own social and psychic problems.

Shallow-water Foraminifera.

Department of Marine Biology of the Carnegie Institution of Washington. Vol. xvii.: *Shallow-water Foraminifera of the Tortugas Region.* By Joseph A. Cushman. (Publication 311.) Pp. 85+14 plates. (Washington: Carnegie Institution, 1922.)

IT is no disparagement of the excellent work which Dr. Cushman has already done to say that his report on the "Shallow-water Foraminifera of the Tortugas Region" marks a significant step in advance. We do not agree with his practice of reviving obsolete generic names, such as Discorbis, Quinqueloculina, and Triloculina; the first has long been abandoned in favour of Discorbina, and the two latter have become merged in Miliolina. It appears to be undesirable to complicate synonymies by the revival of early names. But, after all, this divergence of opinion is a minor point which, however confusing to the novice, in no way detracts from the value of Dr. Cushman's work to the advanced student.

The memoir is well worthy of its place amid the zoological literature published by the Carnegie Institution of Washington, and its value is increased by a map of the region, some excellent figures in the text, and fourteen plates which compare favourably with the illustrations of some of the author's earlier works, their enhanced value lying in the fact that they are original drawings "*ad nat.*," and not

mere *clichés*. The introduction contains valuable observations on living species, an addition to the scanty literature of this subject which has real interest. Dr. Cushman here directs attention to the protective coloration of a small crab which has reddish spots of the same colour as *Homotrema rubrum* (Lamarck), the remainder of its carapace and legs being of the same colour as the dead coral with which both the crab and Homotrema are associated. So far as we remember, this is the first record of a rhizopod in such a connection. There is also a short note on the colours of living Foraminifera, but this adds little to our knowledge of the subject, and we regret that Dr. Cushman, with the facilities at his disposal, has not gone more deeply into this question, especially as regards Homotrema, *Globigerina rubra*, and *Truncatulina rosea*.

Space does not permit us to discuss many interesting points raised by the author, but his observations are always temperate and demanding attention. We cannot, however, agree with his suggestion that *Marsipella cylindrica*, Brady, is really a species of Haliphysema. If we have any quarrel with Dr. Cushman it is but the old feud between "lumpers" and "splitters." Dr. Cushman has an enthusiasm for the creation of new species and varieties for what in many cases appear to be merely local variations, a practice which, in our opinion, is to be deprecated as tending to increase an already intolerable state of confusion. There is less excuse for him than for most "splitters," as his knowledge of the literature of the order is phenomenal. In this memoir, out of 144 species and varieties recorded 23 are described as new to science, and there are 9 others previously separated by the author. Consideration being had to the existing literature of West Indian Foraminifera, we cannot help regarding the proportions as excessive.

E. H.-A.
A. E.

Our Bookshelf.

Organic Chemistry, or Chemistry of the Carbon Compounds. By Victor von Richter. Edited by Prof. R. Anschütz and Dr. R. Meerwein. Translated from the eleventh German edition by Dr. E. E. Fournier D'Albe. Vol. 2: *Chemistry of the Carbocyclic Compounds*. Pp. xvi+760. (London: Kegan Paul, Trench, Trubner and Co., Ltd., 1922.) 35*s*. net.

"RICHTER" is too well known to need description, and the only matter requiring attention is the way in which the translator has done his work. In the first place, it must be pointed out that the German edition on which the translation is based was published so long as ten years ago, and the volume for review is, therefore, relatively out of date. In the second place, a much more serious fault is the surprisingly inexact way in which the translation has been carried through. Even an elementary knowledge of chemistry and of technical German would have prevented such translations as "carbohydrate" for "Kohlenwasserstoff," and would have allowed the German names "benzol," "anilin," "hydrazin," "hydrokinone," "mono-sulpho-per-acid," etc., to have been rendered into their English equivalents. As examples of chemical errors may be mentioned the use of *ferric* sulphate as a reducing agent, MnKO as the formula of potassium permanganate, etc. These are but a few of the elementary blunders for which the translator is responsible, and as a result the book will be found very confusing by students. As a book of reference for those who already have a good knowledge of organic chemistry it will certainly be found very useful.

The Chemistry of Combustion. By Dr. J. Newton Friend. Pp. viii+110. (London: Gurney and Jackson, 1922.) 4*s*. net.

THE account given by Dr. Friend of the chemistry of combustion, including flame, ignition temperatures, and the propagation of flame in gaseous mixtures, is clear and concise and should be of interest to students. Most of the newer work, especially that of Dixon and his students, is covered, and adequate references are usually given. If one might venture a criticism of many recent monographs, including that under review, it would be that far too little attention is now paid to the experimental methods. To young students a study of the way in which practical difficulties have been faced and overcome is of much greater value than a bald abstract of the results finally won. One misses here, for example, an adequate account of the highly ingenious apparatus of Dixon for the measurement of the velocities of detonation waves (is there not a difference between "detonation" and "explosion"?), and that of Petavel and of Pier for the measurement of explosion pressures (there is not even a reference to the latter). The collected numerical data in the book are useful; a more critical treatment would perhaps have been possible only if the author had been an expert.

A Course of Instruction in Quantitative Chemical Analysis for Beginning Students: With Explanatory Notes, Questions, and Analytical Problems. By Prof. G. McP. Smith. Revised edition. Pp. x+218. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1921.) 12*s*. net.

PROF. SMITH'S book is intended for students who have completed a year's work in elementary chemistry, including qualitative analysis, and are beginning the study of quantitative analysis. In England a certain amount of volumetric analysis is usually included in the first year's course at the university, so that some of the second half of this book could be used with intermediate students. The directions are usually arranged under the headings of "Method," in which a brief but fully adequate account of the process is given; "Procedure for the Determination," in which all the needful practical details of manipulation are described, so that the work of the demonstrator may be reduced to a minimum; and, finally, "Notes," in smaller type, which give the reasons for the procedure, equations, theoretical explanations (in which physical chemical conceptions are explained and used), and

practical hints. The book, which is attractive in appearance, is the work of an experienced teacher and can be recommended with confidence.

Experimental Physiology. By Sir E. Sharpey Schafer. Third edition. Pp. viii+131. (London: Longmans, Green and Co., 1921.) 6*s.* net.

THIS laboratory manual of experimental physiology, first published in 1912, has now reached a third edition. To those who do not know the book it may be said that the matter is arranged in thirty-two chapters, each of which contains, on the average, enough to occupy the student for a laboratory period. The book does not deal with chemical physiology; hence the amount of time demanded by a course such as the present is more than some schools will find themselves able to devote to it; a certain number of the exercises, however, are intended for advanced students, though the author does not attempt to mark these off from the rest, the selection having been left to the teacher. The author's experience is a sufficient guarantee of the suitability of the matter, and of the method of arrangement; the descriptions of the experiments, though concise, are lucid; and the book is amply illustrated by ninety explanatory figures.

Laboratory Exercises in Applied Chemistry for Students in Technical Schools and Universities. By Dr. W. Moldenhauer. Authorised translation by Dr. L. Bradshaw. Pp. xii+236. (London: Constable and Co., Ltd., 1921.) 12*s.* 6*d.*

THE long title of this book is somewhat misleading; "Technical Chemical Analysis" would have been much more appropriate. The explanations of industrial processes which are interspersed are clear and concise, but some of the methods differ from those in common use in this country. No mention is made of the important ammonia oxidation process in describing the fixation of nitrogen. The exercises cover a wide field, including water, fuels, alkali industry, fertilisers, metals and ores, oils, fats and waxes, soap, glycerin, and lubricants. The translation appears to have been carefully done, and the book may be recommended to senior students who intend to follow industrial chemistry.

The Haunts of Life: Being Six Lectures delivered at the Royal Institution, Christmas Holidays, 1920–1921. By Prof. J. Arthur Thomson. Pp. xvi+272+xvi plates. (London: Andrew Melrose, Ltd., 1921.) 9*s.* net.

THE Christmas Holiday Lectures at the Royal Institution have resulted in several books that charm the general reader as thoroughly as the spoken word held the attention of the juvenile audience to which the lectures were delivered. To those already existing Prof. Thomson has added "The Haunts of Life," where, in simple language, he sketches the problems that confront the inhabitants of the waters fresh and salt, shallow and deep, open and coast-bound, of the dry land, and of the air. His brief studies of animal adaptations, and of race-migrations from one "haunt" to another, are admirable, and open to the thoughtful reader a wide field of deep philosophic interest. The book should be on the prize-book list of every school.

The Alo Man: Stories from the Congo. By Mara L. Pratt-Chadwick and L. Lamprey. (Children of the World.) Pp. 170. (London and Sydney: George G. Harrap and Co., Ltd., 1921.) 3*s.* 6*d.* net.

THE series of which the volume under notice forms a part, is designed to open for young readers the study of geography and history as living subjects. It is written as a narrative of events in the tribal life of a boy and girl in the Congo Forest, culminating in an exciting fight between the tribe and a band of Arab slave traders which ends in the discomfiture of the latter. The Alo Man, a wandering story-teller, is responsible for the introduction into the narrative of a number of folk-tales of the animal type. The book is true to detail of a generalised forest type, although both type and area might perhaps have been more precisely defined with advantage.

Alternating Currents. By G. C. Lamb. Part I. Pp. viii+73. 5*s.* 6*d.* net. Part II. Pp. viii+127. 7*s.* 6*d.* net. (Cambridge: At the University Press, 1921.)

IN the books under notice a full explanatory syllabus is given of the lectures delivered to third-year students in the Engineering Laboratory at Cambridge. The volumes are meant primarily to be a help to the student when writing up his lectures. They will also be useful to teachers in technical schools, as the diagrams are beautifully clear, the descriptions are good, and many of the proofs given are very neat. The notation and nomenclature are practically international. "Effective," however, is now preferred to "virtual." Personally we prefer "sine-shaped" to "sinoidal," and "not sine-shaped" to "non-sine."

The Structure of the Atom: Notes on some Recent Theories. By Dr. Stephen Miall. Pp. iii + 26. (London: Benn Bros., Ltd., 1922.) 1*s.* 6*d.* net.

DR. MIALL states that he has published this pamphlet in the hope that it "might interest, and even instruct, some junior students of chemistry." To treat of the structure of the atom, radioactive changes, isotopes, and the octet theory in twenty-six pages, and in such a way as to be clear and interesting as well as accurate and instructive, is a task which calls for no little skill. Dr. Miall has undertaken it with a great measure of success, and his small pamphlet should fulfil the object he had in mind in its publication. If he had given some account of Sir J. J. Thomson's recent theory the whole range of the subject would have been covered: perhaps he will do this in future issues.

Insects and Human Welfare. By Prof. C. T. Brues. Pp. xii+104. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1920.) 10*s.* 6*d.* net.

THOUGH embodying no original research, this book is a useful and pleasantly written compilation of the results achieved by economic entomologists (including medical investigators), and of the tasks that are yet to be undertaken in Man's battle with his most formidable rivals on earth. The majority of the statistics and facts narrated are from the United States; but this circumstance in no way impairs their value to the British reader, whether doctor, farmer, or forester.

Letters to the Editor.

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The Small Haloes of Ytterby.

THE following letter, received from Mr. Svein Rosseland, of the Institute of Theoretical Physics, University of Copenhagen, contains an interesting suggestion. I publish it with the writer's consent.

". . . In connection with your letter to NATURE of April 22 on radioactive haloes in Ytterby mica I venture to comment upon the probable location of the hypothetical element in the periodic table. You make in your letter the interesting remark that the element cannot belong to the radioactive disintegration series previously known, since the life period, according to the Geiger-Nuttall relation, would have to be so immensely large, and the intensity of the radiation correspondingly feeble, that it is difficult to believe that the radioactivity of the element could be detected. This remark raises the question of the origin of the energy of the α-particles and the meaning of the above-mentioned relation.

Now it is known that the α-particles are strongly repelled by the nuclear electrostatic field of the parent atom, and it is clear that this repulsion must contribute appreciably to the energy of the particle. Without further knowledge of the exact dimensions of the nucleus and the character of the field close to it we cannot of course calculate the relative importance of this energy in the resulting energy of the particle, but we can calculate inversely a minimal radius for the nucleus of the transformation product by supposing the whole energy to be due to the nuclear electrostatic repulsion.

In this way we obtain a series of minimal radii for the elements consecutive to the α-radiating elements. The longer the life period the larger is this radius. The largest radius is afforded by uranium-X_1, where, corresponding to a range of 2·53 cm. N.P.T., it comes out as $6{\cdot}5 \times 10^{-12}$ cm. This value is so large that in view of the experiments on single scattering it seems improbable that the real radius will be much greater. But then we are led to the assumption that the main part of the energy of the α-particle from uranium-1 comes from the nuclear repulsion. As it seems unlikely that variations in the nuclear dimensions will be so large as to account for the energy of the swifter α-particles, there must be an energy term of expulsion from the nucleus, resembling in some respects the energy difference between two stationary states of an atom. If we assume the term due to electrostatic repulsion to be only slightly variable, as is the case if the nuclear dimensions vary but slightly, the variability of the ranges of the α-particles will be due mainly to variations in this energy of expulsion, and it is this which is linked to the life period of the elements according to the Geiger-Nuttall relation. It seems not wholly improbable that the difference between the constants in this relation corresponding to the different series may ultimately be due to differences in the nuclear dimensions.

If the Ytterby haloes were due to an element of an atomic number of the order found in the families of the known radioactive elements, the nuclear dimensions of its transformation product would be nearly 1·8 as large as that calculated for uranium-X_1. If, on the other hand, we reject such a size for the nucleus as improbable, we can calculate the atomic number of the element in question by assuming a law for the large scale variation of the nuclear radii, assuming at the same time the energy of expulsion of the transformation to be small. As the volume of the protons included in the nucleus on the basis of current opinion is negligibly small, it seems natural to assume as a rough approximation that the volume of the nucleus is simply the sum of the volumes of the individual electrons contained in the nucleus, where, however, this electronic volume is not necessarily equal to that calculated from the mass of the electron. This assumption is equivalent to assuming the nuclear radii to be proportional to the third root of the number of electrons in the nucleus, A – N, where A is the atomic weight and N the atomic number.

Calculating in this way the radius of the transformation product of the element in question corresponding to a range of 1 cm. in air we finally arrive at an atomic number in the neighbourhood of 40. Since the β-radiating element rubidium is number 37 this calculation immediately suggests that hibernium is identical with yttrium, which is related to rubidium just in the right way to account for the β-radioactivity of the latter.

This calculation of course is to be regarded merely as a suggestion, but I should be interested to know if yttrium were ever found to be associated with Ytterby mica."

The conclusion arrived at by Mr. Rosseland seems not improbable. In a paper by Ivar Nordenskjöld (Bull. of the Geol. Inst. of Upsala, vol. ix.) two analyses of the black mica of Ytterby are given, one referring to a much altered variety and the other to a less altered mica. The former contains yttrium, the latter contains none. This suggests that the yttrium has been introduced in the process of alteration. The mica containing the reversed or bleached haloes has, to all appearance, been considerably altered. It is therefore probable that it contains yttrium. On the other hand, according to Mr. Rosseland's theory, rubidium should be present, or—derived from it by loss of a β-ray—strontium. Neither of these elements appears in the analyses. Nor am I aware of any mineral analysis in which there is an association of any two of the elements in question. But it is, of course, quite possible that spectroscopic examination of yttrium minerals would reveal such traces of rubidium and strontium as would support Mr. Rosseland's deductions.

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Muscular Efficiency.

IN NATURE, April 15, 1920 (vol. 105, p. 197), there is a letter of mine on this subject, and the proposition there given relating to maximum efficiency is in the following applied to the case of the most efficient speed for a bicycle. The values chosen for the constants are merely guesswork, but the result is more or less in accordance with the facts.

The assumptions made are :

(1) The total power developed remains constant.

(2) All the power used in the acceleration of the limbs is lost.

(3) There is a perpetual leakage of power when a muscle is exerting any force.

I do not suppose that (1) is strictly true, but the tendency is in that direction.

I believe that (2) is correct, for no energy is restored when a contracted muscle is again extended either by the action of outside forces or by the contraction of other muscles.

(3) also is true, but in what way the leakage varies with muscular stress is not known. It probably lies between "as the force" and "as the square root of the force," and in this note I shall assume the latter hypothesis.

If P, P_A, P_L are respectively the total power developed and the powers lost by acceleration and leakage, then, f and v being the force and velocity, $P=fv$, $P_A=A/f^3$, and $P_L=Bf^{\frac{3}{2}}$.

The useful power is $P_E=P-P_A-P_L$, and the efficiency $E=1-\frac{P_A+P_L}{P}$. Differentiating E with respect to f it will be found that the minimum of P_A+P_L occurs when $f=\left(\frac{2A}{B}\right)^{\frac{2}{9}}$.

The constants A and B may be determined by the conditions that, when the whole power is expended in accelerating the limbs $A=f_a^3P$, where f_a is the force which can be maintained at the greatest practicable velocity, and $B=P/f_L^{\frac{3}{2}}$, where f_L is the greatest average force which the muscles can apply.

In the case of the bicycle I will assume (1) that the gearing is 70 with a 7-inch crank; (2) that the power available is 40 ft. lb. per sec. (about 1/14 H.P.); (3) that the greatest speed attainable with that power and in the absence of air resistance is 40 ft. per sec. (about 28 M.P.H.); and (4) that the greatest average force which can be continuously exerted on the crank is 30 lbs., from which it may be deduced that A = 5000 and B = ·24.

These values were used in computing the curves in Fig. 1.

The minimum of P_A+P_L is 12·5 ft. lbs. per sec., thus leaving 27·5 ft. lbs./sec. for useful work, which, with the assumed length of crank and gearing, would

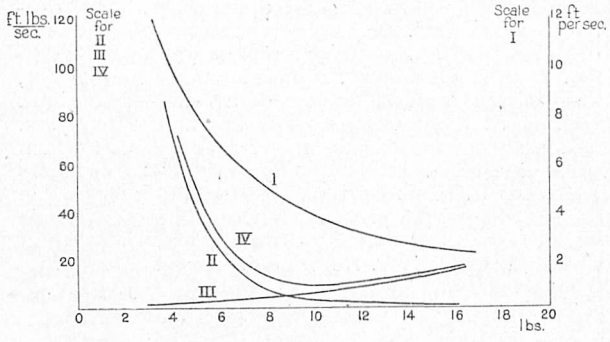

FIG. 1.

Curve I is the hyperbola $fv=P$; f in lbs., v in ft. per sec.
,, II P_A, the power lost in acceleration of the limbs.
,, III P_L, the power lost by leakage from the strained muscle.
,, IV P_A+P_L, which has a minimum value of 12·5 ft. lbs./sec.

suffice to lift a load of 200 lbs. (weight of rider and machine) up a gradient rather less than one in thirty. Hence even with this gentle gradient it would pay to ascend the hill obliquely, *i.e.* in a series of tacks.

The P_A+P_L curve, however, is very flat near the minimum, so that a considerable increase of gradient would not do much to diminish the efficiency.

Whether the assumed maxima of speed and force are anywhere near the truth I do not know, and it would be interesting to have laboratory experiments on these quantities.

A. MALLOCK.

9 Baring Crescent, Exeter, May 10.

"G. B. M."

I FIRST saw the late G. B. Mathews on June 4, 1884, at the Queen's Hotel, Chester, when the staff of the newly founded University College of North Wales was appointed. He was chosen for the Chair of Mathematics, and almost from that time we were linked together in friendship as well as in our offices as teachers of intimately related subjects in the same institution. I well remember his youthful and striking yet attractive appearance. He was the senior wrangler of the previous year, and came full of eager enthusiasm for the teaching of mathematics and for original mathematical work, and for ten years laboured hard in the hope of founding something like a school of mathematical study in North Wales. But alas! these hopes were dashed. Perhaps he was a little impatient, and I certainly did my best to counsel him to wait, and to find out the effect of the new Welsh university on the studies of the place, but without effect. The best of the Welsh students were at that time attracted by the Neo-Hegelian philosophy, and some of them, as seems to be the way of such students, seemed not a little proud that their mental tendencies were not mathematical. To this curious type of intellectual pride Mathews referred eloquently in the posthumous paper published in NATURE of April 22.

In that paper he lamented the revival of the fallacious arguments for the supremacy of the Latin-Greek classics as an educational instrument; but he in no way undervalued classical culture, only he thought that to an Englishman, the inheritor of a copious and flexible language, and of a literature unequalled in the past, a training in Latin and Greek was far from indispensable, and might have its disadvantages. Certainly many classical people, tutors of colleges and old-fashioned classical schoolmasters, often write English which can scarcely be regarded as a model to be imitated, as any one can convince himself by reading the prefaces and introductions to editions of classical texts. He always thought Greek more important for students of science than Latin. And truly the technical language of zoology and physiology, and in a less degree that of physics, is much more exclusively of Greek than of Latin derivation.

Mathews had a knowledge of Latin and Greek as minute and accurate as that generally possessed by professional classical scholars. He wrote pure and elegant Latin. I remember his amusing himself by turning into Latin prose an original philosophical dissertation which happened to come into his hands and arrested his attention. I remember also some Latin verses which he published anonymously and which were much praised by a very eminent scholar.

He wrote also charming English essays in the style of Charles Lamb, of whom he was a great admirer. These I fear are lost, but one of them, "On a cock-loft," was a perfect gem, a charming piece of the most natural and simple prose, somewhat after the manner exemplified more recently by Kenneth Grahame in his "Golden Days." He gave much time to Arabic in later years, and it is to be hoped that his translations of Arabic poetry will ultimately be published. I have seen some of them, which certainly seemed very remarkable. His most valuable work was done in mathematics, and this has been well appraised by a mathematician who knew him well in later years. It is, I think, a pity that the variety and strength of his interests distracted him from mathematical work, and prevented him, until it was too late to take it up again, from finishing his work on the Theory of Numbers. But in his NATURE articles his extraordinary wealth of knowledge and his keen and yet genial criticism must have helped innumerable students. A. GRAY.

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Half Quanta.

THE Wilson-Sommerfeld principle when applied to the case of a rotating molecule, supposed rigid, leads to the expression $mh/2\pi$ (m integral, h Planck's constant) for the angular momentum of the molecule, and on this basis, with the help of several other assumptions, it has been found possible to account very satisfactorily for the main features of the structure of band-series. The theory is found to apply not only to ordinary bands in the region of the visible spectrum but also to absorption bands of very different appearance, such as those due to the halogen acids which occur in the infra-red. In the latter case, however, a discrepancy exists which has given rise to a good deal of discussion. The observed bands consist of a number of lines distributed, to a first approximation, according to the formula

$$\nu = \nu_0 \pm m\omega,$$

where m takes successive positive integral values and ω is a constant. The line of wave-number ν_0 (*i.e.* $m=0$) is invariably absent.

The theoretical expression, on the other hand, is of the form

$$\nu = \nu_0 \pm (m - 1/2)\omega,$$

which, it will be noted, represents a similar set of lines displaced through a distance $\omega/2$. The reality of the discrepancy is therefore dependent upon the correct identification of ν_0, and as this is not entirely beyond question some workers have preferred to take the value indicated by the theory, although by doing so fresh difficulties in the interpretation of the results arise. Einstein, however, pointed out (quoted by Reiche, *Zeitschr. f. Phys.*, 1920, p. 283) that theory and observation would agree if instead of the usual value $mh/2\pi$ for the angular momentum one assumed it to be given by $(m+1/2)h/2\pi$. The evidence from the infra-red absorption bands seems scarcely strong enough to warrant such a revolutionary change, but other data bearing on the question have recently become available. In the band spectrum of helium, for example, series exist which show this same peculiarity, and here its existence is indubitable, for the normal (*i.e.* theoretical) series are in this case also present, and a trustworthy value for ν_0 can be determined from them.

Following up Einstein's suggestion, I have found that the abnormal series may in all cases be very simply derived from the normal group by displacing the quantum number by one-half. As an illustration of the sort of agreement which is obtained I may cite the case of the λ5730 band (see Curtis, Roy. Soc. Proc., 101, 1922, p. 38), which consists of six series, only three of which satisfy completely the theoretical requirements. The "half-quantum series" calculated from these three are as follows:—

$$17436{\cdot}6 - 31{\cdot}5m + 0{\cdot}95m^2$$
$$17436{\cdot}6 + 31{\cdot}5m + 0{\cdot}95m^2$$
$$17436{\cdot}6 + 0{\cdot}95m + 0{\cdot}95m^2$$

The remaining three observed series are represented by the formulæ:—

$$17437{\cdot}3 - 30{\cdot}0m + 0{\cdot}87m^2$$
$$17436{\cdot}8 + 29{\cdot}5m + 1{\cdot}09m^2$$
$$17437{\cdot}3 + 1{\cdot}15m + 0{\cdot}87m^2$$

The correspondence is very close, having regard to the approximate character of the formulæ upon which the calculation is based. It is certainly good enough to justify the proceeding as an empirical method of expressing the relationship between the two groups and to encourage theoretical inquiry into its physical significance.

As the matter stands at present, the inference—illusory though it may be—is that the molecules fall into two classes, according to whether their angular momenta are given by $mh/2\pi$ or by $(m+1/2)h/2\pi$. Transitions between the two classes do not occur (or, if they do, give rise to no radiation), since there are no lines corresponding to changes of one-half in the quantum number. That is to say, whether or no the half-quantum may be involved in the determination of the possible states of a molecule, it does not appear to play any direct part in the radiation process.

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Fossils in Burmese Amber.

AMBER mines have long been known in Upper Burma, or rather in the adjacent "unadministered tracts." In 1916 Mr. R. C. J. Swinhoe, of Mandalay, began to send me specimens of Burmese amber (Burmite) containing insects. As opportunity has offered, he has continued to obtain such material, all of which has been transmitted, after investigation, to the British Museum (Natural History). Up to the present time I have been able to describe 38 species of insects, three arachnids and one diplopod. Many other species, which I did not feel competent to deal with, or which could not be seen properly, exist in the amber, and will, I hope, eventually be described by others. On the whole, the fauna is very remarkable, containing a large preponderance of types which are usually considered primitive. The amber was said to come from Miocene clay, in which, however, it was presumably of secondary origin. Judging from the fossils, I suggested as early as 1917 that the amber might be actually very much older than Miocene, conceivably even Upper Cretaceous (*Amer. Journ. Sci.*, Nov. 1917, p. 360).

Recently, information has been received which tends to confirm the suspicion that the amber is much older than Miocene. Dr. F. A. Bather of the British Museum has kindly transmitted a letter from Dr. E. H. Pascoe, Director of the Geological Survey of India, dated July 20, 1921. Dr. Pascoe states that Dr. M. Stuart, in his recent journey down the Hukong Valley, saw something of the amber mines, and reported that the shafts were sunk in beds which appeared to be identical with the Tipam sandstone or the Irrawaddy series. Whether they passed through into underlying rocks could not be determined, but from the evidence obtained by Noetling and others it seemed probable that they frequently did. The Tipam sandstone is unconformable on the underlying beds, and frequently contains fragments of them in its lowest horizons. Such fragments may very well include lumps of amber derived from the underlying clays. Dr. Pascoe continues: "Among the debris of some pits sunk into these clays, which are the true home of the amber, Dr. Stuart found a fragment of chalky nummulitic limestone. The pits had been sunk into the clays, not to obtain amber, but flint from the chalky limestone lying in them. Dr. Stuart describes the clays as totally unlike any Disang beds that he had seen, and he is inclined to accept the view that they are Eocene in age. If it is possible to determine the species of the nummulite, I will let you know; but it is, of course, not certain that this nummulitic limestone occurs *in situ* within the clays."

On August 1, 1921, Dr. Pascoe wrote that Dr. Stuart thinks the nummulite is *Nummulites biaritzensis* d'Arch., characteristic of the uppermost zone of the Lower Khirthar. The Khirthars correspond approximately, according to Mr. E. Vredenburg, to the Lutetian. The Lutetian represents the earlier part of the Middle Eocene, below the Bartonian.

Thus, the evidence seems to indicate that the Burmese amber fauna is Eocene, and older than the Eocene (Bartonian) beds which have produced fossil insects in the south of England.

At this point, however, a new problem is introduced. A few days ago I received from Mr. Swinhoe a number of beads of extremely pale and pellucid amber containing well-preserved insects, all different from those previously described. These insects include a small bee, which seems not to differ at all from the common living Indian *Trigona læviceps* Smith. The other amber contained no ants, but this includes a worker of Crematogaster, workers of Pheidole, and males of Monomorium. I also find a winged termite, a psyllid, a fly of the genus Phlebotomus, some acalyptrate muscoid flies, a mycetophilid, some small spiders, etc. So far as can be seen, this is a modern series of types. Mr. Swinhoe found that the beads, when he purchased them, had been artificially coloured to enhance their value, and he had this colouring matter removed. He learned that several stained necklaces had been imported from China, so he could not be sure that the material was really from Burma. At one time he even wondered whether the specimens could have been included in artificial amber, as is sometimes done. He decided that this last suspicion was unfounded, and I quite agree. His letter ends: "Probably this light amber comes from a locality a few miles off." My own opinion is that this light amber (or copal) is of very recent origin, not earlier than Pleistocene, and contains a fauna which doubtless consists mainly (at least) of species still living. The bee which I recently described as *Meliponorytes* (*?*) *devictus* probably belongs to this material, and not to the Eocene amber. We may surmise that we have the product of some Dipterocarpaceous tree allied to Vateria; something similar to Miss Ruth Holden's *Dipterocarpoxylon burmense*, based on fossil wood from Burma. More exact information on this matter is greatly to be desired.

T. D. A. COCKERELL.

University of Colorado, May 1, 1922.

Radium Synthesis of Carbon Compounds from Air.

Now that photo-synthesis is attracting special attention it may be interesting to record some recent preliminary experiments on the production of synthetic carbon compounds by the action of radium rays on atmospheric air. Under normal conditions of temperature and pressure, it seems evident that this radio-synthesis is capable of producing carbon compounds apart from living cells, and without the agency of solar radiation.

The experiments arose from an observation, made some nine years ago, during an investigation of the curvature of thin plates of mica when acted upon by radium. After long exposures—some weeks in duration—I noticed a deposit of brown patches, mere specks, on the uppermost side of the thin strips, that is, the side which became concave during α-ray bombardment.

As this deposit was found not to be responsible for the bending, it was not mentioned in the resulting paper (Journal Röngten Society, No. 44, vol. xi., "Alpha Ray Effect Mechanical"), but left for future investigation, which eventually had to be abandoned on account of urgent war work.

Having recently made further experiments, I find that the deposits can be detected more quickly, and better observed, by using freshly drawn fibres of quartz or glass, diameter about 0·04 millimetres. Several of these may be spaced about 1 mm. apart, supported on a framework immediately over the radium salt, about one-eighth of an inch above the uncovered radio-active surface (one or two milligrammes of radium or mesothorium is sufficient).

The whole arrangement should be put into a clean cardboard box (about one litre capacity, to reduce convection currents), with loose fitting lid, which is then put away in a dark room. After remaining undisturbed for a week, it will be seen, using a Coddington lens (or better if transferred to a microscope with one-inch objective), that the fibres are covered with a clear white viscid liquid film, which is beginning to gather up into beads, or droplets, at more or less regular distances. After a further exposure of a few days, it will be found that all the droplets have increased in size, some having reached a pale sherry colour. Further exposure leads to increase in size, eventually resulting in dimensions about double the diameter of the fibre. The colour changes may be from white to sherry, red, then dark brown, after about six weeks' exposure; later a little irregularity of contour of the brown droplets may be noticed, showing that the liquid is tending to solidify with irregular contraction; fresh deposits may appear in the interspace between old droplets, so that a fibre may contain droplets in all stages.

It is evident that the first liquid product, colourless at the beginning, is soon oxidised in the ozone which is produced by the α-rays. By reason of the time required and the minute quantity of the first product, it is difficult to make tests before oxidation has taken place to some extent.

Preliminary microscopical examination of the final dark brown product, which becomes a strongly adherent scaly deposit, on a mica strip (after nine years), demonstrated that the brown deposit was insoluble in alcohol and chloroform but dissolved in hot water. On evaporation of this solution a brown film was formed which cracked into scales on drying. This film became carbonised on heating, at about the same temperature as a particle of gum acacia, on the same electric hot-plate.

So far, I have not obtained deposits by using α- β- or γ-rays, either separately or in combination. The gaseous emanation of radium seems to be necessary, which points to the probability that the radium products of short period are chiefly concerned in the synthesis, or in facilitating condensation on solids. On this point, and on the physical aspects, further experiments are in progress, but it is very desirable that the chemical examination of the products should be made by others with better facilities than those I possess for dealing with very minute quantities. Possibly increased production may be obtained by increasing the proportion of water vapour and carbon dioxide in the air. I should be very glad to know of any work already done bearing on the subject. Have such products ever been found in the atmosphere? If ultra microscopical, rain may contain some.

F. HARRISON GLEW.

156 Clapham Road, London, S.W.9.

Cephalic Index and Sex.

IN NATURE of March 23, p. 389, I find the statement—in a summary of a paper by Miss R. M. Fleming—that "British women show more development of pigment, brachycephaly, and prognathism than do men."

As to the cephalic index I see quite the same in Arthur Thomson and Randall-MacIver's interesting account of skulls from "The Ancient Races of the Thebaid" (Oxford, 1905); and probably this "more development of brachycephaly" in women is a general law.

But, as I pointed out in 1907, in my Danish paper, "Om Kortskaller og Langskaller" (Oversigt over D. K. Danske Videnskabernes Selskabs Forhandlinger, 1907) —also published in a German translation in "Archiv für Rassen- und Gesellschafts biologie" (IV., 1907) —such indications need correction because of the correlation between absolute length of skull and cephalic index: the index diminishing greatly with increasing length.

I will here reproduce only one of the concluding tables of my paper in which I have given computations of the English authors' splendid material. The whole of the material (775 males and 754 females) gives for the skulls these averages:

Males: L., 18·426 Br., 13·536 Index, 73·48
Females: L., 17·682 Br., 13·187 Index, 74·58

i.e. showing "more development of brachycephaly" in women.

But if we compare what ought to be compared, namely, the skulls having the same lengths, we find quite different results.

Comparisons of the cephalic index in men and women within the same classes of absolute length are given in the following table:

Limits of Length-Classes.	Index of Skulls.		Difference and Mean Error.
	Male.	Female.	
17 cm. . .	77·34	75·86	1·48±0·47
17·5 ,, . .	75·40	74·28	1·12±0·29
18 ,, . .	73·88	73·18	0·70±0·30
18·5 ,, . .	72·42	71·24	1·18±0·51
19 ,, . .			

The same divergence runs through all special series of the material. The same class of absolute length of head (again correlated with the height of body and so on) shows more development of brachycephaly in *men* than in women!

In this short letter I need not enter into the various questions concerning cephalic index and heredity, Mendelism, etc. W. JOHANNSEN.

University of Copenhagen.

THE point which Prof. Johannsen raises is interesting, though absolute measurements on men and women are scarcely comparable. Absolute measurements on women are not only smaller than those on men of the same type, but also differ in their relationships. As pointed out in a summary of our measurement results in *Man* for May 1922, a range of absolute head length 181-193 mm. in women of a certain race type corresponds with a range of absolute head length 194-204 mm. in men of that race type. It will thus be seen at once that a comparison of a man and a woman having the same absolute head length means a comparison between two people not only of different sex, but also of different race type. In such a comparison one gets a woman towards the long headed end of the series compared with a man towards the short headed end of the series for that sex. The smallest absolute measurements for head breadth are among women, for all women's measurements are small, but at the same time these heads need not necessarily be narrow proportionately to their length, which may also be very small. Classifying race types on the basis of summation of characters our thousands of measurements undoubtedly show that women's heads show greater *relative* breadth (*i.e.* are not so oval in shape) as those of the men nearest to them in general features.

In conclusion, may I refer to Prof. Johannsen's mention of length of head *correlated with height of body*. Our results have gone to show that on the whole the greatest absolute length of head is to be found in a race type the height of which is distinctly sub-normal. The longest headed man I have measured is of this type and is under five feet in height. This of course may not apply to the race types Prof. Johannsen has measured, but it would be interesting to have his observations on the point.

R. M. FLEMING.

The Organisation of Knowledge.

REGARDING the remarks made in NATURE of May 6 on the address of Dr. F. L. Hoffman at the American Association, it might be suggested that the organisation of facts for commercial uses is of a different order than the organisation of knowledge for the purpose of understanding the operations of Nature or of ascertaining a particular law of cause and effect. A man who collects data may, or may not, have imagination. A man may also classify facts quite mechanically according to a scheme laid down. The successful "business organiser," however, usually has a new plan and sets others to work to collect facts for him to organise or re-organise. He knows at the start *why* he wants the facts and *how* to use them. Imagination is required by such an organiser because he has to adjust his methods not only to his data but to human beings and a changing world.

Mathematics, however, in the Pythagorean sense of *Mathesis*, certainly is not necessary for the actuaries' arithmetical operations. But, so far, neither actuaries nor the inductive method of inquiry alone have been able to predict epidemics of disease, revolutions or wars, not to mention earthquakes and tidal waves; nor have they anticipated discoveries of fundamental laws, such, for example, as that of Dalton's doctrine of atomic proportions or Faraday's law of electromagnetic induction. Dalton, we know, was a mathematician and was not personally engaged in collecting evidence; his laboratory work was insignificant. Faraday himself stated that he had reached his conclusion by a *process of thought* and *knew* it must be true before he obtained the evidence by experiment. Who, even then, suspected the industrial results that followed in later years through the application of the principle by others? It is to mathematics in the original Greek sense of principles or proportions (not *calculation* merely) that we owe the really epoch-making discoveries of science. Even inventions are not the result of examining facts. A mechanical genius has a knowledge (instinctive or mathematical) of a law he tries to demonstrate practically; he does not attempt to formulate a law from a collection of facts. The evidence proves the law to the senses; but a law is not created nor even discovered by evidence. Inductive science has been necessary in order that we should become acquainted with the different kinds of materials and variety of species, etc., in the world, for, before Bacon's instructions had been carried out, there was no opportunity to apply the laws of Nature (understood, without doubt, in a general way by Bacon himself) even when a genius with mathematical imagination saw them in his thought. Inductive and deductive methods are each ineffective without the other.

Again, the history of modern chemistry and physics does not support the contention that the laws of mechanical engineering were evolved by rule-of-thumb experiments amongst primitive peoples before, for instance, the pyramids could be built. Modern hydraulic engineering arose in the mind of one Carnot, a mathematical genius who demonstrated its laws

by symbols on paper. Industry and business have benefited considerably from the application of this *unbusinesslike* mathematical method!

The fact is that the most practical sciences, and the only sciences that have been applied industrially, are the exact sciences of chemistry, physics, and engineering—sciences which can predict effects from known causes.

No statement of evidence is really a fact until all the factors are known, and, therefore, statistics cannot predict, and man cannot forestall disease or economic distress, in spite of the sciences of biology and medicine and the "science of economics."

W. WILSON LEISENRING.

IN a notice (NATURE, May 6, p. 596) of an address by Dr. Hoffman, the words are used: "Imagination is what the mathematician is ever trying to get rid of." As such misconceptions as this are unfortunately rather widespread, it may be useful to protest against them. Imagination is essential to mathematics. The work of the great mathematicians affords many striking examples of creative imagination, and for the proper understanding and appreciation of even the elementary parts of the subject the use of imagination is necessary. One of the most important qualities of a good mathematical teacher is the power of stimulating the pupils' imagination, and it is, perhaps, the neglect of this faculty by some teachers which is responsible for the dulness and lifelessness of what is too often taught in schools under the name of mathematics. F. E. CAVE.

Girton College, Cambridge, May 10.

DR. HOFFMAN'S charge against the mathematicians was not that they lack imagination but that they set before them as the ideal of their science the getting rid of it. The quotation from Prof. Whitehead, who certainly is not lacking in that faculty, makes the meaning clear. There is, however, a drawback in our language in the fact that we use the same word for imagination when we mean æsthetic creation, what the Italians call *fantasia*, as we do when we mean the anticipation which is pure reproduction, what the Italians call *immaginazione*. It is of course the æsthetic creation the mathematician aims at dispensing with in order to preserve the purely logical character of his ideas. Even Kant represented it as a kind of handicap that mathematical concepts should require sensuous intuition for their expression. THE WRITER OF THE ARTICLE.

The Elliptic Logarithmic Spiral—a New Curve.

IF, in an elastic system with one degree of freedom, and friction proportional to the velocity, the relation of the "free" force to the displacement be considered, an interesting curve results.

Thus if the displacement be

$$x = ae^{-kt}\cos nt$$

the force is given by

$$F = be^{-kt}\cos(nt+\epsilon),$$

and by eliminating the cosines we have

$$\frac{x^2}{a^2} - \frac{2Fx}{ab}\cos\epsilon + \frac{F^2}{b^2} = e^{-2kt}\sin^2\epsilon,$$

which may be termed an elliptic logarithmic spiral or a damped Lissajous' curve.

If the vibrations are maintained or forced by a force of harmonic character, the force displacement curves become ellipses.

The same equations hold for the compounding of two damped harmonic motions of equal periods at right angles, so that the path of a body at the lower part of an oiled sphere or of the bob of a conical pendulum in a viscous medium would be, in plan, an elliptic logarithmic spiral. H. S. ROWELL,

Director of Research.

Research Association of British Motor and Allied Manufacturers,

15 Bolton Road, Chiswick, W.4, May 3.

Intelligence Statistics.

I WAS interested in a short note in NATURE of February 16, p. 218, on the dependence of the standard of intelligence of individuals on the part of the year in which they were born. Statistics appear to show that the standard of intelligence is higher in individuals born in the autumn (say October) than in those born in the spring (say April). At first sight this result may seem rather unexpected, as one might expect that the influence of summer would be beneficial to a child born in the spring, whereas, in the case of a child born in the autumn, it would not be surprising if the succeeding winter were to have a deleterious effect on the mental growth.

It appears to me that the chances of a child surviving the first year of life are greater for a child born in the spring than for one born in the autumn, and I do not doubt but that statistics have shown that this is so. Coupled with this one would expect that the general "fitness" of the survivors of the first year of life would be greater for individuals born in the autumn, because the weaklier members have been weeded out by the severity of winter in the first few months of life. This would appear to be sufficient to explain the result mentioned at the beginning of this letter. We should thus expect that, in the southern hemisphere, children born in the spring (April) would in later life have a higher average standard of intelligence than those born in the later months of the year. Statistics from the southern hemisphere would thus be of value in this connection.

It is possible that this aspect of the problem has already been dealt with. As the papers on this work are not accessible to me, however, I have not seen the explanations offered for the above-mentioned interesting phenomenon. ROBERT W. LAWSON.

The University, Sheffield.

A Rainbow Peculiarity.

IN NATURE of March 9, p. 309, Major Lockyer asks if it is a fact of general observation that "the whole area of the inside of the primary bow is brighter than the region outside," and he refers to the phenomenon as "a fact in Nature which appears to have been rarely noticed visually." The following quotation from "The Divine Adventure," by Fiona Macleod (William Sharp), shows that the mystic poet not only saw clearly into the heart of Nature, but was also a keen observer of her outward manifestations:

> It is not Love that gives the clearest sight:
> For out of bitter tears, and tears unshed,
> Riseth the Rainbow of Sorrow overhead,
> And 'neath the Rainbow is the clearest light.

Probably the phenomenon was commonly known amongst the Western Isles he loved so well.

JOHN P. DALTON.

University of the Witwatersrand, Johannesburg.

Non-Specific Therapy.

By Dr. J. STEPHENSON.

IN inoculation against typhoid fever, dead typhoid bacilli are injected subcutaneously or into a muscle. Inoculation against plague consists in the injection of an emulsion of dead plague bacilli artificially grown in broth. These are prophylactic measures for the protection of persons who are likely to be exposed to infection. Hydrophobia vaccine, used in order to prevent the development of the disease in persons who have been bitten by a rabid animal, is prepared according to a definite system from the spinal cords of rabbits inoculated with the disease. Anti-diphtheritic serum, used in the treatment of patients actually suffering from diphtheria, is the blood-serum of a horse which has had diphtheria toxin (the broth in which diphtheria bacilli have been grown, and from which the bacilli have been filtered off) repeatedly injected into it.

In using vaccines the object is to stimulate the individual to produce protective substances in his own body; in using sera, the protective substances, elaborated by some other animal, are themselves supplied to the patient. But in all the above instances, and in numerous other similar modes of treatment,—whether the treatment takes place before infection (*i.e.* is prophylactic), or is carried out during the incubation period, or during the actual disease; whether bacilli are used, or a serum free from bacilli but containing an antitoxin,—the implication is that certain substances are protective against one disease, certain other substances against another; in other words, the treatment is *specific*. The idea of specificity may go even further, as where a patient is treated by means of the particular strain of micro-organism, or the particular mixture of them, that he himself harbours (the use of autogenous vaccines in asthma, acne, boils, etc.). As Sir Almroth Wright has recently written :—

"That immunisation is always strictly specific counts as an article of faith; and it passes as axiomatic that microbic infections can be warded off only by working with homologous vaccines, and that we must in every case, before employing a vaccine therapeutically, make sure that the patient is harbouring the corresponding microbes."

To attempt treatment on a non-specific basis would seem therefore at first glance to be a step backward, and investigation of such a subject illogical, if nothing worse. But while reason, working on the accepted lines, was all against the idea, facts have cropped up repeatedly which seem to give a value to non-specific treatment. At first these were ignored; but a time has come when this method of disposing of them is no longer possible. Thus, to quote Wright again :—

"I confess to having shared the conviction that immunisation is always strictly specific. Twenty years ago, when it was alleged, before the Indian Plague Commission, that anti-plague inoculation had cured eczema, gonorrhoea, and other miscellaneous infections, I thought the matter undeserving of examination. I took the same view when it was reported in connection with anti-typhoid inoculation that it rendered the patients much less susceptible to malaria. Again, some years ago, when applying pneumococcus inoculations as a preventive against pneumonia in the Transvaal mines, I nourished exactly the same prejudices. But here the statistical results which were obtained in the Premier Mine demonstrated that the pneumococcus inoculations had, in addition to bringing down the mortality from pneumonia by 85 per cent., reduced also the mortality from "other diseases" by 50 per cent. From that on we had to take up into our categories the fact that inoculation produces in addition to "direct" also "collateral" immunisation. This once recognised, presumptive evidence of collateral immunisation began gradually to filter into our minds. . . . From such cases hints are conveyed to us that there may exist a useful sphere of application for collateral immunisation; . . . we should discard the confident dogmatic belief that immunisation should be strictly specific, and that we should in every case of failure endeavour to make our immunisation more and more strictly specific. We should instead proceed upon the principle that the best vaccine to employ will always be the vaccine which gives on trial the best immunising response against the microbe we propose to combat."

The present position of non-specific therapy is explained in a recently published volume by Dr. Petersen of Chicago,[1] from which the above quotation from Wright is taken. When we come to inquire into the rationale of the procedure, we find that a theoretical basis to account for the results has been lacking,—the treatment has been empirical. With Petersen, we may perhaps put the matter broadly thus: the reaction of the body is fundamentally the same in all cases of injury; there is an effort to dilute the noxious agent (increased flow of lymph), to remove it (phagocytosis by leucocytes), to neutralise it (manufacture of antibodies); these failing, to wall it in. We may, in trying to influence this process, adopt one of two avenues of approach; we may proceed against the cause of the inflammatory reaction by fostering the production of an antibacterial agent or an antitoxin; treatment on these lines must necessarily be specific, must be directed against the particular micro-organism or toxin. Or we may endeavour to alter the inflammatory reaction of the body itself,—to stimulate the potential forces, latent or held in abeyance until the non-specific stimulation brings them into activity. This is somewhat vague; Wright has, in a recent lecture (see the *Lancet*, May 6), described one way, at least, in which the activation works. He has discovered that "the intravenous injection of a vaccine is immediately followed by the appearance of bactericidal substances in the blood, which are not specific but can act upon various types of organisms. . . . The late result of an inoculation with, say, a typhoid vaccine, is the production of antibodies which are specific for the typhoid bacillus, but the immediate result of such an inoculation is the appearance of non-specific antibodies. Inasmuch as leucocytes possess the power of inhibiting the growth of organisms on culture media, it seems likely that these non-specific substances exist ready-formed in the leucocytes which yield them in response to the immediate demand."

[1] Protein Therapy and Nonspecific Resistance. By Dr. William F. Petersen. Pp. xviii+314. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1922.) 21s. net.

Already a large number of substances have been used as non-specific agents; in many cases, of course, these remedies were employed long before any explanation of their action had been formulated on the above lines. Of the long list of agents given by Petersen only a few can be mentioned.

First comes counter-irritation by means of thermo-cautery, seton, blisters, etc. Each of these procedures has for object the production of a focus of inflammatory exudation, suppuration, or necrosis; the absorption of the pathological exudates must lead to a tissue stimulation similar to that which follows more modern non-specific injections. Our non-specific therapy is thus but part and parcel of this older practice of counter-irritation.

Normal animal sera have been used,—horse, beef, goat, sheep, chicken, and other sera; these were first injected subcutaneously, and in more recent years into a vein; as much as 250 c.c. of beef serum have been given in anthrax without injury. Antibacterial sera and antitoxins have been widely used,—diphtheria and tetanus antitoxin, antistreptococcic, antipneumococcic, antidysenteric serum, etc.;—as remedies, that is, not in the homologous diseases, but in other morbid conditions, *e.g.* diphtheria antitoxin against streptococcus infection, tuberculosis, lupus, etc. The numerous vaccines, prepared in the first place as specific agents,—typhoid, dysentery, streptococcal, pneumococcal, influenza vaccines,—have also been used with a non-specific object.

Various native proteins have been given,—solution of egg albumen and serum albumen injected subcutaneously, milk by intramuscular injection, casein, gelatin; of protein split products, proteoses (albumoses) prepared from different proteins sometimes give a very prompt and satisfactory reaction. The enzyme treatment of cancer, exploited some years ago, consisted in the subcutaneous injection of a trypsin solution; a general reaction,—chill, sweating, and rise of temperature,—followed the injection, and the patient would have several days of comparative comfort.

Colloidal metals constitute another group of remedies; these are active catalytic agents, and it is supposed that they act therapeutically in virtue of this property as inorganic ferments; they whip up the organism, which responds, if response is possible, by producing more leucocytes. A number of colloidal metals have been prepared for therapeutic employment; the colloidal silver preparations have been in use longest, but arsenic, zinc, gold, manganese, iron, mercury, and other metals, as well as sulphur and iodine, have been employed with varying success in septic conditions, endocarditis, rheumatism, trench fever, etc.

The use of light, Röntgen rays, and radium must also be mentioned. These agents first stimulate tissue cells, and later, with prolonged exposure, cause their death. In both cases substances enter the blood stream which produce a general reaction; this may be mild, or accompanied by severe fever. After moderate reactions of this type, if the patient is in good condition and able to respond, improvement of appetite, nutrition, and general well-being may set in, just as after other non-specific agents. Here, then, we have at least a partial explanation of the effect of heliotherapy in tuberculosis, as used, for example, at Leysin in Switzerland, of which the public has heard much in the last few months.

About half of Dr. Petersen's book is occupied with an account of the methods used and the results obtained in the numerous diseases for which non-specific therapy has been tried. The last chapter, on indications and contra-indications, gives much useful advice. We are reminded that the method can only be applied intelligently if we recognise that by it all the forces of cellular and humoral resistance are for a short period of time keyed to the highest pitch; stimulation of this kind is useless when the cells of the body are profoundly fatigued, and hence injections must be given early in the course of the disease. But "the non-specific method of treatment should under no circumstances be considered as a rival or a substitute for the proven specific measures that we have at our command. That a non-specific factor is at times and possibly often associated with the specific reaction may be true, the more reason that both should be studied and both utilised in their proper time and place."

The bibliography runs to no less than fifty pages, and must, one would think, be complete up to date. The book as a whole forms an interesting, convenient, and comprehensive account of a recent development of medical thought and practice.

The Solvay Institute of Chemistry.

THE first meeting of the "Institut International de Chimie Solvay" was held in Brussels on April 20-27, under the presidency of Sir William Pope. It will be remembered that before the war M. Ernest Solvay set aside a capital sum to be expended in the course of thirty years by the International Institute of Physics, and that meetings under the auspices of this Institute have been held in Brussels both before and since the war. More recently M. Solvay has set aside a further capital sum of one million francs, also to be expended in thirty years, for the promotion of the science of chemistry.

The meetings of the Institute are attended by delegates from different countries, the number being limited to about thirty, so that the discussions may be as free and as informal as possible. The recent meeting was devoted to the consideration of a number of those questions which affect the foundations of modern chemistry, and its programme included the presentation of papers on isotopes, by Soddy, by Aston, and by Perrin and Urbain; on X-ray analysis and molecular structure, by W. H. Bragg; on the electronic theory of valency, by Mauguin; on optical activity, by Pope and by Lowry; and on chemical mobility, by Job.

In connection with the papers on isotopes, considerable discussion was aroused as to the possibility of two dissimilar arrangements of planetary electrons around the same type of nucleus. The possibility of such an isomerism in the external domain of the atom was conceded, although at present only as a hypothesis;

but, in view of the fact that radiation by the atom is attributed to the movement of electrons from one orbit to another, the prospect of realising two different stable configurations of the orbits appears somewhat remote. Another possibility, that atoms may exist of equal atomic weight as well as of equal atomic number, has been discussed in connection with certain members of the radium and actinium series or radio-elements. The supposed necessity for recognising this subtle type of distinction between atoms is based on the assumption that radium and actinium are derived from a common parent and that all the members of both series of radio-elements must therefore have atomic weights of the type $(238-4n)$. If, however, radium and actinium are derived from isotopic forms of uranium, the two series of radio-elements may well prove to differ in atomic weight, *e.g.* by one unit. The discussion on Aston's paper dealt largely with the question of how an "element" should be defined, in view of the discovery of isotopes not only amongst radio-elements but also amongst the common elements. Aston appeared to voice the feeling amongst physicists by suggesting that each atomic number should represent one element; but he was opposed by a number of chemists, who argued that the word "element" carried with it an idea of homogeneity which could not be reconciled with the proposal to describe as an element a mixture of isotopes, the separation of which might at any time become a practical possibility. The paper on the separation of isotopes, presented by Perrin and Urbain, was to have been prepared by the late Prof. Guye. It certainly served to emphasise the extreme difficulty of the separation, since nearly all the methods derived from analogy with rare earths or isomeric hydrocarbons have been shown, both by theory and by experiment, to be impracticable.

Bragg's demonstration of recent results obtained by the X-ray analysis of crystals was greatly aided by models, which could be not only viewed at close quarters, but handled and studied during the whole period of the conference. Some discussion arose in connection with his demonstration of the relationship between the crystal structure of diamond and of graphite, and of the two kinds of relationship between carbon atoms which are shown by the model of graphite. Two different kinds of linkage were also shown between atoms of bismuth, corresponding perhaps to co-valence and electro-valence respectively. The principal subject of discussion arose, however, from the application of X-ray analysis to organic compounds and a bewildering array of chemical problems was suggested, in connection with which X-ray analysis might lead to useful results. A modification of Barlow and Pope's theory of crystal structure, in which a quadrivalent atom is represented by an aggregate of four unit spheres, was described, and shown to present many points of close agreement with the crystalline structure actually recorded in organic compounds.

The discussion on the electronic theory of valency which followed Mauguin's paper included perhaps a larger proportion of adverse criticism than is usually accorded to it. In particular, the lack of any adequate explanation of variable valency, and the indeterminate character of the valency equations (which do not admit of a unique mathematical solution) were the subjects of much comment.

The discussion on optical activity dealt mainly with the usefulness or otherwise of retaining the idea of the asymmetric carbon atom. It was agreed that the asymmetry of the molecule was the only thing that mattered; but expression was given to the view that the term was of value as enabling the organic chemist to recognise at once the existence of many cases of molecular asymmetry, although this might still be looked for in many cases where no asymmetric atom was present. In the discussion on rotatory dispersion the idea was expressed that liquid media which gave rise to complex dispersion-curves might be suspected of containing more than one type of optically-active molecule; in the case of coloured compounds, however, a looped curve might result from the presence of an absorption band in the region under investigation.

The discussion on chemical mobility was for the most part focussed on the radiation theory of chemical action. The lack of agreement between the predictions of the theory, and the results obtained in seeking to verify it, was emphasised. Thus, the observed temperature coefficient of the thermal dissociation of phosphine leads to the conclusion that an absorption band should appear in the violet region of the spectrum. No such band is found, and the theory has therefore been modified in a way which suggests that the active radiations may be found at lower frequencies, *e.g.* in the infra-red region of the spectrum. Actually, however, the change is very sensitive to ultra-violet radiations, and a further modification of the theory would be needed to account for this persistent deviation from the experimental facts.

Universal Wireless Telephony.

IN view of the great technical progress that has been made during the last few years in the development of the wireless telephone, and the attention that has been given by the Postmaster-General to the framing of regulations for its orderly use in this country, a considerable popularisation of wireless telephony appears imminent. It is therefore of some interest to examine briefly the facilities as well as the limitations which exist regarding its use. It is obvious that anything like secrecy in conversation over the radio-telephone, as it is now often called, is out of the question, as any one in possession of a half-guinea licence and a receiving set, which can be tuned to the wave-length employed, can "listen in" and pick up the message irrespective of the station for which it was primarily intended. On account of the publicity which thus attends the utterances of the wireless telephone, its field, except in such special cases as aeroplane work, is practically limited to the dissemination of public information, news, music, and other entertainment items, or as it is now commonly called, "broadcasting." Unless, however, these broadcasting stations are rigorously controlled, they will not only defeat their own ends by drowning each

other's messages in a confused babel of sounds, but will interfere with other forms of radio-communication, as already happens to a considerable extent in America.

The most important consideration is that of wave-length, as simultaneous messages at or near the same wave-length mutually "jam" one another, and it may be mentioned that the margin of wave-lengths within which wireless telephone apparatus can be made to "tune out" other messages is not so fine as it is with the best class of wireless telegraph receivers. In order to avoid interference with other established services, the Post Office has allotted the range of 350 to 425 metres to the broadcasting stations. In this connection it should be recalled that the greater part of ship and shore Morse communication is on a 300 to 600 metre wave, and that amateur stations are allowed a wave-length of 440 metres. The well-known Writtle station will work in future at 400 metres, and the Air Ministry wave-lengths are 900 metres for the Croydon aeroplane service and 1400 metres for long-range weather reports, etc., while most of the powerful stations use longer waves up to the 2500 metres of the Eiffel Tower. Possibility of interference will also be limited by allowing broadcasting only between the hours of 5 and 11 P.M. on week-days or any time on Sundays.

Further considerations are the locality and range of the transmitting stations. To avoid too much overlapping, one station will probably be allowed at each of the following points: London, Cardiff, Plymouth, Birmingham, Manchester, Edinburgh, Glasgow, and Aberdeen, and arrangements will be made between the licencees at these stations as to wave-lengths and times of operation within the allotted limits.

With the view of circumscribing to some extent the field of each station, its power will be limited to that corresponding to an input of 1½ kw. The actual distance over which a station can be heard, however, depends more on the receiving than on the transmitting apparatus, but with modern delicate equipment an approximate idea of the possible working range is given by taking about ½ mile for every watt input. Thus, although a simple set may only be able to hear the nearest of such a group of stations, a really sensitive set, say in London, could readily pick up all of them.

The cost of a receiving set for private use in picking up whatever programmes are to be broadcasted, varies considerably with its sensitiveness. Roughly, the minimum that need be expended will depend on the distance from the nearest public station, assuming that to be the only one the owner desires to hear. A set of this kind with a range of 25 miles or so would cost from 5*l.* to 10*l.* complete with the simple aerial that would be necessary. Actually, however, the cost of the equipment selected for any particular case will depend upon whether the apparatus is required to be used to pick up waves from longer distances as well, such as to hear the wireless concerts already being radiated from the Hague, and the time and other signals from the Eiffel Tower. In this case a detector of the thermionic valve tube type must be employed, with one or more degrees of amplification and a greater range of tuning inductances, etc., and a multicell dry battery or other source of voltage for the tubes, as well as the two-cell accumulator, which would otherwise be sufficient. A moderately sensitive apparatus of this kind, with a range of 75 miles or more, would cost about 20*l.*, and further requirements of sensitivity could easily bring the price to, say, 75*l.* Another point influencing the cost of the equipment is the class of aerial which it is convenient to use, as the more sensitive the set the smaller is the aerial with which it will work over a given distance. As a rule, the simple crystal set will require some form of outside aerial, whereas the more delicate set with amplifying valves will give surprising results with a portable aerial, inside a room, composed of a few turns of wire on a rectangular frame.

Although probably the best results are obtained with these sets by the use of headpiece telephones, loud-speaking sets, audible to a number of persons at once, can be used with all the better-class apparatus, and this feature will doubtless add greatly to the popularity of wireless telephone reception.

A number of firms are devoting themselves to the manufacture of this kind of apparatus, including, of course, such well-known establishments as the Marconi Co. The Radio Communications Corporation is also well to the fore, and, as we have already announced, special arrangements are being made at the Trafford Park Works of the Metropolitan-Vickers Electrical Co. Other firms specialising in wireless receiving apparatus suitable for these purposes include Radio Supplies, C. F. Elwell, Ltd., and the R.M. Radio Company. We hope before long to have the opportunity of publishing some particulars of the actual apparatus made by some of these firms.

Obituary.

T. SANDMEYER.[1]

TRAUGOTT SANDMEYER, well known to all chemists as the discoverer of the reactions which bear his name, was born at Wettingen in Aargau in 1854. Left an orphan by the death of his father the day after his birth, his mother had to resume her former occupation as a school teacher. His father, who was a science teacher, left a library of scientific books, the perusal of which led young Sandmeyer to interest himself in scientific apparatus, and after spending some time in an engineering workshop, entered the employment of Mr. J. F. Meier, of Zurich, a manufacturer of physical apparatus. Sandmeyer afterwards started business on his own account, and supplied apparatus to the Polytechnic institution. He became in this way connected with the staff of the institution, and in 1882 was appointed lecture-assistant to Victor Meyer.

The story is often told how Victor Meyer, in attempting to show his class what was then known as the "indophenin reaction" with coal-tar benzene, used benzene obtained by distilling calcium benzoate with lime and failed to produce the expected result. It is

[1] This account is mainly gathered from an interesting obituary notice by Dr. Fierz in the issue of the Journal of the Society of Chemical Industry for May 15.

not so well known that Sandmeyer directed the attention of the professor, who had forgotten the incident, to this remarkable difference between the two kinds of benzene, which subsequently led to the discovery of thiophene and its numerous congeners. When Prof. Meyer was transferred to Göttingen in 1885, Sandmeyer accompanied him, but very shortly returned to Zurich, where he became assistant to Prof. Hantzsch. In 1888 he joined the firm of J. R. Geigy, manufacturers of dyestuffs of Basle.

Apart from the Sandmeyer reactions and his remarkable synthesis of indigo from thiocarbanilide in 1899, Sandmeyer's discoveries are little known to chemists unconnected with the synthetic dye industry, in which his later activities lay, and where his greatest successes were achieved. He was a man of reserved habits and made few friends outside the small coterie of his collaborators and fellow-workers, but is described by one, formerly associated with him, as a colleague who was always ready to help and advise. His skill as an expert mechanician, his scrupulous care as an experimenter, and his powers of observation often led him to discoveries which others had overlooked, and the long list of new and valuable dyestuffs of which he was the author placed him in the forefront of colour chemists.

In recognition of his work the University of Heidelberg conferred upon Sandmeyer the degree of Ph.D. *honoris causa* in 1891, and in 1915, at the celebration of the 150th anniversary of the firm of J. R. Geigy Co., of which he had meantime become a director, he was made an honorary doctor of the Zurich Technical School. On his retirement in 1919 Sandmeyer left a large portion of his wealth to the pension fund of the firm with which he had been so long associated.

Prof. H. M. Howe.

Prof. Henry Marion Howe, whose death was recently announced, in his seventy-fifth year, was the doyen of American metallurgists. He was well known both here and on the Continent. He was born at Boston on March 2, 1848, the son of Dr. Samuel Gridley Howe, who was one of the earliest to assist the Greeks in their struggle for freedom. His mother, Mrs. Julia Ward Howe, was the author of the famous "Battle Hymn" of the Republic.

Prof. Howe graduated at the University of Harvard in 1869 in arts, and two years later in science at the Massachusetts Institute of Technology. He then engaged in metallurgical work in Pittsburg, Pa., and Troy, N.J., and soon became known as a keen observer and investigator. In 1880 he designed and built the works of the Orford Nickel and Copper Company at Capeltown in the province of Quebec, and at Bergenpoint, N.J. From 1883 to 1897 he resided at Boston, and set up in private practice as a consulting metallurgist and expert witness in metallurgical patent suits. With this he combined the position of lecturer on metallurgy at the Massachusetts Institute of Technology. He was an original member of the American Institute of Mining Engineering, founded in 1871, and soon contributed to its transactions. His first paper was on "Blast-furnace Economy," which was followed by "Thoughts on the Thermic Curves of Blast-furnaces" and "Nomenclature of Iron," the latter a remarkable contribution to the discussion inaugurated by A. L. Holley in his famous paper, "What is Steel?" His first book, published in 1885, dealt with copper smelting. This was followed in 1891 by "The Metallurgy of Steel," a book which did much to lay the foundations of scientific steel metallurgy, and created for him an international reputation in the subject.

In 1897 Prof. Howe was called to the chair of metallurgy at Colombia College, New York, a position which he filled for some fifteen years. On his retiring to become a consulting metallurgist, he was appointed professor emeritus. He was one of the small band of metallurgists who helped to lay the foundations of the science of metallography, and his name will always be remembered in connection with those of the late M. Osmond, Martens, H. Le Chatelier, Tschernoff, Anossov, Stead, Roberts-Austen, and Arnold. In this connection, his principal contribution is his book entitled "The Metallography of Steel and Cast-iron," a monumental work, which displays a remarkable grasp of the subject and an unusual power of weighing scientific evidence. Prof. Howe was not primarily an experimentalist, although in his later years he published several papers with the late A. G. Levy, dealing particularly with the iron-carbon equilibrium. He was, however, a prolific writer, and in all published more than 300 papers. He was vice-president of the Taylor Wharton Iron and Steel Company, and introduced the manufacture of manganese steel into the United States in 1890.

Prof. Howe was president of the American Institution of Mining Engineers, honorary vice-president of the Iron and Steel Institute, chairman of the engineering division of the National Research Council, consulting metallurgist of the U.S. Bureau of Standards, and research associate of the Carnegie Institution of Washington. Many honours came to him from various countries. In 1895 he was awarded the Bessemer Medal of the Iron and Steel Institute, later the Elliot Cresson gold medal of the Franklin Institute, a special prize and gold medal from the Société d'Encouragement pour l'Industrie Internationale, and finally, in 1917, the John Fritz gold medal, the highest honour in the gift of the engineering institutions of the United States of America. He also received several foreign orders, including the Legion of Honour and the Russian order of St. Stanislas. Prof. Howe was a frequent visitor to this country, and his genial personality will be greatly missed by metallurgists over here.

Dr. Robert Bruce-Low.

Dr. Robert Bruce-Low, the distinguished epidemiologist, died on May 11 after a brief illness. Born in Edinburgh in 1846, he was educated at the Royal High School and University of that city, and graduated in medicine in 1867. After a year spent in post-graduate study in London and Germany, he settled down as a general practitioner, first in Lincolnshire and afterwards at Helmsley in the North Riding, becoming the medical officer of health of the latter district.

This nineteen years of general practice gave him

an insight into the conditions of rural hygiene which was most useful to him in after life. So valuable did the central health authority of those days consider Bruce-Low's work in Helmsley that he was invited in 1887 to become a medical inspector of the Local Government Board, an invitation which he readily accepted. Here he came into intimate association with Buchanan, Thorne-Thorne, and Power, who, as successors to John Simon, were engaged in building up the English public health service. Bruce-Low conducted several inquiries and wrote many important reports for the Local Government Board, the best known of which are those on the progress and diffusion of plague, cholera, and yellow fever, the epidemiology of typhus fever, acute anterior poliomyelitis (1916), and smallpox (1918). Through his epidemiological studies Bruce-Low acquired an intimate knowledge of port sanitary administration, and in reply to an inquiry, furnished the Rockefeller Institute with a statement on the facts which led to the abandonment of quarantine in the United Kingdom. After holding many examinerships for the diploma of public health, he was appointed by the General Medical Council their Inspector of Examinations for degrees and diplomas in public health, work which occupied him for the greater part of the last two years of his life, and the outcome of which was a valuable report and a revised scheme of examination, now under consideration. Bruce-Low became assistant medical officer of the Local Government Board in 1900, retiring in 1911. He served on the War Office Anti-typhoid Inoculation Committee, 1904–12, and on the outbreak of war he was recalled to the Local Government Board, finally retiring in 1920.

Bruce-Low was always ready to help his colleagues, to whom he was a true friend; he was proud of being a Civil Servant, and his distinguished services to his country and to the science of preventive medicine were officially recognised in 1919, when he was appointed C.B. R. T. H.

WE notice with much regret the announcement in the *Lancet* of the death, on May 18, of Prof. Charles Louis Alfonse Laveran, Foreign Member of the Royal Society, at the age of seventy-six years.

Current Topics and Events.

THE Royal Academy of Belgium celebrated the one hundred and fiftieth anniversary of its foundation on May 23 and 24 in the presence of a large number of its members and of delegates from other academies and learned institutions. On the Wednesday afternoon, May 24, numerous congratulatory addresses were presented at the Palais des Académies, and the members and visitors were afterwards received at the Hôtel de Ville by the Mayor of Brussels, M. Adolf Max, and his Aldermen, MM. Steens, Vande Meulebrouck and Coelst; a reception was held at the Palais des Académies in the evening, where an exhibition of medals and portraits connected with the history of the Academy had been arranged. The anniversary celebration itself was held in the large hall of the Academy on the afternoon of May 25 in the presence of the King, the Minister of Arts and Science, M. Hubert, formerly Rector of the University of Liége, Cardinal Mercier, and the English, French, Dutch, Spanish, and Japanese Ambassadors. The president, M. Vauthier, in an address of welcome, briefly sketched the history of the Academy and its influence on the intellectual development of Belgium. The Minister of Justice, M. Masson, tendered the congratulations of the Belgian Government, and Monseigneur Baudrillart spoke in the name of the Institut de France. Sir William B. Leishman, as vice-president of the Royal Society, represented the British universities and learned societies; he referred to the activities of Belgian bacteriologists and paid a high tribute to the work of M. Jules Bordet. MM. Lameere, Pirenne, and Verlant, representing respectively the classes of science, of letters, and moral and political sciences, and of fine arts, contributed summaries of the activities of their several sections of the Academy. Later the visitors were received by the King and the Queen at the Palace of Laeken, and in the evening a banquet was held at the Hôtel Astoria.

THE Council of the Museums Association has addressed an emphatic protest to the Prime Minister against the proposal to reinstitute charges for admission to the National Galleries and Museums. It is only in recent years that the importance of Museums and Art Galleries as factors in the educational machinery of the country has been fully recognised, and this is due largely to the progressive action of the Government in advocating consistently the policy of free admission and in providing guides which have advanced materially the popularity and usefulness of our National Institutions. The Association feels that the proposed reversal of a policy adopted after many years' experience will be a serious set-back to Museum work, both in regard to the wider education of the nation and the provision of wholesome recreation for the people. If the proposal is adopted it is bound to have an influence on the policy of provincial Museums, the governing bodies of which are largely influenced by the example set by the State. The Association suggests that the far-reaching injury likely to follow the imposition of admission fees would greatly outweigh the small additional income, 10,000*l.*, which is expected to accrue.

THE highly controversial subject of the college-trained engineer was chosen by Prof. Frederic Bacon for his presidential address to the Swansea Engineering Association of Students of the South Wales Institute of Engineers. Prof. Bacon had a good deal to say about the conditions which the student is likely to find in works after he leaves college, and the kind of experience which he will then acquire. One of the least satisfactory features of the pre-war position was that scarcely any British firms were undertaking new development work; nearly every innovation in engineering practice was imported from the continent or the United States, a state of affairs

extremely damaging to the prestige of British engineering and very unfair to the scientifically trained engineers of this country. The war showed the capabilities of British men of science and engineers when they work hand in hand and with the necessary resources placed at their disposal. It is the duty of college-trained men to show their faith in science, and to champion her cause when it is unfairly attacked by men who are ignorant of her methods and mission. The engineer can never lose sight of utilitarian ends, but he should know enough of the spirit of science and the recent history of industry and invention to respect and encourage the work of the investigator in pure science.

THE third International Congress of the History of Medicine will be held in London on July 17 to 22 inclusive. The congress will be opened at 10.30 A.M. on July 17 by the Minister of Health at the Royal Society of Medicine, where the delegates will be received and an address will be delivered by the president, Dr. Charles Singer. In the afternoon there will be a reception and an address by Sir Norman Moore, President of Honour, at the Royal College of Physicians. In the evening the President and Mrs. Singer will receive the members of the congress at the Royal Society of Medicine, when an address will be given by Prof. Elliot Smith. The sessions of the congress will be held on the following days from 10.30 A.M. to 12.30 P.M., and from 2.30 P.M. to 4.30 P.M., at the Royal Society of Medicine. A committee of ladies has been organised to conduct ladies attending the congress to various places of interest in London. The Wellcome Historical Museum, 54A Wigmore Street, where a special exhibition will be held, will be open from 10 A.M. to 5.30 P.M. daily. Objects of interest will also be on view in the library of the Royal Society of Medicine. Arrangements have been made for visits to the Royal College of Surgeons, the Society of Apothecaries, the Barbers' Hall, St. Bartholomew's Hospital, and other places of medico-historical interest. Further information can be obtained on application to the general secretary, Dr. J. D. Rolleston, 21 Alexandra Mansions, King's Road, S.W.3.

EXCEPTIONALLY hot weather for the time of year was experienced over the south-eastern and central portions of England on the four days from May 21 to 24, and record temperatures occurred in many places. At the Royal Observatory, Greenwich, observations of the highest order are obtainable for the past 80 years, since 1841, and approximately trustworthy observations can be obtained for as far back as 1814, embracing in all a period of 109 years. In the recent hot spell the sheltered thermometer at Greenwich registered 90°·2 on May 22 and 90°·6 on May 24. The previous records for May since 1841 show only eight days with a temperature so high as 85°, the maximum being 87°·5 on May 26, 1880, followed by 87°·0 on May 19, 1868, and 86°·5 on May 25, 1920, while a temperature of 90° has occurred only seven times during June since 1841, and once only since 1897. The mean maximum shade temperature for the four consecutive hot days was 88°·8, and the mean solar radiation temperature was 148°·5, the maximum being 151° on May 23. In May 1913 there were five consecutive days with the temperature above 80°, the highest temperature being 84°·1 and the mean for the period 82°·2; this is the record for consecutive hot days and also for the number of hot days in the month, the total days being five, the same as this year, which includes May 8 last. In 1870 there were four consecutive days with the temperature above 80°, the mean for the four days being 82°·4. On three consecutive nights during the hot spell the minimum temperature was above 58°, the temperature on the warmest night being 58°·9, and the lowest temperature for four days was 57°·9. Previous records from 1841 show three instances only of warmer nights, 61°·5 on May 25, 1841, 61°·3 on May 24 and 60°·3 on May 29, 1847. The mean daily temperatures at Greenwich for the three days May 22 to 24 were 74°·5, 73°·5, and 74°·8 respectively, which is 20° above the average. The previous highest day mean in May since 1841 was 71°·3 on May 28, 1841, and going back to 1814 the highest day mean was 72°·4 on May 15, 1833. Since the extreme heat of 90°·6 at Greenwich on May 24 the day temperatures steadily decreased, reaching 73° by the end of the week. Thunder-storms accompanied by a heavy fall of hail and rain were associated with the recent hot spell.

AT the annual general meeting of the Institute of Physics held on May 23 in the rooms of the Royal Society, the following Officers and Board were elected to serve for the year beginning October 1, 1922: *President*, Sir J. J. Thomson; *Past-President*, Sir R. T. Glazebrook; *Vice-Presidents*, Sir Charles Parsons, Prof. W. Eccles, Prof. C. H. Lees, Mr. C. C. Paterson; *Non-Official Members of the Board*, Dr. R. S. Clay, Prof. C. L. Fortescue, Prof. A. Gray, Major E. O. Henrici, Sir J. E. Petavel, Dr. E. H. Rayner, Sir Napier Shaw, Mr. R. S. Whipple; *Representatives of Participating Societies*: Physical Society—Mr. C. E. Phillips, Mr. F. E. Smith; Faraday Society—Mr. W. R. Cooper; Optical Society—Mr. John Guild; Röntgen Society—Dr. G. W. C. Kaye; Royal Microscopical Society—Mr. J. E. Barnard. The Annual Report stated that there were 408 Members of the Institute at the end of the year, of whom 258 were Fellows. The Institute is watching the possibility of establishing a central library for physics, although the financial difficulties in the way of its realisation are stated to be considerable. In the course of his presidential Address, Sir J. J. Thomson, after dealing with the project to establish a Journal of Scientific Instruments, spoke of the present depression in industry, but he made the reassuring statement that out of 67 students who graduated with distinction in physics and chemistry in 1921, 46 had obtained suitable positions, while 14 were doing research work. He hoped that the series of lectures on physics in industry which had been established would act to some extent as "Refresher Courses." Speaking of the difficulties which

the Safeguarding of Industries Act had, in many instances, placed in the way of research, he characterised research itself as a "Key Industry," and he hoped that the Government would put every facility in the way of research workers to enable them to obtain without delay the apparatus they required.

THE idea of establishing an International Hydrographic Bureau was suggested some years before the war, and the project took definite shape when the Admiralty called an International Hydrographic Conference in London in July 1919. Twenty-four of the maritime states of the world were represented and steps were taken to establish a permanent bureau. A committee was appointed which, after nearly two years' work, devised an organisation that proved acceptable to the states represented. Captain Spicer-Simson, the secretary-general, gives some details regarding the Bureau in the *Geographical Journal* for April. The aim is to establish close and permanent association between the hydrographic services of various states, to co-ordinate their efforts with the view of rendering navigation easier and safer, and, so far as possible, to obtain uniformity in hydrographic documents. The Bureau is consultative only and has no authority over national hydrographic offices, which remain entirely independent. It will have a collection of all charts and works published by the various hydrographic and other offices, and will collect papers bearing on hydrography and navigation. An important duty of the Bureau will be the collection and distribution of information on the subject of hydrographic surveys and other publications which are being prepared in the various national offices, and it will also undertake the organisation of an International Hydrographic Conference, if possible, every five years. The Bureau is directed by a board, of which the present members are: Vice-Admiral Sir J. Parry, president; Rear-Admiral J. M. Phaff (Netherlands); Captain S. H. Müller (Norway), and Captain G. Spicer-Simson (Great Britain). The address of the Bureau is, 3 rue du Port, Monaco.

THE British Non-Ferrous Metals Research Association has just issued, in its Quarterly Bulletin, a Union List of periodicals of interest for reference on industrial metallurgy. The service provided by 14 libraries in London, Birmingham, and Manchester is clearly indicated, so far as concerns the 118 periodicals which have been selected. Since one of the main functions of the Industrial Research Associations is to serve as distributing centres for scientific and technical information to their members, such a key-index should prove of great value and will doubtless be followed by other bodies for their own special subjects. It may also be taken as an indication of the interest that is likely to be taken in the proposed World List of Scientific Periodicals of the Conjoint Board of Scientific Societies.

MR. HARRY ALLCOCK, in a pamphlet entitled "The Power of the Penny," advocates a system of decimal coinage of which the shilling would be the unit, divided into ten pennies of a new series, each of which would be worth $1\frac{1}{5}$ of the existing penny; in other words, an existing sixpence would represent five of the new pennies. His view is that the present time is specially favourable for a reform of this kind, which would contribute to the reduction of postal and other charges, which have been raised from 1d. to $1\frac{1}{2}$d., to a penny of the new issue. One thing is obvious, that the currency is at present in an unsatisfactory condition requiring the careful consideration of experts, and the possibility of adopting a decimal system might well form part of such an inquiry. Mr. Allcock has not dealt with the question of fractions of a penny. Each of his new pennies would have to be divided into ten smaller coins, representing $\frac{3}{5}$ of the existing penny in value: in other words, the old-fashioned halfpenny would have to give place to a new coin of higher value.

THAT well-known optical toy, the kaleidoscope, is occasionally used to illustrate the principles of reflection and to study symmetrical patterns. A simple modification has appeared under the name of a "patternscope" in which two metallic reflectors and a glass window form the three sides of a hollow triangular prism about 3 in. long and closed at both ends. A number of small curvilinear pieces of celluloid and glass of different shapes and colours are enclosed, which together with their reflections form an endless variety of beautiful patterns which can be seen through the window more comfortably than is possible through the eyepiece of the kaleidoscope, and also can be seen by more than one person at one time. Either end of the prism may be used as the base, each having a different coloured design on the inside and so adding to the number of patterns obtainable. The instruments are sold by Messrs. "Patternscopes," 85 Duckett Road, Harringay, London, N.4.

DR. L. SILBERSTEIN, mathematical physicist of the Research Laboratory, Eastman Kodak Company, has been appointed an associate editor of the Journal of the Optical Society of America.

SIR WILLIAM PHIPSON BEALE, who died on April 13 last, bequeathes, on the death of his wife, sums of 5000*l.* and 200*l.* to the Royal Institution of Great Britain and the Mineralogical Society respectively.

DR. GORDON HOLMES will deliver the Croonian Lectures of the Royal College of Physicians of London, on Tuesdays and Thursdays, June 8, 13, 15, 20, at 5 o'clock, at the College, Pall Mall East. His subject will be: "The Symptoms of Cerebellar Disease and their Interpretation."

AT the anniversary meeting of the Royal Geographical Society held on May 29, the following officers were elected: *President*: Lord Ronaldshay; *Vice-presidents*: Sir Francis Younghusband, Col. Sir Charles Close, Dr. D. W. Freshfield, Lord Edward Gleichen, Sir T. H. Holdich, and Sir J. Scott Keltie;

Treasurer: Mr. E. L. Somers Cocks; *Trustees*: Lord Curzon of Kedleston and Mr. H. Yates Thompson; *Hon. Secretaries*: Dr. A. P. Maudslay and Lieut.-Col. E. M. Jack; *Foreign Secretary*: Sir Maurice de Bunsen; *Members of Council*: Mr. Henry Balfour, Prof. R. Beazley, Sir Sidney Burrard, Mr. Oliver Bury, Lord Chelmsford, Prof. J. Norman Collie, Sir W. Martin Conway, Sir C. L. Des Graz, Sir Henry Galway, Sir Sidney Harmer, Dr. D. G. Hogarth, Col. C. K. Howard Bury, Admiral Sir Edward Inglefield, Mr. P. Lake, Sir Henry McMahon, Prof. J. L. Myres, Capt. C. W. R. Royds, Major-Gen. Sir Frederick Sykes, Brig.-Gen. Sir Percy Sykes, Dr. A. F. R. Wollaston, and Mr. J. M. Wordie.

MESSRS. DULAU AND CO., LTD., 34 Margaret Street, W.1, have just issued a catalogue (No. 93) of second-hand books in zoology offered for sale by them. Upwards of 3000 works are listed under the following headings: entomology and Arachnida; conchology and Mollusca; minor classes; general zoology; Mammalia, fishes, reptiles, etc.; ornithology and oology.

MESSRS. BERNARD QUARITCH, LTD. (11 Grafton Street, W.1) have just issued a catalogue (No. 370) of important and rare second-hand books on natural history. Upwards of 2000 titles are listed under "General Works" and eleven classified divisions. Mr. F. Edwards (83 High Street, Marylebone, W.1) has just circulated Catalogue No. 431, which is largely devoted to publications of learned and scientific societies, and to works on the topography of the English counties.

Our Astronomical Column.

LARGE FIREBALL.—On May 21, at 12.32 G.M.T., a large meteor was observed by the well-known variable star observer, M. Felix de Roy, at Antwerp, Belgium. The object moved slowly among the stars of Leo, and left a tail of sparks like a rocket. Its path was from 169° +9° to 155° +18°. The same meteor was observed by Mr. J. P. M. Prentice, at Stowmarket, and he recorded the path from 203° +1½° to 179° +15½°. The duration was estimated at six seconds. Comparing the two observations the radiant point is indicated at 280° −33° in Sagittarius. The height of the object was from about 60 to 57 miles and the velocity 15 miles per second. The meteor passed over the region from the south-west of Surrey to south of Warwick.

It is possible that the object radiated from Scorpio at 250° −27°, and that its height was 60 to 42 miles, but the observations are not quite conclusive, and more data are required.

COMETS.—There is great difference of opinion as to the magnitude of Skjellerup's comet; Dr. Steavenson makes it mag. 9; other observers, mag. 12. The following approximate orbit has been deduced from observations at Heidelberg, Yerkes Obs., and Milan, on May 20, 21, 22.

T 1922, May 19, 22 G.M.T.
ω 1° 15′ 55″
Ω 207 56 17
i 21 19 4
log q 9·94569

EPHEMERIS FOR GREENWICH MIGNIGHT.

	R.A. h. m. s.	N. Decl.	log r.	log Δ.
June 2	9 38 28	36° 34′	9·9638	9·5856
6	10 18 28	40 58	9·9747	9·5680
10	11 4 53	44 39	9·9871	9·5592
14	11 57 13	47 5	0·0011	9·5600
18	12 51 8	48 2	0·0161	9·5695

The comet should be looked for as soon as the sky is dark; its path lies through Lynx (near Alpha on May 30), Leo Minor, and Ursa Major (near Mu on June 6, near Psi on June 10). Mr. G. Merton points out that the orbit closely resembles that of comet 1830 I; identity does not seem to be possible, but the two comets are probably portions of a primitive single comet.

The Annals of Tokyo Observatory, Tom. v., fasc. 5, contains an investigation of the perturbations of Wolf's periodic comet from 1884 to 1918, by M. Kamensky, Director of Vladivostock Naval Obs., who has revised the work of M. Thraen, finding several small corrections, which produce a marked improvement in the comparison with observation. Definitive elements are given for each return, the perturbations by all planets except Mercury, Uranus, and Neptune having been computed. M. Kamensky notes that there will be a close approach of the comet to Jupiter at the end of 1922; "it will experience such large perturbations that it is doubtful whether its seventh return to the sun—provided that it takes place—will be capable of being connected with the six preceding ones by a common system of elements." It is interesting to note that Brooks's periodic comet (1889 V) also makes a close approach to Jupiter this year, about the middle of June.

Lick Observatory Bull. No. 334 contains an investigation by H. M. Jeffers of the orbits of the two components of Taylor's comet, 1916 I, which was discovered at Capetown on November 24, 1915, as a small nebulosity 20″ in diameter, with an eccentric nucleus. On February 9, Barnard found the comet to be double, the two components being 10″ apart; the northern component was at first fainter, but afterwards became the brighter, and remained visible for two months after the southern one had disappeared; the following are the definitive elements found for the two components; perturbations by Venus, Earth, Mars, Jupiter, Saturn have been applied. They are for the equinox of 1916·0.

Epoch and Osc.	Northern Component. 1916, Jan. 21, 0 G.M.T.	Southern Component. 1916, Jan. 21, 0 G.M.T.
M	−1° 32′ 6″·4	−1° 32′ 4″·9
ω	354 47 57·7	354 47 21·8
Ω	113 54 10·2	113 54 25·1
i	15 31 40·6	15 31 27·8
ϕ	33 7 29·6	33 6 36·6
μ	557″·274	557″·695
log a	0·535959	0·535740

The linear distance between the components was least at perihelion, when it was 0·000047 astr. unit. Four months later it was 0·000168. It is noted that in the case of Biela's comet the distance was a maximum at perihelion. The elements show some resemblance to those of Daniel's comet of 1909, but identity is not possible. Taylor's comet is due at perihelion about June 13, 1922, but the conditions are unfavourable for observation; it may, however, be detected in the autumn.

The splitting of Taylor's comet does not appear to have been caused by Jupiter; the nearest approach in the revolution preceding 1916 was 1·1 unit, which is scarcely close enough to explain disruption.

Research Items.

KNOTS IN ANCIENT EGYPT.—Miss M. A. Murray contributes to *Ancient Egypt* (Part I., 1922) an interesting article on the representations of various kinds of knots on early Egyptian monuments. It is a remarkable fact that in the early dynasties knots were never represented, but in the Middle Empire, though the same prejudice still existed, there was a movement towards an accurate presentation of the knot, showing that there was a change, and that the old ideas were beginning to pass away. Miss Murray does not propose an explanation of this curious taboo of the knot on the ancient monuments. It may be suggested that it was based upon the use of knots in magic. Among many races, knots, real or symbolical, are used as a magical means of obstructing some special action. Thus the use of knots at marriage is often disapproved. However this may be, the paper, with good illustrations of various forms of knots and their uses, is of considerable interest.

THE PILTDOWN SKULL.—An important contribution to the controversy over the Piltdown Skull was made by Profs. Elliot Smith and Hunter at a meeting of the Anatomical Society held on May 12, when they exhibited a reconstruction of the skull and its endocranial cast. The reconstruction has been made by a careful and minute examination and correlation of the anatomical points of the fragments of the skull. The result confirms generally the reconstructions made by Dr. Smith Woodward and Mr. Pycraft when first the skull was discovered, and agrees in showing the remarkable breadth of the skull and its low capacity, which is, in each case, placed below 1300 c.c. This later reconstruction, however, differs in one important particular. The occipital fragment assumes a more vertical position, with the effect that the skull is brought into closer relation with the skull of the anthropoids. As a result, the cranium falls into complete harmony with the chimpanzee-like jaw, and the paradox which has hitherto been a stumbling-block to the acceptance of the jaw as indubitably belonging to the fragments of the cranium now disappears.

SAND- AND MUD-BINDING PLANTS.—An interesting exhibit is made in Museum IV., at Kew, of plants used for binding sand and mud. Erosion of bare sand dunes and mud flats by wind and tide is so serious in some coastal regions that the services of engineers and forest officers are constantly engaged upon protective work. Violent winds disturb large quantities of sand, the contour of dunes is constantly changing, and sand encroaches upon cultivated land or is piled in positions that interfere with the domestic and business life of the people. Bare mud flats also undergo constant change by tidal action, and adjacent agricultural land is imperilled. Protective work takes the form of barriers to check scour, and the insertion of such plants as are capable of binding sand or mud. After sand dunes have been fixed by low, dense grasses, other plants soon appear, and the forester assists by planting pine trees, thereby changing desert areas into pleasant places of residence. Mud flats that become overgrown with coarse grasses collect debris and, rising gradually above high-water mark, are turned into rich pasturage. The most satisfactory sand binder is "Marram Grass" (*Ammophila arundinacea*) (Kew Bulletin, No. 9, 1913, pp. 363-366, "Marram Grass for Paper-making"), and the best grasses for binding mud flats are species of Spartina. Articles on Spartina in connection with coast erosion appeared in the same journal (No. 5, 1907, pp. 190-197, and No. 1, 1918, pp. 26-31).

ADDITIONS TO THE INSECT FAUNA OF BRITAIN.—Recent issues of the *Entomologist's Monthly Magazine* contain records of several interesting and, in some cases, important additions to the insect fauna of Britain. In the March number, Mr. K. G. Blair mentions the occurrence of the beetle *Carpophilus ligneus*, Murray, in several widely separated localities, ranging from the Isle of Wight northwards to Liverpool. In each case it was discovered associated with merchandise. The species was originally described from Mexico, and has also occurred in Central America, but does not appear to have been noticed hitherto in Europe as a possible pest of commerce, although its congener, *C. hemipterus*, L., is an almost cosmopolitan species affecting dried fruits and other provisions. In the April issue, Mr. H. St. J. Donisthorpe records the beetle *Nebria iberica*, Oliv., which appears to have been confused hitherto with the very common *N. brevicollis*. Dr. G. Enderlein publishes in the May number of that same journal the description of a new genus and species of scaly-winged Psocids, specimens of which came from Crowborough, Sussex (F. J. H. Jenkinson). The insect, which he designates as *Pteroxanium squamosum*, belongs to a sub-family previously known only from New Guinea and Ceylon; the occurrence of a representative in Europe is therefore very remarkable and suggests the possibility that it is not indigenous but has been imported by some means or other. In the same issue Mr. F. W. Edwards describes a new genus and species of gall midge from North Sussex, the early stages of which are passed among bark-encrusting fungi, upon which blister-like swellings are caused. It appears to be the first record of an Cecidomyiid fly producing a fungus gall. Prof. F. V. Theobald, in *Bulletin of Entomological Research*, Feb. 1922, describes a new genus and species of aphid, *Laingia psammæ*, from marram grass and meadow foxtail in Kent. It was preyed upon by numerous ladybirds, particularly the common two-spotted species.

INCREASING THE SENSITIVENESS OF PHOTOGRAPHIC PLATES.—M. Clerc, in his "Paris Notes" in the *British Journal of Photography*, May 19, refers to M. F. Monpillard's success in 1912 in increasing the sensitiveness of autochrome plates about 30 times. The process was also applicable to ordinary plates, increasing their colour sensitiveness as well as their ordinary sensitiveness. The defect of the method was that the treated plates would not keep in usable condition for more than a day at the very longest. Hoping to overcome this difficulty M. Monpillard did not publish the details of his method, but deposited a sealed packet with the French Photographic Society. As he is unable to continue the work, he has now desired the Society to open the packet and disclose the information given therein. The process consisted in adding a small quantity of silver chloride dissolved in dilute ammonia to the mixture of the usual isocyanine and carbocyanine dyes (pinaverdol, pinacyanol, etc.). As soon as the sensitising bath has been used, the liquid that adheres to the plate must be quickly removed with a whirler, and the plate then dried by a rapid current of air.

International Astronomical Union.

THE meeting of the International Astronomical Union at Rome on May 2-10 must be considered an unqualified success. The unique interest of the selected meeting-place was doubtless a useful auxiliary in drawing together so large a number of delegates; upwards of 100 were present, representing England, France, Italy, Spain, Holland, Belgium, Denmark, Norway, Sweden, Poland, Egypt, S. Africa, Australia, New Zealand, Canada, United States, Japan, etc.

The inaugural meeting of the Union at Brussels in July 1919 was mainly occupied with questions of procedure; the way was thereby cleared for more purely astronomical discussions on the present occasion. The main aim underlying these was the co-ordination of various branches of observation and computation, so as to obtain as large an output as possible without waste of energy through unnecessary duplication; there was also consideration of methods of observation and reduction, and of the unification of notation. Much of the credit of the success obtained is due to the presidents of the various committees, who had drawn up careful and thorough programmes, after correspondence with their members; these served as a basis for discussion, and were in most cases endorsed with small changes.

The opening meeting was held in the Campidoglio in the presence of the King of Italy; it was addressed by the Mayor of Rome, the Minister of Public Instruction, the president of the organising committee (Prof. Volterra) and by the presidents of the astronomical and geophysical unions (MM. Baillaud and Lallemand). The subsequent meetings were in the beautiful rooms of the Reale Accademia dei Lincei, Palazzo Corsini. The Union met in full conference at the beginning and end of the meeting; the more important discussions were carried on in separate committees, the conclusions of which were reported to the final meeting of the Union.

A summary of the more important conclusions may be of interest. In the matter of notation the Harvard system of spectra was considerably amplified; the prefixes *c*, *g*, *d* are used to denote super-giants, giants, and dwarfs; *e* to denote the presence of emission lines; *p*, *q* to denote peculiarities tending in the direction of Nova spectra; *s*, *n* denote that the spectral lines are sharp and diffused respectively (*n* was used by Rowland to denote nebulous lines in the solar spectrum); *r* denotes reversal, *i.e.* bright lines with a dark centre; *k* denotes stationary calcium lines.

It is proposed to use Mo, M3, M8 instead of M*a*, M*b*, M*c*, and to drop M*d*, it being suspected that the underlying spectrum in the latter case is not of M type; similarly No and N3 replace N*a* and N*b*. S is used for a new type of red stars, to which R Cygni and R Andromedae belong; Q is used as before for Nova spectra; they are subdivided by the suffices, *a*, *b*, *c*, *u*, *x*, *y*, *z*, in which the absorption spectrum grows progressively weaker, and the bright-line spectrum stronger; in general a star traverses these types in the above order in the weeks or months succeeding the outburst.

Another point of notation decided was that the constellations should be given their Latin names, which has been done in England but not in France. As regards the Carte du Ciel, special votes of thanks were passed to Cardinal Maffi and to the Nizam of Hyderabad for their great assistance in carrying out the astrographic work at the Vatican Observatory and at Hyderabad. Representations were sent to the respective governments concerned, urging the completion of the work of photography and of printing at the observatories of Catania, Melbourne, and Sydney. The progress of work at the other observatories is good or hopeful, though it was much retarded by the war. Prof. Turner reported that the maps of the lunar surface had been completed, and the list of crater-names prepared, but not yet inserted on the maps. M. Lecointe announced that the Uccle Observatory would not continue the distribution of astronomical telegrams after the end of 1922. The offer of M. Strömgren to send them from Copenhagen (as he did for some years after the outbreak of war) was accepted.

The variable star committee met under the chairmanship of Prof. H. Shapley; it is in this section, above all, that co-ordination of work is imperative. It was decided to print several appendices, giving bibliographies of variables, lists of those needing observation, and determining centres of publication for various classes of stars; the Cracow Observatory undertook the preparation of ephemerides of eclipsing variables; attention was also directed to the useful reprints of Father Hagen's charts of the fields of several variables. Regarding the nomenclature of Novae, it was recommended to use the constellation name followed by the year of discovery; the method of giving numbers 1, 2, 3, etc., to the Novae in each constellation leaves a doubt as to which early observations to include; their status as Novae is sometimes doubtful.

It was decided to continue to give the grants in aid of the distribution of wireless time-signals, at least for the next three years. Prof. Sampson, the president of the committee, spoke in support of the great value of these signals both for longitude determinations and for checking the time determinations at different observatories; he discussed these recently, finding that each observatory had frequently a large discordance that remained nearly constant for some time. These discordances were the subject of an interesting debate between the astronomers and geodesists; the latter stated that they did not find these discordances in their field work, and ascribed them to irregularities of refraction due to the walls surrounding the observing room.

The committee on calendar reform reported in favour of continuing the Gregorian calendar, and of omitting one day in each year (two in leap-years) from the weekly reckoning; however, the latter point was not adopted by the general meeting of the Union.

The committee on stellar parallaxes expressed the hope that workers would photograph each parallax field at ten years' interval, in order to determine the proper motions in each element of the comparison stars.

Great praise is due to the Italian astronomers for their excellent arrangements for the meeting, and the help they afforded to the visitors; mention may be made in particular of Prof. Abetti, who showed great skill as an interpreter.

The next meeting was fixed for 1925 (probably in August) at Cambridge, with Prof. W. W. Campbell as president. The Geodetic and Geophysical Union will meet in Madrid in 1924.

The members of the Astronomical Union were received in audience by the Pope on May 10, being individually introduced to him by Prof. Pio Emanuelli, secretary of the Vatican Observatory. The Pope briefly addressed them, expressing the hope that the meeting of so many nations for a common object would tend to the pacification of the world, and that their studies of the marvellous structure of the heavens would lead to increased knowledge of and reverence towards the Creator.

A. C. D. CROMMELIN.

British Science Guild.

MUCH success attended the annual dinner of the British Science Guild, which was held at the Prince's Restaurant, Piccadilly, on May 23, with the president of the Guild, Lord Montagu of Beaulieu, in the chair. After the loyal toasts had been given by him, Sir Arthur Mayo-Robson, in proposing "The British Science Guild," said he was sure that there is a wider and deeper interest among the public in regard to recent scientific work, and this interest would be far greater if only scientific discoverers would put their discoveries into works that were more accessible to the public. In nearly all cases technicalities could be very much modified in description, and it would be a great advantage if some of the wonderful discoveries could be put in plain language. Thinking people of various parts of the Empire are just as anxious to learn of these matters because they see much of the application of science. The Guild would be doing very valuable work if it could establish centres in those distant places. The toast was supported by Commdr. L. C. Bernacchi, who spoke of the appeal which will shortly be launched with the object of raising funds to enable the Guild to carry out its legitimate and laudable aims, the encouragement of research and the application of scientific method to all public affairs.

Lieut.-General Sir Alfred Keogh, proposing "Science and Industry," said it had been the custom to rail at industries as having no appreciation of science, or modern discovery, and of being slow to adapt themselves to new developments. However true this may have been in the past, there is no truth in it now. The leaders of industry are fully alive to the importance of science, and that is due partly to the wonderful work of the Department of Scientific and Industrial Research and the Research Associations which had been formed in connection with the great trades.

Sir Edward Boyle, replying, said that we were faced to-day as never before by political, social, industrial, economic, and ethical questions. We can face them with hopes of success only in the spirit in which men of science have fought disease; that is, if we face them logically, by investigation, by experiment, impartially, thoroughly, accurately; in a word, if we face them scientifically. Prof. Huxley, who was fighting the battles of the Guild thirty and forty years ago, said that science was nothing more than organised common-sense.

The president gave the toast of "The Guests," and referred to the way in which science was solving modern problems. In one direction with which he was associated, the making of roads, we had only just begun to apply the teachings of science. The chemist is just as necessary to-day for making roads, for example, in deciding the proper mixture of bitumen and sand to make the surface or carpet of the road, as he is for making dies, explosives, or medicines. The toast was acknowledged by Principal Ernest Barker, Mr. H. G. Wells, and Mr. F. W. Sanderson.

Mr. H. G. Wells, who was called upon unexpectedly, said that science was to him a thing so great, so all-important, so entirely such salvation as man had before him, that it was with a feeling of irreverence that he found himself talking about it in an unprepared fashion. By science is meant a process of human intellectual energy which is exhaustively and reverently criticised, leading, it is hoped, to action exhaustively criticised before it is exhaustively planned. In that he expressed the whole of his faith, the whole of his belief in human life. An uncharitable person might entertain the view that the Guild had some idea of monopolising science or claiming science for the purposes of the British Empire, but there was something bigger in their minds than that. Science is a great thing which is going to carry human affairs above those levels, and when we think of science and of the Guild, it means that we of the British community hope to contribute our share to the bigger human process, and to play our part to the best of our ability, with no national and imperial aggressiveness, in the huge task of humanity which is involved in the scientific process.

University and Educational Intelligence.

CAMBRIDGE.—Dr. Searle, Peterhouse, has been reappointed University Lecturer in Experimental Physics, Mr. S. Lees, St. John's College, University Lecturer in Thermodynamics, and Mr. F. Lavington, Emmanuel College, Girdlers' University Lecturer in Economics.

The Botanic Garden Syndicate invite the attention of the University to the very critical financial position of the garden. They have received generous gifts to help in restoring the garden to its pre-war efficiency, but unless the income of the garden can be considerably increased drastic steps will have to be taken which must involve a diminution in its educational value.

It is proposed that a site of seven acres belonging to King's and Clare Colleges and lying between West Road and Burrell's Walk should be purchased for the erection in due course of a new library, the present library not being large enough to meet its growing requirements.

LONDON.—The Senate has made the following appointments:—Dr. R. W. Chambers to the Quain Chair of English language and literature, tenable at University College, in succession to Dr. W. P. Ker, resigned.

At the meeting of the Senate on May 24, Dr. R. M. Walmsley took his seat for the first time since his election as Chairman of Convocation in succession to Sir Edward Busk. In this connection a resolution was adopted in the following terms: "That on the occasion of Sir Edward Busk's retirement from the Chairmanship of Convocation the Senate desire to place on record their cordial appreciation of the services which he has rendered to the University during the past thirty years."

Mr. N. B. Jopson has been appointed to the University Readership in Comparative Slavonic Philology, tenable at King's College, and Mr. R. B. Forrester, to the Sir Ernest Cassel Lectureship in Commerce, tenable at the London School of Economics.

A course of four lectures on "Phänomenologische Methode und phänomenologische Philosophie" will be given in German by Prof. Edmund Husserl, professor of philosophy in the University of Freiburg, at University College, on June 6, 8, 9, and 12 at 5.30 P.M. At the Imperial College of Science and Technology (South Kensington, S.W.) Dr. A. F. Holleman, professor of organic chemistry in the University of Amsterdam, will lecture in English on recent investigations on the substitution in the benzene nucleus, on Wednesday, June 7, at 5.15 P.M.

The following lectures will be given by professors of Dutch Universities at the Royal Society of Medicine (1 Wimpole Street, W.1): On Monday, June 12, "Injurious Agents and Growths," by Dr. M. Jansen (of Leiden) at 5 o'clock. On Wednesday, June 21, "The Pathology of Hæmoglobin," by Prof. Dr. A. A. Hijmans van den Bergh (of Utrecht).

Both lectures will be delivered in English. Admission to all the above lectures is free without ticket.

APPLICATIONS for a Mackinnon Research Studentship of the annual value of 300*l.* will be received by the Secretaries of the Royal Society until June 19. The studentship, which is awarded in the first instance for two years with a possible extension, is for the furtherance of natural and physical science, and for original research and investigation in pathology. Particulars and forms of application can be obtained from the Assistant Secretary of the Royal Society, Burlington House, W.1.

APPLICATIONS are invited by the Ministry of Agriculture and Fisheries for a number of research scholarships in agricultural science, each of the annual value of 200*l.* and tenable for three years. Candidates must be honours graduates of a British University with special qualifications in chemistry, botany, zoology, physiology, or economics. The object of the scholarships is to train agricultural research workers, and the work undertaken must be approved by the Ministry. Scholars may be required to spend a part of their time at an approved foreign laboratory or university. Conditions of the award and copies of the form upon which applications must be made are obtainable from the Secretary of the Ministry of Agriculture and Fisheries, Whitehall Place, S.W.1. Nominations for scholarships, which must be signed by a professor or lecturer of a university or college, must be received by July 15.

THE *Chemiker Zeitung* of May 11 reports that Prof. K. Freudenberg is to succeed Prof. Pfeiffer at the Technische Hochschule, Karlsruhe.

IT is announced in *Science* that Miss Kate C. Garrick, daughter of the late Sir James Francis Garrick, for ten years agent-general in London for Queensland, has by her will bequeathed 10,000*l.* to the University of Queensland to found a James Francis Garrick professorship of either law or medicine, as may seem best to the University, in memory of her father.

ON Saturday, May 6, the undergraduates of Aberdeen University concluded a week's "Carnival" on behalf of the local hospitals with a sand-castle competition on the beach and a pageant in the Mitchell Hall. There were 20,000 spectators at the building of the sand castles. More than 3000*l.* was collected in the city and surrounding towns to which artistes were dispatched in the early days of the week.

FURTHER Research Studentships, about four in number, are being offered to university graduates by the Empire Cotton Growing Corporation and the British Cotton Industry Research Association. The studentships are each of the value of 250*l.*, with certain additional allowances, tenable for one year with a possible renewal for a second year. They are intended to provide opportunities for further training in scientific research bearing on plant genetics and physiology, entomology, physics, etc., or in special subjects relating to administration and inspection in tropical agriculture. One studentship is offered for a candidate having special interest in bacteriology. Further particulars and forms of application are obtainable from the Secretary of the Empire Cotton Growing Corporation, Millbank House, Millbank, S.W.1, not later than June 19.

WE learn from *Chemiker Zeitung* of April 22 that Prof. A. Gutbier, Rector of the Technische Hochschule, Stuttgart, has succeeded Ludwig Knorr as professor of chemistry at the University of Jena.

Calendar of Industrial Pioneers.

June 3, 1803. William Reynolds died.—The son of a successful ironmaster at Ketley, Staffordshire, Reynolds invented a method of raising boats from one level to another by inclined planes, with Telford constructed a cast-iron aqueduct at Longden, Shropshire, and in 1799 patented a method of preparing iron for conversion into steel by the use of manganese.

June 3, 1899. John Nixon died.—The pioneer of the steam-coal trade of South Wales, Nixon was born in Durham in 1815 and was trained there as a mining engineer. In 1839 he removed to South Wales and then to France. His observations on the steaming qualities of Welsh coal led to his shipping a cargo to Nantes, and to a contract for the supply of coal to the French Navy, steps which led to the foundation of the great trade in this coal.

June 4, 1907. Sir Charles Mark Palmer died.—The founder of the great shipbuilding and iron-works at Jarrow, Palmer, who was born in South Shields in 1822, was the son of a shipowner. He early became partner in a colliery business, and in 1851 built the first iron steam-collier for carrying coals from Newcastle to London. During the next forty years no fewer than 600 vessels were built at Jarrow.

June 4, 1906. Francis William Webb died.—A prominent locomotive engineer, Webb was an assistant first to Francis Trevithick and then to John Ramsbottom of the London and North-Western Railway, and in 1871 succeeded the latter as chief mechanical engineer, a post he held till 1903. He was a pioneer of the compound locomotive, and in 1881 with the *Experiment* introduced three-cylinder compound engines, and in 1897 with the *Black Prince* introduced the four-cylinder compound engine.

June 6, 1878. Robert Stirling died.—Stirling, who was born in 1790, was for 53 years minister of the parish church of Galston, Ayrshire. Ordained in 1816, the same year he took out his patent for an engine which produced motive power by means of heated air.

June 7, 1884. Richard March Hoe died.—The well-known New York firm of printing-machine makers, Messrs. R. Hoe and Co., was founded by Robert Hoe, an inventor who was born in England in 1784, emigrated to America in 1803, and died in 1833. His son, Richard March Hoe, born in 1812, was the inventor of the high-speed printing press. He devised the means of holding the type on the cylinder, and built machines having ten cylinders and capable of printing 20,000 newspapers per hour. These machines were used in London in 1858. Many improvements were added by Richard Hoe and by his nephew Robert Hoe (1839–1909), who became head of the firm, and it has been said that "to think of 166,000 sixteen-page newspapers printed in an hour, all folded ready for delivery, a feat made possible by the combination of distinct machines, is to think of the name of Hoe."

June 8, 1882. John Scott Russell died.—One of the most eminent naval architects of last century, Russell was born in Glasgow, May 8, 1808. An original investigator, he made experiments on the resistance of water to the motion of floating bodies, discovered the wave of translation, and developed the wave-line system of construction of ships. Removing to London he became secretary to the Society of Arts, and a commissioner of the Great Exhibition of 1851, and established shipbuilding works at Millwall, where Brunel's *Great Eastern* was built. This remarkable vessel, begun in 1854 and completed in 1859, was 680 feet long, 82 feet beam, and of 27,384 tons displacement.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, May 18.—Sir Charles Sherrington, president, in the chair.—T. B. **Wood** and J. W. **Capstick**: The progress of metabolism after food in swine. Using a calorimeter recording electrically the main loss of heat, the resting metabolism of a hog has been recorded at intervals after feeding, varying from a few hours to six days. The excess of the resting metabolism above the basal, at any moment, is independent of temperature, weight, and age of animal. This excess falls off according to the equation $\log y + At = C$, y being the excess, t time since meal, and A and C constants. This equation is identical with Guldberg and Waage's Law of Mass Action, that the rate of decomposition of a substance at any time depends on amount remaining undecomposed. Analysis shows that the excess depends on the pressure in the body of substances resulting from digestion and affecting the rate of metabolism, which are themselves metabolised according to the mass-action law.—J. A. **Gardner** and F. W. **Fox**: The origin and destiny of cholesterol in the animal organism. Pt. XIII.—On the autolysis of liver and spleen. The autolysis of pulped spleen and liver, during periods varying from one day to a month, shows that the cholesterol content remains constant, within the limit of experimental error, and the addition of pure cholalic acid has no effect. Autolytic experiments afford no evidence that these organs are concerned with the synthesis or destruction of cholesterol in the organism.—C. G. **Lamb**: The geometry of insect pairing. Cases of asymmetrical hypopygium found in certain dipterous families, and in other insects would necessarily result if the usual vertical position of pairing was adopted subsequent to a primitive linear position.—G. E. **Briggs**: Experimental researches on vegetable assimilation and respiration. Pt. XV.—The development of photosynthetic activity during germination of different types of seeds. The seedling leaves of Helianthus showed practically full activity immediately after germination, both when light and when temperature were limiting. Other plants showed practically none. In the type showing the lag between germination and development of photosynthetic activity, the seedling possesses a specialised photosynthetic organ separate from the storage organ, while in the other type the same organ serves the dual purpose. Pt. XVI.—The characteristics of subnormal photosynthetic activity resulting from deficiency of nutrient salts. *Phaseolus vulgaris* was grown in a complete culture solution, and in culture solutions devoid of potassium, magnesium, iron, and phosphorus, respectively. The assimilation of leaves from the plants was measured by determining their output of oxygen. Two types of determinations were made: in one the intensity of illumination was so small that light was limiting; in the other, the intensity was increased until assimilation was limited by temperature. Plants grown in normal solution showed greater photosynthetic activity, and in the others the depression was the same when light was limiting as when temperature was limiting. Probably the factor inside the plant involved is the amount of "re-active chloroplast surface." Therefore activity should be sub-normal when carbon dioxide is limiting, a condition for which some evidence exists.

Geological Society, May 10.—Prof. A. C. Seward, president, in the chair.—E. **Garwood** and Miss E. **Goodyear**: The lower Carboniferous succession in the Settle District and along the line of the Craven Faults. Detailed mapping of definite faunal horizons was employed. Two distinct facies can be recognised, the North Country and the South Country types. The whole of the country north of the North Craven Fault belongs to the North Country type. The beds show a deeper water origin than those of corresponding horizons in Westmorland. There is no Bryozoa band, but the Porcellanous Bed which also occurs at that horizon is taken as the base of D_1. The Main Limestone is less fossiliferous than is the case in Wensleydale, while both the *Cyrtina-septosa* band and the Girvanella nodular band are well developed, and constitute admirable horizons for mapping. A second nodular band occurs in the Lower Lonsdalia Bed. The strip of country between the faults belongs, as a whole, to the North Country type, and marks the southern margin of the North-Western Province. The Orionastræa band forms an important horizon here, and represents the summit of the Hardraw-Scar Limestone round Ingleborough; below it occurs a Bryozoa band. The area is traversed by numerous normal faults trending usually north-westwards and south-eastwards; but, near Ingleton, the beds are repeated on themselves by thrusts. At three places, between the faults, patches of rock belonging to the South Country type occur. The change in the faunas is everywhere accompanied by an abrupt lithological change, which usually takes place along the line of the Middle Craven Fault. There is no evidence that the change was influenced by faulting during Lower Carboniferous times. The "knoll-reef" limestone represents a special type of deposit. The two facies were probably laid down some distance apart, and brought together by thrusting; the patches of rock of the southern type lying between the faults are portions of an overthrust mass from the south which have escaped denudation. The Middle Craven Fault is a normal fault which took place subsequent to the thrusting.—E. J. **Wayland**, and A. M. **Davies**: The Miocene of Ceylon. Arenaceous and calcareous strata of Miocene age are found over an extensive area in the north and north-west of Ceylon, and in a small part of the southern coast, at Minihagalkanda. At the latter place the beds rest upon Archæan rocks. The whole series appears to constitute a cycle of sedimentation, beginning and ending with areno-argillaceous deposits, and consisting mainly of fossiliferous limestones. The fossils consist of Foraminifera, corals, echinoids, and molluscs. The lower horizon of Minihagalkanda is characterised by *Ostrea virleti*, Deshayes, and is dated as Vindobonian (probably Tortonian), while the higher horizon of the northern area contains *Orbiculina malabarica*, Carter, and may possibly be Pontian. The transgression of the sea on the continental area of Southern India and Ceylon is thus contemporaneous with its recession from the Himalayan geosyncline, in accordance with Haug's principle.

Physical Society, May 12.—Dr. Alexander Russell, president, in the chair.—S. O. **Pearson** and H. St. G. **Anson**: Some electrical properties of neon-filled lamps. The lamp is shunted by a condenser and connected in series with a high resistance to a D.C. voltage supply. When cold no current passes through the lamp until the E.M.F. reaches about 171 volts. If the voltage be reduced when the lamp is glowing, current continues to pass until about 140 volts is reached. When, therefore, an E.M.F. of 200 volts is applied, some time elapses while the condenser is charging up to the necessary 171 volts. Then the lamp begins to take current, the current increases, and the voltage across the lamp falls to the limit of 140 volts, when the lamp goes out.

The cycle repeats indefinitely. The arrangement might be used at low frequency for flashing signs, at audio-frequency for telephonic measurements, and at high frequency (up to about 15,000 ~) for radio-signalling.—A. **Griffiths** and W. T. **Heys**: A new apparatus for the measurement of the polarisation capacity of platinum plates in sulphuric acid. Corrections can be made for leakage and self-depolarisation of the cell. It gives results consistent to one or two per cent., and of the same order of magnitude as those obtained by other observers.—Herbert **Chatley**: The molecular forces involved in cohesion. Cohesion may be expressible as a function of molecular masses or of electronic charges. In either case it will also comprise a space-function, and attention may be concentrated on the latter. The r^{-4} law suggested by Sutherland's theory and Van der Waal's rule, would indicate a greater difference in strength than exists in practice between amorphous substances and crystals. The crystal lattice elucidated by Bragg implies a very gradual space-gradient of force as compared with non-crystalline matter. The r^{-4} law is also inconsistent with the Cavendish experiment. Results more consistent with facts are obtained with an r^{-6} law.

Association of Economic Biologists, May 19.—Prof. E. B. Poulton, president, in the chair.—W. **Rushton**: Further contributions to the biology of freshwater fishes. A short account is given of the effects of the effluents from a series of distilleries, a woollen-mill, and from town sewage on the spermatozoa of trout. The life of the sperms is affected, but the eggs can be fertilised in the presence of the effluents. The effects of tree felling on the water supply to a trout hatchery was an increased acidity causing the appearance of a "bloom" on the sides and gills of the young trout, together with a coagulation of the mucus, which resulted in death.—J. H. **Priestley**: The toxic action of illuminating gas on plants. It has been known for many years that the presence of very small traces of unburnt coal gas in the atmosphere may produce a harmful effect upon growing plants under certain conditions. German observers were the first to notice how very sensitive "etiolated" shoots (the shoots of plants grown in continuous darkness) of the pea or potato or many other plants are to the presence of traces of gas. American workers have since extended these observations, and have shown that traces of coal gas in the atmosphere or the fumes from cigarette smoke or smouldering paper might have a very deleterious action upon plants, especially upon such etiolated shoots. Both German and American workers agree that the deleterious effects of coal gas or these other fumes can be traced to the gaseous unsaturated hydrocarbons, such as ethylene, always present in such fumes. If etiolated shoots or roots are placed in an atmosphere contaminated with coal gas or pure ethylene they cease to grow in length and expand in girth instead. These changes in form can be associated with changes in internal structure, notably with the disappearance of the functional primary endodermis. This endodermis forms close behind the growing point in both the etiolated shoot and in the root, and its disappearance seems to account in large measure for the other structural changes and abnormalities of growth seen in plants poisoned by traces of coal gas. The disappearance of the endodermis in the presence of fumes containing unsaturated hydrocarbons can be attributed to the displacement by these substances of the unsaturated fatty acids which normally accumulate upon the walls of the developing endodermis and give this tissue its characteristic properties. The normal leafy stem growing in the light does not develop such an endodermis, and proves relatively insensitive to the presence of these gaseous unsaturated hydrocarbons. These results are of some practical interest in that they suggest diagnostic features by which the occurrence of gas poisoning in horticultural practice may be recognised. The effect is produced by such very low concentrations of ethylene—of the order of one in a million—that although normal British illuminating gas contains very small quantities of ethylene, toxic effects may be produced by traces of the gas too small to be detected by smell. In fact the most delicate test we have for a gas leak possibly consists in the behaviour of etiolated shoots growing in darkness in the contaminated atmosphere. These results may also be of some interest to municipalities interested in the growth of shade trees along urban routes. The gas leaking from the pipes in the soil may be retained around the roots long enough to do damage because of the impermeable nature of the macadam or asphalte of the road surface.

PARIS.

Academy of Sciences, May 8.—M. Emile Bertin in the chair.—The President announced the death of M. René Benoît, correspondent for the section of general physics, and of Sir Patrick Manson, correspondent for the section of medicine and surgery.—A. **Haller** and Mme. **Ramart**: The dehydration of 2-methyl-2-phenyl-1-propanol and of 2·2-dimethyl-3-phenyl-1-propanol. The product varied with the method of dehydration (passage of vapours over infusiorial earth at 300°-400° C., action of $SOCl_2$ with or without pyridine). Substituted ethylenes were obtained, the physical and chemical properties of which are given, together with the oxidation products establishing their identity.—C. **Guichard**: The asymptotic lines of surfaces. The study of a particular case.—P. **Montel**: A new theorem of algebra.—J. **Sudria**: A demonstration and the generalisation of Menabrea's theorem.—D. **Riabouchinski**: Some cases of plane movements of fluids round solids with vortices.—Th. **De Donder**: An electromagnetic field comparable with the corresponding gravific field.—L. **Roy**: The electrodynamics of homogeneous isotropic media in repose.—A. **Bigot**: Kaolins, clays, bauxites, etc. Porosity and loss on heating. The loss on ignition of bauxites and kaolins of different origin at temperatures up to 900° C. are shown graphically, and a second diagram shows the changes in porosity of the same materials. M. **Palfray**: Neutral homocamphoric esters and their reduction products.—J. **Froidevaux**: The estimation of ammoniacal nitrogen in nitrogenous organic material, particularly in proteid materials, and their products of hydrolysis. The liquid is treated with a large excess of concentrated caustic soda solution, and the ammonia removed by a purified air stream without heating, with subsequent correction for ammonia formed from the proteid.—A. **Schoep**: Becquerelite, a new radioactive mineral. This is found as a yellow crystalline crust on pitchblende from the Kasolo Mine (Belgian Congo). Its composition is $VO_3 . 2H_2O$.—A. **Gruvel**: The fluvial origin of the bay of Lévrier. The discovery of two species of Potamides proves that the bay of Lévrier is the ancient estuary of a large river.—P. **Thiéry**: The limit of the Bathonian and the Bajocian in Lorraine.—J. B. **Charcot**: The temperatures at different depths in the chasm of Cap Breton. Observations on the variation of the temperature of the sea in the neighbourhood of this gap in the sea-floor agree with the views recently put forward by M. Gorceix, but are opposed to the results of P. E.

Dubalen.—Mlle. Yvonne Boisse de Black: The Wurmian in the high valleys of the Cère and the Goul (Cantal).—J. Thoulet: The distribution of the chalk in deep-sea sediments. A study of the sediments from soundings taken in the region of the Azores and Canaries shows that the depth has little influence on the composition of the deposits arising from Globigerina.—G. Bertrand, M. Freundler, and Mlle. Ménager: The variations in the chemical composition of sea-water and the evaluation of salinity. From determinations of chlorine, calcium, and magnesium in sea-water from the Atlantic and the Mediterranean, the authors conclude that the relative chemical composition of sea-water is not constant.—L. Mayet: The Villafranchian fauna of the Chagny Sands (Saône-et-Loire).—J. Stoklasa: The influence of selenium on plant evolution, in the presence or absence of radioactivity. Radium emanation exerts a very favourable influence on plant growth, and can (in daylight) neutralise the toxic properties of selenium as dioxide.—F. Lecomte du Nouy: The surface equilibrium of serum and of certain colloidal solutions.—P. Béhague and J. Beyne: Study of the times of tactile psycho-motive reactions in normal man.—L. Roule: The ontogenesis of the Scombriform fishes belonging to the family of the Luvarides. The young of this species at first resemble, not their adult parents, but other families (Coryphenides, Lampridides, Stromateides). The metamorphosis is of long duration and the principal changes do not take place in the very young fish, so that the latter might easily be mistaken for individuals of a distinct species.—F. Ladreyt: The histogenesis of the basocellular epitheliomas.—H. Plotz: Contribution to the study of the culture *in vitro* of the vaccine virus. A rabbit is inoculated with vaccine pulp, and after a suitable interval is bled. Its serum is cultivated *in vitro* in glucose-broth medium. After the fifth passage, the culture fluid inoculated into the skin of the rabbit gives lesions similar to those produced by vaccine pulp. The animals vaccinated in this way are immune to the virus of vaccine pulp.

Official Publications Received.

Agricultural Research Institute, Pusa. Bulletin No. 129: The Preparation of Anti-Rinderpest Serum, using Animals of Moderate Susceptibility as Virus Producers. By W. A. Pool and T. M. Doyle. Part 1: Buffaloes. Pp. 44. (Calcutta: Government Printing Office.) 12 annas.

Annales de l'Observatoire Astronomique de Tokyo. Université Impériale de Tokyo, Collège des Sciences. Tome 5, 5 Fascicule: Recherches sur le mouvement de la comète Wolf. Par M. Kamensky. Pp. ii+65. (Tokyo: Université Impériale.)

Commonwealth of Australia. Institute of Science and Industry. Bulletin No. 22: A Classification and detailed Description of the Barleys of Australia. Being the Second Report of the Special Committee on Seed Improvement. Pp. 33. (Melbourne.)

Diary of Societies.

FRIDAY, JUNE 2.

DIESEL ENGINE USERS' ASSOCIATION (at Institution of Electrical Engineers).—H. F. P. Purday: Marine Diesel Engines.

SATURDAY, JUNE 3.

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS (Annual Conference) (at Polytechnic, Regent Street), at 10.30 A.M.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Hugh Allen: Early Keyboard Music (2).

MONDAY, JUNE 5.

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS (Annual Conference) (at Polytechnic, Regent Street), at 10 A.M.—J. Paley Yorke: Presidential Address.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.

TUESDAY, JUNE 6.

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS (Annual Conference) (at Polytechnic, Regent Street), at 10 A.M.—Viscount Burnham: Address.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Percy Sykes: The Foundation of the Persian Empire.

WEDNESDAY, JUNE 7.

ROYAL SOCIETY OF MEDICINE (Electro-therapeutics Section) AND THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF RADIOLOGY AND PHYSIOTHERAPY (at 1 Wimpole Street), at 10 A.M. and 2.30.—Congress of Radiology and Physiotherapy.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 5.30.—Clayton-Greene, D. Harmer, Dr. E. P. Cumberbatch, and others: Discussion on Diathermy in Surgical Practice.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—N. Lea: The Performance of a Radio-Telegraphic Transmitter, with Special Reference to the New Installation at North Foreland.—Prof. C. F. Jenkin: A Dynamic Model of Tuned Electrical Circuits.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—Dr. J. C. Thresh: The Action of Natural Waters on Lead.—Dr. H. E. Annett and M. N. Bose: The Estimation of Meconic Acid in Opium.—Dr. A. F. Joseph and F. J. Martin: The Composition of Cows' Milk in the Sudan.—W. Singleton: The Use of the Daylight Lamp in Volumetric and Colorimetric Analysis.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

THURSDAY, JUNE 8.

ROYAL SOCIETY OF MEDICINE (Electro-therapeutics Section) AND THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF RADIOLOGY AND PHYSIOTHERAPY (at 1 Wimpole Street), at 10 A.M. and 2.30.—Congress of Radiology and Physiotherapy.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Very Rev. Dean Inge: Theocracy (3). The State Invisible.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 5.—Dr. D. S. Maccoll: What is Architectural Design?

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—L. J. Mordell: (1) Gauss's Sums and the Law of Quadratic Reciprocity in any Field. (2) The Integer Solutions of the Equation $ey^1 = ax^3 + bx^1 + cx + d$.—J. E. Campbell: The Deduction of the Ground-form of Einstein's Statical Gravitational Field from Gauss's Expression for the Ground-form in Ordinary Two-way Space.—J. L. Burchnall and T. W. Chaundy: Commutative Ordinary Linear Differential Operators.—G. H. Hardy and J. E. Littlewood: Fourier's Series and Power-Series.—Lt.-Col. A. Cunningham: On Pellian Chains.—H. W. Turnbull: On the General Invariant Theory of Quadrics.—J. Vint: Surface Waves on Limited Sheets of Water.—D. K. Picken: The Euclidean Geometry of Angle.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. Gordon Holmes: The Symptoms of Cerebellar Disease and their Interpretation (Croonian Lectures) (1).

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Joint Conference between Ophthalmologists and Opticians on Spectacle Construction.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 8.—Dr. H. H. Dale: Chemical and Physiological Properties (Lecture).

OIL AND COLOUR CHEMISTS' ASSOCIATION.

FRIDAY, JUNE 9.

ROYAL SOCIETY OF MEDICINE (Electro-therapeutics Section) AND BRITISH ASSOCIATION FOR THE ADVANCEMENT OF RADIOLOGY AND PHYSIOTHERAPY (at 1 Wimpole Street), at 10.30 A.M. and 2.30.—Congress of Radiology and Physiotherapy.

PHYSICAL SOCIETY OF LONDON, at 3.30.—Visit to the National Physical Laboratory, Teddington.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4.30.—Major Sir Humphrey Leggett: Tanganyika Territory.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society).

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—Annual General Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—J. Barcroft: Physiological Effects at High Altitudes in Peru.

SATURDAY, JUNE 10.

ROYAL SOCIETY OF MEDICINE (Electro-therapeutics Section) AND THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF RADIOLOGY AND PHYSIOTHERAPY (at 1 Wimpole Street), at 10 A.M. and 2.30.—Congress of Radiology and Physiotherapy.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Hugh Allen: Early Keyboard Music (3).

PUBLIC LECTURES.

(*A number in brackets indicates the number of a lecture in a series.*)

TUESDAY, JUNE 6.

KING'S COLLEGE, at 5.30.—Dr. D. Subotić: Influence of Geography on the Economic Conditions of Jugo-Slavia (2).

UNIVERSITY COLLEGE, at 5.30.—Prof. E. Husserl: Phänomenologische Methode und phänomenologische Philosophie (1). (In German.)

WEDNESDAY, JUNE 7.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.15.—Prof. A. F. Holleman: Recent Investigations on the Substitution in the Benzene Nucleus. (In English.)

THURSDAY, JUNE 8.

ST. MARY'S HOSPITAL (Institute of Pathology and Research), at 5.—Prof. W. Bulloch: The Historical Development of the Doctrines of Croup and Diphtheria.

UNIVERSITY COLLEGE, at 5.30.—Prof. E. Husserl: Phänomenologische Methode und phänomenologische Philosophie (2). (In German.)

FRIDAY, JUNE 9.

UNIVERSITY COLLEGE, at 5.30.—Prof. E. Husserl: Phänomenologische Methode und phänomenologische Philosophie (3). (In German.)