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The Development Commission.[1]

THE Development Commissioners have just issued a report on their operations during the year ended in March last. For a Blue-book it is an unusually interesting document, containing as it does many verbatim reports from Directors of Research who do not disdain, on occasion, the aid of the poets in describing their labours. We may instance Mr. W. B. Hardy on fishery research :

"The frontal attack," he says, "usually called, 'taking a practical view' of the problem, often fails, and rarely gives more than a partial and incomplete solution.

"Scientific history shows that the solution of a problem more often than not comes from a direction totally unexpected—

"'For while the tired waves, vainly breaking,
Seem here no painful inch to gain,
Far back, through creeks and inlets making,
Comes, silent, flooding in, the main.'"

And the corollary is well expressed :

"The search for the fundamentals of knowledge must remain the business of specialists trained to the use of the test tube and microscope. But it is one of the gravest fallacies responsible for the suspicion with which the 'practical' man often views science, which represents the work of the specialist as something different from that of the man engaged in the day-to-day employment of industry."

No man has a wider contact with research in its practical outcomes than has Mr. Hardy, and no one is entitled to speak with greater authority on the State organisation of research.

In the year under report the Development Commissioners recommended the expenditure of 368,450*l.*, of which 41,372*l.* was by way of loan. The grants to agriculture amounted to 226,253*l.* Under the head of fisheries the grants recommended totalled 71,218*l.* Fishery research workers appear to be in the happy position of explorers of a new and rich country, and the Commissioners were well advised in devoting a large section of their report to a detailed review of the progress made in the solution of fishery problems. As the British sea fisheries alone provide about 13 million tons of fish annually, it is clear that even the wide seas about our coasts cannot continue to furnish such a quantity unless the increased control which increased knowledge alone will bring comes to the rescue. Of this knowledge and the need for its extension, here is an example :

"The study of the edible crab," says Mr. Hardy, "now in progress at Aberdeen, has revealed the fact that there is a steady migration from the East Coast to the Moray Firth. One marked crab was found to

[1] Twelfth Report of the Development Commissioners for the year ended March 31, 1922. H.M. Stationery Office. 3*s.* 6*d.*

have covered over 100 miles of coast in just about as many days. All the lines of migration meet at a point in the Moray Firth. Why? We do not know, but it is something gained to have established the fact of the migration."

Another interesting discovery is a method of purifying mussels (and, probably, oysters too) by treating them with chlorinated water and thereby inducing them to cleanse themselves of sewage bacteria. Researches in plankton are proceeding vigorously at many research stations. This, of course, provides the most fundamental problem of all. Just as the harvest of the land depends, ultimately, on the activities of certain microscopic organisms in the soil, so the harvest of the sea depends, in the long run, on the microscopic organisms it contains. It is interesting to learn that, equally with the soil workers, fishery investigators are giving much attention to hydrogen ion concentration. In sea water, this measure of acidity appears to be correlated with the content of organic matter. Perhaps the most important fishery problem is connected with the herring. The mysterious movements of this fish, affecting as they do the livelihood of thousands of persons, have been celebrated in song and story. Shoals may suddenly desert waters which they have frequented for centuries. The Hanseatic League (a German domination of England) was terminated in the fifteenth century largely by the failure of the herring fishery in the Baltic; within living memory, the herring has deserted Loch Fyne in Scotland. As the Scottish song, "Caller Herrin'" runs:

"You may ca' them vulgar farin',
Wives and mithers, maist despairin',
Ca' them lives o' men."

The problem is as yet unsolved, but it is the business—and the certain hope—of science to solve it.

Of the many forms of State organisation of research, that under which fishery investigations are regulated appears to be one of the best. In outline there is provision for (1) "free" and (2) "directed" research. The latter is devoted to the solution of definite economic problems, whereas the former is concerned with the study of fundamental problems which lie at the root of any advance in the practical sphere. But no attempt has been made to lay down a definite border line. Controlling both there is an Advisory Committee of scientific men, the advice of which the Commissioners appear to accept unhesitatingly.

We notice that the various Agricultural Research Institutes continue to produce much valuable work, though the section of the report devoted to agricultural research does not include much new matter of interest.

The report does not contain, as in the past, an account of the present finances of the Fund. In an article published in NATURE for April 8 (vol. 109, p. 433) some apprehension was expressed on the score of the low ebb which last year's report showed the Fund had reached. Having survived the attack of the Geddes Committees, it would be indeed unfortunate if the future of fishery research should prove to be still uncertain, while it is equally necessary that the valuable researches of such institutions as the Plant Breeding Stations should be continued and placed on a permanent basis.

The Petroleum Industry.

The Petroleum and Allied Industries: Petroleum, Natural Gas, Natural Waxes, Asphalts and Allied Substances, and Shale Oils. By James Kewley. (The Industrial Chemistry Series.) Pp. xi+302. (London: Baillière, Tindall, and Cox, 1922.) 12*s.* 6*d.* net.

THE literature concerned with petroleum and its products is becoming almost as extensive as that which relates to coal. But whereas that of coal is the growth of some centuries, the literature of petroleum has been accumulated within living memory. This is due, of course, to the extraordinary development of the use of petroleum as a source of light and heat. The growth of motor transport has been remarkable, due in no small measure to the influence of the Great War, directly and indirectly. Aviation has arisen wholly within our own time, and is one of the most striking of the new departures which the twentieth century has witnessed. The exploitation of our oil-fields has become a question of national importance, and, it may be added, of international difficulty. The growth in the use of petroleum is well illustrated by the subjoined table, taken from the recently published Report of Lloyd's Register of Shipping for the year 1921–1922, showing the progressive demand for oil-carrying vessels:

	Oil-tankers.	
July 1914	1,478,988	gross tons.
July 1919	2,929,113	,,
July 1920	3,354,314	,,
July 1921	4,418,688	,,
July 1922	5,062,699	,,

It is further shown by the increase in gross tonnage of vessels either originally fitted to burn oil fuel or subsequently converted for that purpose:

	Vessels fitted for burning oil fuel.	
July 1914	1,310,209	gross tons.
July 1919	5,336,678	,,
July 1920	9,359,334	,,
July 1921	12,796,635	,,
July 1922	14,464,162	,,

Additional evidence is furnished by the large increase

in the number of motor vessels during the same interval:

	Motor Vessels. Number.	Gross tons.
July 1914 . .	297	234,287
July 1919 . .	912	752,606
July 1920 . .	1178	955,810
July 1921 . .	1473	1,248,800
July 1922 . .	1620	1,542,160

These statistics, it must be understood, are those recorded in the Register books of the society, and are probably an underestimate of the growth which has actually occurred throughout the world. They are, nevertheless, highly significant and instructive, and serve to illustrate what is a great factor in world-wide progress, and eminently characteristic of our own age.

The book under review may be recommended as a concise and well-informed account of the rise and growth of this important industry. It is well arranged and well written, and considering its limitation as to space, deals in sufficient detail with its more important phases. It is divided into nine main sections, or parts, each of which is further subdivided into several subsections. The classification is rational, and conduces to a logical treatment of the subject-matter.

Part I. is introductory, and treats of the terminology of petroleum products and of the history of the petroleum industry; of the chemistry, geology, and mode of origin of natural petroleum. Part II. is concerned with natural gas, its occurrence, distribution, composition, and applications. Part III. treats of crude petroleum, its occurrence, distribution, and character; of drilling and mining operations, and of the storage and transport of crude oil and its liquid products. Part IV. describes the manufacture of shale oils and of the various tars obtained as by-products. Part V. deals with asphalts. Part VI. with the natural mineral waxes. Part VII. with the working up of crude oils, their distillation, fractionation, and chemical treatment; the manufacture of paraffin wax and lubricating oil; "cracking" and hydrogenation processes; and refinery waste products. Part VIII. describes the characters and uses of petroleum products, and Part IX. gives some account of the methods of testing and standardising them.

As regards the origin of petroleum, in spite of much discussion and the voluminous literature to which the subject has given rise, we know nothing with certainty. The volcanic or inorganic theory, although advocated by such authorities as Humboldt, Berthelot, and Mendeléeff, is inconclusive, and there is an increasing body of evidence against it. On the other hand there are many objections to the assumption that petroleum has been produced from organic remains, although the geological evidence, at least in the case of certain oil-bearing districts, lends a certain measure of support to it. The question is fairly discussed by the author in the light of the most recent contributions to it, and, on the whole, he is inclined to consider that the majority of crude oils are probably of vegetable origin, although he advances no surmise as to the mechanism of their formation.

One of the most important developments connected with the petroleum industry is the utilisation of the natural gas which is evolved in enormous quantities in certain oil-bearing regions. This utilisation has mainly occurred on the American continent owing to the circumstance that certain of the oil wells are not too remote from centres of population. Many towns in America are supplied with this gas at a very low cost. Much of the gas is consumed in the manufacture of so-called carbon-black, an extremely fine form of soot far superior to ordinary lamp black as a pigment and for the manufacture of printing-ink. It is calculated that one pound of carbon black suffices to print 2250 copies of a sixteen-page newspaper. Upwards of fifty million pounds of this material were produced in the United States in 1920, from thirty-nine operating plants in various States, mainly in West Virginia and Louisiana. Considerable quantities are used in the rubber tyre industry, for the manufacture of stove polishes, Chinese and Indian ink, paper manufacture, tarpaulins, etc. But even when the gas cannot be immediately utilised it is now liquefied and stored under pressure by modern compression and refrigerating plant, and can be transported.

Mr. Kewley is to be congratulated on the production of a valuable contribution to the literature of an industry which is pre-eminently characteristic of our own epoch.

Unified Human History.

A Short History of the World. By H. G. Wells. Pp. xvi+432. (London: Cassell and Co., Ltd., 1922.) 15*s*. net.

THIS is a new work covering the same ground as the "Outline of History" and in the same spirit, but re-written and better written, and correcting many of the faults of judgment and proportion which disfigured the earlier book. Mr. Wells has digested his material in the interval and writes now with ease and mastery. The arrangement and general division of the space is quite satisfactory, and the production and illustrations are excellent. It is a great feat, following so quickly on the labours of the "Outline," and all who are interested either in history, in education or in the social progress of the world as a whole, are under a deep debt of gratitude to Mr. Wells for carrying it out. Nothing has done so much to awaken the public to the social importance of history, and the readers of history to the unity of their subject. The books are a prodigy of industry and skill and in the realm of literature the

best thing we owe to the war. It was at a gathering of thinkers and social workers during the war that the idea of teaching world-history to all nations on a common plan was first mooted, and Mr. Wells responded to the appeal. His "Outline" has sold in hundreds of thousands, especially in the United States. It has provoked demands among working men to be taught history in that spirit; it has changed the outlook and the syllabuses of scores of teachers; it has helped to success other similar books such as the fascinating "Story of Mankind" by Van Loon, which has come over to us from America this autumn.

In view of all this, it is paltry and unworthy to dwell on minor defects or on differences of judgments, and still worse to condemn Mr. Wells because not being a "historian," he has done a work which "historians" ought to have done over and over again before.

It was probably this fact, that he was not a historian in that sense, immersed in the details of some special period or aspect of history, which, added to his own incomparable powers of reception, production, and imagination, enabled Mr. Wells to accomplish the feat. The freshness of his mind prompts him constantly to some interesting new view, some comparison especially of ancient and modern times, some wholesome challenge to accepted judgments; *e.g.* "It was not so much the Jews that made the Bible, as the Bible that made the Jews." "How important a century this sixth B.C. was in the history of humanity. For not only were these Greek philosophers beginning the research for clear ideas about the universe and man's place in it, and Isaiah carrying Jewish prophecy to its sublimest levels, but, as we shall tell later, Gautama Buddha was then teaching in India and Confucius and Lao Tse in China. From Athens to the Pacific the human mind was astir."

Even in the case of Rome, to which Mr. Wells still does less than justice, it is enlightening to have the comparison with our modern empire. "The Roman empire after all was a very primitive organisation; it did not educate, did not explain itself to its increasing multitudes of citizens, did not invite their co-operation in its decisions. There was no network of schools to ensure a common understanding, no distribution of news to sustain collective activity."

All such comparisons, whether of contemporary happenings or of earlier and later social states, are useful and inspiring and arise from the synoptic frame of mind which qualifies a man for such work as this. It is an antidote to the excessive criticism and tendency to pessimism which mark so much of our literature at the present time. But it needs to be based on a sound knowledge and appreciation of the historical fact, and it is naturally on this latter side that Mr. Wells is weaker. He does not estimate duly what Rome did for the world, the greatness of her legal work, its continued progress, its permanence in the modern world. Nor does he allow for the constructive value of the medieval Church and Catholic doctrine. No word of Dante (or of Descartes) with a whole chapter for Charles V.! That is a blemish impossible to pass over. It goes with a general tendency in the book to lay stress rather on the externals and the picturesque figures in history than on the deeper, spiritual, or intellectual factors. Thus Archimedes and Hero appear but not Pythagoras, Stephenson and Watt but not Descartes and Leibniz, or even Newton. Science appears as the transformer of industry, the generator of steam-engines and steamships, but not as the knitter-up of men's minds, the new universal doctrine which replaces theological dogma. Even science as the healer and preventer of disease seems to find no place: there is no word of Hippocrates or Pasteur.

We know well how easy it is in reviewing such a book to draw up lists of inexcusable omissions. It would be ungrateful in this case, for Mr. Wells has given us so useful and attractive a gift and has worked so valiantly for the cause both of history and of science, and especially of science as coming into and modifying history. His answer, no doubt, to the last criticism would be that this was an introductory volume, and that therefore he avoided such matters as philosophy. But can one properly treat of religion without philosophy? And there are sympathetic chapters about Christ and Buddha. It would help his general cause, which is the salvation of mankind by education and unity, to lay more stress on the spiritual or intellectually constructive aspect of science and less on its mechanical applications. It is not the difficulties of posts and tariffs which will ultimately bring mankind together in harmonious progress: it will be a spiritual union of which knowledge and sympathy, science and law are co-operating factors, and may be traced growing, sometimes fitfully, and at various times and places, but never quite extinguished from the beginning of history till now. These should be the leading threads in any short sketch of human history as a whole, and it is because of their decisive contributions to those elements that Greece, Rome, Christianity, and modern times deserve a special place.

F. S. MARVIN.

Naturalisation of Animals and Plants.

The Naturalisation of Animals and Plants in New Zealand. By the Hon. George M. Thomson. Pp. x + 607. (Cambridge: At the University Press, 1922.) 42*s.* net.

FROM those early days in the neolithic age when the nomad tribesman drove his domestic stock from the region of its creation to new areas, naturalisa-

tion of plants and animals has been a fact to be reckoned with in the evolution of faunas and of humanity. Even in countries where the introduced creatures belonged to groups identical with, or closely related to, members of the indigenous fauna, and where, on that account, a simple speeding-up of a process already in force might have been expected, the influence of naturalisation on fauna and flora has been profound. It is easy to imagine how much more intense that influence might be in countries where the new-comers belonged to orders of animal and plant life unrepresented in the native fauna and flora, and entered a free field unhampered by the checks which, in the course of ages, had created in the old country a tolerably stable balance of Nature. It is this unusual mingling of the faunas of distinct and widely different zoo-geographical regions that gives special significance to the events in Australia and New Zealand, and has made the attempts of the settlers there a by-word in the history of acclimatisation.

Another special interest attaches to these areas, however, and adds enormously to the value of this book. In the old countries, lying in the way of the migrations of palæolithic and neolithic man and his successors, introductions of plants and animals have taken place from time immemorial, with the result that, since the beginnings are lost to view, results can be only dimly envisaged; but in New Zealand, apart from a few prehistoric Polynesian introductions, almost every beginning has a date, and almost every stage of progress can be measured in terms of years.

Mr. Thomson has dealt with the unique opportunity that lay to his hand in the scientific spirit; he has been chary of broad generalisations, and he has been at endless pains to collect and verify information, much of which in a few years would otherwise have slipped from ken. Consequently his work must be regarded as a standard contribution to the history of acclimatisation.

The plan of the book is of the simplest: after a short introduction and historical review, it proceeds to consider each animal and plant introduced to New Zealand, whether or not it has become established, in its order in systematic classification. (The author has overlooked the fact that all his rodents are grouped under the heading "Carnivora.") The mass of material handled can be only roughly gauged by the fact that of mammals and birds alone, 48 of the former have been introduced, of which 25 have become truly feral, and of the latter, 24 out of 150 introduced species are now thoroughly established; while of plants, more than *six hundred species* have become "more or less truly wild."

It is impossible here to follow Mr. Thomson's catalogue of events; even the familiar stories of the ill-starred introductions of the rabbit and its enemies, and of the introduction of humble-bees to fertilise the introduced red clover, are filled with new and significant detail; but let us turn to some of the broad results of this century and a half's intense interference with Nature.

Great expectations were formed of the probability of seeing the development of new variations and of incipient new species; but fifty years of close observation lead the author to state that he is "aware of no definite permanent change in any introduced species" (p. 513). The statement does not exhaust the possibilities, however; first, because the time is short—the first animals were introduced in 1773, and most have been in the country for scarcely more than half a century; secondly, because changes are noticeable—red deer introduced from Forfarshire only fifty years ago, now carry, instead of a former limit of 12, up to 20 points on their antlers; and, thirdly, because the progeny of introduced animals has not been submitted to that minute examination and comparison of cranial and other characters on which racial distinctions are now based. Again, Darwin and Wallace both expected that the wholesale naturalisation of European plants would ultimately exterminate part of the native flora. The author sees no evidence of such a process: "The native vegetation can always hold its own against the introduced" (p. 528); "the struggle . . . will result in a limitation of the range of the native species rather than in their actual extermination" (p. 533). But is the conclusion not doubtful, or at any rate premature? In long-civilised countries, for example, Scotland, it has been shown that there are no bounds to the cumulative effect of man's influence, and that limitation of range is too often but a first step to ultimate, even if long-delayed, extinction.

Yet many changes have been observed. Introduced trout established new records in size, water-cress grew to a length of twelve to fourteen feet, "with stems as thick as a man's wrist," the common spear thistle formed thickets six to seven feet in height; even since 1868 nine species of birds have disappeared to a great extent or altogether, and many have been driven to the wildernesses; several species of fish have been exterminated by established introductions; habits have changed—many species have adopted introduced food plants, the Kea parrot supplements its fruit diet with the flesh of living sheep. On the whole, the introductions have done much more harm than good. Of all the birds introduced, the only one against which no complaint has ever been made is the hedge sparrow; but there must often be difficulty in assessing the balance of good and evil. In one place we are told

that "the evidence regarding the destruction of the native avifauna by stoats and weasels is very inconclusive" (p. 73), and in another that "these animals [weasels and other vermin] are largely responsible for the decrease in the numbers of native birds" (p. 89).

One conclusion, however, is manifest, that neither in New Zealand nor elsewhere should naturalisation of exotic animals be permitted, except with the consent of a properly constituted advisory committee containing a strong representation of biological science. Perhaps we can afford to smile at the enthusiasm of men who endeavoured to establish migratory birds, or brought from Britain the humble-bee, *Bombus terrestris* (now the commonest species in New Zealand), to fertilise the red clover, not knowing that its trunk was too short to reach the bottom of the clover flower; but we should not be subject to the vagaries of such as the New Zealand legislator who, when it was proposed to introduce half a dozen Venetian gondolas, to be placed on a lake in the public gardens of Nelson, protested against the extravagance and desired to import only a pair, "and then let Nature take its course."

JAMES RITCHIE.

Boscovich and Modern Science.

A Theory of Natural Philosophy. Put forward and explained by Roger Joseph Boscovich. Latin-English edition. From the Text of the First Venetian edition published under the personal superintendence of the Author in 1763. With a short Life of Boscovich. Pp. xix+470. (Chicago and London: Open Court Publishing Co., 1922.) 63*s*. net.

IN the time of Boscovich the line of demarcation between the philosopher and the physicist or mathematician was much less clearly marked than it is to-day—perhaps it is better to say than it was a few years ago. It is therefore to be expected of a man of Boscovich's energy and versatility, living in the eighteenth century, that he should have explored the borderland of philosophy and science. The book before us contains the contribution of Boscovich to this domain—for us the most important work of his life. In it he appears to a modern as a philosopher rather than a man of science, interested largely in the search for and use of *a priori* arguments, but in close touch with the scientific theories and explanations of his day.

Whether this classification is right or wrong, the book is full of interest. Boscovich is sometimes claimed as the father of modern atomic theory, and this volume provides at any rate partial justification for the claim. For Boscovich shows with admirable clearness how many diverse phenomena in mechanics and even in other branches of physics can be explained in a natural qualitative way on his hypothesis that matter consists of discrete points accelerated towards each other by a perfect definite law of suitable form. But from the modern point of view his work in this connexion is scarcely more interesting than the earlier work of Daniel Bernoulli, or the still earlier ideas of Hooke. To a mathematician perhaps the most interesting sections of the book are those in which Boscovich expounds the law of continuity, the doctrine of impenetrability, and their consequences. It is at once evident that his ideas of the properties of a continuum and of a progression, though of course not extensive, are invariably clear and accurate.

Other interesting passages are those in which Boscovich makes use of proofs by induction or criticises the inductive reasoning of others—for example, attempts to establish thus that matter must have continuous extension. He is always careful to explain why he believes his own inductive arguments to be valid when he makes them. In fact one may strongly suspect that his first instinct in all such cases is to take up a sound sceptical point of view, with perhaps a slight weakness for his own favourites. In this he is by no means unique, and in full agreement with a certain distinguished man of science of to-day who is reported to have defined scientific truth in conversation with a friend as "the theories which you and I believe, and I include you for courtesy."

Boscovich is firmly convinced of the underlying simplicity of all natural phenomena. The main thesis of his book is to show that it is conceivable that all the properties of matter might be explainable on the basis of his unique acceleration law. In a delightful passage (pp. 105-7) he attacks the multiplicity of forces used by the physicists of his day and the danger of concluding that Nature is complicated when it may only be that the mathematics is inadequate.

Both as a final example of the depth and range of his ideas and for its latter-day interest we must quote the following passage, in which he is discussing the form of his acceleration law. He has just assumed that the mutual acceleration of two of his points is always bounded except when the distance between them actually tends to zero. He proceeds: "In this case it is evident that, if a sufficiently great velocity can be given to any mass, it would pass through any other mass without any perturbation of its own parts, or of the parts of the other. For the forces have no continuous time in which to act and produce any finite sensible motion; since if this time is diminished immensely . . . the effect of the forces is also diminished immensely. We can illustrate the idea by the example of an iron ball, which is required to pass

across a plane, in which lie scattered in all positions a great number of magnetic masses possessed of considerable force. If the ball is not projected with a certain very great velocity . . . its motion will be checked by their attractions. But if the velocity is great enough, so that the actions of the magnetic forces only last for a sufficiently short interval of time, then it will certainly get through and beyond them, without suffering any sensible loss of velocity." Further evidence of his clarity of thought need scarcely be given.

In conclusion let us admit the great debt of gratitude which we owe for the production of this book to the translator, Mr. J. M. Child, and to the Government of the Kingdom of Serbs, Croats, and Slovenes who generously financed its publication.

Our Bookshelf.

Chelsea Porcelain. By William King. Pp. xv+135+70 plates. (London: Benn Bros., Ltd., 1922.) 73*s.* 6*d.* net.

IT seems appropriate that this elaborate and sumptuously illustrated volume should proceed from an official of the ceramic department of the Victoria and Albert Museum, where an extensive and thoroughly representative collection of Chelsea porcelain is permanently displayed for the delectation of the public. Such a handbook of one section of the treasures housed in the museum, setting forth the story of their manufacture and the reasons or sentiments which inspired the decorations they bear, should bring many fresh visitors to the collections. It should stimulate the interest which each succeeding generation manifests in the doings of the potters and porcelain-makers of a past age, for they have proved themselves the unconscious historians of its social customs. It is impossible for any one, however limited his purview, to linger among these brilliant and fascinating objects without feeling a desire to know more of their history and how they came to be decorated as they are. Even to those who know little of historic styles in decorative art it must be obvious that whatever is native and English in these porcelains is interwoven with motives caught from the work of other countries than ours, Oriental as well as European, so that they provide even a casual observer with endless food for thought and research.

To-day, after a century and a half of change, it stirs our blood to examine such masterpieces of patient skill and elaboration, wrought in a beautiful but difficult material with an insufficient regard to time and cost, when an English factory tried conclusions with the state-aided establishments of Europe and won a well-deserved reputation for its courage and skill.

The gradual development of the Chelsea enterprise from its modest beginnings to the heyday of its success is traced with a wealth of detail drawn from the patient labours of many previous investigators, but its story is enriched by the knowledge which is only to be acquired from the constant handling and critical examination of fine and authentic examples; so that, for many a long day, this volume is likely to remain a standard authority on its subject.

The numerous illustrations are remarkable for their variety and excellence. They cover the whole field of the porcelains made at the Chelsea factory, and, whether in colour or in half-tone, convey an excellent idea of the range and quality of the productions of that famous factory. WILLIAM BURTON.

Blood Transfusion. By Dr. Geoffrey Keynes. (Oxford Medical Publications.) Pp. vii+166. (London: Henry Frowde and Hodder and Stoughton, 1922.) 8*s.* 6*d.* net.

THE transference of blood from healthy persons to make up for deficiencies of quantity or quality in the sick has been proposed and occasionally practised for 300 years or more, but it is only within the last decade, and especially since the experience of the war, that this valuable therapeutic procedure has been put on a firm foundation and has come into common use. Dr. Keynes gives here an admirable account of our present knowledge of the theory and practice of transfusion. There is a most interesting historical account of the work of the pioneers, and it is curious to note that Higginson, in the middle of the nineteenth century, invented and used his syringe for this rather than its present purpose. The selection of blood donors is fully considered and a good description given of the different "blood groups" found in human beings—a topic of much wider importance than its immediate application to human therapy. In technique, the author's experience has led him to prefer the method of withdrawing the blood into a solution of sodium citrate to prevent clotting and then injecting a known amount at leisure into the recipient: anastomosis of the blood vessels of the two parties is difficult and uncertain.

In practice, the main usefulness of transfusion has been found in cases of hæmorrhage and shock, in which, as might be expected, blood has proved of more value than salt solution or Bayliss's gum. It has given good, if generally transitory, results in pernicious anæmia and a few cases of severe bacterial infections, but there is no very clear evidence of its utility unless the patient has the definite indication of too small a blood volume or too little hæmoglobin.

There is a bibliography of more than 300 items and a good index. Complete as is the account from the point of view of the practical surgeon, some further consideration of the experimental work of Worm Müller and his successors would have been welcome. There is, too, no adequate discussion of what happens to the red cells in their new home, how long they last, and how they are destroyed. A. E. B.

The Voice Beautiful in Speech and Song: A Consideration of the Capabilities of the Vocal Cords and their Work in the Art of Tone Production. By Ernest G. White. Third edition. Pp. viii+166. (London: J. M. Dent and Sons, Ltd., 1922.) 7*s.* 6*d.* net.

THE author's devastating thesis, that the human voice is *produced* by the frontal sinuses and other cavities in the bones of the head, while "the vocal cords," which he regards as strings, "are not the seat of sound," is not supported by a particle of evidence. That so

misleading a book should not only find a publisher but also reach a third edition, is disquieting. A teacher should be teachable, and the serious student of phonation will find sound information as to the parts played by the sinuses and the glottal lips in the production of vocal tone in Musehold's "Akustik und Mechanik des menschlichen Stimmorgans," 1913, which gives excellent laryngo-stroboscopic photographs of the miscalled "vocal cords" in action, confirming and supplementing Manuel Garcia's famous communication to the Royal Society in 1855 on the differing laryngeal mechanism for chest and falsetto registers. The kinematograph might do good service here.

The exhibition of a slow-motion film, such as that prepared by Prof. Panconcelli-Calzia and Dr. Hegener, of Hamburg, showing the lips of the glottis producing a definite note of chest register by periodically parting and meeting, parting and meeting, letting out as many tiny puffs of compressed air per second as there are double vibrations in the note sung (quite in agreement with what R. Willis, of Cambridge, wrote in 1828), and finally opening very wide for the singer to draw breath, would give in one minute a clearer idea of their double-reed action than pages of careful description may convey. Few misnomers, surely, have wrought so much pseudo-scientific havoc as Ferrein's *chordæ vocales* (1741). W. P.

An Introduction to Psychology. By S. S. Brierley. Pp. viii+152. (London: Methuen and Co., Ltd., 1921.) 5*s.* net.

UNLIKE many writers for non-professional students of psychology, the author of this work does not attempt to minimise the difficulty of the subject, nor does she seek to evade problematical conclusions by specious dogmatism. The book consists of two parts, the first dealing with the scope and method of psychology, and the second with some of the general problems of the subject. This latter part brings before the reader the fascinating but bewildering array of problems with which the modern psychologist is confronted. The reader is not left with the idea that having perused this book he knows everything about psychology, but he will feel that he has an excellent basis for continued study. The general plan is original, and while incorporating much of the work of such writers as James, McDougall, Freud, and Jung, yet it is much more than a mere compilation of the work of others. It will be of the greatest value not only to the beginner but also to any reader who wishes to get a clear survey of the state of psychology at the present time.

Physiology and Biochemistry in Modern Medicine. By Prof. J. J. R. MacLeod, assisted by Roy G. Pearce, A. C. Redfield, and N. B. Taylor, and by others. Fourth edition. Pp. xxxii+992. (London: H. Kimpton, 1922.) 42*s.* net.

THE first edition of this valuable text-book was reviewed at some length in NATURE of December 18, 1919 (vol. 104, p. 389), so that little remains to be said except to congratulate the author on the rapid appearance of successive editions. This fact is good evidence that the work fulfils a want. It will be remembered that it is especially directed to satisfy the requirements of the student and the practitioner of medicine, so that it is natural to find certain branches of physiology more fully discussed than others. It is perhaps open to question whether, for the class of reader contemplated, the common practice of treating such questions as osmotic pressure and the colloidal state apart from that of the physiological processes in which they play an important part, is to be recommended. Prof. MacLeod has kept the book well up-to-date, and it has received valuable improvements and additions since the appearance of the first edition in 1919.

The Conquest of the New Zealand Alps. By Samuel Turner. Pp. 291. (London: T. Fisher Unwin, Ltd., 1922.) 21*s.* net.

MR. TURNER is a mountaineer of varied experience extending over a quarter of a century. His latest book describes six seasons' climbing in the New Zealand Alps, including ascents of Mounts Cook and Tasman, the two summits of the group. It is mainly a climber's record of difficulties and triumphs, but incidentally it contains much description of the peculiarities of the New Zealand Alps and the ice conditions encountered there. On the whole, the climbs in most cases were not of exceptional difficulty, but there seems to be a tendency for the snow slopes to hang steeper than in most countries. This is due possibly to the nature of the rock, but more likely is the outcome of the snow falling frequently and at relatively high temperatures, which gives it greater binding power. The snowfall at low altitudes even in midsummer is an additional difficulty.

La Séparation Industrielle des Solides en Milieu Liquide. Par Prof. Léonce Fabre. Pp. v+227. (Paris: G. Doin, 1922.) 16 francs.

THE treatment of filtration from the point of view of chemical engineering forms the principal subject of this book. The various types of apparatus, including immersion and rotary filters, are fully dealt with, and the auxiliary apparatus, including pumps, thickeners, and classifiers, are also described, and methods of decantation are considered. The book is up-to-date, and the numerous illustrations add considerably to its interest and value: it is a most useful contribution to the literature of chemical engineering. As is usual in French books, the absence of an index takes away practically half the value of a work of this kind. This may seem a small point to the author, but English and American readers of technical books will consider it a very serious defect.

Seven Ages of Childhood. By Ella L. Cabot. Pp. xxxiv+321. (London: Kegan Paul and Co., Ltd., 1921). 12*s.* 6*d.* net.

MRS. CABOT divides the period from coming into the world to coming of age into seven sub-periods which she names the dependent age (0-3), the dramatic age (3-7), the angular age (7-11), the paradoxical age (12-14), the age of the gang or team (11-16), the age of romance (15-18), the age of problems (16-21). On all these she writes pleasantly and sympathetically. There may be little of striking originality in her pages; but there is a touch of serene wisdom which may perhaps be found more helpful.

Letters to the Editor.

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

A Type of Ideal Electric Atoms.

THE *Philosophical Magazine* for December contains a long and interesting mathematical paper by R. Hargreaves, in which he explores possibilities of constructing self-subsisting orbital systems out of free massive positive ions combined with free negative electrons, held together by a rotation common to all. The solutions at which he arrives give a possible structure for an ideal atomic nucleus of the Rutherford type, namely, a revolving ring of alternate positive ions and negative electrons, with or without a positive ion at the centre or a number of ions lying along the central axis of the ring transverse to its plane. It is found that a limited number of structures of this type can subsist, stability requiring that the central charge shall be positive.

Analysis of the deformation of such a free ring by a field of electric or magnetic force yields striking results as regards the polarisations thereby produced, recalling cognate classical results obtained by Lord Kelvin and others long ago, relating to vortex rings in fluid. Around such a ring-nucleus outer electrons can describe orbits as satellites, either a few of them or many arranged in rings in the manner now familiar in illustrations of the outlying structure of atoms: their reactions on the ring-nucleus are analysed. So also are the reactions on the whole system of stray electrons or ions coming within its range from without, which may even combine with it in definite ways: interesting analogies to phenomena of ionisation and of emission of electrons come to light. The scale of magnitude of the system remains open to satisfy other conditions.

The author modestly disclaims authority to judge whether the properties he discovers have any substantial analogy with the radio-active and spectroscopic phenomena of actual atoms. But, apart from the mathematical interest, there can be no question that the result of such a systematic rigorous analysis of the dynamical behaviour of a definite group of free systems, proved to be possible and stable, is calculated to expand the range of ideas in this field of physical speculation, and so is well worth the labour it has entailed. The alternating arrangement of ions and electrons in the nuclear ring calls to mind recent theories in the very different domain of crystalline structure and conductance in metals, based on space-lattices in which metallic ions and electrons occur alternately. J. L.

Cambridge and the Royal Commission.

KINDLY permit me to reply to the criticisms in NATURE of November 25, p. 689, on my article in the *Quarterly Review*. (1) I note with satisfaction that my critic admits that "many of those who do not share [my] fears will agree with [me]" on the importance of having the proposed grants "charged on the Consolidated Fund." My fears arise from (*a*) the declaration made to the Commission by the Labour Party that the "control of the Universities merely by statute assisted by occasional Royal Commissions has now definitely failed and that something in the nature of a continuous administrative control by the State must be undertaken," and (*b*) from the imperious demand that this control should be exercised "by representatives of Trades Unions, Elementary School Teachers, Women's Organisations, County Councils, the Board of Education, etc." (Report, p. 72, *Q.R.*, pp. 350-351). Are my fears groundless in view of the fate which has befallen the Universities of France, Germany, and Holland, under State control?

(2) My critic tries to defend the proposal to hand over the control of all teaching and research to the Council, a political body, largely composed of men whose interests are in administration rather than in the advancement of knowledge, and seeks to justify this by the vague statement that "the electorate which chooses both bodies is the same," leaving out of sight the fact that the elections to the Council are almost wholly on very clearly defined party lines with little regard to educational questions. It is proposed to supersede the General Board of Studies (composed of representatives of the 14 Special Boards of Studies and 8 nominated by the Council chiefly from their own members) by a new Board of Studies and Research subordinate to the Council, to consist of 12: 6 appointed by the Council and 6 only by the whole body of University and College teachers. As the General Board has on it representatives of all the Special Boards the co-ordination of the various studies and a proper standard for the higher Doctorates can thus be, and is, well maintained. The bureaucrats hate the General Board because they cannot prevent the Special Boards from placing on it their leading men, no matter what their politics may be. The General Board is charged with being "unwieldy," and at the same time not wholly representative of all branches of study, and that "its co-ordinating functions seem to be impeded to some extent by the fact that it is largely composed of specialists." The animus shown against "specialists" gives the key.

My critic does not attempt to meet my statements that it is not "unwieldy" since it has the same number as the Oxford Council (23), that it does its work excellently, while the Council, when it interferes with education, deals badly with it and is slovenly in its routine business. If the General Board is "not wholly representative of all branches of study," then the new Board of 12 will be much less so, and the evil effects of such a Board are already felt in the new Board of Research set up by the Council to deal with applicants for the Ph.D.

(3) With regard to the disfranchisement of the Senate, my critic says that "In his criticism of detail Sir William Ridgeway is not happy. When he says 'The Cambridge Commissioners know perfectly well that it would not be easy to get fifty signatures to any appeal within a week,' the obvious answer is that Sir William Ridgeway knows perfectly well that in any issue of importance where an appeal to the Senate is likely, fifty signatures could be collected in the Senate-House from the defeated minority," etc. Here are my actual words: "It would not be easy to get fifty signatures to any appeal within a week, and to get those of one-third of the House of Residents within 14 days would be impossible in view of the further proposal that if a Grace passed by the House of Residents were rejected by the Senate, that Grace could be re-affirmed within two terms and become final." No one would think of getting up, or signing, an appeal to the Non-Residents to waste their time and money in coming to oppose a measure (nor if asked would they come) which even if defeated by the Senate would become law in two terms. As my critic has not dared to challenge any of my facts, his only resort was to impugn my honesty by garbling my statement, an attempt as futile as disingenuous. He repeats the charge that the control of the Senate is "capricious," because "its interven-

tion is made at the capricious decision of a body of resident conservatives who, through the Senate, wield a wholly disproportionate power on matters vitally affecting the well-being of the University." Yet he had just admitted that only thrice in twenty-five years has the Senate come up in force, and that only once did it outvote the resident majority. His picture of wicked conservatives "constantly" calling up non-residents to oppose progressive Radicals is just as devoid of fact as the assumption that Radicals are always progressive.

When, in 1910, a like charge was made against the Senate, I recited in the Senate-House a list of much-needed reforms and progressive measures (in all of which I was concerned), *e.g.* a proper audit and control of Departmental funds, the reform of the Press, the reform of the Fizwilliam Museum, the founding of the Departments of Anthropology and of Architecture, etc., etc. (all of which had later to be carried out), and I charged to their faces the Radical leaders who then controlled the Council, with heading the obstruction to all these reforms. No one then or since has disputed my allegations. The suggestion that resident conservatives are an insignificant body is disproved by our important gains in the late elections to the Council (even without the much-needed secret ballot). My critic does not deny that the proposals of the Report respecting the powers of the Senate, the constitution of the Council and of the Board of Studies and Research go much further than the proposals made by the committee of younger graduates (men under 40) who represent the most advanced opinion among residents. They wish that the ultimate decision on statutes should rest with the Senate, and that the professoriate should keep its representation on the Council, and have some on the proposed new Board of Studies.

WILLIAM RIDGEWAY.

Flendyshe, Fen Ditton, Cambridge,
December 2.

LEAVING on one side the more personal aspects of Sir William Ridgeway's letter—his zeal for progressive reforms and the disingenuousness of his critic—a reply may be made to one or two of the points raised by him. He is mistaken in saying that the committee of younger graduates (men under 40) represent the most advanced opinion among residents. They have not unfairly been nicknamed "The Cambridge Whigs." Even this body, however, has suggested that members of the General Board (or Board of Studies and Research) should be nominated by the Council and that the Board should be reduced in size by abandoning the direct representation of the Special Boards of Study. It is held by many, who are equally keen with Sir William Ridgeway on the independent development of educational policy in the University, that the best solution lies in a small Board akin to the present Board of Research Studies, well balanced between the different faculties and working in close co-operation with the Special Boards. As to the question whether an appeal against the House of Residents would ever be made under the Commission's scheme, the writer differs absolutely from Sir William Ridgeway. Differences of opinion are too acute, and the fighting spirit of both sides too strong, to allow certain proposals to pass without a stern contest at every possible point.

THE WRITER OF THE ARTICLE.

Gravity Variations.

MR. R. D. OLDHAM'S letter in NATURE of November 18, p. 665, makes the disquieting suggestion that the force of gravity at Dehra Dun may be subject to fluctuations. The changes that he points out in the times of oscillation of the Indian pendulums can, however, be quite reasonably attributed to alterations in the lengths of the pendulums and errors of observation, and are not, in my opinion, so grave as to warrant a belief in anything more fundamental. As Mr. Oldham says, there is neither proof nor disproof of a change in gravity. But the discussion undoubtedly indicates a weak spot in the Indian operations, namely the connexion of Dehra Dun with Kew Observatory, which is the base station for this country. It rests on the results obtained with four pendulums swung at Kew and then transported to Dehra Dun and swung there. The pendulums have never been brought back to this country, so if they suffered any changes of length on the journey from Kew to Dehra Dun the value of g found at the latter place will be erroneous.

It would, of course, have been necessary to undertake a return journey long ago if no corroboration of the result of the first journey had been available. There was, however, the strong corroboration afforded by Hecker's observations in 1905, as mentioned by Mr. Oldham, and the valuable though less powerful evidence obtained by Alessio in 1906. Hecker's result was of special value because at Jalpaiguri his apparatus was set up alongside the Indian one and simultaneous observations were made using the same clock. Thus there was good reason to believe that the effects of fluctuations of temperature and variations in the clock's rate—the chief sources of uncertainty—would be the same on both sets of observations, and that therefore the check on the Dehra Dun value of g would be nearly as satisfactory as if Dr. Hecker's pendulums had been swung at Dehra Dun itself.

The links forming the connexion of Dehra Dun with the value of g determined at Potsdam are as follows:

	Result.
Potsdam—Kew (Putnam, 1900) Kew—Dehra Dun (Indian operations, 1904)	979·063
Potsdam—Jalpaiguri (Hecker, 1905) Jalpaiguri—Dehra Dun (Indian, 1905)	979·065
Potsdam—Genoa Genoa—Bombay (Alessio, 1906) Bombay—Dehra Dun (Indian, 1904)	979·059

The probable error of each of these results may be estimated to be between ±0·003 and ±0·005. The agreement between them is therefore better than the probable errors would have allowed us to anticipate.

Commander Alessio's observations in 1913–14, however, give a value of 979·079 for g at Dehra Dun, which differs from the above by nearly four times the probable error.

Alessio's observations were most carefully made with a strong equipment of eight pendulums, and carry great weight. They have not, so far as I am aware, been published in detail as yet, and it is not possible to form a final judgment on them; but in the article in the *Rivista Marittima* quoted by Mr. Oldham, there is a remark which may perhaps indicate a weak point. Commander Alessio says that the comparison of the times of oscillation of the pendulums at Genoa before and after the journey show that certain changes had taken place in the lengths of the individual pendulums, but that fortunately the length of the mean of the eight pendulums had remained absolutely unchanged. If the changes in the individual pendulums were large, and if they, or any of them, took place before the pendulums reached Dehra Dun, then the deduced value of g at Dehra Dun may be burdened with a considerable error.

Whatever opinion may be formed when the whole of the details of Commander Alessio's work are avail-

able for examination, it is clear that the Dehra Dun value of g should be strengthened by a new direct determination of the difference Kew—Dehra Dun.

This could be made by sending the Indian pendulums back to Kew for a further set of observations to be made there, or, if the use of Invar pendulums is contemplated, then the new set of pendulums could be employed for this purpose. It is imperative that the value of g at Dehra Dun should be established so thoroughly as to be unimpeachable.

G. P. LENOX-CONYNGHAM.

Trinity College, Cambridge,
November 29.

THE remarks by Mr. Oldham in NATURE of November 18, p. 665, relating to a suggested variation in gravity, are of great interest. As a result of measurements of g at Melbourne in 1913, a doubt as to the invariability of g relative to that at Potsdam was forcibly borne to mind. The report (Gravity Observations, British Antarctic Expedition, 1910–1913) which gives the results of the Melbourne measurements, has been delayed in the press, but it is felt that there is some evidence in this case of a lack of constancy in the value of g relative to Potsdam.

The problem is discussed in greater detail from another point of view in the Glaciological Report (Wright and Priestley), which is due to appear shortly.

C. S. WRIGHT.

Wey Lodge, Portmore Park, Weybridge,
November 20.

Action of Cutting Tools.

IN the interesting letters by Mr. Mallock and Prof. Coker which have recently appeared in NATURE, some points of importance to the elucidation of the action of a tool when operating on materials have been raised.

Mr. Mallock appears to adhere to the view expressed in his paper of 1881 that the action is simply a phenomenon of shear. H. Tresca, however, two years after Mr. Mallock's paper showed in his classical and extensive "Mémoire sur le rabotage des métaux" (*Mémoires présentés par divers savants à l'Académie des Sciences de l'Institut de France*. Tome 27, No. 1,

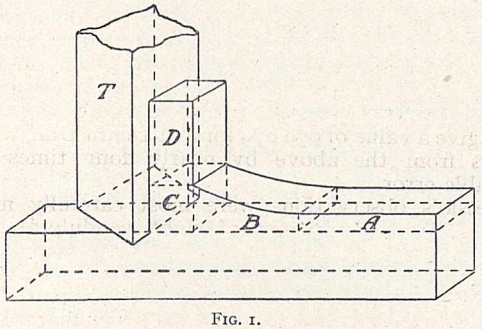

FIG. 1.

1883) that the phenomenon was primarily one of plastic flow. The periodic rupture of the chip which takes place is subsequent to the plastic flow stage and depends upon the nature of the material being operated upon, the angle the tool face presents to the advancing stream of material, and the velocity with which the material moves relative to the tool.

This stage of the action is complex and does not appear to be understood fully. The plastic flow stage, however, is comparatively simple.

In the diagram (Fig. 1) suppose that the tool T presents a plane face square to the advancing material. The portion A, which will ultimately form the chip D, as it approaches the tool begins to flow in region B, which is Tresca's *zone d'activité*. The flow reaches a maximum in the region C from which the chip or jet of metal D emerges, and Tresca in the light of the results of his remarkable and historical investigations on the flow and deformation of solids likens the action to the flow of the metal through a tube of shape ABC with its orifice open horizontally at the top part of C. Since no change in the density takes place the product of the co-ordinates xy (where the origin is at the tool edge) of a point on any surface in B and C continuous with a horizontal plane in A must be constant, so that the traces of these surfaces in the sides and also the free edges of B are hyperbolas.

This zone B can be seen in some of the beautiful photographs of cutting tools published by Mr. J. F. Brooks (Proc. Inst. Mech. Engrs., 1905, p. 365) and more especially in the last photograph of Plate 10. If now vertical lines be scribed upon the sides, the state of affairs during flow of a material which does not rupture for large body-shifts, such as lead, is represented by Tresca in Fig. 2.

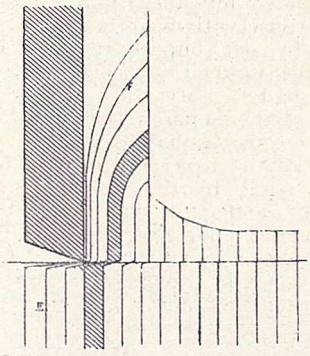

FIG. 2.

Here the maximum slide velocity is at the edge of the tool and in the horizontal plane through the edge. But one of the two important principles enunciated by Tresca is that during flow the maximum shear and maximum slide velocity are co-directional. We should therefore expect the material to rupture along this horizontal plane, and I think this can clearly be seen in Plate 11 of Brooks's photographs of the tool in action on mild steel.

Turning now to Prof. J. T. Nicolson's and Dempster Smith's experiments (*Engineer*, 1905, p. 358) and their diagram of the formation of a chip (Fig. 9), it may be seen that though the diagram is complicated by rupture phenomena and by the fact that the tool is acting on a wedge-shaped part of the forging, Tresca's representation of the plastic phenomena is well substantiated and the maximum shear is clearly seen in the initial stages.

The start of rupture along the horizontal plane is also clearly shown by Frederick Taylor in his presidential address before the American Society of Mechanical Engineers in 1906 (vol. 28), which is a monumental work on "The Art of Cutting Metals."

The same views are expressed by C. Codron in his extensive series of "Expériences sur le travail des machines-outils pour les métaux," published in the "*Bulletin de la Société d'Encouragement pour l'Industrie Nationale*," 1903–1905.

The second important principle enunciated by Tresca, namely, the maximum shear across any face of a small right six face is a constant = K (Tresca's plastic modulus), together with the one already mentioned, enabled Saint Venant to develop the general equations of plastico-dynamics. If the mathematicians

could concentrate on this subject, they would do industry a real service, for nearly all industrial operations such as punching, shearing, forging, milling, spinning, and, of course, the turning of metals, are plastic flow phenomena.

During experiments I carried out with heavy lathes in 1908 for the purpose of finding the most economical high-speed steel to use, I encountered some chips which were not only straight but actually presented concavity to the tool face, and I have one of these chips now. They were produced at very high speed on steel, and are mentioned in the discussion of a paper read before the Siemens' Stafford Engineering Society in 1908 (Proc., vol. 1, p. 93), on "The Plastic Deformation of Solids."

Brewster's beautiful photo-elastic method and Professor Coker's important applications of it enable the stresses during *elastic* strain of the tool and material in the region A to be computed, but Taylor, in the work cited, has shown how a tool should be forged and supported on the saddle to give it maximum life and maximum strength.

Unfortunately for engineering industry in this country, nearly all lathes are built with the vertical space between the upper surface of the tool rest and the line of centres far too small to enable Taylor's important conclusions to be put into practice.

ALAN POLLARD.

Imperial College of Science and Technology,
November 29.

I GATHER from Mr. H. S. Rowell's letter published in NATURE for December 9 that, while interested in the subject of the flow of metals in shavings, he is not altogether familiar with the work that has already been done on the subject. In a comprehensive "Mémoire sur le rabotage des métaux" (which cannot be so well known as I have hitherto believed) published more than forty years ago, M. H. Tresca investigated the question of the curling of shavings, both experimentally and mathematically, the actual flow of the metal (expressed by a *coefficient de réduction*) being especially selected for study under very varied conditions. The following quotation indicates only part of the scope of the work: "Ces phénomènes sont aussi ceux dans lesquels, pour la première fois, les métaux les plus durs, tels que l'acier, le fer, se comportent en réalité comme le plomb, comme le savon, comme le cire, nous dirions presque comme les liquides, tant est complet le rapprochement que l'on doit faire entre les rides de nos différents copeaux et de véritables vagues de métal."

The memoir is published as one of the "Mémoires présentés par divers savants à l'Académie des Sciences de l'Institut de France," tome xxvii., 1883. Those familiar already with the beauty of the results obtained will pardon this effort to direct the attention of others to the work.

E. N. DA C. ANDRADE.

Artillery College, Woolwich,
December 11.

The Secondary Spectrum of Hydrogen.

SINCE the negatively charged hydrogen atom is known to exist, from work on positive rays, it seemed likely that Silberstein's particular solution of the three-body problem, applied by him to the case of neutral helium (*Astrophys. Jour.*, September 1922) should also be applicable in this case. Consequently the formula used by him was modified so as to apply to hydrogen (charge E instead of 2E, and hence N instead of 4N), and also a small but important correction was made to the value of N so as to take account of the fact that with two electrons instead of one, the correction to the mass of the electron for the finite mass of the nucleus is no longer the same.

It was assumed as a first approximation that the electrons would be arranged antipodally, and consequently the forces would be again central. So Curtis's value of N for hydrogen was corrected so as to apply to a nucleus of infinite mass:

$$N_\infty = N_H\left(1+\frac{m}{M}\right).$$

Frequencies were then calculated from the formula

$$\nu = N_\infty\left(\frac{1}{n_1^2}+\frac{1}{n_2^2}-\frac{1}{m_1^2}-\frac{1}{m_2^2}\right).$$

These frequencies were then sought for in the secondary spectrum of hydrogen; it is known that negatively charged atoms are to be found in hydrogen at fairly high pressures with intensity quite comparable with that of the positively charged atom ("Rays of Positive Electricity," p. 39). As a result it was found that 47 lines in the secondary spectrum agreed with the calculated values within an absolute error of one unit of frequency, taking integral values of n_2 and m_1 from 1 up to 10, and values of m_2 from 1 to 15, while n_1 was taken as 2 and 3.

This means that the frequencies can be looked on as a kind of "summation tone," being the sums of a Balmer or a Paschen frequency and a frequency in the infra-red.

It was also found that in several cases a physical similarity of behaviour was common to "series" of the lines grouped according to the *m's* and *n's* concerned, though this was not exclusively true. As a standard of reference for the observed frequencies the values obtained by Merton and Barratt (Phil. Trans. A, 1922, pp. 388-400) were employed.

As typical may be given the following:—

Formula.	Calculated.	Observed.	Error dv.	Character.
$\frac{3\cdot9}{2\cdot6}$	16934·9	16934·51	+0·39	2++CD
$\frac{3\cdot10}{2\cdot6}$	17192·3	17192·14	+0·16	6++CD++HP+He
$\frac{3\cdot12}{2\cdot6}$	17527·6	17527·47	+0·13	3++CD+HP ++He
$\frac{3\cdot13}{2\cdot6}$	17638·8	17639·89	−1·09	0++CD ++He
$\frac{6\cdot6}{3\cdot3}$	18289·8	18288·26	+0·54	0
$\frac{6\cdot8}{3\cdot3}$	19623·4	19622·74	+0·66	0+He
$\frac{6\cdot10}{3\cdot3}$	20240·7	20240·71	−0·01	3 +LP

In the foregoing table, the figures in the last column refer to intensity and the symbols to the physical properties of the lines as given by Merton and Barratt (*loc. cit.*).

It is hoped to complete these and similar calculations shortly and also to investigate the conditions under which these lines should be enhanced.

A. C. MENZIES.

Physics Laboratory, The University, Leeds,
December 8.

Science and the Empire.

THE admirable sentiments expressed in the leading article in NATURE of December 16 will undoubtedly be re-echoed by every scientific worker in the country. In stating, however, that the British Science Guild is the only organisation which exists to undertake the propaganda work "for the extension of an understanding of the influence of scientific research and its results," the very effective propaganda which is being carried out by scientific workers themselves under the

ægis of the National Union of Scientific Workers is overlooked.

Of this body you say "it is a Trade Union affiliated, we believe, to the Labour Party, and it exists to secure suitable conditions of work and payment for its members rather than for the extension of natural knowledge." In that statement truth and error are intermingled. The National Union of Scientific Workers is a registered Trade Union; it registered as such when industrial and Civil Service joint councils on the Whitley plan were being set up and when it was announced that none but members of Trade Unions would be given representation on those bodies. The Employers' Federations registered as Trade Unions also and for the same reasons. But the National Union of Scientific Workers is not affiliated to the Labour Party or to any political party; it has no political funds, and it imposes no restraints upon the political activities of its members, three of whom stood for Parliament at the recent election, one in the Conservative interest and the other two as Labour candidates.

Again, while it is true that the National Union of Scientific Workers exists to secure suitable conditions of work and payment for its members—and all other scientific workers incidentally—it considers that the best way to do this is by raising the professional standard of scientific workers by improved training and education, and making them aware of their importance as citizens on one hand, and on the other, by pointing out to employers and captains of industry that it is an economy to employ the best scientific workers, to encourage research, and to assist the universities. In order to persuade private employers, corporations and governing bodies to deal justly with scientific staffs, it is true that the Union would be prepared to follow the methods employed by such bodies as the British Medical Association; but it believes with the British Science Guild that the attitude of the general public towards science is due to ignorance or apathy. Accordingly, it puts propaganda efforts, designed to cure these diseases, in the forefront of its programme, hoping thereby to increase the demand from industry and the State for the best scientific knowledge. It is ready to co-operate with any other body for this purpose, and to assist any political party with its advice on matters appertaining to science and scientific workers. It believes, however, that scientific workers themselves must be their own propagandists, and that the first step towards really effective action is unity in the profession of science.

A. G. CHURCH,
General Secretary.

National Union of Scientific Workers,
25 Victoria Street,
Westminster, London, S.W.1,
December 18.

[THE National Union of Scientific Workers is an occupational organisation; therefore its propaganda efforts, useful as they are, are naturally regarded by the public as arising from self-interest. The British Science Guild, on the other hand, requires no technical or other qualification for membership; and, as was pointed out in our article, it bears the same relation to scientific workers that the Navy League does to the Royal Navy. It seems to us that a body of this type, in which citizens engaged in many and diverse departments of national life are concerned, can afford much more effective and disinterested support of science than is possible by any group consisting of members of the profession alone. That was the main point of the article to which Major Church refers, and we see no reason to depart from it.—EDITOR, NATURE.]

The Hermit-crab (*E. bernhardus*) and the Anemone (*C.* (*Sagartia*) *parasitica*).

IN NATURE of December 2, p. 735, I described observations and experiments on the common hermit-crab (*E. bernhardus*) with its messmates, the anemone (*C.* (*Sagartia*) *parasitica*) and the polychæte worm *Nereis fucata*. By the kindness of Mr. Hugh Main, it has been pointed out that the observations mentioned above with regard to the natural position of the anemone confirm those of J. Sinel (p. 39, "An Outline of the Natural History of our Shores," 1906). Sinel states that "the woodcuts that appear in many text-books—even our high-class ones—which represent this anemone and its congener, are in one respect incorrect. The anemone is always represented as upright—palm-tree like—on the top of its equipage, as if its chief object were display—or a ride. . . . I have invariably found the anemone affixed to the rear of the shell and in such a position that when the hermit is at a meal or even moving about, the margin of the tentacles just touch the ground, like some patent sweeping-machine. It, no doubt, finds this position a paying one."

Sinel's unique and fascinating book contains a fund of information hidden away in a popular description of natural history on the shore. It is plain that, owing probably to the popular character of the book, many naturalists have passed over important original observations described therein by Sinel, whose knowledge of the biology of the shore has probably never been equalled.

Sinel's observations were previously unknown to me, but the agreement in the two sets of independent observations is valuable in opposing a traditional error, and will be sufficient to establish the correctness of the interpretations; the natural position of the anemone on the hermit-crab was clearly first shown by Sinel.

J. H. ORTON.

Marine Biological Laboratory,
Plymouth, December 13.

Winter Thunderstorms.

MAY I through your columns again ask for reports of thunderstorms occurring in the British Islands between January 1 and March 31? With the help of your readers and of observers of the British Rainfall Organization I was able to collect a mass of information on winter thunderstorms for 1916, 1917, 1918, and 1920, from which it appears that on more than 40 per cent. of the days in question, thunderstorms occurred somewhere in the British Islands. In collaboration with the Meteorological Office I propose to collect information again. The chief points to be noticed are the times at which the storms occur, and especially the times of passage of such storms as pass overhead; whether a severe storm or whether there are only one or two flashes of lightning or only one or two claps of thunder; whether there is a change of wind or a drop of temperature with the storm; whether there is rain, hail, or snow; in the case of lightning seen at night the direction in which it occurs; and any other information the observer thinks of interest. Reports are wanted especially from the west and north of Scotland, and from the south-west, west, and north-west of Ireland, but any information however slight from any district in the British Islands will be of great use to the investigation. Reports should be sent by postcard or letter to my address (not to the Meteorological Office).

C. J. P. CAVE.

Stoner Hill, Petersfield, December 20.

The Corrosion of Ferrous Metals.

IN 1916 a committee was formed by the Institution of Civil Engineers under the chairmanship of the late Sir William Matthews, with sixteen members of the Institution to investigate the "Deterioration of Structures exposed to Sea Action." The project was, in the first instance, submitted to the Department of Scientific and Industrial Research, which gave it every encouragement and promised the committee substantial financial assistance which has already amounted to several thousand pounds.

An important part of the committee's investigations is that connected with the corrosion of iron and steel structures exposed to sea action. In an exceptionally well-illustrated paper, read before the Institution of Civil Engineers on April 4, 1922, Sir Robert Hadfield gives a detailed account of the progress of the work down to that date.

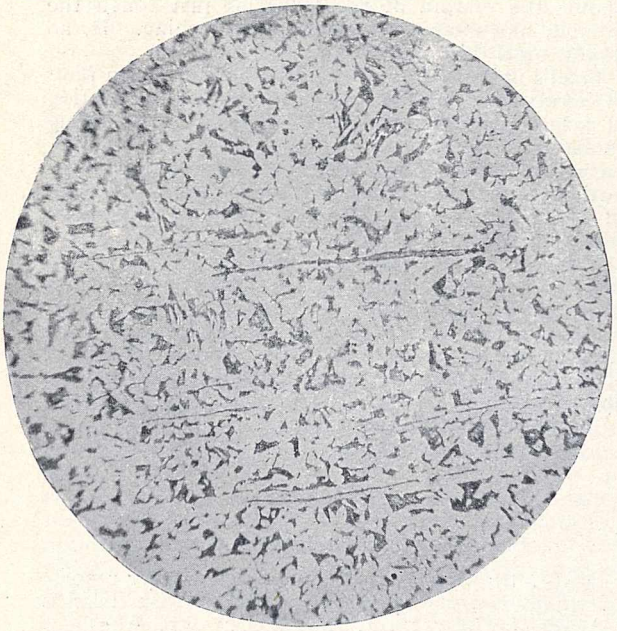

FIG. 1.—Mild steel (with 0·7 per cent. manganese). Longitudinal section × 100 (untreated).

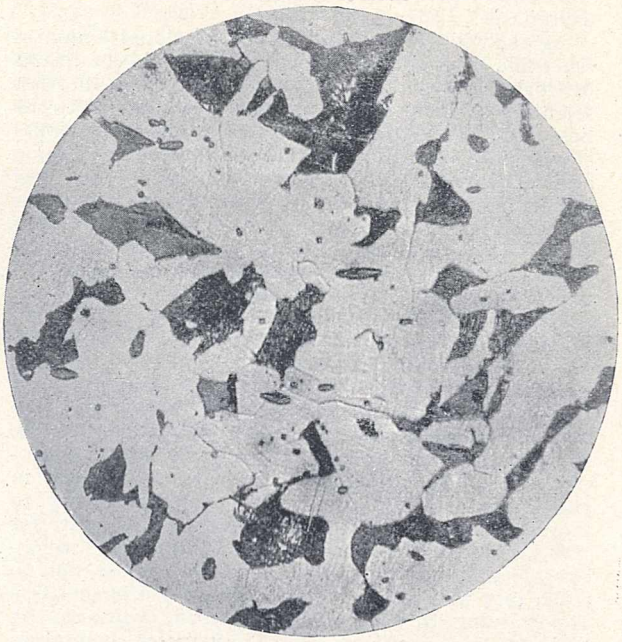

FIG. 2.—Mild steel (with 0·7 per cent. manganese). Transverse section × 600 (untreated).

The committee decided to expose fourteen types of ferrous material to sea action in various parts of the world and to determine by quantitative measurement their relative powers of resistance towards corrosion. The metals comprised "Armco" iron, Swedish charcoal and wrought irons, four types of carbon steel, cupriferous, nickel and stainless steels, and two samples of cast iron, cold and hot blast respectively. With the exception of the cast irons, the various metals were prepared in the form of rolled plates measuring 24 inches in length, 3 inches in breadth and 0·5 inch in thickness. The cast irons were of like dimensions, and were prepared by casting in the ordinary way. No further heat treatment was accorded the metals, for the committee considered that the tests would be of a more practical character if carried out with the metals in a condition resembling as closely as possible that obtaining in constructive work. In general the specimens were allowed to retain their outer skin of oxide, normally present on the rolled or cast metals; in two cases, however, additional specimens were prepared from which the skin was removed by grinding, in order to obtain information as to the effect of oxide layers upon the corrodibility of the metal.

Specimens of all the metals were subjected to various mechanical tests, such as the Izod and Frémont shock tests, and the Brinell hardness test. Tensile tests were carried out on bars cut in the longitudinal direction. Save in the case of the cast irons the bars were marked at regular intervals along their lengths, and, after pulling, their elongations from point to point were carefully determined. This was done in order to ascertain the effect of strain upon the corrodibility of the metal, the intention being to cut small test pieces from different parts of the strained bars and subject them to laboratory corrosion.

A duplicate set of tensile test bars, machined ready for testing, was prepared for immersion in that condition in the sea at Plymouth. After a prolonged exposure they will be removed and examined with the view of determining whether or not the mechanical qualities of the material are impaired. Very little work has been carried out on this aspect of the subject and the results obtained should prove of particular interest and value.

In addition to the foregoing, one bar of each material, excepting the cast-iron specimens, was suitably heat-treated in order to obtain test-data representing the physical properties of the materials under optimum conditions. The results obtained are detailed in the Appendix to Sir Robert Hadfield's paper and illustrate in a striking manner the enormous superiority in every

way of the heat-treated over the untreated metal. One illustration will suffice. In the case of mild steel, containing 0·25 per cent. carbon and 0·7 per cent. manganese, the yield point was raised by the heat treatment from 22·2 to 30·5 tons per square inch; the maximum stress from 33·5 to 42·8 tons; while the Brinell Ball Hardness Numbers rose from 145 to 197.

Needless to say, all the metals have been subjected to careful chemical analysis, and both the treated and untreated specimens have been studied photomicrographically, horizontal and longitudinal sections having been prepared of all the metals save the cast irons. This was rendered desirable in view of the fact that all the wrought irons and steels had been rolled. The longitudinal sections were taken at 100 diameters magnification, this being regarded as particularly suitable for examining the elongation of crystal grains due to rolling; the transverse sections were photographed at 600 diameters. Fifty-four beautiful reproductions of the photomicrographs are given in the paper, and four of these are reproduced in these columns through the courtesy of the Institution of Civil Engineers.

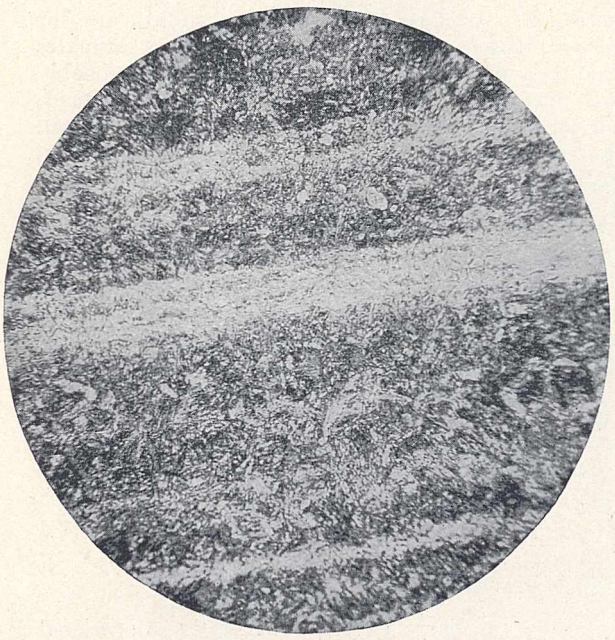

FIG. 3.—Mild steel (with 0·7 per cent. manganese). Longitudinal section × 100 (treated 900° water : 700° water).

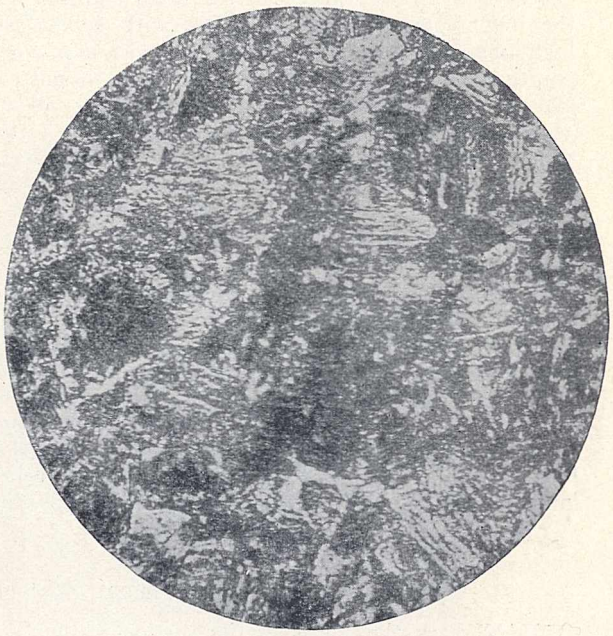

FIG. 4.—Mild Steel (with 0·7 per cent. manganese). Transverse section × 600 (treated 900° water : 700° water).

It is to be anticipated that the microstructure of the metals will play an important part in their powers of resistance to corrosion. Correlation of the micrographs and mechanical tests reveals several interesting features. In so far as the wrought irons are concerned, the heat treatment, by reducing the grain size, distinctly improves the shock test figures. The effect of heat treatment on the carbon steels has been, in the main, in the direction of preventing the marked separation of ferrite and pearlite, such as exists in the bars as rolled, and thus to produce a more homogeneous structure. This is well illustrated in the accompanying photographs.

This serves, in a large measure, to account for the better shock test results obtained with the treated material. It is calculated that in one of the mild steel specimens the number of grains per square inch is 820,000, while, when heat-treated, including quenching, the ferrite grains number about 5 million per square inch. This gives an idea of the closeness of the structure and the greater homogeneity produced by suitable heat treatment.

The necessary bars having been prepared, the committee were now faced with numerous problems connected with their despatch to various parts of the world, namely to Plymouth, Auckland, Colombo, and Halifax (Canada). One of the most difficult of these was the method of marking the bars. In view of the possibility in some instances of very severe corrosion, there was a distinct probability that any ordinary marking would be obliterated. It was intended that, when exposed to corroding influences, the two ends of the bars should be firmly embedded in concrete in a special frame erected for the purpose. Although a precise record would be kept of the position of each specimen in the frame, which would serve as some protection against mixing, there was the further danger that badly corroded bars might fall out of place and their identity be lost. The difficulty was eventually overcome by an ingenious system suggested by Mr. Maurice F. Wilson, a member of the committee, and now the chairman. The method consists in having one, two, or three holes drilled through the plates at both ends where they will be preserved by the enveloping layers of concrete. The holes are drilled in different positions; those at one end give what is termed the "classification letter" and indicate the type of metal, whether, for example, it is Swedish iron or cupriferous steel. At the opposite end the holes indicate the number of the bar.

In order to determine the effect of strain and of contact of dissimilar metals a few bars were bent at

right angles, others were fitted with ordinary rivets and bolts, while others were bolted one to the other. When all the bars had been carefully weighed they were packed in tin-lined cases and despatched to their respective destinations. The committee arranged that, at each place, one set of bars should be completely immersed in sea water; one immersed at half tide level, thereby becoming alternately wet and dry; and one set should be exposed to the sea air only.

When this comprehensive piece of research work is completed, the results should be of the greatest value not only to engineers but to all concerned in the use of ferrous metals.

Sir Robert Hadfield also gives an interesting account of the employment by the Admiralty of stainless steel during the war. Considerable difficulty had been experienced in consequence of the rapid corrosion of the diaphragms used in connexion with submarine hydrophones, which were put out of service in a comparatively short time. Messrs. Hadfield submitted experimental diaphragms of steel containing about 36 per cent. of nickel, and others of steel with a 12 to 14 per cent. chromium content. The latter alloy, the so-called "stainless steel," quickly proved its superiority, and was finally employed for the hydrophones. Although the nickel steel was very resistant to corrosion, its acoustic properties were not so good. These depend not only on the hardness of the metal but also upon its elastic limit, in both of which points the chromium steel was the superior. The diaphragms were placed in the hull of the submarine several feet below the water line, and it was noticed that although the surrounding plates of ordinary steel were soon covered with barnacles the chromium steel was entirely free. One of the diaphragms, after having been immersed in sea water under service conditions for six months was found to have undergone practically no alteration. A small film of a dark-brown deposit was noticed patchwise here and there on the surface, but this was easily rubbed away with the finger, revealing the bright metal beneath.

One diaphragm did manifest local corrosion, and a photomicrographic examination revealed a coarse grain due, in all probability, to over-heating. A portion was suitably heat-treated and restored to a normal condition, after which it showed the usual full resistance to corrosion.

As this chromium steel is one of the metals employed by the Corrosion Committee in their programme of tests, it will be particularly interesting, in view of the foregoing results, to see how this metal behaves.

In conclusion Sir Robert Hadfield very rightly directs attention to the economic importance of the problems of corrosion. Accurate statistics on the subject are, for obvious reasons, unobtainable, but Sir Robert estimates that the annual cost of wastage due to rusting is probably well over 700 million pounds sterling, this sum including an estimate for the cost of galvanising the metal, and allowance being made for painting, sheathing, etc., all of which processes would usually be unnecessary if the metal were not so prone to oxidise.

One feature of this estimate deserves special attention. The amount of the annual production of iron and steel by no means represents an equal increase in the world's stock of these materials. The quantity swallowed up merely in replacing wastage is enormous. We unite with the author in the hope that his memoir "will arouse still more attention than the subject has received in the past, and will create greater interest in the production of alloy steels, which have the capacity of resisting corrosion, if not entirely, at any rate to a much greater extent." J. N. F.

The American Museum of Natural History.

THANKS to the ideals of its president, the enthusiasm of its staff, and the abundant illustrations, the reports of the American Museum of Natural History are always interesting reading, and that for 1921 forms no exception. Indeed the president, Prof. H. F. Osborn, lays particular stress on this report, and he has reissued certain pages of it in a neatly bound booklet under the title of "The American Museum Ideal." That ideal he expresses in the words of Francis Bacon: "a model of universal nature made private. . . . A goodly huge cabinet, wherein whatsoever the hand of man by exquisite art or engine hath made rare in stuff, form, or motion; whatsoever singularity, chance, and the shuffle of things hath produced; whatsoever nature hath wrought in things that want life and may be kept, shall be sorted and included."

In short, the American Museum is become a world museum, and to that end it is sending out its explorers all over the world to gather and compare both for the benefit of Americans and for the benefit of every country which they may visit. Acknowledgment is made of the cordial co-operation which the American Museum receives from the Governments and scientific institutions of all those countries, while at home, thanks to the large development of the educational side of its work, the museum continues to enjoy strong support from the city government. By the latter at the end of last year the sum of 1,500,000 dollars was unanimously voted for the erection of two new sections of the building as originally planned in 1875. There is also under consideration, as previously noticed in NATURE, a special school service building to be devoted exclusively to school education in all its grades.

Prof. Osborn's ideal, however, goes far beyond this. He says, "It is evident that astronomy will be the central feature of our plans, because all the processes of earth's history and all the processes of life centre around original astronomic causes." Plans for an astronomical hall have already been drawn up and published, and have been confirmed by the trustees. All that is wanted is the money. It is estimated that the buildings when finished will cost not less than 9,000,000 dollars, and Prof. Osborn calls for a new general endowment of 2,000,000 dollars. This latter, he says, will not only restore the museum to its full-time efficiency, but will enable it to prepare to keep its promise to the city government; and when its Asiatic and Oceanic sections are completed the museum will be able to fill them with the specimens now in store, including many

large groups already prepared and others awaiting preparation.

The large amount of space, and consequently money, that is required is partly due to the plan on which the American Museum of Natural History is arranged. Our own Natural History Museum has its exhibited collections arranged on a systematic or classificatory basis, but in the American Museum the basis is faunistic or geographical, and an even more serious attempt is made to display the animals in associated groups and under their natural conditions. One of the most striking exhibits illustrated in the present report is an African elephant group (Fig. 1) opened to the public during the past year. This includes a male, a female, a young one, and a baby elephant, each in a different and characteristic position, and all together forming an impressive assemblage. This is the result of eleven years work by Mr. Carl E. Akeley, who went to Africa in 1909 to collect the material, and has since been developing and putting into effect a new method of mounting. No sooner was this finished than Mr. Akeley again left for Africa, where he has secured five fine specimens of the gorilla from the Lake Kivu District of the Belgian Congo. Another interesting exhibit consists of models of the marsupial frog of North America, Ascaphus, a primitive member of the Discoglossidæ. This frog lives only at high altitudes among the Olympics and other western mountains. A number of specimens were sent alive to the museum by shipping them in a device allowing water to drip continually upon them. They were thus kept alive nearly five months, while studies were conducted upon them. The extinct vertebrates form an important section of the American Museum, and reference is made to many new reconstructions and exhibits. A complete series illustrating the evolution of the horse is being prepared. This section of the report is illustrated by a photograph of Erwin S. Christman at work upon the model of Brontotherium. We regret to read that Mr. Christman, who had been connected with the department from boyhood as draughtsman, artist, and sculptor, died on November 27, 1921. Another illustration represents a vigorous wall-painting, by Charles R. Knight, of the vertebrates found in the asphalt deposit at Rancho La Brea, and includes the sabre-tooth tiger, ground sloth, Columbian mammoth, and an extinct vulture.

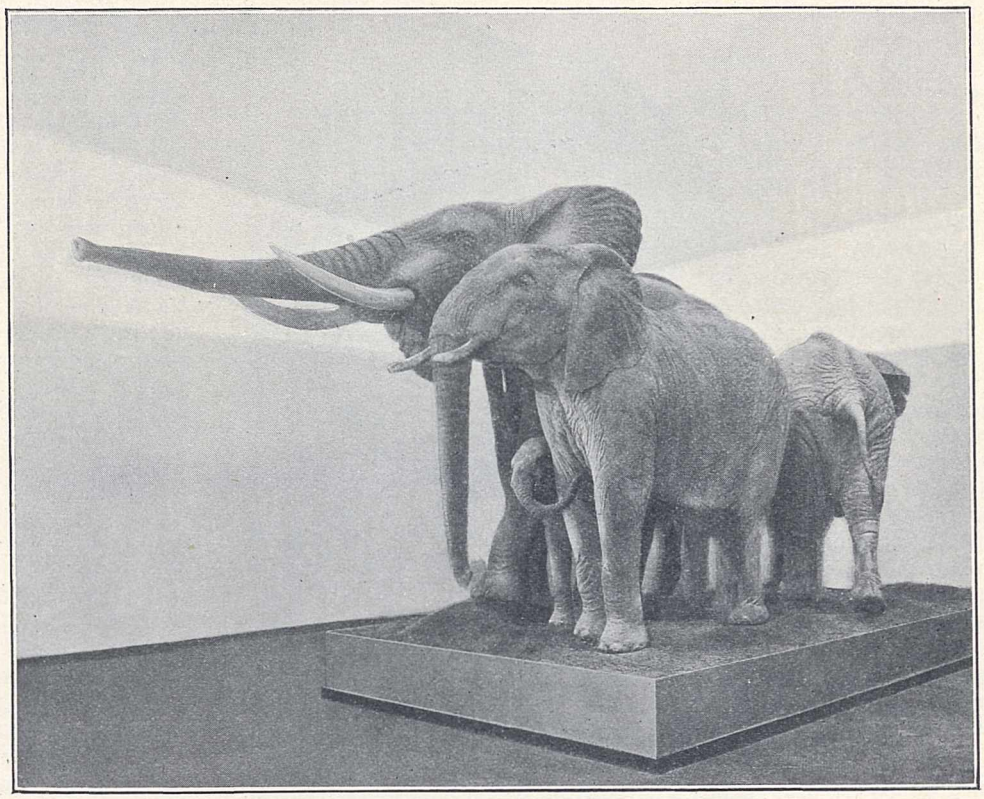

FIG. 1.—African elephant group in the American Museum of Natural History.
(From a photograph kindly supplied by the Director.)

Space does not allow us to comment on the very interesting reports from all the other sections of the museum, but we may remind our readers that the building serves as a centre for a large number of societies. So many as forty-three are mentioned as having held meetings, exhibits, or lectures at the museum during 1921. In addition to these the museum was the headquarters of the second International Congress on Eugenics, which Prof. Osborn considers to be the most important scientific meeting ever held in the museum. It was attended by leading eugenists from all parts of the world, and a special exhibit of genetics and racial heredity was prepared for it. Many members of the congress visited the museum to study this exhibit, and it is satisfactory to learn that

the newspaper press of the United States ended by according to the work of the meeting serious and satisfactory treatment. We commend this report to any one who wishes to learn in a pleasant and easy manner of the extensive and varied work that is carried out by a modern museum, and to those museum curators who may desire inspiration in their daily labours.

Presentation to Sir Edward Sharpey Schafer, F.R.S.

RATHER more than a year ago the suggestion was made that the Edinburgh meeting of the British Association would form a fitting occasion for the presentation to Sir Edward Sharpey Schafer of some token of their esteem from his present and past demonstrators and fellow research workers in London and Edinburgh. As so many of those who had been trained under Sir Edward now occupy posts in distant lands it was found impossible to make the necessary arrangements for the presentation at that early date.

Prof. Halliburton, however, made a statement at one of the largely-attended meetings of the Physiology Section of the Association, expressing the desire of all who had been associated with their old master in the prosecution of physiological research to present him with some mark of their esteem and affection, and indicated the form it would probably take.

Finally, it was arranged that the presentation should take the form of a full-sized plaque (Fig. 1), and that a medal replica should be presented to each of the many subscribers. The medal shows in bold relief the head and shoulders of Sir Edward, and bears on the reverse the inscription :—

Sodali bene merito
Sodales bene volentes
MCMXXII

[Photo by Drummond Young.]

FIG. 1.

The work was entrusted to Mr. C. d'O. Pilkington Jackson, A.R.B.A., sculptor, and has been carried out in an eminently satisfactory way. It is most artistic and, moreover, an excellent portrait. The large bronze plaque from which the medal was reduced has been mounted on stone, with the inscription underneath it (Fig. 1). Sir Edward feels that it should eventually come to the University of Edinburgh, but at present it remains in the sculptor's studio as he wishes to exhibit it at the Royal Scottish Academy.

The large list of subscribers includes many of the leaders in physiology and other branches of medical science in this and other lands, a few of whom may be named—Bayliss, Rose Bradford, Halliburton, L. Hill, MacWilliam, Mott, Starling, in this country; and Hunter and Tait (Canada), Jolly (S. Africa), Malcolm and Mackenzie (New Zealand), Addis and S. Simpson (U.S.A.), Row (India), Itagaki and others (Japan). Among the original subscribers were two of great distinction who have unfortunately passed away—A. D. Waller and Benjamin Moore.

The recognition of Sir Edward Sharpey Schafer's invaluable services to physiology by those who have worked with him in the laboratory is a matter for sincere congratulation in which all who have the interests of the development of medical science at heart will join. All will unite in expressing the hope that he has still before him many years in which he will continue his life-work.

Obituary.

F. B. BRYANT.

WE regret to record the death, on November 28, at the age of sixty-three, of Mr. Frederick Beadon Bryant, formerly Inspector-General of Forests to the Government of India. Mr. Bryant received his professional training at Nancy, joined the Indian Forest Service in 1881, and was posted to the North-West Provinces and Oudh. Some of the earlier years of his service were spent in the preparation of working plans for the important sub-Himalayan forests lying between the Ganges and the Sarda rivers. This early training, together with some years of successful executive work in his province, marked him out subsequently for the

post of Assistant Inspector-General of Forests and Superintendent of Forest Working Plans, which he held for three years from 1896. After holding successively the posts of Conservator of Forests in the Punjab and Burma and Chief Conservator of Forests in Burma, he became Inspector-General of Forests to the Government of India, an appointment which he held from 1908 till 1913, when he retired from the service of Government. Mr. Bryant succeeded to this post at an important period in the history of his department. The Forest Research Institute at Dehra Dun had been established two years previously on the initiative of his predecessor, Mr. (now Sir Sainthill) Eardley-Wilmot. It fell to Mr. Bryant to guide the destinies of the Institute in its earlier years, and his handling of this task was marked by sound common sense and careful judgment. A man of cheerful personality, he made a popular chief, and enjoyed to an unusual extent the goodwill of his department. In recognition of his services to Government he was awarded the C.S.I. in 1911. He is survived by a widow and grown-up family, to whom we extend our sympathy. He had the misfortune to lose one of his sons on active service during the war.

M. E. BOUTY, professor of experimental physics at the Sorbonne and member of the Academy of Sciences, died in Paris on November 5 in his seventy-seventh year. To the present generation of physicists in this country he was probably best known as the editor of the *Journal de Physique* and of the *Annales de Physique*, but to those of thirty or forty years ago he was the joint author of a text-book on physics much appreciated by all who wished to keep themselves up-to-date—the "Cours de physique de l'École Polytechnique" and its supplements. His principal published researches deal with problems connected with the passage of electricity through liquids and gases, but these memoirs by no means represent the whole of his work in the field of research. He succeeded in building up a school of research at the Sorbonne, and much work published by his pupils owed its inspiration to Prof. Bouty.

THE death, on December 10, is announced of Mr. Edward Degen, sometime of the staff of the British Museum and the Melbourne Museum. Mr. Degen was born in Basle in March 1852, and was educated in Basle and Paris. He travelled extensively and collected zoological material in West Africa, Uganda, Abyssinia, and Sakhalin. He was an expert taxidermist and had paid considerable attention to the moulting of birds, and to vertebrates generally. He was a Swiss and a citizen of Basle.

Current Topics and Events.

IT is stated by the Paris correspondent of the *Times* that the centenary of Pasteur was celebrated officially during the afternoon of December 26 at the Academy of Medicine. The French Minister for Health, M. Paul Strauss, was present, and a number of eminent medical men spoke on Pasteur's life and work. The Under-Secretary of Posts and Telegraphs has approved a design, showing a profile of Pasteur's head, for a special fifty-centimes postage stamp to be issued during the coming centenary celebrations.

IT may be remembered that, early in the present year, a proposal to prohibit the teaching of evolution in the schools of the State of Kentucky failed to pass the State legislature by one vote. In an article which appeared in NATURE of May 27 (vol. 109, p. 669), the opinion was expressed that further agitation with the same object might be looked for in the near future. That this apprehension was but too well founded appears by the fact that a "State-wide meeting of protestant ministers" in Minnesota has lately passed resolutions demanding that "the State shall prove its impartiality toward its citizens by dispensing with a subject (*i.e.* evolution) that is utterly divisive [*sic*]; and is, in the judgment of thousands of its taxpayers, utterly false." A reason given for this remarkable action is that "this hypothesis . . . has increasingly shown itself to be a foe to the Christian faith, denying as it does the veracity of the Scriptures." Such attempts at suppression are completely out-of-date, and the importation of religious intolerance into the question cannot but make the judicious grieve. The Minnesota meeting was perhaps not aware that the Catholic University of Louvain sent a special representative to the Darwin celebration at Cambridge.

YET another appeal has reached us on behalf of the famine-stricken people of Russia, this time from Dr. Nansen's committee by way of the Medical Aid Committee for Sufferers from the Russian Famine. It is addressed primarily to medical men, and, following out, apparently, the principle we have suggested in previous comments on these appeals, of approaching each group or profession on behalf of its co-workers in Russia, it is mainly for the assistance of medical men in Russia. It is stated that the latter, amid thousands of sick and starving people, are helpless for the lack of drugs and medical stores, and medical men here are asked to press for the formation of an international committee on medical relief to fight the effects of the famine. Men of science are needed to attack the sanitary and biological problems with which Russia and, through her, the whole of Europe are confronted. In the meanwhile supplies of medical and other stores will enable Russian doctors to struggle on with their task. Gifts in kind should be forwarded to the Secretary, Medical Aid Committee, 68 Lincoln's Inn Fields, W.C.2; contributions in money to the committee's treasurer at the London Joint City and Midland Bank, 6 Chancery Lane, W.C.2.

THE *Library Journal* for November 1 contains an article by Mr. E. C. Richardson, director of Princeton University Library, entitled "International Co-operation in Intellectual Work." Mr. Richardson refers to the recent appointment by the League of Nations of a Committee on Intellectual Co-operation, and writes with appreciation of the practical utility of three enterprises which this committee will necessarily take into consideration. Mr. Richardson

was present, as an observer, at the Brussels meeting of August 20–22 to consider the future of the great bibliographical undertaking carried on for so many years by M. Lafontaine and M. Paul Otlet. He gives an outline of what he saw at the Palais Mondial at Brussels, where a portion of the former exhibition building is devoted to international co-operation. The building contains not only libraries and card catalogues, but also a permanent exhibition of the activities of all nations and an International Summer University. MM. Lafontaine and Otlet have for years superintended this work, sustained by their zeal, without drawing salaries. Mr. Richardson also attended the Convention of the International Catalogue of Scientific Literature held at Brussels on July 22 and 24. Of this meeting he writes: "Not only were there nine or ten nations represented by official representatives, but several of these showed a very vigorous interest and a disposition to continue contributions and to assist in paying the accumulated debt." Mr. Richardson also visited the Concilium Bibliographicum at Zurich. With the aid of funds secured for the purpose by the American Research Bureau, the work of the Concilium, which had been in abeyance since the death of Dr. Field, has been taken up again vigorously by Dr. Kellogg and the new director, Dr. Strohl. It is expected that printing will be resumed next July. Mr. Richardson believes that, with these enterprises in bibliography in existence, a "Committee on Intellectual Co-operation" should be able to secure that, by a proper division of labour, the bibliography of science should be well and completely executed.

DR. SALAMAN'S address to the Potato Conference at Ormskirk on November 2, which is published in the *Gardeners' Chronicle* for November 25, should prove of permanent value to horticulture, as while pointing out a present abuse it indicates at the same time that the remedy is ready to hand. Dr. Salaman dealt in vigorous language with the habit of seedsmen of listing the same variety of potato under different synonyms, frequently giving different descriptions to the variety upon its successive appearances, and often quoting it at different prices! The horticultural world is obviously concerned with the effect of the practice in commercial horticulture, but the scientific student of horticulture has to remember this ever-present source of error when he has to rely upon commercial firms for the supply of material in the form of cultivated plants for study or experiment. Fortunately the careful work now in progress at various plant-breeding stations throughout Great Britain, a work which is entirely disinterested from the commercial side of horticulture, is making it continually more possible to check the accuracy of popularly named varieties, not only of potatoes, but also of fruit stocks and scions, cereals, etc. Such work must precede any careful study of such a problem as the behaviour of a variety under continuous vegetative propagation, and bodies like the Synonym Committee of the National Institute of Agricultural Botany, of which Dr. Salaman is chairman, are rendering considerable service to science as well as to horticulture.

IN the Journal of the Washington Academy of Sciences (vol. 12, No. 15), Mr. T. A. Jaggar makes a plea for geophysical and geochemical observatories. Instruments of precise measurement need to be applied to the problems of geology. A record of the changes, for example, in a river system or mountain range, is essential if the processes involved are to be understood and given their due weight in the evolution of the earth's surface features. Geological science is lacking in measured facts of change within human time. The nature of changes may be gauged from temporary expeditions to different localities, but quantitative data can be obtained only by permanent observatories. The expedition method of study is never free from the reconnaissance element, and unexpected phenomena call for special instruments not included in the equipment. Moreover, there are seasonal and cyclic variations which an expedition misses. Mr. Jaggar cites his own experiences at the Hawaiian volcanic observatory as an illustration of how continuous measurement may reveal rhythmic recurrences. He dwells on the nature of the work which might be done by river and mountain observatories. A glacier observatory would be equally valuable.

IT is probable that the most important development of the cinematograph lies in its application to natural phenomena. To be able to make a leisured scrutiny of occurrences so momentary that the eye fails to hold them, is an inestimable gain. Appreciating the importance of such moving pictures, the Selborne Society has recently issued a list of cinematograph lectures ("Cinelogues") and films which, under arrangements made with leading film companies, can be hired on application to the society's Extension Secretary, Mr. P. J. Ashton, 72 High Street, Bromley. The topics dealt with are very varied, including the life-histories and habits of insects, birds, and other animals, both terrestrial and aquatic, the rites and customs of Australian aborigines, the physical properties of water and of air, the solar system, and others in the realm of science, besides a number illustrative of history, English literature, travel, and topography. The selection offered is admirable, and can be unreservedly commended to the notice of schools, societies, and other educational bodies.

WE have already referred in these columns (December 2, p. 743) to the film record of this year's Mount Everest Expedition, which was taken by the official photographer of the expedition, Capt. J. B. L. Noel. The film is now being exhibited at the Philharmonic Hall, Great Portland Street, W., so that all may have an opportunity of seeing this wonderful picture-story; the proceeds are to be devoted to the cost of a third expedition. It is a wonderful and inspiring entertainment. The first part shows the country through which the expedition passed on its way to Mount Everest, and it is ably described by Capt. Noel. The second section deals with monastic life in Tibet, and records the curious ritual dances which the party was so fortunate to see at the Rongbuk monastery at the very foot of Mount Everest. The

dances are performed by Lamas, attired in fantastic costumes and wearing huge masks, who represent the good and bad spirits the devout will meet in the next world; devil dances, dances in which ghouls carry a small dummy representing a dead body, and a procession of the gods, are among the scenes depicted. The whole scene is accompanied by music recorded by Mr. T. Howard Somervell, who has endeavoured to reproduce the actual sound of a Tibetan band. As may be expected, it consists largely of drum and trumpet, but there is a well-marked rhythm, and Mr. Somervell, who conducts the music himself, manages to keep his orchestra fairly well in time with the dancing figures on the screen, producing a most realistic effect. Anthropologists will welcome this record of Tibetan dances and music. The third section of the film shows the actual assault on Mount Everest. The film is described by Mr. Somervell, who formed one of the high climbing parties. Scene after scene of indescribable grandeur is shown. Many portions of the film, such as those showing the final attempts on the summit from the highest camp, at about 25,000 feet, were taken with a telephoto lens. The music played in the interval and during the exhibition of the film by Mr. Somervell is based on Nepalese and Tibetan airs and pastoral music, and some of the tunes provide very beautiful though simple subjects. "Climbing Mount Everest" is more than an entertainment; it is a story of high adventure, of great endeavour, which was robbed of success chiefly by the bad weather encountered in the last stage of the journey.

THE College Board of the London Hospital is offering for competition the Liddle Triennial Prize of 120*l.* for the best essay on "Rheumatic Fever: its Cause and Prevention." The last day for the receipt of essays is June 30, 1923. They should be sent to the Dean of the College, Turner Street, E.1.

THE Foulerton Award of the Geologists' Association for the year 1923 has been given by the Council to Mr. A. S. Kennard, F.G.S. Mr. Kennard was associated with Mr. M. A. C. Hinton in the paper on "The Relative Ages of the Stone Implements of the Lower Thames Valley," and with Mr. B. B. Woodward in the production of several important papers on the Post-Pliocene non-marine mollusca of England and Ireland.

THE international review *Scientia* promises its readers next year "a great international inquiry into the Einstein theories." It proposes as the fundamental purpose, first, to make the theory itself accessible to all philosophically minded persons, whether or not they are mathematicians; second, to submit the theory to an objective, unprejudiced, exhaustive criticism, which, by making clear the weak points in need of revision, shall give them their true value as objections; and third, to endeavour to appreciate the value and importance of the theory and the part it has played in the general progress of science.

THE following awards have been made by the Society of Engineers (Inc.) for papers read or published during 1922:—President's gold medal to Dr. C. V. Drysdale, for his papers "The Testing of Small Electrical Plant"; Bessemer premium to Mr. E. E. Turner for his paper "The Atlantic Cruise of H.M. Airship R 34"; Nursey premium to Dr. Herbert Chatley for his paper "The Physical Properties of Clay-Mud"; Society premiums to A. S. E. Ackermann for his paper "The Physical Properties of Clay" (fourth paper), and to C. H. J. Clayton for his paper "The Economics of Arterial Land Drainage"; W. Dinwoodie for his paper on "Wave Power Transmission"; Clarke premium to R. C. Hill for his paper on "The Submersible Pump"; and Geen premium to A. G. Short for his paper on "Heating."

A SERIES of new charts of the currents of the North Sea is contained in a paper by Dr. G. Böhnecke (Veröfflich. Inst. f. Meereskunde, Berlin, N.F. Ser. A, Heft 10, 1922). The charts are based mainly on a study of the data representing the variations in the salinity of the area in question.

THE Library Press, Ltd., 26 Portugal Street, W.C.2, will shortly publish a work entitled "Fur Dressing and Fur Dyeing," by W. Austin, consulting chemist to the fur industry, which is intended to cover very completely the subjects treated of, and to supply a want felt by workers in the industry.

DR. C. DAVISON has in preparation (for publication in June next if enough copies are subscribed for) "A History of British Earthquakes," in which about 1200 earthquakes in the British Isles from 974 to 1921 will be dealt with. The work will be illustrated by 91 maps and 9 diagrams, and it will cost 32*s.* net. Orders should be sent, with remittance, as soon as possible to the author, 70 Cavendish Avenue, Cambridge.

A BIBLIOGRAPHY of meteorological literature, prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office, is now given as a separate publication for each half-year. No. 2 of the series, which deals with literature received from July to December 1921, has just reached us. This half-yearly issue takes the place of the bibliography previously given in the Quarterly Journal of the Society. The publication has become of considerable value to a small body of workers actively engaged on meteorological research and to others who desire to keep abreast of advances in meteorology. Meteorological science is, without doubt, making considerable advance at the present time, and increased activity is given to the subject by such publications, especially with regard to the many intricacies of the upper air, not only in this country but by most countries the world over.

DR. T. F. WALL thinks that the comment of our engineering contributor, appended to his letter in NATURE of December 16, p. 810, may lead to a possible misapprehension as to wherein lies the novelty of the condenser formed by inserting in

dilute sulphuric acid two lead plates pasted with an oxide of lead—that is to say, using plates of the same nature as are used in secondary cells. The aluminium electrolytic condenser is an electrostatic type of condenser, whereas in the arrangement of pasted lead plates in dilute sulphuric acid the energy is stored in the form of chemical energy, and it is in this respect that the novelty of the new type of condenser appears. "For this reason," Dr. Wall adds, "the term 'electro-chemical condenser' more correctly describes the action of the pasted lead plate arrangement than the term 'electrolytic condenser.'"

THE third edition, recently issued, of the General Catalogue of the Oxford University Press is a volume of 480 pages. Supplementary to the catalogue itself is an alphabetical list of authors and editors extending to no less than 128 pages. A preface gives some interesting statistics, and the activity of the press is illustrated by the fact there stated, that it publishes, in one way and another, more than two books every day. The fifth section of the catalogue deals with books on natural science, including mathematics, physics and chemistry, astronomy, geology, biology, and the history and methods of the sciences. The present volume is more than a mere catalogue; besides giving many bibliographical details—including size in inches, number of pages, and date of publication—it sets out the full contents of books in several volumes and of joint works by several authors. It describes not only all Clarendon Press books, but also all books published by the press for learned societies other than the University of Oxford. The fact that many of these books are in their nature unremunerative affords good evidence of the service rendered by the press to the cause of education and learning.

Our Astronomical Column.

GREAT METEOR OF DECEMBER 6.—This brilliant object passed over Lincolnshire at $11^h\ 40^m$ and illuminated the north-east part of England with remarkable intensity. It was seen so far away as Armagh in Ireland, where the observer considered that its refulgence overpowered the light of the moon. A number of observations have been received, and they indicate that the radiant point was in Taurus at about 56° +8°, and that the luminous flight of the object commenced in the neighbourhood of Grantham; its direction was north-north-west. It passed nearly over Lincoln and Grimsby, and at the latter place its height appears to have been 24 miles. Continuing its course, it fell to about 2 miles in height when a short distance south-east of Hedon, near Hull, and about 2 miles further on probably fell to the ground. No meteorite has, however, been reported as having been discovered up to the time of writing, but such an object might very easily escape detection.

The meteor appeared so late at night that, in spite of its great lustre, it was noticed by comparatively few observers.

STELLAR TEMPERATURES AND PLANETARY RADIATION.—In an earlier communication, Dr. W. W. Coblentz gave estimates of the temperatures of sixteen stars as determined from their spectral energy distribution, which was obtained by means of a new spectral radiometer, consisting of a series of transmission screens and a vacuum couple. By means of these screens, which, either singly or in combination, had a uniformly high transmission over a fairly narrow region of the spectrum and terminated abruptly to complete opacity in the rest of the spectrum, it was possible to obtain the radiation intensity in the complete stellar spectrum as transmitted by our atmosphere. The standard used for comparison was a solar type star α Aurigæ, type Go. Being now equipped for making radiometric measurements of the sun, the effective temperature of which is known with a considerable degree of accuracy, Dr. Coblentz communicates the results of this comparison in the Proc. of the U.S. National Academy of Sciences, Vol. 8, No. 11, Nov. 1922. In this he describes the apparatus and method of procedure. He finds the agreement between the observed temperatures of α Aurigæ and the sun satisfactory, and thus verifies the previous measures of stellar temperatures, which range from 3000° K for red, class M stars, to 12000° K for blue, class B stars. In the case of the planets, Dr. Coblentz differentiates between the thermal radiation as a result of warming by exposure to solar radiation and the heat radiated by virtue of a possible high internal temperature of the planet itself. The planetary radiation he finds increases with decrease in the density of the surrounding atmosphere, and as a percentage of the total radiation emitted he gives the following values: Jupiter 0, Venus 5, Saturn 15, Mars 30, and the Moon 80.

SPECTROSCOPIC PARALLAXES OF B STARS.—Mr. D. L. Edwards read a paper at the meeting of the Royal Astronomical Society in November on the pioneer work on these stars that has been carried out at the Norman Lockyer Observatory, Sidmouth, where 200 negatives have been studied and the intensities of various lines correlated with respect to type and absolute magnitude.

The helium lines at 4472 and 4026 were found to be good indexes of spectral type, and by their aid some gaps in the Harvard series were filled. Line 4472 was found to vary also with absolute magnitude. The measures of the intensities of lines could be made very accurately by noting the point of disappearance in a darkened wedge.

The difficulty in getting absolute magnitudes was that very few trigonometrical parallaxes of B stars had been obtained. It was necessary to use also parallaxes derived from proper motions, and the hypothetical parallaxes already published for many binary stars. In the discussion it was noted that the assumed mass used in getting the latter was twice that of the sun, but that this is probably too small for B stars. The use of a larger mass would reduce the hypothetical parallax. For this and other reasons it was felt that, while there was every reason to believe the method would prove a very useful one, it was advisable to look on the calibration of the curves as provisional. Mr. Edwards used Kapteyn's value, $0''{\cdot}04$, for the parallax of η Tauri (in the Pleiades), but some recent determinations give $0''{\cdot}01$.

It is of particular importance to extend our knowledge of the limits of absolute magnitude of the B stars, since the results will have important bearing on the distances of the globular clusters.

Research Items.

SCIENCE AND PHILOSOPHY.—An article by Sir Oliver Lodge appears in the December number of *Scientia* on "The Philosophy of Science or the Principles of Scientific Procedure." Sir Oliver endeavours to draw a clear distinction between questions which definitely and legitimately belong to science, and those which, though of interest to science, belong to philosophy and cannot be answered by the ordinary methods and procedure of science. The size of an atom is an example of one, the infinity of space of the other. Sir Oliver is quite ready to admit that we can make no sharp separation between our philosophic, artistic, and scientific interests, which are an integral part of human nature and inextricably combined, but he seems to think that on the objective plane we can separate out the different realms and clearly demarcate their frontiers. No one is likely to dispute that there are certain kinds of fact which admit of being investigated with an isolation which is practically complete. What we want to know is whether any fact enjoys its isolation by right and not in consequence of a practical interest on the part of the investigator who contrives it? Some points in the article illustrate how doubtful this is. Sir Oliver attaches prime importance to the æther of space as a scientific explanation; would he class it as a scientific or as a philosophic problem? How can it be discussed without reference to the infinity of space, which is a question the man of science is to leave to the philosopher? Again, as an example of scientific deduction and prediction we are given the discovery of Neptune, but we are not told where to place or how to explain the failure to discover Vulcan.

OAT STRAW AS A CATTLE FOOD.—S. H. Collins and B. Thomas have an interesting paper in the *Journal of Agricultural Science*, vol. xii. pp. 280-286, 1922, upon "The Sugars and Albuminoids of Oat Straw." The authors set out to answer a question that first occupied the attention of one of them twenty-two years ago. "Why can cattle be fattened on roots and straw in Scotland and not in England?" Limitations of time apparently prevented the prosecution of experimental work then, and in the last twenty years there has been considerable development in our knowledge of animal nutrition, so that the authors can now attack with considerable precision the question as to whether the nutrients available in the straw will supplement the deficiencies of grain feeding. The answer appears to be that good oat straw, mainly owing to its relatively high percentage of albuminoids, may well do this, but oat straw has been found to vary in this percentage between 1·12 and 8·05. The low percentages are usually for the straw from the south of England, the high from Scotland; this may be, in part, a question of latitude, but the high figures for Cumberland and Westmoreland, and the values for differently manured crops, lead the authors to think that good husbandry and suitable supplies of organic nitrogen are even more important. These investigations certainly seem to bring the original question appreciably nearer solution. An interesting point in the sugar estimations reported is the fact that the main sugar of the straw appears to be lævulose, while the main digestible carbohydrate constituent of the grain is the dextrosan starch. If the ideal carbohydrate for nutrition be cane sugar, then this is an additional argument for the good straw proving a valuable supplement to the grain ration.

DEEP ROOT SYSTEMS OF CROP PLANTS.—The difficulties attending the study of the root systems *in situ* has led to a comparative neglect of this important branch of research until recent years. Prof. J. E. Weaver, F. C. Jean, and J. W. Crist, in the "Development and Activities of Roots of Crop Plants" (Carnegie Institution of Washington, 1922), are to be congratulated on realising the urgency of this problem. The value of this work is much enhanced by the numerous sketches of actual root systems made during excavation, together with full details of environmental conditions and experimental results. Repeated investigations at various stations indicate that all cereals possess two distinct groups of roots, one spreading in a more or less horizontal direction in the upper layers of soil, and the other penetrating deeply into the subsoil to a depth of six or seven feet. The lower roots are often much branched and appear to be of the normal absorbing type. In potatoes, on the other hand, the original shallow roots turn vertically downwards and form the deeper portion of the system. As a general rule, only the first six or eight inches of soil are regarded as being of much value in plant nutrition, but controlled experiments indicate that these deep roots play a great part in water absorption, as much or more water often being removed from a depth of three feet as from the surface layers. Maize was proved to absorb large quantities of water from the fifth foot. It was similarly shown that such fertilisers as nitrates were freely removed from the lower soil depths, to five feet in the case of maize, and at least two and a half feet with barley and potatoes. Furthermore, when roots came into contact with a fertilised layer they developed more strongly and branched more profusely, and at the same time normal penetration into the soil below was apparently retarded. The depth at which manures are placed in farm practice must therefore have a considerable effect on root development, and surface applications during times of drought may be very detrimental by keeping the roots from penetrating into the deeper layers with greater water supply. The authors conclude that "the deeper soils are not only suited to plant-life, but that they play an exceedingly important part in the life of the plant, and deserve careful consideration in a study of crop production."

BOTTOM-LIVING COMMUNITIES IN THE SEA.—A very full account of the biology of the Danish crustacea, *Gammarus locusta*, and *Mysis inermis*, *flexuosa* and *neglecta*, is given by H. Blegrad in the twenty-eighth Report of the Danish Biological Station (Copenhagen, 1922). The work has interest in connexion with Dr. Petersen's studies of bottom-living communities in the sea. It is not nearly enough that the numbers of animals inhabiting a unit area should be known; some good estimates of the rates of reproduction and the number of generations that occur throughout a year, for example, are necessary if we have to attempt a measure of the productivity of a sea-bottom area. The object of the memoir under notice is to supply some information on these subjects.

MOLLUSCS OF THE COLORADO DESERT.—Dr. S. S. Berry's notes (Proc. Acad. Nat. Sci. Philadelphia, lxxiv. 1922, pp. 69-100) on the molluscs of the Colorado Desert include short descriptions of specimens belonging to eight genera, most of them represented by a single species, but one genus (Micrarionta) is represented by five species, two of which are new. This land snail fauna is confined to the steep mountain slopes, while the fresh-water mollusca are centred

around the relict-covered bed of the ancient lake Cahuilla—*i.e.* the Colorado Desert in the exact original sense of this term. The enormous numbers of shells present in many parts of the valley and the discovery of many of the same species still flourishing in certain of the outlying springs and rivulets have long ago attracted attention to this section of the fauna. A list of papers on the mollusca of the Colorado Desert is given.

ANIMAL ASSOCIATIONS OF SOME CRUSTACEA.—A memoir on the Pontoniinæ—a sub-family of the decapod Crustacea—based chiefly on material in the collection of the Zoological Survey of India, is contributed by Dr. Stanley Kemp to the Records of the Indian Museum (xxiv. 1922, pp. 113-288, 9 pls.). A detailed systematic account of and keys to the genera and species are given, and Dr. Kemp directs attention to the ability shown by members of the sub-family to form associations with other animals. Some are found on sponges, others on actinians, on Alcyonaria, or on corals, a few on star-fishes and sea-urchins, many live on crinoids, a considerable number of species live in the mantle cavity of bivalve molluscs, and some are known from the branchial sac of ascidians. In the case of those which live in the mantle cavity of bivalve molluscs, in practically every example a male and female prawn are found together in the same mollusc, and Dr. Kemp infers that after the prawns are once established in their host they never leave it. A list of the animal associations recorded in the Pontoniinæ is given.

AMERICAN OLIGOCENE MAMMALS.—Mr. W. J. Sinclair has two papers on American fossil vertebrates in a recent number of the Proceedings of the American Philosophical Society (vol. lxi. 1922, with text figs.). The first, treating of "The Small Entelodonts of the White River Oligocene," discusses the relationships of *Archæotherium coarctatum*, Cope, and *A. mortoni*, Leidy, in the light of fresh specimens acquired by one of the Princeton Expeditions. After a careful analysis it is suggested that, so far as the assumed primitiveness of *A. coarctatum* is concerned, every one of its characters which might be regarded as primitive is possessed in some degree by specimens which differ from it in other respects, so that it would be necessary either to name every variant or to refer all to one species for which the name *A. mortoni* would have priority. The other paper, on "Hydracodons from the Big Badlands of South Dakota," distinguishes four specific types:—*H. arcidens*, Cope, *H. nebrascensis*, Leidy, *H. apertus*, sp.n., and *H. leidyanus*, Troxell; and their range in time is shown in tabular form. The distinctions between these species, or possibly subspecies, are based primarily upon structural differences in the upper posterior premolars. No intermediate stages have been observed.

THE LAVAS OF SNOWDONIA.—A marked gap in our detailed knowledge of the igneous rocks of the Snowdon area has been filled by Howell Williams in a recent paper in the Proceedings of the Liverpool Geological Society (vol. 13, part 3, p. 166, 1922). The author deals with the country near and mainly east of Capel Curig, tracing the devitrified rhyolitic lava-flows of Snowdon across the district. Considerable attention is given to alterations due to solfataric action, and the puzzling "bird's-eye slates," with their strings of small ellipsoids of calcite arranged across their bedding, are compared with those of the Lake District, and are attributed to an epoch when carbon dioxide was the principal escaping gas. These unusual rocks are limited to an horizon between the middle and uppermost rhyolites of the Capel Curig suite.

EARTH CURRENTS IN FRANCE.—In *La Nature* (November 25, p. 339, and December 2, p. 355) Dr. Albert Nodon has described a new series of researches upon the electric currents flowing in the earth. An observing station for this purpose was set up in the summer of 1921 near Sauveterre in the Basses Pyrénées; the district is far removed from any industrial electric circuits, being in a wide, well-watered prairie on clay soil, the humidity of which is probably fairly constant; it is therefore well suited in many important respects for such observations. Four overhead wires (the lengths of which are not stated) branch out in directions north-south, east-west, south-east to north-west, and south-west to north-east, from a small observatory. The earth-contacts at the ends of the wires were made by large zinc plates; the contact electro-motive forces from these plates annul one another and appear to have given no trouble. The currents were measured by a milliamperemeter, eye-readings being taken with a lamp and scale; no continuous photographic registration is arranged. The conductivity of the soil in various directions is measured from time to time by applying a known E.M.F. to the wires. Other observations include the earth's horizontal magnetic force, and the intensity of penetrating radiation, the latter being measured by a delicate electrometer in a closed metal case. The currents which flow along the direction of latitude appear to be small and invariable in direction, namely, from east to west; those from north to south are very variable both in direction and magnitude; the currents in the intermediate directions agree with the resultant of the east-west and north-south currents along these directions. The conductivity of the soil appears to vary in parallel with the intensity of penetrating radiation, and also to be augmented when the earth currents are large. Various other correlations, with meteorological and solar phenomena, are indicated, but the results can only be regarded as provisional in view of the short period over which the observations extend.

STREET LIGHTING.—A meeting of the Illuminating Engineering Society, on December 12, was devoted to a discussion on street-lighting. Mr. Haydn T. Harrison, in an introductory paper, pointed out the importance of correct distribution of light and described several devices for improving the natural distribution of illuminants, notably the holophane lantern and the "longitudinal system" for which he himself was responsible. He pointed out that the classification of streets in terms of minimum illumination adopted in the United States agreed closely with that recommended in this country, and urged that "minimum horizontal illumination" was the best basis of specification for public lighting. A contribution by Mr. L. Gaster dealt mainly with street lighting in relation to traffic, and some figures were quoted showing how the diminished lighting in war time had contributed to the increase in street accidents. Experiments in 32 American cities indicated that 17·6 per cent. of accidents occurring at night were due to inadequate illumination. Dr. Clayton Sharp gave an interesting survey of methods adopted in American cities. A feature of such tests has been the utilisation of a length of road for actual experiments with different forms of lamps. Another point, mentioned by Mr. Thomson, chairman of the Street Lighting Committee of the Westminster City Council, is the desirability of arranging lights so as to illuminate the exteriors of important buildings, so as to render them visible by night as well as by day. The advice of architects in considering this aspect of public lighting would be of value.

Weather Cycles in Relation to Agriculture and Industrial Fluctuations.[1]

TWO years ago Sir William Beveridge was led to investigate the problem of weather periodicity from a new point of view, or at least with materials hitherto unused—using wheat prices in past centuries as evidence of harvest yields and so of the weather. The investigation falls into three stages, namely:

(1) Construction of an index of wheat price fluctuation in Western Europe from 1550 to 1869, the index showing the price in each of those 370 years as a percentage of the average price for 31 years of which it is the centre.

(2) Harmonic analysis of this index for about 300 years to 1850 in order to discover periodicity. In this analysis all possible trial periods between 2½ and 84 years in length have been examined and every apparent periodicity has been tested by analysing separately the two halves of the sequence. The result of the analysis is remarkable; not one or two but many distinct periodicities—thirteen or more—are suggested, and the suggestions are confirmed in varying degrees by the discovery of similar periodicities in meteorological records. In view of all the evidence, two of the periods—of 5·1 years (found independently by Capt. Brunt and Mr. J. Baxendell), and 35·5 years (found by Dr. Brückner in 1890)—may be regarded as "certain," though not necessarily the most important. Seven others, with lengths 5·67, 9·75, 12·84, 15·23, 19·90, 54·0, and 68·0 years, are classed as "nearly certain"; all of these show more strongly than the Brückner and many of them more strongly than the Brunt-Baxendell cycle. Four more periods of 3·41, 4·41, 5·96, and 8·05 years are "probable." There are six other "possibilities" including an 11-year period, corresponding in phase and in instability as well as length to the sun-spot period.

(3) Comparison of deductions from this analysis of wheat prices before 1850 with the actual rainfall from 1851 to 1921 on the assumption that the meteorological factor most uniformly adverse to wheat in Western Europe is rain.

For this purpose eleven out of the thirteen "certain," "nearly certain," and "probable" cycles, with the lengths and phases given by harmonic analysis, have been drawn for the years 1851 to 1921 and combined by a simple graphic method. The resulting "synthetic curve" shows a large measure of agreement with the actual rainfall for those years; for the 55 years to 1905 the coefficient of correlation is 0·38 or about five times its probable error. The principal droughts of the last seventy years, including that of 1921, are particularly well shown and so foretold by the "synthetic curve."

This investigation, it is submitted, establishes the existence, importance, and persistence over more than 300 years, of definite periodicities in the yield of European harvests, some or all of which must be attributed to cycles in the weather. It opens up the possibility of valuable forecasts of general conditions. But no such forecasts either as to the year 1923 or any other year are now possible, and Sir William Beveridge makes none. He claims for his investigation nothing more than that it affords a starting-point for more detailed studies; his hope is that competent meteorologists may be encouraged once again and more hopefully to take up these studies.

Mr. R. A. Fisher suggested that a periodicity in yields is not necessarily an indication of a periodicity in weather since it may indicate merely a periodicity of economic conditions. For example, the amount of a farmer's crop is affected by the state of the labour market and the state of his own bank account. Nevertheless, if any considerable and persistent periodicity really exists in the weather, it would be likely to affect the crops and hence their prices with a similar periodicity. The crop data suitable for an investigation of this kind should be obtained, however, not under commercial but under experimental conditions. The figures obtained at Rothamsted differ from those of the Ministry of Agriculture. Detailed examination of these figures and comparison with rainfall records, indicates that rainfall apparently accounts for 30-50 per cent. of the total variation in crop.

Examination of the distribution of the rainfall in each year shows that slow changes in yields seem to be affected only by (*a*) the total rainfall in the year, and (*b*) the excess of summer and winter rain over that in spring and autumn. Between the two latter there is a striking difference. In total rainfall there have been spells of wet and dry years, two wet spells about 35 years apart. But these spells can scarcely account for more than 10 per cent. of the changes in the yields, though they may account indirectly for a larger percentage, *e.g.* by favouring weed infestation. A period of 70 years is not enough, however, to determine periodicity; in any case the quantitative value of the spells is not great, probably less than 7 per cent. of the variation in crop: the remaining 93 per cent. appears to be quite fortuitous. It is here that the weak point occurs in any argument which would make the yield of farm crops to be dependent on the weather.

The change which variation in excess of winter and summer rain over that of spring and autumn causes is more interesting than that caused by total rainfall. Examination of ten-year means reveals a steady increase for the last 70 years with no sign of slackening. The effect of an increase in December rain on the wheat yield is rather striking; on dunged plots, for example, a loss of more than 1½ bushels per acre occurred.

The general result of examining these weather records is that in most features the succession of seasons appears to be wholly fortuitous, and in all features by far the larger part appears to be fortuitous. The two cases in which distinct changes are noticeable account for a very small proportion of the variation in yield. It is of course not denied that any series of values, however arbitrary, may be expressed by Fourier's expansion as a number of harmonic cycles; but in the case of the weather, these cycles will be for the most part of short duration, and cannot be expected to reproduce themselves in the series of crop yields. For given weather the crop may be predicted with some accuracy, but Mr. Fisher is of opinion that the crop cannot be predicted even approximately without a detailed prediction of the weather.

Dr. Simpson remarked that meteorologists might be divided into two classes, those who had discovered a period and those who had not. The latter as a rule did not believe in periodicity, while the former generally believed only in the period they had themselves discovered. He exhibited on the screen a table showing 88 periods discovered by various investigators in solar and meteorological phenomena. These ranged from 1800 years to 2 hours, and he directed attention to the fact that from such a large

[1] Joint discussion of Section A (Mathematical and Physical Science), F (Economic Science and Statistics), and M (Agriculture) of the British Association at Hull on September 7.

number of periods—no attempt had been made to make the table complete—it would not be difficult to find a period near any specified period, especially if one were allowed to consider multiples and sub-multiples. He then discussed the two chief meteorological cycles, the Brückner cycle and the sunspot cycle. The hundred-year record of London rainfall has been analysed for a 35-year period, and a curve added to a diagram of monthly totals to show on the same scale the contribution of the cycle to the total rainfall. The amplitude of the cycle is absolutely insignificant in comparison with the monthly variations. Dr. Simpson admitted that there is an appreciable correlation between sunspots and meteorological factors, but as sunspots have no true periodicity they cannot introduce a periodic term into meteorological phenomena.

Turning to Sir William Beveridge's results Dr. Simpson regretted that he had not seen Sir William's recent paper in the Journal of the Statistical Society but only his papers in the *Economic Journal*, because the periods on which Sir William appears now to rely are different. He was prepared to admit that Sir William Beveridge had discovered certain periodicities in his curve of prices of wheat which were many times greater than one would expect by chance, but he strongly contested that these were meteorological periodicities. Sir William Beveridge laid great stress on a periodicity discovered by Capt. Brunt in Greenwich temperature, 5·1 years, which coincided with one of his cycles, but it was pointed out that Capt. Brunt discovered 9 cycles, four of which had greater and four smaller amplitudes than this particular cycle. Also Capt. Brunt's cycle of 5·1 years reduced the standard deviation of mean monthly temperatures at Greenwich only from 2·80 to 2·77, an insignificant change.

Dr. Simpson also criticised Sir William Beveridge's synthetic curve and asked why that curve should be compared with rainfall. There appeared to him no more reason why it should apply to rainfall than to any other meteorological or economic or even biological factor which might conceivably affect a harvest. In conclusion, admitting all that Sir William claimed to have done, he did not think that a prediction which gave a correlation coefficient with actuality of only 0·38 had any practical value. When Sir William had increased his correlation coefficient to about 0·83 he would be a valuable forecaster, but not until then.

Mr. Udny Yule said that the comments of Dr. Simpson seemed to him unfair. It must certainly be recognised that mere inspection of data was wholly inadequate and might lead to unfounded ideas as to the existence of periodicities, but this criticism had no bearing on work carried out by the periodogram method. He felt a good deal more doubt than some previous speakers on the question whether crop cycles were or were not a vital factor in the general economic cycle, which required far more study. From the statistical side the most important work now to be done is the determination of the crop cycles in areas other than Western Europe, *e.g.* South America and India: in so far as crop cycles are an important factor in the economic cycle, the resultant in any one country must be a complex effect dependent on the sources of its raw materials. On the side of economic theory it seemed to him there is also work to be done. The treatment of economics is in general static. The economist is too apt to tell us that "in the long run" a pendulum will hang vertically, whereas the whole interest of the pendulum is that it swings, and the problem is why it swings and how it swings. The treatment of economics should be dynamic. The question might be asked, for example, whether there is not an equation relating production not merely to price but to price and its time differentials, an equation which might (or in given circumstances might not) have a periodic solution.

Prof. H. H. Turner considered that we should be grateful to Sir William Beveridge, first, for producing a long series of annual values, going back much further than our longest rainfall record; secondly, for having himself analysed them completely by the periodogram method, so that others can profit by his analysis; and thirdly, for two considerable successes in the outcome. One of these is remarkable. He had succeeded in forecasting the weather in some sort—a rare, if not unique, achievement up to the present. The other success consisted in isolating several periods which must be further investigated. The periodogram gives us only the beginning, not the end of an investigation. Having obtained, for example, the definite suggestion of a 15-day period we must then see how it behaves throughout the series; the maximum phase seems to oscillate in this case. Such oscillations frequently occur in manifestations of periodicity which may itself be quite regular; thus, the rotation of the earth is quite regular, but one of its manifestations is sunrise, which swings to and fro. Sir William Beveridge had given us a good start, which it is to be hoped will be followed up.

Geology of the North Sea Basin.

THE long-standing custom of devoting at least part of a session of the Geological Section of the British Association to matters pertaining to the geology of the district in which the meeting is being held, was extended this year to the consideration of the wider question of the geological history of the North Sea basin, the discussion on this subject being the first of a series held in different sections on various aspects of the North Sea.

The discussion was opened by Prof. P. F. Kendall, president of the section, and was continued by Mr. J. O. Borley, of the Fisheries Research Laboratory, Lowestoft, who described the nature and distribution of the deposits now being laid down. Mr. Thomas Sheppard dealt with the geology of the Hull district, and Mr. C. Thompson contributed an interesting paper on the present rate of erosion of the coast of Holderness.

The main tectonic lines of the British Isles and of the neighbouring area, the North Sea, were produced prior to the formation of the Permian rocks, the three main axes of folding being the Caledonian (N.E. and S.W.), the Pennine (N. and S.), and the Armorican (W. and E. approximately). Later movements, for the most part along these old lines, were responsible for the changes in the distribution of land and water which have taken place.

The region now occupied by the North Sea appears to have been an area of depression since a very remote period. Thus it is found that movements which took place during late Carboniferous times and during the period, unrepresented by any deposits in Europe, that elapsed before the deposition of the Permian rocks, caused the coal measures to dip into the basin in Holland and Belgium, in Northumberland and Durham, and probably also in Lincolnshire, to re-emerge at Ibbenbüren.

The sinking of the basin thus formed appears to have continued intermittently in Permian, Jurassic, and Cretaceous times, the Permian and Jurassic deposits in the Durham-Yorkshire area being thicker than in almost any other part of Britain, and the Lower Cretaceous beds (the Speeton clay), being of a deep water type, contrasting strongly with the shallow water and estuarine deposits of that age to be found in parts of Britain more remote from the basin. The chalk also reaches its maximum British development on the East Coast.

After the formation of the chalk, the area was uplifted and much denudation took place prior to the deposition of the Woolwich and Reading beds and London Clay, which marks the commencement of a further downward movement. These Lower Tertiary beds still occupy the London and Hampshire basins and extend below the southern part of the North Sea. Prior to the great denudation which followed the uplift in Miocene and early Pliocene times, they doubtless occupied a much wider area—the then basin of the North Sea with its embayments and estuaries.

Then followed intermittent movements of the Armorican folds in the south of England, Northern France and Belgium extending into Pliocene (Diestian) times.

From this time onwards it is possible to trace the southern and western shores of the North Sea with some degree of accuracy. In Diestian times, Harmer suggests that the coast-line ran from the neighbourhood of Dover across the straits into Belgium, the shore deposits being represented by the Lenham beds and the Diestian of Belgium. The later Pliocene deposits indicate a gradual retreat of the sea to the northwards, the fossils of the Red Crag and Norwich Crag showing a gradual increase in the number of living as compared with extinct species as they are traced from Essex to the Wash.

At the close of Pliocene time much of the southern portion of the North Sea Basin must have been low-lying land, and across this meandered the great rivers of Northern Europe. The estuary of the Rhine, according to Harmer, crossed Norfolk; and in it were laid down the Chillesford beds.

To the north of the Humber the coast-line of this period has been traced by a line of buried cliff with accompanying beach deposits running from Hessle on the Humber, inland to the west of Beverley, and emerging on the line of the existing coast at Sewerby, between Bridlington and Flamborough Head. The plain of marine denudation in front of this old coast-line has been charted and contoured by means of information obtained from numerous borings which have been put down in search of water in the Plain of Holderness.

The next phase was a retreat of the sea and the formation of sand dunes along the foot of the cliff. The geological date is indicated by the occurrence of *Elephas antiquus*, *Rhinoceros leptorhinus*, and hippopotamus in the deposits, a fauna which accompanies implements of Chellean type in the south of England.

Throughout Pliocene times, a gradual refrigeration of the climate was in progress, as is shown by the molluscan fossils and also by the land flora, where remains of this have been preserved; and the next episode was the formation of a great ice-sheet having its radiant point in the neighbourhood of the Gulf of Bothnia. This appears to have displaced the waters of the North Sea at least as far south as the coast of Essex. Retreats and readvances took place, but the final retreat of the ice can be traced with great detail and precision by the drainage phenomena developed along its margin up to its last contact with British shores on the Ord of Caithness.

Oscillations of level accompanied the retreat of the ice and raised beaches were left, but on the completion of the withdrawal the land stood about 80 feet higher than at present. The southern part of the North Sea became a marshy plain, peat bogs covered much of its surface and forests clothed its margins, while great rivers such as the Rhine, Thames, and Weser meandered through it.

A depression to the present level then ensued and the great shallow bay of the North Sea south of the Dogger Bank was formed. The sea ran up the estuaries, and thus the Humber itself and its tributary the Hull came into being.

The work now being carried out by the officers of the Fisheries Board is throwing much light on the distribution of the various grades of material accumulating on the floor of the North Sea at the present time. Both the mineralogical character and the size of grain of the material are being investigated, though, of course, the latter is of more importance from the immediate point of view of fisheries, since it controls to a large extent the distribution of life.

By means of experiments with floats the direction of the main surface currents has been determined, and the maps exhibited by Mr. Borley showed that the floor deposits were spread out under the influence of the same movements. Several different types of material exist on the coast, but in each the grading of the deposits, coarse to fine, is in the general direction of the currents already determined by other means.

Along a great part of the east coast of Britain the North Sea is at present eroding the cliffs at a fairly rapid rate, and this has been measured by Mr. Thompson in the case of the coast of Holderness, which consists of glacial deposits. His method was to take the six-inch Ordnance Survey map published in 1852 and to measure thereon the lengths of all easily identifiable lines running at right angles to the coast, and then to measure up the remains of these lines on the ground. In this manner it was possible to draw the coast-line as it is to-day on the map of 1852 and thus to indicate the strip of land lost to the sea in the last seventy years. This strip varies considerably in width in different parts of the coast, there being a few points at which erosion is practically nil while at others it has caused serious loss.

New Japanese Botanical Serials.

DURING the last few decades the universities and colleges of Japan have produced a large number of scientific investigators, many of whom have continued postgraduate training for several years in Europe or America. The result is that in Eastern Asia a large number of well-equipped scientific investigators are now actively prosecuting research and there is a danger that, working in a field still far distant as regards practicable modes of communication, their work may not be sufficiently known in Europe, with corresponding loss of efficiency to the workers in both continents. Japanese scientific leaders are evidently alive to the danger, and the reopening of extensive scientific contact following the gradual cessation of war conditions has been followed by the organisation and issue of a number

of scientific publications, containing communications in European languages, mainly German and English.

Thus there have recently reached this country the first issues of two such new serial publications, the *Japanese Journal of Botany* and the *Acta Phytochimica*.

The *Japanese Journal of Botany* is only one such publication of nine which are being issued by the National Research Council, Department of Education, Japan. Besides a long communication (53 pp.) by Saito upon the fungi (yeast) occurring naturally in the atmosphere at Tokio, in which a connexion is traced between the number of these organisms present and the meteorological conditions, a series of abstracts follow which summarise the more important papers on botany and allied subjects which have appeared in Japan during January-June 1921. No fewer than thirty-nine papers are thus reviewed, many of economic importance and some of very general interest.

The first number of the *Acta Phytochimica*, dated March 1922, contains two papers. In the first Asahina and Fujita summarise the researches published by them so far only in the Japanese Journal of the Pharmaceutical Society of Japan. These investigations enable them to assign a constitutional formula to anemonin and to the most important acid derivatives so far obtained from it.

Anemonin is a crystalline product obtained from the acrid ranunculus oil distilled from fresh plants of various species of the Ranunculaceæ and extraction of the distillate with ether, benzol, or chloroform, but anemonin itself is not the acrid principle. The Japanese workers have a very large phytochemical field in the many interesting natural products of Eastern Asia, and the second paper, by Majima and Kuroda, deals with the pigment extracted by cold benzene from the dried outer portion of the root of *Lithospermum Erythrorhizon*. The main constituent of this pigment has been isolated in pure crystalline form and is described as the monoacetyl derivative of the compound, $C_{16}H_{16}O_5$, which the authors have named shikonin (from the Japanese name for the plant "shikon.")

It is proposed to issue one volume of *Acta Phytochimica* a year, each volume to consist of about 350 pages. The editor is Prof. K. Shibata, Botanical Garden, Koishikawa, Tokyo.

The two papers now published are written, one in German and one in English; communications in French are also acceptable for publication. The journal states that it aims at ensuring a closer correlation between chemical and physiological studies of plant constituents, but these first papers are essentially chemical in outlook. Both journals are well printed, in clear type on good paper, with curves and tables adequately reproduced. In the *Japanese Journal of Botany* three plates are included. Curves and drawings are very well reproduced in these; a lack of contrast in a series of photographs of yeast colonies on agar may be the fault of the original photographs.

Colloid Chemistry.

By Prof. W. C. McC. Lewis.

THAT increasing attention is being paid to the subject of colloid chemistry is becoming manifest in various directions. Already the subject has taken its place in the chemical instruction of some if not of all our universities, while the technological literature shows (though as yet to a rather limited extent) that the significance of colloidal behaviour is no longer overlooked in a number of technical operations. The subject is one of comparatively recent growth, for, although originating with Graham more than sixty years ago, its importance has begun to be realised only within the last twenty-five years.

It is not altogether surprising, therefore, that there are still a number of people engaged in chemical work to whom colloid chemistry has not as yet made an effective appeal. To a large extent the further recognition of the subject will depend not only upon the measure of success attending the publication of works such as text-books and memoirs which aim at bringing the subject within the scope of ordered presentation, but also upon the efforts of agencies the aim of which is to correlate the scientific principles and generalisations (in so far as they exist at present) with technical problems and practice, and to demonstrate how numerous and varied are the industrial operations in which colloid considerations are fundamentally involved. In the latter connexion a very useful service has been performed during the past few years by a committee of the British Association in publishing a series of reports on Colloid Chemistry and its General and Industrial Applications. The fourth of these reports,[1] a compilation of more than 380 pages, has been issued, and in view of its undoubted importance a brief indication of its general nature will not be without interest.

[1] Department of Scientific and Industrial Research: British Association for the Advancement of Science. Fourth Report on Colloid Chemistry and its General and Industrial Applications. Pp. 382. (London: H.M. Stationery Office, 1922.) 5s. 6d. net.

As in previous reports the subject matter is considered so far as possible under two heads, namely, subjects mainly academic in nature, and subjects mainly technical. Under the first head we find the following sections: Colloids in analytical problems, cataphoresis, colloid systems in solid crystalline media, molecular attraction, membrane equilibria, disperse systems in gases, the theory of lubrication, and the application of colloid chemistry to mineralogy and petrology. Under the second head are grouped: Colloid chemistry of soap boiling, flotation processes, catalytic hydrogenation, the rôle of colloids in metal deposition, rubber, and colloidal fuels. Each section has been written by a man who is specially conversant with the subject which he treats, and it may be added that the entire work here represented—and it amounts in the aggregate to much—has been given gratuitously.

Among subjects of such a divergent kind it is not easy to discriminate. Some readers will be attracted by the comparative novelty of the idea of introducing colloidal considerations at all into such problems as metallic alloys, mineralogy, and petrology, or the subject of lubrication. Others will be specially interested in obtaining some definite and clear information on subjects which possess a certain degree of familiarity, but about which most of us have, it is to be feared, somewhat confused ideas, subjects such as soap boiling, or ore-flotation, or catalytic hydrogenation. The fact that the latter two subjects are dealt with at all indicates the wide view which the committee quite rightly takes of the nature and range of its activities. The enormously wide scope of certain of the subjects themselves is well demonstrated by the article on disperse systems in gases, which ranges from the pollution of the atmosphere, metallurgical smokes, and problems of chemical warfare to Millikan's work on the charge of the electron. By way of contrast we find in the section on molecular attraction a minute and searching

account of a single problem which is fundamental not only to colloid chemistry but to molecular physics as well. The variety of the subjects here indicated should strengthen the appeal which the report makes to readers possessing widely different individual interests.

Finally, it may not be out of place to direct attention to the valuable assistance which the committee has received from the Department of Scientific and Industrial Research, without which the report could not have been published. To any one appreciating the value of these publications for the advancement of chemical science and industry, it will be apparent that the assistance thus rendered has been wisely as well as generously given.

Early History of the Sussex Iron Industry.

MR. RHYS JENKINS, vice-president of the Newcomen Society, formed recently for the study of the history of engineering and technology, who has contributed two papers on the early history of the iron industry in Sussex, has followed this up by some notes on the early history of steel-making in England. His paper deals with the history of the production of steel before Huntsman's invention of cast steel.

That steel was produced in the time of Queen Elizabeth is well known, but very little, if any, research has been done on the history of the industry between that period and about 1750. The earliest mention of a works for the production of steel found by the author is in 1573. He finds that John Glande held a tenement called "A forge of steel" in Ashdown Forest, Sussex. This forge came into the hands of John Bowley in 1525, who still held it in 1548. It appears that Sir Henry Sidney of Penshurst, Kent, the father of Sir Philip Sidney, was a steel maker of that period. Steel was manufactured at Robertsbridge in Sussex with the aid of Dutch labour obtained from the neighbourhood of Cologne. The method used was the so-called "finery" process, in which the iron from the blast-furnaces, instead of being cast into sows or pigs, was cast into thin flat bars. Another site of steel forges in Sussex was Warbleton.

An important landmark in the development of the industry was the invention of the cementation process. The earliest mention of this is in 1614, when William Ellyott and Mathias Meysey obtained a patent for converting iron into steel "by means of a reverberatorie furnace with potts louted or closed to be put therein containing in them certain quantities of iron with other substances, mixtures and ingredients, which being in the said furnace brought to a proportion of heate doth make and convert the same iron into steel, which steel with other heate temperatures and hammerings to be afterwards given to the same doth make good and fitt for the use before mentioned." Ellyott and Meysey were both natives of this country, and there is no suggestion that they employed foreign workmen. The author thinks that this invention may have been a development of the case-hardening process, possibly in the light of knowledge acquired from the manufacture of brass. The works of Ellyott and Meysey were probably situated in London, and in 1616 they obtained another patent for carrying out the main invention with pit coal instead of wood.

Later developments of the industry appear to have taken place to some extent in the Forest of Dean, and also in Yorkshire. Prince Rupert was an inventor of the period, about 1650. On the whole, the best steel seems to have been made in the Forest of Dean. The records of that period indicate that it made good edge-tools, files, and punches.

University and Educational Intelligence.

CAMBRIDGE.—Dr. A. P. Maudslay has been elected an honorary fellow of Trinity Hall.

GLASGOW.—The University Court has accepted the generous offer, already referred to in this column, of a gift of 25,000*l.* from Mr. Henry Mechan for the establishment of a Henry Mechan chair of public health. In making the gift, in recognition of "the great and important work which is being done by the University of Glasgow," Mr. Mechan made no conditions, preferring that "the accomplishment of my purpose should be left to the University authorities." The department of public health to which the new chair is given has hitherto been joined with that of medical jurisprudence under Prof. Glaister.

LEEDS.—At the meeting of the Court of the University on December 20, the Pro-Chancellor stated that there are now 1535 full-time students as compared with 1646 in the year 1921–22. The local education authorities of Yorkshire are increasing their help to the University. In addition to subsidies from the City of Leeds, the West Riding and the East Riding County Councils and the City of Wakefield, the University now receives financial aid from the North Riding County Council and from the City of York.

The laboratory of the British Silk Research Association has been established in temporary quarters, and the National Bensole Association has instituted researches in the department of fuel and metallurgy. The premises used as a Marine Biological Laboratory at Robin Hood's Bay have been purchased by the University. With the help of a grant from the Government the funds required for the new building of the department of agriculture (the headquarters of agricultural education in Yorkshire) have been secured, and an early start will be made with the work.

The Clothworkers' Company has recently made to the University a gift of 2250*l.* in addition to its earlier munificent endowments.

The Court, on hearing of Prof. Smithells' decision to resign the professorship of chemistry in order to devote himself to scientific investigation in London, "records its profound gratitude to him for service of immeasurable value to the University during the thirty-seven years in which he has held his Professorship. He is one of the founders of the University, which owes more than it can ever express to his unselfish devotion to the public interest, to his untiring labours in the application of science to industry, to his strenuous and at last victorious defence of the recognition of scientific technology as an element in the highest type of university education, and to his undeviating adherence to a high and exacting standard in university studies. The Court rejoices to think that he now hopes to escape from some of the administrative cares which have eaten into the leisure which otherwise he would have devoted to scientific research, and assures him that his name and work will be inseparably connected in future with the history of the rise of the University of Leeds."

The title of Emeritus Professor was conferred upon the following: Percy Fry Kendall, professor of geology, 1904–1922, who retired after reaching the age limit in September; John Goodman, professor of civil and mechanical engineering, 1890–1922, who resigned his chair in September.

Dr. W. H. Pearsall, lecturer in the department of botany, was appointed reader in botany in recognition of his contributions to learning and research, especially in ecology.

A COURSE of eight lectures on "Changing Geographical Values" will be delivered by Sir Halford

Mackinder on Wednesdays at 5 P.M., beginning January 24, at the London School of Economics and Political Science, Houghton Street, W.C.2.

PART I., consisting of ten lectures, of a course on Oil Well and Refinery Technology and Geology of Petroleum, will be given at the Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C.3., during the coming term. The opening lecture, on Monday, January 15, at 7 P.M., will be by Sir John Cadman on "Imperial Aspects of the Petroleum Question."

THE Bureau of Education of the Government of India has just issued a second volume of "Selections from Educational Records," edited by J. A. Richey (Calcutta, Superintendent of Government Printing, India, pp. 504, rupees 6½). The period covered by these selections, 1839–59, was one of great educational activity in India, during which provincial systems of education were gradually evolved, and many of the documents reproduced in this volume are of great interest, as are likewise the accompanying series of portraits of statesmen, administrators, missionaries, and unofficial patrons of education. The frontispiece is, appropriately, a portrait of James Thomason, Lieutenant-Governor of the North-western Provinces, 1843–53, who of all the administrators of those times rendered the greatest services to the cause of education in India. Among these not the least was the establishment of the Engineering College at Roorkee which bears his name. Had his appreciation of the needs of the time in regard to the teaching of applied science been more fully shared by the court of directors and their successors, there might have been in India developments comparable with those which in the United States of America followed the adoption by the Federal Government of the policy of endowing colleges of agriculture and mechanical arts. A number of interesting documents are grouped together under the heading: the beginning of professional education — medical, engineering, and legal — and a useful bibliography is given at the end of the volume.

STRIKING testimony of the excellent morale of the students of the University of Hong-Kong was given in the course of an address delivered on November 14 at the Royal Colonial Institute by Sir Frederick Lugard, to whose initiative the inception of the University was primarily due. After speaking of the need for training character in African dependencies, he said: "A university was founded in Hong Kong in 1912 mainly for Chinese students. In the forefront of its declared objects the principles of co-operation and discipline were laid down. This year the community was disorganised by a series of strikes of a political nature. Trade and social life were alike paralysed. It seemed inevitable that the students—as in Egypt and India—would espouse the cause of reaction. But the Vice-Chancellor reports that though it would have been entirely in accord with Chinese student practice elsewhere that the undergraduates should demonstrate on the same side, what actually occurred was a very striking testimony to the success obtained in inculcating the lessons of co-operation and discipline. When the whole of the servants joined the strikers the students devoted themselves with the utmost cheeriness to cooking and to menial household duties. Sir W. Urungate adds that the hostels had never been cleaner. When the staff of mechanics went out the students manned the power station and the medical students unanimously resolved to carry out hospital duties, which are regarded by Chinese as especially derogatory." On the re-establishment of stable government in China the potential usefulness of this university will be vastly increased and it is to be hoped that it will be enabled to rise to the height of its great opportunities.

Societies and Academies.

LONDON.

Aristotelian Society, December 4.—Prof. Wildon Carr, vice-president, in the chair.—Gerald **Cator**: The one and the many. Contents of monadic type, which seem to occur in experience, prove on examination to be "convergence illusion effects." To admit this, however, is fatal to the claims of logic. The question, "How are synthetic judgments possible?" can only be answered by the denial that there can be genuine judgments, as contrasted with psychological compositions of representations. The writ of logic, we should have to say, does not run in our world. To this dilemma the intellectualist metaphysic of St. Thomas Aquinas offers a legitimate though not dialectically-necessary way of escape. According to it every character of the world, correlative to an intelligence of any grade, is a function of the position of that intelligence in the scale of beings, and the human intelligence is intelligence at threshold value. It follows that the form of the human universal will be the unification of a multiplicity by reference to a *point de repère*. But this is precisely the structure of a "convergence illusion effect." Convergence illusion effects *may*, therefore, be genuine universals at threshold value, and consequently our world *may* be continuous with the intelligible world.

Society of Public Analysts, December 6.—Mr. P. A. Ellis Richards, president, in the chair.—E. W. **Blair** and T. Shirlock **Wheeler**: A note on the estimation of form- and acet-aldehydes. In investigations of the action of oxygen and ozone on various hydrocarbons, the formaldehyde and acetaldehyde present were estimated by finding the total aldehydes by Ripper's bisulphite method (*Monat. für Chem.*, **21**, 1079), and formaldehyde alone by the cyanide method. In solutions containing formaldehyde, formic acid, hydrogen peroxide, and a trace of ozone these substances were estimated *seriatim*, formic acid with N/100 alkali, ozone with neutral potassium iodide, hydrogen peroxide by Kingzett's method (*Analyst*, 9, 6), and formaldehyde by Romijn's method.—H. A. **Peacock**: Note on the presence of sulphur dioxide in cattle foods after fumigation. Sulphur dioxide may be absorbed by cattle cakes and meals during fumigation, but after about a week the sulphur dioxide disappears. The amount absorbed depends on the variety of cake—the harder cakes absorbing less than the softer—and the condition of the feeding stuff, *i.e.* whether in block or powder form.—C. H. Douglas **Clark**: A sliding scale for the convenient titration of strong liquids by dilution and use with aliquot parts. The device enables the operator to see at once what alternative dilutions are available in any particular case in order to obtain a convenient burette reading at the end of titration, and it assists in choosing the most suitable dilution.—D. W. **Steuart**: Some notes on the unsaponifiable matter of fats. The proportion of sterol in the unsaponifiable matter varies from 48 per cent. in maize oil to 7 per cent. in palm oil; and from 38 per cent. in lard to 9 per cent. in hardened whale oil. Highly hardened fats still contain sterol. The cholesterol acetate of animal fats melts at 114 to 114½° C.; the phytosterol acetate of vegetable fats is a mixture, a fraction of which melts at 125° or above, but some pure vegetable oils yield a fraction melting about 114° C. These facts are utilised in analysing margarines.—Norman **Evers** and H. J. **Foster**: Note on the sulphuric acid test for fish liver oils. The addition of natural oils increases the sensitiveness of the test to

a remarkable extent. The brown colour produced by sulphuric acid with liver oils after oxidation, behaves in exactly the same manner as the violet colour with the fresh oils, being similarly increased by the addition of natural oils. Oxidation of the natural oils destroys this power, but it is unaffected by hydrogenation.

The Optical Society, December 14.—Sir F. W. Dyson, president, in the chair.—T. **Smith**: A large aperture aplanatic lens not corrected for colour. A lens suitable for spectroscopic work with aplanatic corrections for all zones may have as large an aperture as *f*/1 or still greater, all the surfaces being strictly spherical. An actual lens made by Messrs. Ross, Ltd., of 3 inches focal length and 3 inches aperture possesses corrections comparable with those given by the theoretical investigation. With a slightly reduced aperture, correction for colour may be obtained without prejudice to the quality of the spherical corrections. The production of suitable glass discs is the outstanding difficulty in the way of great increases in the relative apertures of telescope objectives.—T. **Smith**: The optical cosine law. The law of refraction, the sine law relating to coma, and other exact laws of optical instruments are particular cases of a very general law which assumes the form of a cosine relation. As an example of the application of the law, the principles which should govern the construction of a variable power telescope yielding aplanatic correction at all magnifications are investigated.—S. **Weston**: A constant bubble. The alteration in the length of the air bubble in a spirit level due to variation of temperature is avoided in the new type of level produced by Messrs. E. R. Watts and Son, Ltd., known as a "constant" bubble. The first consideration is to obtain the exact proportion of air and spirit. The cross section of the tube containing the liquid is so shaped that as the temperature is raised and the surface tension gradually decreased, only the cross sectional area of the bubble is affected, its length remaining unaltered.

PARIS.

Academy of Sciences, December 4.—M. Emile Bertin in the chair.—M. Guillaume Bigourdan was elected vice-president for the year 1923.—G. **Bigourdan**: The Observatory of Paris, on the 200th anniversary of its construction. An historical synopsis of the work done at the Observatory from its completion in 1672 to 1699.—Maurice **Hamy**: The measurement of small diameters by interference. A development of Michelson's formula, without the restriction $\alpha = 0$ (α being the ratio of the width of the slits to the distance between their centres).—A. **de Gramont**: Quantitative researches on the line spectrum of vanadium in fused salts. Two tables are given showing the persistence of the chief vanadium lines by ocular and photographic observations. In the visible spectrum the sensibility is 1 in 1000, and this is increased by the use of photography to 1 in 100,000. The method can usefully be employed in the examination of minerals.—Sir William H. Bragg was elected correspondant for the section of physics, in the place of the late M. René Benoit, and J. B. Senderens correspondant for the section of chemistry, in the place of the late M. Barbier.—A. **Schaumasse**: Observations of the Skjellerup comet (1922*d*) made with the equatorial of Nice Observatory. Positions of the comet and comparison stars are given for November 29 and 30. The comet is of the 11th magnitude.—J. **Le Roux**: The gravitation of the systems. Reply to some criticisms by M. Brillouin.—J. **Haag**: The constancy of the homogeneity of the fluid representative of the different possible states of a gaseous mass.—Maurice and Louis **de Broglie**: Remarks on corpuscular spectra and the photo-electric effect.—Pierre **Salet**: The law of dispersion of prismatic spectra in the ultra-violet. In an earlier paper the author has given a formula which represents exactly the observed relation between the wave-length and the position of a line in the spectrum, and this was verified for wave-lengths between λ3800 and 4900. Proof is now given of the validity of the formula in the ultra-violet to λ2250.—F. **Croze**: The place of the ultimate lines of the elements in the spectrum series and their relations with the resonance lines.—Pierre **Steiner**: The ultra-violet absorption spectra of the alkaloids of the isoquinoline group. Papaverine and its hydrochloride. The absorption curve of papaverine is not that obtained by the addition of the absorption curves of its constituents: the effect of the isoquinoline nucleus preponderates.—Marcel **Sommelet**: Tertiary amines derived from benzhydrylamine.—Raymond **Delaby**: The alkyl-glycerols. The conversion of the vinyl-alkyl-carbinols into alkyl-glycerols. The ethylenic alcohol is treated with bromine in acetic acid solution, these converted into acetins by prolonged boiling with sodium acetate, and the products separated by fractional distillation. The acetins are hydrolysed by a solution of hydrochloric acid in methyl alcohol.—P. W. **Stuart-Menteath**: The San Narciso mine in Guipuzcoa.—P. **Viennot**: The tectonic of the region of Bagnères-de-Bigorre and of Lourdes.—Louis **Dangeard**: Contribution to the geological study of the bottom of the English Channel, based on recent dredgings by the *Pourquoi-Pas?* (August-September, 1922). The results are given on a chart, with special reference to outcrops of the Lias and Eocene.—M. **Lecointre**: The stratigraphy of the north of Chaouia (Western Morocco).—J. **Cluzet** and A. **Chevallier**: The radioactivity of the springs of Echaillon. The deposits forming these springs are rich in radiothorium. This is the only spa in France admitting the therapeutic utilisation of thorium emanation.—G. **Reboul**: The determination, in cloudy weather, of the vertical movements of the atmosphere: the influence of clouds on the velocity of displacement of depressions.—M. **Bridel** and G. **Charoux**: Centaureidine, a product obtained from centaureine, a glucoside from the roots of *Centaurea Jacea*. This substance, which has the composition $C_8H_{16}O_8$, is probably a derivative of flavone.—M. **Aynaud**: Botrymycosis of sheep.

SYDNEY.

Royal Society of New South Wales, November 1.—Mr. C. A. Sussmilch, president, in the chair.—R. S. **Hughesdon**, H. G. **Smith**, and J. **Read**: The stereoisomeric forms of menthone. The ten stereoisomeric forms of *p*-menthan-3-one stated to be theoretically possible, and certain menthones and menthols derived by reduction from the optically active and inactive forms of piperitone are discussed.—E. **Hurst**, H. G. **Smith**, and J. **Read**: A contribution to the chemistry of the phellandrenes. Muta-rotation and optical inversion on the part of *l*-α-phellandrene α-nitrite occurs when it is dissolved in chloroform, benzene, or acetone, and maintained at 20° C.—H. G. **Smith**: Notes on the chemistry of certain Australian plant products. Pt. i. A resin coating the leaves and stems of *Acacia verniciflua*, the essential oil of the small leaved *Bæckia Gunniana*, and the rubber and wax from *Sarcostemma australe*, are discussed. The milky latex of *Sarcostemma australe* contains about 7 per

cent. of rubber, together with resin.—E. H. **Booth**: Notes on the photographic work of the Sydney University Eclipse Expedition, Goondiwindi, Queensland. The principle adopted was to give full exposures to ensure recording all required material on the plate, to develop to the point of general chemical fog, and to take from each plate a series of prints of different exposures, thus enabling a complete analysis of every degree of density in each plate to be made. This has the same value as a large number of individual exposures. The process appears to have been quite successful, giving a full range of prints showing detail from the extreme photographic limit of the outer corona into the prominences. An outline of exposures and subsequent photographic treatment is given. Photographs showing inner corona and prominences were displayed.—A. R. **Penfold**: The essential oils of two Myrtaceous shrubs, *Homoranthus virgatus* and *H. flavescens*. The shrubs are common to various parts of Northern New South Wales and Queensland. *H. virgatus* contains as principal constituent up to 80 per cent. dextro alpha pinene, sesquiterpene, amyl alcohol, and esters, and a paraffin of M.P. 65-66° C. *H. flavescens* contains 80 per cent. of the olefenic terpene "Ocimene," together with dextro alpha pinene, sesquiterpene, amyl alcohol, etc. This hydrocarbon is recorded for the first time in an Australian essential oil.—F. R. **Morrison**: The essential oil of *Kunzea corifolia*. This dark green bushy shrub, which is one of the commonest growing in the Port Jackson district, yields a light brown mobile oil of fragrant odour. The oil consists principally of dextro alpha pinene, a sesquiterpene closely resembling cadinene, an unidentified alcohol (the odoriferous constituent), and small quantities of acetic and butyric acid esters.—W. M. **Doherty**: A note on the food value of the snapper (*Pagrosomus auratus*). The percentage of fat in the snapper is very small, but it gave indication of the presence of the fat-soluble, growth-promoting factor, vitamin A.

Official Publications Received.

Report of the Department of Naval Service for the Year ended March 31, 1922. (Sessional Paper No. 17a—A. 1923.) Pp. 54. (Ottawa.)

Ministerio da Agricultura, Industria e Commercio: Directoria de Meteorologia. Boletim Meteorologico: Anno de 1916. Pp. vi+136. (Rio de Janeiro.)

The Indian Forest Records. Vol. 9, Part 4: The Constituents of some Indian Essential Oils. Parts 1-7. By J. L. Simonsen and Madyar Godal Rau. Pp. 36. (Calcutta: Government Printing Office.) 6 annas.

Forest Bulletin, No. 49: Note on Thingan (*Hopea oderata*, Roxb.). By A. Rodger. Pp. 15. 7 annas. Forest Bulletin, No. 50: Note on Gurjun or Kanyin. Compiled by W. Robertson. Pp. 7. 4 annas. (Calcutta: Government Printing Office.)

Union of South Africa. Fisheries and Marine Biological Survey. Report No. 2 for the Year 1921, by Dr. J. D. F. Gilchrist; with Introduction by H. Warington Smyth; and Special Reports 1: Heterosomata (Flat Fishes), by C. Von Bonde; 2: Physical and Chemical Observations, by Dr. C. Juritz; 3: Deep-sea Fishes (Part 1), by Dr. J. D. F. Gilchrist. Pp. iv+84+79+12 plates. (Cape Town.)

Transactions of the Leicester Literary and Philosophical Society, together with the Report of the Council for 1921–22, and Annual Reports of the Sections. Vol. 23, 1922. Pp. 74. (Leicester.)

The Annual Report of the Gresham's School Natural History Society, 1922. Pp. 12. (Holt, Norfolk.)

Department of Agriculture and Natural Resources: Weather Bureau. Annual Report of the Weather Bureau. Part 1: Work of the Weather Bureau during the Calendar Year 1919; Part 2: Hourly Meteorological Observations made at the Central Observatory of Manila during the Calendar Year 1919. Pp. 143. (Manila: Bureau of Printing.)

Diary of Societies.

SATURDAY, DECEMBER 30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. H. H. Turner: Six Steps up the Ladder to the Stars (2). The Discovery of the Planet Neptune (Juvenile Lectures).

MONDAY, JANUARY 1.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at University College), at 2.30.—Dr. C. W. Kimmins: The Child and the Cinema.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Lt.-Comm. A. S. Elwell-Sutton: Up the Tigris (Christmas Lecture to Young People).

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 5.—Miss M. Drummond: Children's Drawings.

MATHEMATICAL ASSOCIATION (at London Day Training College), at 5.30.—Dr. S. Brodetsky: Gliding.

NATIONAL LEAGUE FOR HEALTH, MATERNITY, AND CHILD WELFARE (at University College), at 5.30.—Health Problems of Adolescence.

TUESDAY, JANUARY 2.

MATHEMATICAL ASSOCIATION (at London Day Training College), at 10.—Prof. E. H. Neville: A Statement respecting the forthcoming Report of the Sub-Committee on the teaching of Geometry.—At 11.—W. C. Fletcher: The Uses of Non-Euclidean Geometry to Teachers.—At 12.—Prof. R. W. Genese: Simple Geometrical and Kinematical Illustrations of the Plane Complex.—J. Brill: A certain Dissection Problem.—At 2.30.—Sir Thomas L. Heath: Greek Geometry, with special reference to Infinitesimals (President's Address).—Prof. A. Lodge: Differentials as the basis for teaching the Calculus.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. H. H. Turner: Six Steps up the Ladder to the Stars (3). Photographing the Stars (Juvenile Lectures).

NATIONAL LEAGUE FOR HEALTH, MATERNITY, AND CHILD WELFARE (at University College), at 5.30.—Dr. J. Kerr: Physique and Growth.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—H. Lamplough: The Lamplough Flash Lamp.—A. C. Banfield: A Demonstration of the German Aeroplane Camera now in the Society's Museum.

RÖNTGEN SOCIETY (at Institution of Electrical Engineers), at 8.15.—Dr. A. E. Barclay: The Organisation and Equipment of a Modern X-Ray Department with special reference to the New Department at the Manchester Royal Infirmary.—Major C. E. S. Phillips: An Electroscope of New Design.

WEDNESDAY, JANUARY 3.

ROYAL SOCIETY OF ARTS, at 3.—C. R. Darling: The Spectrum, its Colours, Lines, and Invisible Parts, and some of its Industrial Applications (Dr. Mann Juvenile Lecture).

PHYSICAL SOCIETY OF LONDON AND OPTICAL SOCIETY (at Imperial College of Science and Technology), at 3-6, and 7-10.—Annual Exhibition of Scientific Apparatus.—At 4.—W. Gamble: Reproduction of Colour by Photographic Processes.—At 8.—Prof. E. G. Coker: Recent Photo-Elastic Researches on Engineering Problems.

ROYAL MICROSCOPICAL SOCIETY (Biological Section), at 7.30.

THURSDAY, JANUARY 4.

GEOGRAPHICAL ASSOCIATION (at Birkbeck College), at 12.—Sir John Russell: The Influence of Geographical Factors in the Agricultural Activities of a Population (Presidential Address).—At 2.30.—J. Fairgrieve: Report on his Recent Visit to the United States.—At 5.—H. Batsford: Types and Materials of Houses in England.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. H. H. Turner: Six Steps up the Ladder to the Stars (4). The Spectroscope and its Revelations (Juvenile Lectures).

PHYSICAL SOCIETY OF LONDON AND OPTICAL SOCIETY (at Imperial College of Science and Technology), at 3-6, and 7-10.—Annual Exhibition of Scientific Apparatus.—At 4.—Prof. E. G. Coker: Recent Photo-Elastic Researches on Engineering Problems.—At 8.—W. Gamble: Reproduction of Colour by Photographic Processes.

INCORPORATED BRITISH ASSOCIATION FOR PHYSICAL TRAINING (at University College), at 5.—Prof. M. E. Delafield: Hygiene as applied to Physical Training.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—H. Junkers: Metal Aeroplanes.

NATIONAL LEAGUE FOR HEALTH, MATERNITY, AND CHILD WELFARE (at University College), at 5.30.—Dr. W. Brown: Child Psychology and Psychotherapy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—F. Creedy: Variable-speed A.C. Motors without Commutators.

CAMERA CLUB, at 8.15.—W. L. F. Wastell: The Evolution of the Lantern Slide.

FRIDAY, JANUARY 5.

GEOGRAPHICAL ASSOCIATION (at Birkbeck College), at 10.—Dr. Olive Wheeler: The Place of Geography in the Education of the Adolescent.—At 11.45.—Maj.-Gen. Lord Edward Gleichen: Permanent Committee on Geographical Names.—At 12.15.—Prof. W. S. Tower: Geography and Business Life.—At 2.30.—E. E. Lupton and others: Discussion on ways of increasing the Usefulness of Branches of the Association.—At 5.—Prof. P. M. Roxby: The Coming Industrialisation of China.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—R. E. Priestley: Antarctic Adventures (Christmas Lecture to Young People).

NATIONAL LEAGUE FOR HEALTH, MATERNITY, AND CHILD WELFARE (at University College), at 5.30.—Prof. H. R. Kenwood: Health Education.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. Dinwiddie: Wave Power Transmission.

SATURDAY, JANUARY 6.

ASSOCIATION OF WOMEN SCIENCE TEACHERS (at University College), at 2.30.—Dr. Dorothy Wrinch: Relativity.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. H. H. Turner: Six Steps up the Ladder to the Stars (5). Two Great Streams of Stars (Juvenile Lectures).

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—G. J. B. Fox: A Visit to Pompeii.

POLITECHNIKA WROCŁAWSKA BIBLIOTEKA GŁÓWNA