THURSDAY, OCTOBER 18, 1917.

RESEARCH AND THE STATE.

IT was remarked by Prof. W. J. Pope, in an address to which we referred last week, that if suitable provision had been made by the State for the pursuit of scientific research twenty years ago we should have been saved from the horrors of the present conflict. He asked why the Government did not then make the experiment which it has now undertaken by the establishment of a Department of Scientific and Industrial Research with an endowment of 1,000,000*l*. The answer to the question is that our statesmen have never had sufficient knowledge of science to understand its relation to national advancement or sufficient faith in scientific discovery to believe that provision for it would ultimately benefit the community both industrially and politically. The public mind has been awakened to the essential value of research in all progressive industries, and every manifesto recently issued by organisations concerned with the future development of British trade insists upon its importance. Principles which have been persistently urged in these columns by a couple of generations of scientific men are now being proclaimed from the housetops and are heard in the highways, with the result that our political leaders are beginning to follow them.

There is much reason for satisfaction at this change of front, even though it be at long last. The official attitude is now vastly different from that of the Lords Commissioners of H.M. Treasury in 1872, when the British Association asked for a grant of 150*l*. to complete the reduction of tidal observations upon which the association itself had expended four times that amount. Their Lordships, after giving "anxious attention" to the memorial, regretted that the sum required could not be appropriated out of the public funds of this sea-girt isle for tidal investigations, because, if the request were granted, "it would be impossible to refuse to contribute towards the numerous other objects which men of eminence may desire to treat scientifically." Such was the position of State support of science in England in 1872; and the example shows how much remained to be done to bring about the change represented by the establishment of the Department of Scientific and Industrial Research.

Prof. Pope asked why this department was not instituted by the State twenty years ago, but he should have said more than forty years, for one of the chief recommendations of the Royal Commission appointed in 1870 was that a State Council of Science, presided over by a Minister of Science, should be established. The Commission was appointed with the seventh Duke of Devonshire as chairman and Sir Norman Lockyer as secretary, while among other members were Huxley, Sir G. G. Stokes, and the first Lord Avebury. The whole position of science in the United Kingdom was surveyed in the volumes of the Report of the Commission issued from 1871 to 1875; and it was the unanimous opinion of the Commissioners that a special department of State should be entrusted with the duty of promoting the scientific interests of the country. The suggested Council of Science was not intended solely to look after the interests of purely scientific research, but to bring to scientific tests, and advise upon, all Government projects in which scientific principles are involved. The great majority of the witnesses examined upon this point were entirely in favour of the establishment of a Council and Minister of Science.

The decided conviction was also expressed by the Science Commission of 1870 that one of the most efficient methods by which the Government could further research in this country was by the establishment of public laboratories for the pursuit of investigations in connection with the varying and ever-multiplying departments of physics, chemistry, biology, and other branches of science. Even at that time great laboratories had been erected at Berlin, Leipzig, Bonn, Aix-la-Chapelle, Karlsruhe, Stuttgart, and other places at the expense of the State, and special provision had been made in them for original scientific research, while nothing of the kind was done in our own country; and thus the main sources of new trades and improvements in manufactures remained undeveloped. The view then taken, and not altogether unknown even at the present time, was that the more science was left to itself the better for it. Mr. Gladstone, indeed, termed the intervention of the State as "interference" with science, calculated to discourage individual exertion, and so obstruct discovery and progress. A completely different view was taken by Lord Salisbury, who, in his evidence before the Science Commission, remarked: "Research is unremunerative; but it is highly desirable that it be pursued, and therefore the community must be content that funds should be set aside to be given, without any immediate and calculable return in work, to those by whom the research is to be pursued."

We have waited more than forty years for this necessary endowment of research, and the country has lost incalculable millions because no statesman had sufficient foresight to take heed of the

warning and advice of scientific men at a time when profitable action was clearly indicated.

After the publication of the Report of the Science Commission the Government had no excuse for neglect to remedy the evils brought under its notice. It was remarked in NATURE of March 26, 1874: "If means are not forthwith taken to organise our public museums and institutions for scientific research and instruction on some intelligent system, to supplement their lamentable deficiencies, and make them as widely beneficial to the advancement of science in all its departments and conducive to the highest instruction of the public as they are calculated to be, it can no longer be set down to ignorance, but to an utter disregard of the highest welfare of the country. In this direction the Government has a chance of distinguishing itself and winning for itself an enduring and worthy popularity; let it lose no time in showing its wisdom by appointing a responsible Minister of Education, whose duty it will be to keep all our public scientific and educational institutions up to the highest pitch of efficiency, to re-organise them upon some common basis, and to see that the progress of research in all branches of science is not hampered by the want of adequate means for its pursuit."

It is scarcely necessary to remind readers of NATURE that though the case for national care of scientific research was stated as convincingly as it could be by the leaders of science forty years ago, politicians turned deaf ears to their pleadings. It is true that a grant of 1000*l.* for scientific investigations was included in the Estimates from 1855 to 1881, and that in 1876 a further grant of 4000*l.* was voted for the payment of personal allowances to men engaged in research, but this latter grant represented the whole response of the Government to the recommendations of the Royal Commission on Science. Since 1882 the grant of 1000*l.*, which was provided under the Vote for Learned Societies, has been discontinued, and that of 4000*l.* has remained unaltered, except that it is now administered by the Royal Society instead of by the Science and Art Department, to which it was originally allocated.

In 1894 the Council of the Royal Society asked H.M. Treasury to increase the amount of this grant for scientific investigations, but without success. Men of science were not sufficiently organised, or did not possess the necessary political power, to force the subject of provision for research upon the attention of successive Governments until the desired ends were achieved. The first attempt to awaken the public to a sense of national danger on account of neglect of the subject was made by Sir Norman Lockyer in his presidential address to the British Association in 1903. Then, as thirty years earlier in the Report of the Science Commission, a convincing case was presented for the State endowment of universities on a scale which would make our facilities for highest education and research comparable with those of our chief competitors. As a natural outcome of this appeal, the Treasury grant to universities and colleges in England and Wales was doubled in the following year, and further increased later, until it reached the present amount of about 200,000*l.* a year instead of the 28,500*l.* available in 1903. But even this increased subsidy is less than the ordinary annual State endowment of Berlin University alone, while the total of the Government subsidies to universities in Germany is as much as 1,500,000*l.*

It is clear, therefore, that, though much has been done, the nation must be prepared for a further increase of expenditure upon scientific and technological education and research if we are to make good our shortcomings in the past. Mr. Fisher, President of the Board of Education, speaking at Cardiff on October 10, said that the way to establish a strong and powerful university was to get great men, and that not a bad way to secure these was to pay them well. The opportunity has come to ensure that generous provision is made for such assistance to university work as well as to establish a system of education better than that enjoyed anywhere else in the civilised world; and it is the duty of all who believe in these factors of national progress to support the efforts now being made to strengthen them.

The work of the British Science Guild in these directions has been of great national advantage. Inaugurated in 1905 to convince the people "of the necessity of applying the methods of science to all branches of human endeavour, and thus to further the progress and increase the welfare of the Empire," the Guild has been in the forefront of all recent movements for promoting the development of education and industry by the application of scientific principles. Early in its history it directed attention to the need for increased provision for agricultural research, and presented a memorial on the subject to the Prime Minister. The Development Act of 1909 gave the means of supplying this need; and the result is that during the year 1914–15 the total amount distributed by the Board of Agriculture in the form of grants for agricultural education and research was 92,000*l.* instead of the 16,000*l.* available ten years ago. Another State endowment of research was provided for by the National Insurance Act of 1911,

and under this the sum now available for medical research amounts to about 55,000*l.* annually. There is finally the block grant of 1,000,000*l.* made to the Department of Scientific and Industrial Research, which has much the same functions as those of the Council of Science adumbrated by the Science Commission of 1870.

We have good reason to be satisfied that the importance of research which was urged by scientific advocates for so many years without effect is now being recognised by the State; and that the lead thus given is being followed by our manufacturers. What has now to be guarded against is the administration of the funds by executive officers who do not possess sufficient scientific knowledge to prepare promising schemes of work or have not that close sympathy with scientific aims which places the original investigator above all other men in national value. The managing head of every council or manufactory which depends upon progressive science for its maintenance and development should be an expert in science and not an administrator only. The official mind is unwilling to believe that broad scientific knowledge may be combined with administrative capacity; and the result is, as Prof. Pope pointed out in his address, the more a man knows of scientific subjects on which he is engaged in a Government department or industry, the less likely is he to be given charge of them. Whatever provision is made for research by the State or in private industries cannot produce the fullest advantage until this unreasonable principle of appointment has been abandoned and the power of action is placed in the hands of men who can draw up the plans of a scientific campaign, and be given the responsibility of carrying them to a successful conclusion. Until this military method is applied to the scientific services, no machinery provided can be used to its utmost efficiency.

BEETLES AND DRAGONFLIES.

(1) *The Fauna of British India, including Ceylon and Burma. Coleoptera. Rhynchophora: Curculionidae.* By Dr. Guy A. K. Marshall. Pp. xv+367. *Coleoptera. Lamellicornia,* Part ii. (*Rutelinae, Desmonycinae, and Euchirinae*). By G. J. Arrow. Pp. xiii+387+plates v. (London: Taylor and Francis, 1916–17.) Price 15*s.* each vol.

(2) *The Biology of Dragonflies* (*Odonata or Paraneuroptera*). By R. J. Tillyard. ("Cambridge Zoological Series.") Pp. xii+396. (Cambridge: At the University Press, 1917.) Price 15*s.* net.

(1) THE imposing series of monographs on the fauna of India, published under the authority of the Secretary of State, has been enriched by these two volumes now contributed on important groups of beetles by Dr. Marshall and Mr. Arrow respectively. The Curculionidæ, or weevils, are dominant insects in most parts of the world, often forcing themselves on the attention of mankind by the damage that they cause to vegetation. In the volume now issued Dr. Marshall gives a general introduction on the family with respect to structure, life-history, and habit, and deals systematically with the two extensive sub-families Brachyderinæ and Otiorrhynchinæ. In the introductory section there are clear descriptions with figures of those modifications of the jaws and body-skeleton that are of classificatory importance, and a brief account of larval and pupal structure, with illustrations of the early stages in three genera. Dr. Marshall comments on our lack of knowledge about the life-histories of the vast majority of these beetles; nevertheless, he has brought together much interesting information about the habits of various Indian species. It is not generally known, for example, that a white excretory substance which builds the cocoon of certain Larini in the pupal stage "forms an article of commerce in the East, being largely used both medicinally and as a food." The systematic part of the work contains careful diagnoses of 342 species, illustrated by means of a hundred excellent figures.

Mr. Arrow's volume is the second devoted to the large group of the Lamellicorns, which includes the conspicuous stag-beetles and chafers and the highly interesting dung-beetles. It deals with three sub-families of chafers, including the Rutelinæ, to which belongs the common British "garden chafer." Nearly four hundred Indian Rutelinæ are described; many of them are adorned with brilliant colours, and the appearance of these can be judged from a coloured plate. Four other plates give structural details of the male reproductive armature, the systematic value of which among insects is becoming increasingly recognised. Some of the genera have an enormous number of species; Mr. Arrow describes 181 different kinds of Anomala, but he wisely refrains from attempting to divide this huge genus on characters derived from the study of a local fauna even so extensive as the Indian, because such characters "invariably break down when applied to other species or faunas than those upon which they are founded." The Euchirinæ, with which the volume concludes, are large chafers which climb about on trees, feeding on sweet exudations by means of specially modified jaws; the males possess forelegs of abnormal length and puzzling structure.

(2) Dragonflies are among the most interesting of the smaller orders of insects, and accounts of their structure and life-history may be found in many general works on entomology. But never before has the group received such detailed and well-balanced treatment as Mr. Tillyard has given in the handy volume now published as one of the "Cambridge Zoological Series." Students of the anatomy and development of insects are much

indebted to him for providing in this convenient form a trustworthy guide to the external and internal structure of dragonflies at various stages of their life-histories. He knows the literature of the order well and furnishes a full bibliography, but much of the information in the book is due to his own careful studies, pursued first in England and afterwards in Australia, where he now resides.

The "mask," or modified labium, of the dragonfly larva is one of the most remarkable of predaceous organs. Mr. Tillyard supports the view that its lateral lobe is formed by the labial palp; in this he is probably right, but his use of the term "exopodite" for the palp is less justifiable, as it is very doubtful if the crustacean exopodite is represented at all in any insectan appendage. The adaptation of the larvæ to aquatic life is of much interest, and the various types of tracheal gills found among them receive especially full treatment, though the author does not fail to emphasise the imperfection of our knowledge of the physiology of the respiratory process. Perhaps the most abnormal organs possessed by dragonflies are the problematical sclerites on the second abdominal segment that form the genital armature; Mr. Tillyard supplies a clear description of these with original figures. Embryology is treated with relative brevity, but there are some welcome original observations on modes of egg-laying by various female dragonflies. The phylogeny of the Odonata is discussed with reference to extinct genera from the Coal Measures onwards, and there is a full chapter on geographical distribution, accompanied by a map. Mr. Tillyard does not disdain, like some modern students, to retain the classical "regions" which may be used so as to indicate important distributional facts, if the student remembers that they have no guarded land frontiers. Detailed systematic treatment is outside the scope of the book, but the characters of families and sub-families are sufficiently elucidated to set a collector profitably to work in any part of the world, while a synopsis of the British species is welcome to the home-keeping student. There are four plates and 188 text-figures, for the most part excellent both in draughtsmanship and reproduction; the representations of the complicated wing-nervurations that form such important characters for the classification of dragonflies deserve a special word of praise.

Even in these volumes echoes of the war are to be met with. Mr. Tillyard gratefully records how his manuscript and six sets of proofs have passed to and fro between Australia and Cambridge since July, 1915, "without the loss of a single item." Dr. Marshall and Mr. Arrow acknowledge the courtesy of various German students of beetles who, in the days of international scientific helpfulness, facilitated the examination of type-specimens. One trusts that such once friendly entomologists will be glad to know that their fellow-countrymen failed to destroy the results of Mr. Tillyard's prolonged and peaceful labours. G. H. CARPENTER.

THE INDIVIDUAL IN SOCIETY.

Community: A Sociological Study, being an Attempt to set out the Nature and Fundamental Laws of Social Life. By Dr. R. M. MacIver. Pp. xv+437. (London: Macmillan and Co., Ltd., 1917.) Price 12*s.* net.

DR. R. M. MACIVER'S study of community is a plea for the validity and importance of the individual life. The meaning of society is found within the constituent members. Social and individual claims are complementary to each other. Individual autonomy is realisable only within society. The liberty of the self proves itself in the relation of the self with other selves; for freedom is but a means of life, and not life itself. Social order involves the adjustment of individual claims to each other. Communal life is characterised by reciprocal action, and the wonder of the universe is the essential harmony of personal values working in and through society.

In the development of social consciousness the movement is at once both broad and deep. By the strength of a common life we break down the barriers of race and nationality, to find that we have intensified our hold upon the things that serve the well-being of individuality.

The clear-cut opposition of life and environment, as popularly conceived, is false. Environment is but the external correlative without which life would be futile and meaningless. The relation of the two is essential. Change in either involves change in the other. For Dr. MacIver "life is that which feels and knows and wills, that for which values exist and which itself exists as value." It is a shaping force expressing itself in character, of which environment may be the occasion or stimulus, but not the source. The increasing control of the individual over environment is secured in the development of a social co-operation marked by intelligence. In the evolution of society, rational or purposive selection must ultimately replace "natural selection."

Dr. MacIver has given a fine and adequate analysis of the meaning of society. The willed relations of living beings are the primary social facts, and "the ultimate social laws are those which reveal the interrelations of the purposes of living beings, their conditions and their consequences."

Community is defined as an area of common life, with definite characteristics such as are given in traditions, customs, manners, modes of speech, etc. It may transcend the State, in that it is not territorially limited; it may exist without a State, as among the Eskimos. The State is "the fundamental association for the maintenance and development of social order." Society involves co-ordinated rights and obligations embodied in political law and enforced by communal power. Law is the primary instrument of the State; it operates irrespective of the individual will. The State, however, cannot directly affect the spiritual life of its members. It can only deal with ex-

ternal manifestations, and then but formally. But "community is the common life of beings who are guided essentially from within." It is "the world the spirit has made for itself."

One of the most important factors in the development of community is the right of free association. An association is "an organised form of social life within community." Community is greater than any or all of the associations to which it may give birth. Sociology is the science of community. Specific social sciences, such as economics and politics, are concerned with associational forms of life. Dr. MacIver urges that social science must free itself from the quantitative methods and formulæ proper to physical and biological science. For such methods cannot be applied to purposes, to thought, to personality, or to institutions—"ideal constructions without quantitative length or breadth"—the stuff of social science.

In his analysis of community the author insists that "society is nothing more than individuals associated and organised," and that "the quality of a society is the quality of its members." Society is but the individual in human relationship. It is not characterised by the unity which distinguishes the individual organism. An organism is a closed system, but "community is a matter of degree, with no set bounds." The unity given in community is spiritual and not organic.

Dr. MacIver incidentally criticises the definition of mind as "an organised system of mental or purposive forces"—given by Mr. W. M'Dougall in his little book on Psychology—as "totally inadequate," on the ground that it is a confusion of the construction with the nature of the forces that construct. The "collective mind," with which Mr. M'Dougall credits "every highly organised human society," is a gratuitous hypothesis. Minds in association may act differently from each in isolation; but even so, in association it is the individual mind that acts. Community cannot be greater either than the sum or the resultant of its "parts," for such "parts" have never existed separately *as* parts. Stress is laid on the value of personality in community; "in the service of personality alone are laws and institutions justified."

A serviceable discussion on the relation of will and interest—"the two polar factors of all human activity"—helps the reader to understand their place in the creation of community. Society is mind in relationship. Interest and will are the objective and subjective aspects of a vital unity. "The interests of men . . . are the source of all social activity, and the changes in their interests are the source of all social evolution." Community is simply wills in relation.

Within the limits of a brief notice justice cannot be done to the completeness of the author's analysis of interests, associational and institutional life, and the meaning of the State. But we may express our gratitude for so able and suggestive a plea for the value and importance of individual human personality in the life of community, a plea more deeply significant against the background of present-day happenings.

W. L. S.

OUR BOOKSHELF.

General Types of Superior Men: A Philosophico-psychological Study of Genius, Talent, and Philistinism in their Bearings upon Human Society and its Struggle for a Better Social Order. By Osias L. Schwarz. Pp. 435. (Boston, Mass.: R. G. Badger, n.d.) Price 2.50 dollars net.

THIS study of "Superior Men" is hailed in a preface by Jack London as "immortal" and "epoch-making," "truly a revival of Socrates' fight against the shams and sophists who ever bend themselves to the dethronement of ethics and the instalment of the worship of Mammon." It is also introduced by Max Nordau as "teeming with ideas, but still more seething with feelings." "It is Isaiah holding forth on the structure of modern society and on the barrenness and wickedness of the souls of contemporary civilised men."

Whatever the book teems or seethes with, it is not with clear ideas. "Heredity means persistence and transmittal of old environmental influences, *i.e.* of the organism's reactions thereto, as long as the provocative environmental causes remain the same or vary very slightly, *i.e.* in details only." "Any character or trait consists of three parts: One is inherited; one is apparently due to variation, but is mostly due to the actualisation, liberation, or emergence in the child of an inherited latent parental trait, or *vice versa*; it may be due to the latentification or repression of a parental actual trait; the third part is really due to variation, *i.e.* to acquisition made under new circumstances."

The book is full of this sort of muddiness, and yet there is often, we willingly recognise, a striking suggestiveness, as in the comparative curves of development of average man, artist, man of science, and philosopher. The chief merit of the book is in its passionate insistence on the imperativeness of making the most of really superior men—the geniuses in the pursuit of the true, the beautiful, and the good. According to the author, the unpardonable sin is the Philistine's depreciation of what he knows to be genuine, or the pseudo-superior man's attempt to palm off a pinchbeck substitute for good gold.

Our Analytical Chemistry and its Future. By Dr. W. F. Hillebrand. Pp. 36. (New York: Columbia Univ. Press; London: Humphrey Milford, 1917.) Price 1*s.* 6*d.* net.

THIS Chandler lecture for 1916, though purposely restricted to the conditions existing in the United States, is largely applicable, *mutatis mutandis*, to the position of analytical chemistry in this country also. In the early days of chemistry, when there was need for accumulated observations on the

composition of all kinds of matter, the great chemists of the period were of necessity analysts, and the analytical branch of chemistry stood in high repute. Latterly there has been some neglect, and less fundamental knowledge of analysis has been demanded of chemists. This is partly due to the great development of organic chemistry and physical chemistry, which have held out better promise of new discoveries. The lecturer contends, however, that the field of research in analytical chemistry is by no means an exhausted one. He instances, in support of his opinion, the possibility of finding uses for the rarer elements, such as gallium and indium; the influence of minute quantities of elements on the properties of materials; and the importance of exact analytical methods in physico-chemical researches. A national institution of analytical chemistry is wanted, of high scientific authority and in touch with industry: the best conditions for establishing and maintaining such an institution are discussed by Dr. Hillebrand at some length. C. S.

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.*]

Plated Teeth of Sheep.

I HAVE read with interest the letters from various correspondents in NATURE (vol. xcix., pp. 264, 284, and 306) and the abstract of Prof. Liversidge's paper (*ibid.*, p. 290). Since the latter paper was published, operating on a much larger sample than Prof. Liversidge had at his disposal, I have been able to make a complete quantitative analysis of the deposit, not only from the teeth of sheep, but also from those of oxen and of man, both of which in composition agree closely with that from the sheep. A full account of my investigations will shortly be published in the Proc. Linnean Society of New South Wales.

Some of the writers in NATURE attribute the deposit to iron pyrites, either derived direct from fragments of mineral occurring about the pastures, or formed by interaction of iron oxide with sulphates. It would be interesting to know if any of these correspondents have applied tests to prove the presence of iron sulphide. Under the conditions ruling in a sheep's mouth, the formation of iron sulphide from the oxide and a sulphate is quite impossible, nor could iron pyrites be caused to spread itself on, and adhere to, the teeth when chewed along with its food by the animal.

As indicated by Prof. Liversidge, the deposit consists mainly of calcium phosphate with organic matter. As a matter of fact, such deposits, commonly known as "tartar," are of very general occurrence, being found not only on the teeth of sheep, but also on those of all mammals, including marsupials, which I have examined. Sometimes the coating is in a very thin layer, and brown or black in colour, but it varies up to quite a heavy coating one-eighth of an inch or more in thickness. In the case of sheep it does not always present the metallic appearance which has been the cause of so much speculation; it is sometimes nacreous and sometimes chalky. In man it constitutes the "tartar," which is removed from the teeth by dentists in the operation of "scaling."

It is not derived from the food as such, or from any accidentally eaten mineral, but is a true salivary calculus, precisely analogous to the calculi so commonly occurring in the urinary tract, and is derived, probably entirely, from the saliva.

It is extremely unlikely that the deposit found in England differs from that occurring in Australia. I may say that I have handled and examined many hundreds of sheep's jaws, as well as those of other animals, in consignments of bones received at a large bone charcoal factory in Sydney, and in every case the deposit, when present, has been as above described. I have also on several occasions found good examples of the deposit on the teeth in sheep's heads purchased in retail shops. THOS. STEEL.

Sydney, N.S. Wales, August 8.

An Optical Phenomenon.

I HAVE never seen the following phenomenon described; perhaps a physiologist can give the explanation. If the eye is fixed on a stream of water for twenty or thirty seconds, and is then turned on to a fixed object, the part of the field of view that had previously been occupied by the stream appears to move in a contrary direction to that in which the water had been moving; the apparent motion slows down rapidly and ceases in from five to ten seconds. This is seen not only with lateral motion, but also with up-and-down motion, as when a stream is looked down on from a bridge. The phenomenon is perhaps best seen with running water, but it may be observed with other bodies in motion—a passing train, for instance. The effect is very curious, as only part of the field of view appears to move, and it is remarkable to see objects apparently in motion, yet not changing their position relatively to objects above or below.

C. J. P. CAVE.

Lynmouth, October 4.

The Fireball of October 1 last.

SINCE forwarding to you the results of a preliminary discussion of the observations of this fine object, a large amount of additional data has come to hand. A re-examination on the basis of forty-four reports shows that the heights of the fireball as given in my contribution to NATURE of October 11 are as nearly as possible correct. But the radiant point should be further N.E., and the position of the object over England was more probably from forty-five miles E. by N. of Hull to twelve miles S. by E. of Wolsingham, Durham.

There were evidently two fireballs on the same night, one at 6h. 37m., the other at 10h. 46m. (October 1), and they appear to have been both directed from a radiant point near the star γ Piscium. It was this radiant which furnished the brilliant detonating meteorite that fell in a field near Wigan on October 13, 1914. It has also yielded many large fireballs in September. W. F. DENNING.

44 Egerton Road, Bristol, October 12.

The Autumn Moon.

IN the attractive paper on "The Autumn Moon" in NATURE of September 27 Sir Geo. Greenhill refers to the mistakes of poor common folks, and of poets and painters even, when they deal with things astronomical. He instances Coleridge's reported intention (in the first draft of "Christabel") to seat a star within the horns of the crescent moon. The idea seems to have

bitten "S. T. C.," for in the "Ancient Mariner" we have the well-known lines :—

Till clomb above the eastern bar
The hornèd moon, with one bright star
Within the nether tip.

Dr. Geo. Macdonald had a lecture on the wondrous poem, which admirably suited his spiritual nature, in which he gave some explanation of this celestial prodigy, but at this distance I forget what it was. Perhaps some of your readers have more retentive memories.

ALEX. MACDONALD.

Durris, Aberdeen.

EQUATORIAL AFRICA TO-DAY.[1]

I HAVE seldom read a more interesting, easily assimilable, truthful book on modern Africa than this record of Mr. J. Du Plessis's recent journeys backwards and forwards across Equatorial Africa. Between 1913 and 1916 the missionary-author visited the Gold Coast and Ashanti, was on the outskirts of Dahomé, travelled through Lagos and Abeokuta to Hausaland, up the Benue to the Shari, explored the western Cameroons, visited a great deal of Belgian and French Congoland, of Uganda and British East Africa, passed from Congoland through Northern Rhodesia, and revisited Nyasaland and the Moçambique coast.

I have reviewed elsewhere the political and ethical aspects of the book; let me deal here with the light it may throw on the ethnology and zoology of West and Central Africa.

"The journey" (from the coast to Ashanti) "which occupied Sir Garnet Wolseley . . . four months was accomplished by us in a single day," writes Mr. Du Plessis, who travelled from Sekondi to Kumasi by rail. Nevertheless, the mass of the Gold Coast forests retain their former magnificent luxuriance of growth; and perhaps after the war they may be used as object-lessons in botany (like those of eastern Sierra Leone). Certainly our official world, especially our Treasury (which grudges the tiny allowance of money for finishing the Flora of Tropical Africa that the late Lord Salisbury ordained), overlooked the fact that those West African and Cameroons forests under the British flag are distinctly among the world's wonders, and, besides being striking in their splendour, are replete with wealth for commerce which we might turn into coin of the realm were we only as a nation better educated in the lore of the twentieth century. Yet Mr. Du Plessis was a little shocked at evidences of modernity when he saw the forest-dwellers roofing their huts with corrugated iron, and when one of them—in excellent English—inquired if he was a dentist, as he wanted a tooth stopped!

The author has much to say about the *real* "dangerous animals" of Africa, the insects that spread all manner of germ diseases. His remarks about the vicious and cunning tsetse-flies on the Gribingi River are distinctly interesting. He points out that, while the tsetse-conveyed sleeping sickness is being got well in hand, and even extinguished in French and Belgian Congoland, it is spreading fast and far in Nyasaland and the adjoining part of Northern Rhodesia. Unfortunately, too, in this direction the disease is more virulent and less curable than elsewhere. Apparently, also, it is now proved that the ordinary *Glossina morsitans* of South and East Africa, as well as the wicked *palpalis*, can convey the trypanosomes.

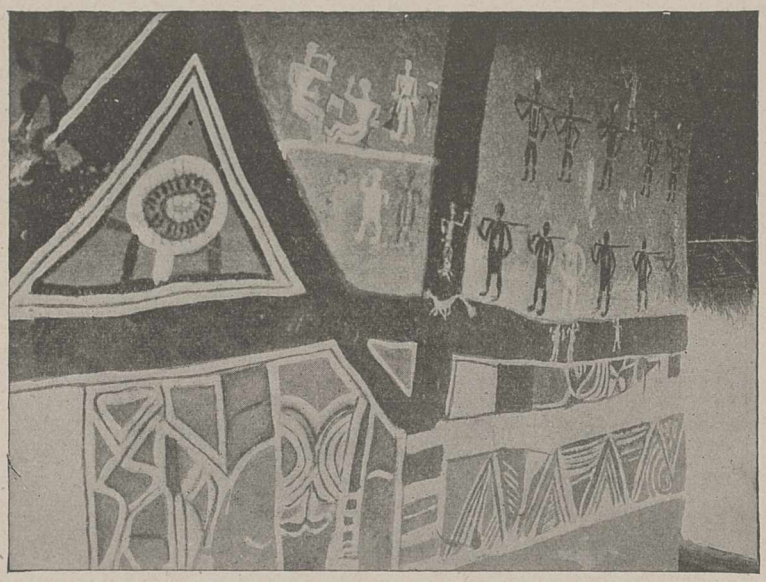

FIG. 1.—Mural ornamentation of the Basongi (Belgian Congo). From "Thrice through the Dark Continent."

Mr. Du Plessis tells us much about the interesting Munshi or Tivi people south of the central Benue. But he is mistaken in regarding their language as one that is quite isolated and almost unknown. It has recently been effectively illustrated—chiefly in the pages of the African Society's Journal, also in manuscripts that I am shortly publishing; and it stands out very clearly as a Semi-Bantu language with strong Bantu affinities, but otherwise connected as regards word-roots and syntax with other Semi-Bantu speech-forms in Nigeria and in the Cross River basin.

The author has something to say about the interesting Mundang tribe of the northern Cameroons, and his example of the language indicates that, like so many other forms of Sudanic speech, it possesses Bantu word-roots, though it can scarcely be called Semi-Bantu. There must be a strong underlying element of Semi-Bantu in many

[1] "Thrice through the Dark Continent: A Record of Journeyings across Africa during the Years 1913-16." By J. Du Plessis. Pp. viii+350. (London; Longmans, Green, and Co., 1917.) Price 14s. net.

of the negro languages between the Shari River on the east and the forests of West Africa, overlaid as these innumerable types of speech may be by other unrelated tongues, implanted at a later date in Equatorial Africa. We now know that the range of actual Semi-Bantu languages extends from the Lower and the Upper Gambia eastwards to the watershed of Lake Chad. Mr. Du Plessis lays stress on the ethnic importance of the A-zande, or Nyamnyam. Undoubtedly they will play a part in the future development of the western Bahr-al-Ghazal and the Mubangi-Wele basin as important as that of the Fula in Nigeria or the Mandingos of Senegambia.

Much information is given concerning the artistic aptitudes of various negro peoples, espe-

FIG. 2.—A specimen of native art (British Nyasaland). From "Thrice through the Dark Continent."

cially of the Nyamnyam, the Basonge (of central Congoland), and the A-nyanja of Nyasaland. A good deal of this desire to draw and paint and decorate is subsequent rather than prior to the establishment of European influence. Personally I believe that the negro may rise very high in the pictile arts, and that he has an inherent good taste and originality in design.

H. H. JOHNSTON.

THE NUMBER AND DISTRIBUTION OF THE STARS.

AN enumeration of the stars, classified according to their brightness and their position in the sky, must form a part of any general investigation into the nature of the stellar universe. It has long been one of the primary aims of astronomy to execute this enumeration. Considerable difficulties of a practical nature have to be faced in the course of the work, however, and only now do they appear to have been so far overcome as to enable a consensus of opinion to be formed amongst astronomers regarding the main features of the results. Whether visual or photographic methods are used, it is anything but easy to determine star magnitudes according to an absolute scale of light-ratio, and to maintain a constant zero point for the scale in widely separated regions of the sky.

The photometric work done at the Harvard and Mount Wilson observatories has greatly facilitated this task, and at these institutions, moreover, extensive schemes for the photographic survey of sample areas of the sky have recently been carried out. The Harvard plates have been measured, and a preliminary discussion of them made, at the Groningen Astronomical Laboratory; an account of this work,[1] and a brief note[2] upon that done at Mount Wilson, have lately appeared. In both cases the investigation has been extended to very faint stars (of magnitude 15·5 and 17·5 respectively); these are so numerous that counts of small sample areas, and the formation of statistical averages, afford the only practical means of attack upon the problem. The areas dealt with were among those

[1] Publications of the Astronomical Laboratory at Groningen. No. 27. "On the Number of Stars of Each Photographic Magnitude in Different Galactic Latitudes." By Dr. P. J. van Rhijn. (1917.)

[2] F. H. Seares, Proc. Nat. Acad. Sci., Washington, v l. iii., p. 217. (1917.)

selected by Prof. Kapteyn for his "Plan of Selected Areas" (1906), the number of regions for which data were available for preliminary discussion being sixty-five at Harvard and eighty-eight at Mount Wilson. Dr. van Rhijn's discussion is much the more detailed, Prof. Seares dealing only with the numbers of stars down to the *limiting* magnitude on each plate. The two investigations agree, however, in indicating a progressive increase in the concentration of the stars towards the galactic plane, as we proceed from brighter to fainter stars. Comparing star densities (*a*) in a belt of 20° on either side of the galaxy, and (*b*) in the caps of 50° radius round the galactic poles, the ratio is found to be 2·5 for stars brighter than $5^{m}\cdot0$ or $6^{m}\cdot0$, 5·5 for stars brighter than $16^{m}\cdot0$ (Harvard), and about 10 for those brighter than $17^{m}\cdot0$ (Mount Wilson); magnitudes are here reckoned on the revised Harvard photographic scale.

These results differ to some extent from those arrived at by earlier investigators, among whom the more recent are Pickering (1903), Kapteyn (1908), and Chapman and Melotte (1914). The differences, however, can now, in the main, be accounted for. The counts on which the first-mentioned work was based were incomplete in the richer regions of the sky, and the galactic condensation thus appeared to increase but little for the fainter stars. Kapteyn's memoir, on the contrary, gave values of the condensation which are larger than those mentioned above, but which are brought into fair agreement with them when his magnitude scale is corrected to the absolute scale determined more recently. Chapman and Melotte's investigation, which was photographic (thirty plates), and in many respects similar to the new Harvard-Groningen study, gave too small a galactic concentration for the faint stars (*i.e.* 3·1 at $16^{m}\cdot0$). Dr. van Rhijn points out that the method of reduction which they adopted was faulty, and would lead to too small a value; from a note in his memoir it appears that, after allowing for this error, Chapman and Melotte find that their data yield results in close accordance with his own.

It is of interest to note that Dr. van Rhijn's estimate of the total number of stars in the sky brighter than the 16th magnitude is approximately thirty-three millions. Also, if the law of increase in number which is obeyed down to this limit is used to obtain, by extrapolation, an estimate of the total number of stars of all magnitudes, the result is found to be 3360 millions; of these stars about half will be brighter than magnitude 25·5.

S. C.

ALCOHOL FUEL AND ENGINES.

THE special committee on "Alcohol Fuel and Engines" of the Australian Commonwealth Advisory Committee on Science and Industry has presented its first report. The need for such an investigation arises from the prospective shortage of supplies of mineral oils and the consequent high price of motor spirit.

There are three branches into which the inquiry divides, namely, the design and manufacture of the engine, the supply of the alcohol, and its denaturation. As the committee points out, there is no special difficulty with the engine; indeed, the use of alcohol, by permitting the compression ratio to be increased considerably, offers a prospect of some gain in thermal economy. Nor with a given engine need there be any loss of power, since the average calorific value per unit volume of a mixture of alcohol with the air necessary for its combustion is almost identical with the corresponding figure for petrol. Nevertheless, if alcohol be compared with petrol pound for pound, the latter has the advantage by some 50 per cent. A comparison gallon for gallon is more favourable to alcohol, but, whichever be adopted, alcohol needs to be at a lower unit price than petrol to be the more economical fuel.

Alcohol unfortunately suffers from the grave disadvantage that an engine will not "start up from the cold" with it, whereas its alternative rival, benzol, will easily enable this to be done on all but the very coldest days. Doubtless the possible use of benzol was outside the terms of the reference of this particular committee; but, had it not been so, the committee would certainly have had to point out that, although the alterations to the engine to suit it to alcohol as fuel are not considerable, the use of benzol enables the engine to be used without any alterations whatever.

The main difficulty seen by the committee is the question of supply. "It appears unlikely that any considerable quantity of alcohol can be manufactured in Australia from either waste or raw materials not at present utilised." The same remark applied to benzol before the war, but will it apply after? The quantity of benzol at present being produced for munitions is shrouded by the secrecy of war, but it is not out of place to speculate that when the need for vast munitions ceases a supply of benzol may be released for use in internal-combustion motors which will give a new aspect to the problem which this Australian committee is considering. The further reports of the committee will be looked forward to with interest.

NOTES.

AMONG the several matters which the deputation from the Joint Committee of Approved Societies and the Conference of the Amalgamated Society of Industrial Assurance brought before the Prime Minister, when he received it on October 11, not the least important was that with regard to the early establishment of a Ministry of Health. Mr. Lloyd George did not fail to recognise its importance, and in the reply which he made to the deputation showed that he was alive to the necessities of the case and understood the point of view of the deputation. In effect, the demand made was that, in connection with the establishment of the Ministry, the aim should be to give satisfaction to the national insurance organisations. It was suggested, too, that the one thing that must be done was to avoid allowing the Local Government Board to have any part in the work. The reason for asking this

was that the Board dealt with pauperism, and insured persons and trade unionists were opposed to it, would not have anything to do with it, and, in short, hated it. As a matter of fact, this was probably all that the deputation desired to say as to the Ministry of Health, except to assure the Prime Minister that the bodies concerned with national insurance were much more capable and deserving of the honour of being charged with the care of the nation's health. Except that he may possibly have been hinting that it was the fault of the Local Government Board that the laws as to public health were not satisfactory, and that there had been no drastic reform in connection with their administration, the Prime Minister said very little in praise or dispraise of this department. If he had words of praise for the national insurance bodies as public health administrators they did not appear in the newspaper reports of the proceedings. From these it would seem that perhaps the most important statement made by Mr. Lloyd George, so far as the Ministry of Health was concerned, was not one likely to bring much cheer to persons desirous of seeing an early settlement of the question. The Prime Minister made it clear that he regarded the matter as important, and that he saw the necessity for drastic alterations. Also he made it plain that he did not think this was the time to ask that changes should be made. It appears to be his view also that even if there is postponement and the country is asked to depend upon the existing arrangements for even a year or two, probably nothing very serious will happen.

UNDER the Representation of the People Bill now before the House of Commons, it is proposed to do away with the Livery vote of the City of London. A meeting was held at the Guildhall on October 15 to protest against this proposal. The Lord Mayor presided, and Lord Halsbury moved the following resolution, which was seconded by Major Rigg and carried by the meeting:—"That the Livery Companies of the City of London, in common hall assembled, earnestly protest against the attempt now disclosed, under the provisions of the Representation of the People Bill, to deprive the Livery of one of its most valued and long-established rights and privileges in exercising the Parliamentary franchise in the City of London; and against the injustice and wrong at such a moment in our history of having to defend these rights; and they further submit that the provisions in the Bill for preserving and extending the university franchise should include the retention of the ancient Livery franchise on educational grounds alone, apart from the other rights of the Livery to its retention. The Corporation and the Livery Companies have from time immemorial represented the founders and supporters of all grades of education, including faculties in science and literature in the universities to which the Bill rightly proposes to preserve or give the Parliamentary vote, and have cherished and supported all forms of manual, industrial, commercial, and scientific training, based upon and combined with such education. The City and Guilds Institute and the schools and colleges founded and still maintained in the City of London constitute in themselves an educational claim to the Parliamentary franchise, based on traditional influence, contemporary activity, and prestige as great as can be claimed for any kindred constituency, and the Livery make their appeal to Parliament to preserve to them rights they have well earned and ever exercised in the public interest." A strong case can certainly be made out for the retention of the Livery vote on the ground of the educational activities of the Livery Companies of the City of London. To the City and Guilds of London Institute alone these companies and the Corporation have contributed more than one million pounds, and they led the way in the provision of facilities for technical education in London. Their historical claims to Parliamentary representation are undoubted, and they are supported by beneficial national influence. Whatever reasons can be adduced for university representation can be applied with increased force to the Livery franchise; we hope, therefore, that the ancient right will be preserved.

ONE of the industries concerning which little is perhaps generally known, but upon which the steel, non-ferrous metals, gas, glass, and other industries are absolutely dependent, is that which is concerned with the production of refractory materials. In the days before the war we were content to draw from abroad not only important supplies of raw materials, but also finished products. The new spirit in manufacturing, however, has led to a movement to make British industries particularly self-supporting in this direction. Mr. W. J. Jones, of the Ministry of Munitions, who is the president of the Ceramic Society, the autumn meeting of which concluded at Glasgow on October 3, in an address delivered to the Refractory Materials Section of that society, referred to the useful work which has been done by this section. He pointed out how the urgent needs of manufacturers for refractory materials have been met by the home industry, which, notwithstanding the depletion for national service of so many of the best men, has increased the output of coke-oven bricks by 100 per cent., of silica bricks by 60 per cent., of calcined dolomite by 80 per cent., and of firebrick by more than 20 per cent. In view of the fact that our manufacturing output must remain at a high level, both during the war period and after, Mr. Jones outlined the steps that should be taken to bring about the necessary increase in the supply of refractory materials of the right quality in order that they might withstand the high temperatures that would be certain to be applied, and the more severe conditions of service generally. What he asks is that there should be a closer combination between manufacturer and consumer, with the scientific investigator as a connecting link, and he urged upon all interested the desirability of at once giving consideration to a scheme of scientific research in which other societies are likely to co-operate. If the suggestions put forward by Mr. Jones commend themselves to the makers, and the necessary steps are taken to bring about their realisation, a great step forward will have been made by an industry which, although in a certain sense a subsidiary one, is intimately bound up with the future prosperity of our staple manufactures.

WE learn from the *Daily Telegraph* that President Poincaré has conferred the Legion of Honour upon Dr. John Cadman, C.M.G., professor of mining, University of Birmingham, in recognition of valuable services rendered by him in the cause of the Allies.

THE King has conferred the dignity of a peerage of the United Kingdom upon the Right Hon. Sir Francis Hopwood, vice-chairman of the Development Commission, and a member of the General Board and Executive Committee of the National Physical Laboratory.

WE regret to note that the *Engineer* for October 12 records the death of Mr. William Robert Sykes, the inventor of the lock-and-block system of railway signalling. Mr. Sykes died on October 2, at the age of seventy-seven years; he was responsible for the invention of many appliances relating to railway signalling.

THE death is announced in the *Engineer* for October 12 of Mr. Bernard Arkwright, chief of the engine works department at Elswick. Mr. Arkwright was born in 1861, and educated at Harrow, and he became assistant manager of the engine works belonging to Sir W. G.

Armstrong and Co., Ltd., at the early age of twenty-seven years. He was appointed a local director of the company in 1912, and was a member of the Institution of Civil Engineers and of the Institution of Mechanical Engineers. He occupied a prominent position in the North-East Coast Engineer Employers' Federation.

DR. ADDISON, the Minister of Reconstruction, has appointed a committee to consider and report on questions connected with the supplies of raw materials which will be required by British industries for the purpose of restoring and developing trade after the termination of the war and the best means of securing and distributing supplies, due regard being had to the interests of the Allies. The committee, which will be known as the Central Committee on Supplies of Materials, consists of the following members:—Sir Clarendon Hyde (chairman), Sir H. Birchenough, K.C.M.G., Mr. Cecil Budd, Sir C. W. Fielding, K.B.E., Sir H. Babington Smith, K.C.B., Mr. W. Thorneycroft, and Mr. A. Weir. The secretary is Mr. J. F. Ronca, who should be addressed at the Ministry of Reconstruction, 2 Queen Anne's Gate Buildings, Westminster, S.W.1.

IN discussing the development of the steel industry in Great Britain the leading article in *Engineering* for October 12 asks whether there are any signs during the last two years in the desire of our manufacturers to profit from scientific methods, and obtains a welcome affirmative from the recent autumn meetings of the Iron and Steel Institute and the Institute of Metals. There has always been great difficulty in getting British manufacturers to combine to solve collectively problems which affected all, and no better evidence that the "old order changeth" could be supplied than the report of Committee No. 1 on ore, fuels, and refractories, with which the Iron and Steel Institute opened its session. This report was compiled by Messrs. Guy Barrett (Ebbw Vale) and T. B. Rogerson (Glasgow), and gives in an admirably concise form the present state of our knowledge regarding the subjects dealt with, and received warm commendation from the members. In connection with the utilisation of low-grade ores, concentration will be required to convert these into high-grade ores, while briquetting will be necessary to make the product usable. Meanwhile there is money to be saved, the conservative estimate of the authors of the report being more than 5000*l.* per furnace-year.

THE *Revue Scientifique* records the death on July 22 last of M. François Cyrille Grand'Eury, correspondant of the Institute of France in the section of botany. Born at Houdreville (Meurthe-et-Moselle) on March 9, 1839, Grand'Eury adopted the profession of a mining engineer, and spent his life in the coalfields. Early in his career he became interested in the fossil plants occurring in and around the coal-seams, and he continued until the end to make the best use of his unrivalled opportunities for observing the fossils in their natural position. He was thus able to make many important contributions to knowledge of the flora of the Carboniferous period, by correlating the roots, stems, foliage, and fruits, which were until then known only by isolated fragments and bore several distinct names. At the same time he made many striking observations in reference to the mode of origin of the coal-seams themselves. There are still differences of opinion as to some of his theories and deductions, but all are agreed as to the keenness of his insight into the problems before him and the success with which he helped to solve many of them. His numerous writings are beautifully illustrated, and will always be esteemed among the early classics of palæobotany. His memoir on the Carboniferous flora of the department of the Loire and the centre of France was published by the Academy of Sciences so long ago as 1876. His great work on the coal basin of the Gard appeared in 1890. At the time of his death he had begun the publication of "Recherches géobotaniques," in association with his only son, who has fallen in the war.

LT.-COL. GODWIN AUSTEN writes with reference to the late Capt. G. F. T. Oakes, R.E.:—"I have only very recently heard of the death of this promising young engineer officer, which took place so long ago as July 15 last year at Ovilliers la Boiselle, when urging his men to complete a communication trench. Educated at Dulwich College, he entered Woolwich in September, 1900, and obtained his commission in December, 1901. Proceeding to India in 1904, he was appointed to the Indian Survey Department, and saw active service in the Abor Expedition of 1911–12, was mentioned in despatches, and received the medal and clasp. He did some fine work in this then unknown part of the Eastern Himalaya, in the great valley of the Dehang (the Tsanspu of Tibet, the Brahmaputra of Assam), carrying the triangulation and topography for 100 miles up the course of that great river to lat. 29° N., long. 95° E., including the great tributaries of the Siyom and Shimang on the right bank, with the Yamne on the left bank. The trigonometrical stations are lofty, up to 11,000 and 12,000 ft., covered with dense tropical forest, climatic and transport difficulties are great, and the people of the country wild; this survey he continued for another season after the troops had retired. Capt. Oakes did, besides, much for zoology, and I shall ever be grateful to him for the fine collection of land Mollusca he brought together; many rare species reached this country alive, and lived through the summer. This material, together with what was collected by Mr. S. W. Kemp, of the Indian Museum, during the Abor Expedition, shows that a very distinct molluscan fauna has developed in the Tsanspu valley, throwing much light on its ancient geological history and course. The Surveyor-General of India has lost a most promising assistant, and the Royal Engineers a brave officer, one who, on the return of peace, would have taken part in future pendulum survey operations in India, for which he was well fitted."

RAINFALL and gunfire is the subject of a note by Dr. H. Deslandres, director of the Meudon Astrophysical Observatory, in the *Comptes rendus* of the Paris Academy of Sciences for August 27. A communication is included from the pen of M. C. Saint-Saëns, whose eminence in the world of music serves him as a passport into the realms of science. The composer relates that in the time of Louis Philippe the evening display of fireworks which terminated the national festival of the "Trois Glorieuses" in July at Paris had to be helped out by the discharge of ordnance with the view of increasing the noise, which was otherwise insufficient to satisfy the public; and that afterwards there was nearly always a heavy storm, although the afternoon was the usual time for such phenomena. M. Saint-Saëns is of opinion, however, that rain is only produced by gunfire in certain circumstances (which are not specified). Dr. Deslandres maintains that gunfire is never the primary cause of rainfall, but that it may serve to provoke, expedite, and increase precipitation. In the latter part of the note the author remarks that the statements of Pliny and Plutarch to the effect that great rains followed great battles in ancient times, long before the invention of explosives, may not be without foundation; he considers that the friction of javelins, arrows, stones, and other missiles may have been sufficient to effect an increased ionisation of the air, and thus by facilitating condensation to bring about premature or excessive rainfall. M. Angot, however, has recently pointed out that the lower

regions of the atmosphere are always highly ionised, and that it has yet to be proved that any addition of ions can excite premature condensation in unsaturated air (see NATURE, August 9, p. 467).

AN extraordinary feat of engineering is reported from America in the *Times* for October 10, under the heading "A Standardised Air-engine." Our American friends seem to have realised at the outset the inadvisability of using a number of engines of different design, and have sought to standardise an engine from the first. With this object in view, two eminent engineers, whose names have not yet been disclosed, were invited to meet and discuss the question of an all-American engine, embodying the best experience available on engine design. Manufacturers and consulting engineers have also co-operated, and, we are told, have patriotically given up trade secrets to assist in the new design. The work of designing and constructing a trial engine was completed in the amazingly short space of one month, and the new engine was run in Washington on Independence Day for the first time. The United States *Official Bulletin* of September 13 states that the tests have given complete satisfaction, and even goes so far as to say that the tests "justify the Government in accepting the engine as the best produced in any country." This is high praise indeed for an engine so rapidly designed and made, and motor engineers will await details of the design with considerable interest. Little is said in the *Official Bulletin* as to the details of the new engine. Standardisation is the keynote of the design, and the cylinders have been so arranged that engines having either eight or twelve cylinders can be built from the same standard parts. It is, of course, impossible to criticise the engine from a technical point of view with so little definite information, but the Americans are to be congratulated upon their early appreciation of the importance of a standard engine, and the immense amount of time in production and repair that can be saved by adopting such a design.

IN a circular letter received from the Decimal Association, and headed "The Breakdown of the Penny," a proposal is again put forward for the establishment of a system of decimal coinage based on the sovereign, or pound sterling, which would retain its present name and value, and would represent "1000 mils." It is pointed out that most of our existing coins down to and including the sixpenny-piece are available for incorporation in such a system without any alteration whatever in their respective values, and that the completion of the system by the division of the florin into 100 parts would involve only a slight modification in the values of our present bronze coins. The circular states that war-time conditions have completely changed the purchasing power of the penny, that the inflexibility of our subsidiary coinage has been one of the causes accentuating the high prices of daily necessities, which have been found to be the root of so much industrial unrest, and that the proposed changes will be of advantage to the industrial classes. Prices of halfpenny goods have in many instances been raised to a penny and those of penny goods to three-halfpence for lack of coins having values intermediate between our present halfpenny and penny and between the penny and three-halfpence. The provision of an enlarged range of low denomination coins in closely graduated steps would accordingly afford much relief to purchasers while enabling the seller to get a fair increase of price for his article. A table of the proposed decimal coinage, given in a pamphlet accompanying the circular, shows that the new coins introduced would be nickel pieces of 10, 5, and $2\frac{1}{2}$ mils, and, if necessary, bronze pieces of 4, 2, and 1 mils.

THE annual report for 1916 of the Agricultural and Horticultural Research Station, Long Ashton, Bristol (the National Fruit and Cider Institute), forms an interesting record of work continued under great difficulties owing to depletion of staff. Cider and apple investigations form, as usual, the most prominent feature of the report, whilst several questions relating to black currants have also been studied. In addition to the staple research work of the station a number of questions which have arisen out of war-time conditions have been investigated, including experiments on the utilisation of cider apples and apple pomace as food for live stock and the substitution of glucose for cane-sugar in jam-making.

THE *Bulletin of the Imperial Institute* (vol. xv., No. 1) gives an account of the results of examination of *Ecdeiocolea monostachya* "leaves" from Western Australia, *Neoboutonia macrocalyx* timber from the East Africa Protectorate, and bark of *Brachystegia Randii* from Rhodesia, which have been investigated at the institute recently as sources of pulp for paper-making. The results on the whole were such as to indicate that these materials could be satisfactorily employed for the purpose. A further addition to the valuable information on oil-seeds supplied by the institute is given in articles on manketti nuts, babassu kernels, tucan nuts, and Paraguay kernels. In an article on the production of wheat in Egypt Mr. G. C. Dudgeon, of the Ministry of Agriculture, arrives at the conclusion that, except in years when the cotton crop is largely restricted in area, Egypt cannot grow enough cereals to supply completely her own necessities. Other reports, articles, and notes, covering a wide variety of subjects, contribute to make an interesting number.

IN his address to the Physical and Chemical Section of the Franklin Institute in January last Prof. Millikan, of the University of Chicago, dealt with one of the unsolved problems of modern physics—the relation of the electron to the absorption and emission of radiation. The fact that short-wave radiation passes through matter without influencing more than one in a thousand billions of the atoms in the space traversed forces us to assume either that the energy of the radiation is not spread evenly over the wave front, or that there is some property of the atom which, while permitting it to take in energy from the radiation gradually, only admits of that energy being emitted in bundles or "quanta." The former alternative has been adopted by Thomson and by Einstein, but Millikan points out the objections to it, and is disposed to think the second alternative the more promising, although in its present state it leaves us in the dark as to the conditions which exist within the atom and the modification of them that the incident radiation brings about. Prof. Millikan's address is reproduced in the September number of the Journal of the institute.

TWO $1\frac{1}{2}$-metre comparators, complete with the necessary standards, have recently been completed and shipped for the Imperial Japanese Government. The object of these comparators is to enable the final standards of length, as used by our Japanese Allies, to be comparable with those in use at the National Physical Laboratory at Teddington. The supreme importance of accurate final standards, from the point of view of interchangeability of ordnance, is universally recognised. The standards themselves are divided in metric units, and consist of H-shaped bars of 58 per cent. nickel-steel with platinum-iridium divided surfaces. In their general method of construction, all

comparators consist of a heavy cast-iron base, on the back of which micrometer microscopes are fixed. The bars, to be compared, are mounted in a moving carriage, which is traversed to and fro beneath the microscopes, thus enabling *plus* and *minus* difference readings to be taken. In this case the moving carriage consists essentially of a double tank mounted on wheels. The two standards are carried on light beams in the inner tank, which beams are fitted with accurate levelling screws. The inner tank is filled with water, so as to maintain the standards at a constant temperature, whilst a complete system of thermometers enables the temperature accurately to be determined. The outer tank acts as a jacket to the inner. By filling the interspace with ice, or, alternatively, hot water, coefficients of expansion can be obtained to a high degree of accuracy. In the general design and in the supply of the detail fittings, the utmost precautions have been taken to eliminate small sources of error, and an accuracy of about $\pm 0{\cdot}1\ \mu$ is anticipated after final erection. These instruments were constructed by the Société Genevoise, of 87 Victoria Street, London, and Geneva, to the specification of Mr. O. Paul Monckton.

THE September number of *La Science et la Vie* contains a description of the stereoradioscope invented by Major Lièvre, of the French Army Medical Corps. The principle of the apparatus is as follows. A body acted upon by the Röntgen rays emanating from two different sources distant from 6 to 10 centimetres from each other projects two parallel shadows on to the screen. If by a suitable arrangement the right eye is made to see only one of the images at the same time as the other image is seen by the left eye only, an observer will have a stereoscopic view of the radioscopic image. To dissociate the two images in this manner and render each visible to the corresponding eye, Major Lièvre has applied the principle of the persistence of luminous impressions on the retina. The apparatus itself consists of three essential parts superposed, viz. a double source of X-rays underneath, followed by the usual screen, then a sighting device provided with a shutter and a commutator. The commutator serves the purpose of operating one of the X-ray tubes simultaneously with the uncovering of one of the eyepieces, and of shutting off the other X-ray source and closing the shutter of the other eyepiece. The device, which has been adopted by the French Army, has the advantage of great mechanical simplicity and ease of application.

THE problem of the landing of an aeroplane in the shortest distance and with the minimum of shock is a very important one in aviation, especially with the advent of the heavier machines of the bombing type. In a very interesting article in the September number of *La Science et la Vie* M. Jean Fontanges deals with the question, and describes the systems of landing carriage employed on various French and German machines. The type of carriage provided with skids only is now practically obsolete, the most usual pattern consisting either of wheels alone, or wheels in conjunction with skids, or a rear crutch. The centre or supporting wheels have to be built on a high-strength framework (usually of steel tubing), with (smaller) front wheels to prevent the machine landing nose down. Some of the types are provided with brakes on the wheels, to give quicker landing. Mention is made of the Paul Schmitt biplane, which is provided with a device for altering the incidence of the wings and so reducing the speed of the machine prior to landing. The article also discusses the types of shock-absorber usually employed.

MR. G. BURTON BAKER contributes to the *Chemical News* for September 21 an interesting note on a colouring matter extracted from Wasahba wood. The latter has a specific gravity 1·214; it is difficult to work, being extremely hard and almost bony in texture. When the sawdust is extracted with hot alçohol a colourless solution is obtained which becomes a bright salmon-pink when treated with an alkali solution, the colour being discharged by acids. If the alcoholic extract is used side by side with a one per cent. solution of phenolphthalein in the titration of ammonia, potassium hydroxide, and sodium hydroxide solutions with hydrochloric acid, the same result is obtained in the case of potassium hydroxide as with phenolphthalein, whilst with ammonia and sodium hydroxide the results were approximately the same. Concordant results could not be obtained when sodium, potassium, and ammonium carbonates were the alkalis employed. Further, the red alkaline solution will act as a dye, staining white pine quite deeply.

THE issue of *Engineering* for September 21 contains an account of the hydraulic power undertakings connected with the town of Barcelona and its electric supply. Under the control of the Barcelona Traction, Light, and Power Co. there has been inaugurated a threefold development of the hydraulic resources of the adjacent country. Power accessible to the extent of 60,000 h.p., under a head of 164 ft., is already obtained from the river Segre, from Lerida downwards for a distance of 18½ miles. By the formation of a dam, 262 ft. high, a reservoir has been formed on the river Noguera Pallaresa, giving a head of 492 ft., from which two power stations of 50,000 and 60,000 h.p. respectively are supplied. The river Ebro is to yield the third quota, a dam 1378 ft. long and 197 ft. high being contemplated, and this will enable its power station to develop no fewer than 300,000 h.p. The Noguera Pallaresa dam has only recently been completed. It impounds a volume of 6,909,000,000 cub. ft. It is constructed across the narrowest part of the valley and is curved to a radius of 984 ft. The dam is a gravity dam, with a volume of 9,500,000 cub. ft. The Tremp power-house is situated about half a mile below the dam, and has four turbines, which run under a maximum head of 229 ft. and a minimum head of 98 ft.

MR. HUMPHREY MILFORD, of the Oxford University Press, announces "Studies in the History and Method of Science," edited by C. Singer. It will contain the following contributions:—"The Scientific Views and Visions of St. Hildegarde," C. Singer; "Vitalism," Dr. J. W. Jenkinson; "A Study in Early Renaissance Anatomy," C. Singer; "The Blessing of Cramp Rings," R. Crawford; "Dr. John Weyer and the Witch Mania," E. T. Withington; "The 'Tractatus de Causis et Indiciis Morborum,' attributed to Maimonides," R. Levy; "Scientific Discovery and Logical Proof," F. S. Schiller. Mr. Milford will also publish "The Determination of Farming Costs," by C. S. Orwin.

THE October list of Publishers' Remainders of Mr. H. J. Glaisher, 55 Wigmore Street, W.1, is miscellaneous in character, and should be seen by those in search of books in new condition at low prices. Among the books likely to be of interest to readers of NATURE are Sir F. Galton's "Memories of My Life"; "The Life of Sir Joseph Banks"; "The Life and Work of Prof. C. Pritchard"; and "Eleanor Anne Ormerod: Autobiography and Correspondence," all of which are listed at a very low figure. The "Library of Useful Knowledge"—a series of shilling volumes—is offered at half-price.

OUR ASTRONOMICAL COLUMN.

THE NATURE OF SUN-SPOTS.—A useful summary of our knowledge of the phenomena presented by sun-spots is given by the Rev. A. L. Cortie in *Science Progress* for October. A spot is regarded as an up-rush of metallic vapours, which become cooled by rapid expansion, so that the spot appears dark by contrast with the bright solar surface. The umbra is considered to rise above the level of the photosphere, while the penumbra is built up by dark radial streams flowing from the umbra and seeking a level slightly lower than that of the photosphere. In round spots the penumbra is a shallow, saucer-like cavity, the lowest portion being due to the falling-in of the photospheric clouds caused by the initial uprush. This falling-in and heaping together of the photospheric clouds to fill the partial void produced by the ejection of the umbral vapours would account for the bright border which is generally seen to separate the umbra and penumbra. At a high level above the spot are the hydrogen flocculi, the rotation of which gives rise to the appearance of the solar vortices. Friction of the gyrating gases and vapours is considered competent to generate electric currents, and the accompanying magnetic fields which produce the Zeeman effects in the spectra of spots. Father Cortie considers it doubtful whether the umbra and penumbra of the spots themselves share this gyratory motion.

SOLAR PROMINENCES IN 1915.—An account of the observations of solar prominences made at Catania during 1915 has recently been given by Prof. Ricco, in continuation of the admirable series commenced by him in 1880 (*Mem. Soc. Spett. Italiani*, July–August, 1917). The number of days of observation was 168, and the total number of prominences exceeding 15″ in height was 1264, giving a mean daily frequency of 7·5. The activity in the northern hemisphere was the greater, the respective numbers being 677 and 587. The prominences were distributed almost symmetrically in the two hemispheres, few or none appearing in the polar and equatorial regions, while there were well-defined maxima in the zones ±30°–35° and ±50°–55°. Twenty-four of the prominences exceeded 100″ in height, and one observed on May 5 reached 286″. The mean latitude of all the prominences was 38·65°, which was rather lower than for the preceding year. There was a marked increase of activity as compared with 1914.

A COMMERCIAL IRON OF UNUSUAL PURITY.

FOR some time past the Shelton Iron, Steel, and Coal Co., of Stoke-on-Trent, has been manufacturing a commercial iron of unusual purity in the basic open-hearth furnace. This iron is guaranteed to be 99·84 per cent. pure, and has been placed on the market under the trade name "Armco Iron." It differs from wrought-iron in that it has been melted and cast, and thus contains much less slag, and from mild steel in that its carbon content is so low that no pearlite is present. It has been found, however, to possess a peculiar property which militates against its practical usefulness, viz. the property of a characteristic red-shortness, or brittleness, when subjected to mechanical treatment between certain limits of temperature. The reason for this peculiar behaviour, which is not shared by other forms of commercial iron and mild steel of high quality, has been investigated by Messrs. Brooke and Hunting, and their preliminary results were communicated in an interesting note to the recent meeting of the Iron and Steel Institute.

Very early in the history of the process it was found that this brittleness always appeared between certain fixed limits of temperature, which they place at from 900°–800° C.; that on heating the iron to well above Ac3, and allowing it to cool, brittleness appeared, first at about 900° C., and disappeared sharply at about 800° C.; and that above and below these temperatures the metal possessed an unusually high degree of ductility and malleability. In fact, they comment on its similarity when cold to copper in respect of malleability, thus emphasising also its resemblance to the electrolytic iron investigated in 1913 by Stead and Carpenter.

The authors then proceeded to carry out systematic experiments on specimens of the iron quenched from various temperatures. They determined the tensile properties, and examined its structure and the type of fracture. Most interesting and illuminating results were obtained with the photographic records. Quenched from temperatures above 1000° C., the structure was that of γ iron with "martensitic" markings. As the quenching temperature fell this appearance altered, and the "γ iron effect changed to a more definite ferrite form." The authors say that at about the Ar3 point a complete change occurred, the ferrite grains increased considerably in size, and at the junctions of many of the crystal boundaries a peculiar structure was observed which was "perfectly constant and always possessed the same characteristic . . . viz. a central structure more or less pearlitic and very clearly defined, surrounded by a space composed of ferrite, and the whole again surrounded by a definite boundary which connects up with adjacent crystal grains." This structure is clearly seen in the photographs published by the authors. They say that a very large number of experiments have been made, and that in every case this peculiar structure has appeared in exactly the same manner. On lowering the quenching temperature somewhat the structure gradually becomes less pronounced, and at just above 800° C. it ceases to exist. Below 800° C. it was never observed, and the structure was that of normal ferrite. The temperatures at which this material is precipitated and reabsorbed coincide so remarkably with the beginning and end of the zone of brittleness that a strong presumption has been established that herein lies the origin of the characteristic red-shortness of the iron. The authors suggest that it is a eutectoid, probably composed of iron carbide, phosphide, and sulphide, with possibly traces of manganese sulphide and ferrous oxide, and that it is thrown out of solution in a semi-liquid or plastic condition, causing the grains to be very loosely held together, and thus making the structure relatively weak. If the iron is quenched in the 900°–800° C. zone, no brittleness is observed in the static tests.

The authors have found that a sample of Swedish iron similar in purity to the above material also shows a brittle zone in the same temperature range, and that an iron containing carbon 0·06 per cent. and manganese 0·10 per cent. shows no brittleness when manufactured in the same way as "Armco" iron. At one stage of the investigation they were inclined to connect the appearance of the material with the existence of dissolved oxide, since in one set of experiments they found it difficult to reproduce the characteristic structure, and this coincided with a remarkable absence of spots of "oxide material." Samples of metal, however, taken from the bath, just before tapping, when it was known to be in a super-oxidised condition, gave only a normal amount of eutectoid structure. Again, when complete deoxidation was attempted it still appeared. There is no reason, therefore, for connecting it with the presence of an unusual amount of oxide, and the nature of the "eutectoid"

structure is still a matter of pure conjecture. It is to be hoped that the authors will investigate this aspect of the research, difficult though it will probably prove to be.

The authors entitled their paper "A Note on the Microstructure of Commercially Pure Iron between Ar3 and Ar2." Strictly speaking, this is not the case. Mr. P. Tucker, who took cooling and heating curves for them, found Ac3 at 888° C. and Ar3 at 874° C., and makes the significant statement that it was "practically impossible so far to determine the Ar2 point of this material even on the most delicate instruments." Now the new structural constituent is shown in the photographs at 899° C., *while the material was still in the γ range*—above Ar3. It does not appear, therefore, that the upper limit of brittleness coincides with the Ar3 change. Ar2 is normally found at about 765° C. in commercially pure irons. This is about 35° lower than the temperature at which the eutectoid structure disappeared. No iron has ever been found to give Ar2 at so high a temperature as 800° C., which is actually below that at which the new constituent vanishes. Neither, therefore, does the lower limit of brittleness coincide with the Ar2 change, assuming that it does exist, according to the evidence at present available.

H. C. H. CARPENTER.

RECENT RESEARCHES AT VESUVIUS.

PROF. ALESSANDRO MALLADRA, the successor of Mercalli at the Royal Vesuvian observatory, has published a number of papers, from 1912 onwards, on the volcanic manifestations and progressive changes in the great crater formed in 1906. It has been possible in recent years to descend, by hazardous paths, to the edge of the central funnel, 250 metres below the crater-edge, and valuable observations have been made on the gases emitted from the fumaroles. Prof. Malladra furnishes a well-illustrated summary of the conditions in 1914 in "Nel cratere del Vesuvio" (*Boll. reale Soc. Geografica*, 1914, p. 753). The gradual widening of the crater by the falling in of its cliffs is shown in plan in a paper, "Sulle modificazioni del Vesuvio dopo il 1906" (*ibid.*, p. 1237). The small aperture of 1900 is also here indicated, almost immediately over the pit that is now active. The volcano remained quiet, in a solfataric stage, for seven years after the enormous outburst of 1906; but a glowing funnel opened in the floor of the crater of explosion on July 5, 1913. Prof. Malladra was engaged in a hypsometrical survey on the cone a few hours after this outbreak ("Sui fenomeni consecutivi all' apertura della bocca 5 Luglio, 1913," *Rend. R. Accad. Sci. Fis. e Mat. di Napoli*, fasc. 11 and 12, 1914), and has recorded a true incandescence, accompanied by the emission of fresh scoriæ, specimens of which were collected on one of many later visits. The "yellow fumarole" in the crater gave a temperature-reading of 128° C. in 1911. In September, 1913, this had risen to 330°, and in October to 347°. During the collection of gases from this fumarole for analysis, water condensed, containing hydrochloric acid in the proportion of 9·21 grams per 100 c.c., and smelling strongly of sulphuretted hydrogen. The author points out that, following the arguments of Brun as to the possibility of the permeation of water into a heated mass from without, this water must be truly magmatic. He thus provides further evidence, in addition to that of Day and Shepherd, against Brun's main contention.

Prof. Malladra illustrates ("I Gas vulcanici e la Vegetazione," *Boll. Soc. Sismologica Ital.*, vol. xviii.) the acid gases of Vesuvius rolling in a dense cloud down the mountain slope. They deposit on the leaves and branches of the trees a white dust consisting of chlorides and sulphates of iron and the alkalies; and these anhydrous or slightly hydrated gases are easily recognisable to the experienced eye from the ordinary masses of water vapour. Like the descending clouds that brought death to Saint-Pierre and Morne Rouge, they consist of very finely divided solid matter and gas, and resemble the smoke of a conflagration. The caustic effect produces brown spots and decay in leaves, and experiments are in progress in the planting of bare parts of the Vesuvian slopes with Euonymus and with a bamboo, appropriately known as *Arundo Plinii*, which flourishes fairly upon Stromboli. Both these, it is hoped, will resist the acid emanations.

An investigation of the rainfall on Vesuvius, and of the distribution of snow on the variously heated areas near the vent ("La pioggia sul Vesuvio, 1863–1913," *ibid.*, vol. xviii.), contains an interesting passage on the snow-accumulations formed by the freezing of the vapour of the fumaroles.

G. A. J. C.

FUEL RESEARCH.[1]

IN its first report[2] the Board stated that it had in view two main lines of research: first, a survey and classification of the coal seams in the various mining districts by means of chemical and physical tests in the laboratory, and, secondly, an investigation of the practical problems which must be solved if any large proportion of the raw coal at present burned in its natural state is to be replaced by the various forms of fuel obtainable from coal by carbonisation and gasification processes.

When the previous report was written it was believed that the survey and classification of coal seams might be proceeded with in advance of the second line of inquiry; but further consideration has shown that from the practical point of view the two lines are so thoroughly interdependent that they can be most satisfactorily dealt with side by side. This view will be further developed after the position and prospects with regard to the second line of inquiry have been more fully explained.

In preparation for the organisation of the first line, however, an experimental study of standard methods for the examination of samples of coal in the laboratory has been made. Hitherto in the systematic examination of coals in the laboratory there has been no generally accepted low-temperature carbonisation test. In the survey and classification of coals for the purposes of the present inquiries a test of this kind is practically indispensable. Certain existing tests are designed to ascertain the suitability of coal for gas- or coke-making, but as both these methods of carbonisation are carried out at temperatures above 900° C. they give little or no direct information as to the behaviour of the coal when carbonised at 500° to 600° C.

As a result of experimental work carried out for the Board in the fuel laboratory of the Imperial College of Science and Technology, a test has now been elaborated which by direct weighing and measurement gives the yields of gas, oil, water, and carbonaceous residue which result from carbonisation at any definite temperature. The apparatus is simple and is so arranged that the progress of the distillation can be watched from start to finish. The products can be weighed or measured with reasonable accuracy, and any or all of them can, if desired, be submitted to further examination.

[1] Report (slightly abridged) of the Fuel Research Board on its Scheme of Research and on the Establishment of a Fuel Research Station. (Published for the Department of Scientific and Industrial Research by H.M Stationery Office.) Price 2*d.* net.

[2] This report was not published.

With regard to the organisation which will ultimately be required in the principal coal-mining districts for the collection and registration of samples, the Board is glad to say that it has found every disposition on the part of the representatives of the coal-owners to co-operate in this work. It is not proposed to start any extensive organisation for this purpose until the preparations for the second line of inquiry are further advanced. The accumulation of large numbers of samples would serve no useful purpose at present, and would be decidedly inconvenient. It is certain that as soon as the arrangements for the examination and testing of samples are in working order it will be an easy matter to maintain the necessary supply of samples to keep the laboratories and the research station fully occupied.

In the first report the following statement with regard to the second line of inquiry was made:—

"The second of the proposed lines of inquiry has been led up to by a variety of influences during the past eight or ten years. Among these influences have been the demands for cheaper and more ample supplies of electrical energy, for home supplies of fuel oil for the Navy, of motor spirit for the Transport and Air Services, and last, though by no means least, for smokeless domestic fuel. This last has been brought about through the growth of public and municipal opinion on the subject of smoke prevention in cities and in industrial centres.

"The only development which would satisfy all these needs simultaneously would be the replacement of a large proportion of the raw coal which is at present burned in boilers, furnaces, and domestic fires, by manufactured fuels prepared from raw coal by submitting it to distillation.

"The greater part of the coal which is consumed in Great Britain is burned in its natural state as it comes from the mines. The question of the moment then is: To what extent can and ought the present use of raw coal to be replaced by the use of one or other of the various forms of fuel manufactured from coal—coke, briquettes, tar, oil, or gas? While there is already in the possession of experts a certain amount of knowledge and experience which might enable them to organise and direct schemes for the replacement of raw coal by manufactured fuel in particular directions and on a fairly large scale, no really comprehensive scheme can be formulated until certain perfectly definite problems in coal distillation have been solved.

"These problems can be solved only by carefully organised experiments on a working scale carried out under the conditions likely to arise in practice."

The gas retort and the coke oven have become highly developed appliances for the carbonisation of coal at temperatures ranging from 900° to 1200° C. In the former the primary object of the carbonisation is to obtain the maximum yield of *gas* suitable for domestic and industrial lighting and heating, while in the latter *coke* is regarded as the principal product. In both cases the by-products of the operation are of economic value, but are necessarily of secondary importance. In considering the broad question of the replacement of any considerable proportion of the coal which is at present being burned in its raw or natural state by manufactured forms of fuel, the part which may be played by high-temperature methods of carbonisation will need to be taken into account. For this purpose a great amount of experience is available, and trustworthy data on which to base the calculation of the economic possibilities are in existence.

The distillation of oil shales at low temperatures for the production of mineral oils, paraffin wax, and ammonia is a highly developed industry, but the oil shales are totally unlike coal in their nature and in the products which they yield, so that the experience gained in this industry, though undoubtedly valuable, is only indirectly useful so far as coal is concerned.

As regards the carbonisation of coal at low temperatures, there is no corresponding body of experience in existence, and there are very few properly accredited data available. Some work has been done by individual inventors and syndicates, and a certain amount of experience has been gained. While only portions of this experience have been disclosed, enough is known to justify the conclusion that much still remains to be done in devising the special forms of apparatus required for the economical carrying out of this type of carbonisation.

The way is clearly open for a serious attempt to determine whether an economical and efficient apparatus can be devised for the carbonisation of coal at low temperatures, and whether, by the use of such an apparatus, for the carbonisation of properly selected coals, products will be obtained of a collective value greater than that of the original coal *plus* the cost of carbonisation and handling. Obviously the evolution of an economical and efficient apparatus is at the root of the whole matter, for only after a thoroughly practical apparatus is available can trustworthy tests of the various classes of coal be made and the economic possibilities of the method be fully weighed and considered.

The solution of these fundamental problems will supply a new base from which to attack questions like the following:—

(1) Can the thirty-five to forty million tons of raw coal which is used every year for domestic heating be wholly or partially replaced by smokeless fuel, solid and gaseous, prepared by the carbonisation of this coal?

(2) Can adequate supplies of fuel oil for the Navy be obtained by carbonisation of the coal which is at present used in its raw form for industrial and domestic purposes?

(3) Can supplies of town gas be obtained more economically and conveniently by methods of carbonisation and gasification other than those at present in use in gasworks?

(4) Can electric power be obtained more cheaply if the coal used for steam raising is first subjected to processes of carbonisation and gasification?

(5) Will the more scientific development of the preparation and use of fuel, which would be implied in the successful working out of the foregoing questions, enable the peat deposits of the United Kingdom to take a serious place as economic sources of fuel for industrial purposes?

(6) Can the use of gaseous fuel in industrial operations be forwarded by the development of more scientific methods of combustion in furnaces, muffles, and ovens used in metallurgical, ceramic, and chemical operations?

The answers to these questions will be obtained only by co-ordinated research carried out on the lines of a broad and well-considered scheme. The subjects to be dealt with are already attracting the attention of serious workers in the industries, and it is to be expected that solutions of some of the problems will be supplied by these workers. The Board sincerely hopes that this will be the case. It would regard it as a great misfortune if the establishment of a Government organisation for fuel research were to result in the discouragement or limitation in any way of the activities of outside workers or organisations. It ventures to hope rather that many of these workers will be disposed to welcome a national scheme of research, the aims of which are broad and yet definite, and in which the more specialised contributions from all sides will naturally take their place.

In considering new and extensive schemes of carbon-

isation it is necessary to bear in mind that outlets for all the products of carbonisation must be found. The gas, coke, and shale-oil industries are all of old standing, and each has had to develop outlets for its products by patient and continuous effort. No new carbonisation scheme can be justified economically if it can only live by poaching on the preserves of the existing industries. Even if an efficient method of low-temperature carbonisation is evolved, it will be valueless in the wider sense unless profitable outlets for all the important products can be developed. It is obvious that the Fuel Research Board, which is in official touch with the Admiralty, the Ministry of Munitions, the Board of Trade, and other public departments, is exceptionally placed for the furtherance of schemes which involve the finding of large outlets for products new and old. It is known, for instance, that the Admiralty attaches great importance to the development of supplies of fuel oil from home sources, so that it may be taken for granted that this requirement alone would absorb all the oil which could be produced by the carbonisation of tens of millions of tons of coal per annum. This fact alone gives an entirely new aspect to the extension of carbonisation in hitherto untried directions, but while it will undoubtedly help on the economic side of the problem, it in no way relieves the pressure on the technical side. In a way, moreover, it accentuates the problem now to be referred to, the profitable disposal of the coke or carbonaceous residue left when the volatile products are distilled from the coal. The percentage of coke obtained varies with the quality of the coal and the temperature at which it is carbonised, but it may be taken on the average that each ton of coal carbonised will give about 15 cwt. of coke. Thus to obtain one million tons of fuel oil for the Navy it would be necessary to carbonise twenty million tons of coal, and the coke produced would amount to fifteen million tons.

The disposal of this very large quantity of coke or char at a profitable price must be regarded as the vital question if low-temperature carbonisation is to be established on a sound economic basis. The research scheme must therefore include a very complete inquiry on three main lines :—

(1) The use and value of this coke for the direct firing of steam boilers.

(2) Its gasification in producers for the manufacture of low-grade fuel gas and the recovery of its nitrogen as ammonia.

(3) Its use for industrial and domestic heating either directly, as it comes from the retorts, or after its conversion into briquettes.

The second of these inquiries will involve the development of a special form of gas-producer and auxiliary plant if the best results are to be obtained from the coke. It will also involve the development of a system of boiler firing in which fuel gas of 130 B.T.U. can be burned at least as efficiently as coal, both as regards thermal efficiency and the effective evaporation per square foot of heating surface.

In all that concerns the preparation and use of special forms of fuel there are two distinct stages of development to be passed successfully. In the first stage apparatus and methods have to be evolved and tested until a practical standard of efficiency is reached. In the second stage the consumers of fuel must be induced to study the new apparatus and methods until they thoroughly understand and in the end adopt them. This second stage will be most readily passed if an expert staff trained at a fuel research station is available to undertake the education of those who desire to adopt the new methods and appliances.

The use of town gas as a fuel for industrial purposes has made great strides during the past few years, and a number of experts are to-day engaged on the design and adaptation of furnaces and apparatus for these purposes. The actual practice of gas-heating still lags a long way behind the ideals of economy and efficiency, and there is room for much useful experimental inquiry into principles and methods.

The use of the lower grades of fuel gas, though successfully carried out in certain directions, is very imperfectly understood in the majority of industries in which gas might be used for heating and power purposes. In this direction there is scope for much useful work, both in research and in the education of experts and consumers.

A single illustration may be given of the complicated inquiries which will have to be conducted before an answer can be given to what seems to be a simple question.

There is a very general belief among electrical experts that the future of British industry will be greatly affected by the cost at which power in bulk can be supplied in the form of electricity. It has been proposed, for instance, that large electrochemical works should be established in this country for the manufacture of products which in the past have been manufactured in parts of the world where cheap water-power is available. In this connection it has been suggested that the cost of producing power from coal in this country would be substantially reduced if instead of burning the coal directly under the steam boilers it were first subjected to carbonisation and gasification processes which, in addition to fuel gas, would yield valuable by-products. Plausible statements have been issued showing the enormous savings or profits which would accrue if schemes of this sort were adopted. Unfortunately, these estimates have generally been made on a very slender foundation of knowledge and experience. On the other hand, those who, by experience and practice, are best qualified to judge hesitate to prophesy as to what the economic result of a combined carbonisation and power generating scheme would be, but they agree that the interests at stake are so great that the question ought to be authoritatively answered once for all. But no answer can be accepted which is not founded on the complete working out of the scheme, no important step in the series of operations being omitted or slurred over. This series of operations will start from the mechanical preparation of the coal and its conversion into solid, liquid, and gaseous products by carbonisation. It will end with the delivery of a known weight of high-pressure steam under the conditions most favourable for power production by turbo-generators. In the proposed scheme of research it will be seen that the investigation of each of the steps involved in the above inquiry is provided for. Three, at least, of these steps involve pioneering work on an industrial scale, and the work may occupy a considerable time. The Board realises that it is possible that the net result of this particular inquiry may be to show that purely as a means of cheapening the cost of electric power, the use of carbonisation methods has not much to commend it, but that certain incidental advantages will justify its use in particular cases.

The Fuel Research Station.

The scheme of research which has been outlined in this report can be efficiently carried out only in a fuel research station designed and equipped for the purpose, in which operations on an industrial scale can be carried out under proper working conditions.

It is desirable that the station should be within easy reach of London, that there should be ample railway and other facilities for the transport of coal from all parts of the kingdom, that there should be ready means for

the disposal of the large quantities of coke, oil, and gas which would be produced in the regular course of experimental work, and that a supply of labour, skilled and unskilled, should be available. It was realised that these conditions could be fulfilled only by a site in the neighbourhood of a large gasworks, and some months ago the Director of Fuel Research approached Dr. Charles Carpenter on the subject. Dr. Carpenter is chairman of the South Metropolitan Gas Company, and he is a member of the Carbonisation Sub-Committee of the Coal Conservation Sub-Committee of the Reconstruction Committee, of which the Director is vice-chairman. Following this conference, Dr. Carpenter, on behalf of the board of the South Metropolitan Gas Company, made the following very generous offer to this Board:—(1) To lease to the Government at a peppercorn rent sufficient land at the East Greenwich gasworks for the erection of a research station; (2) to prepare drawings and specifications for this station on lines to be laid down by this Board, and to make contracts for its erection; (3) to give every facility for the transport of coal and other supplies to the station, and to take over at market prices the surplus products, gas, tar, liquor, and coke resulting from the operations at the station. After further conferences a suitable site was agreed upon. The proposed site is a strip of level ground about 250 ft. wide by 700 to 800 ft. long, situated on the main siding which connects the gasworks with the South-Eastern Railway and with access to an existing road.

The foregoing scheme of research is obviously not intended to cover the whole of the territory which is open for exploration to-day. Still less ought it to be regarded as setting any limits to the exploration of new territories in the future. The root idea of the scheme is that certain fundamental changes in the preparation and use of fuel which have been proposed are of such far-reaching importance that the solution of the technical and economic problems involved ought to take precedence of all other matters. This does not mean that other lines of research will be ignored, but only that the larger issues must be kept well to the front until definite solutions of those technical and economic problems can be given. Though no direct reference has been made to the preparation and use of fuels from oil shales, brown coals, and peat, it is obvious that experimental inquiries on these matters will naturally find a place in the developments of the present scheme.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The term has begun with a greatly depleted number of undergraduates. The entry of freshmen, which used to average nearly 1000, fell in 1914 to 550, in 1915 to 238, and last year to 150. The number for the present academical year is about 100. Some colleges have none. The American Rhodes scholars, who have hitherto helped to raise the numbers above the vanishing point, are now called up for military service. Among the men who are now coming into residence for the first time are some who, after service at the front, have been discharged on the ground of wounds or sickness.

On October 10 a memorial tablet was unveiled at Oxford, commemorating the life and work of Roger Bacon. The tablet has been fixed to the old wall of the city, dating from early in the thirteenth century, close to the site of the Grey Friars Church in the precincts of which Roger Bacon was buried. The church has long since disappeared, but the position of the burial ground, though not the exact spot of Bacon's grave, is known. After the celebration at Oxford in 1914 of the seven hundredth anniversary of Bacon's birth, it was thought fitting that in addition to the statue then erected in the University museum, a permanent and public memorial should be set up as near as possible to the site of the Franciscan friary in which Bacon passed so many years of his strenuous life. This has now been accomplished, and the prophecy uttered by the Elizabethan dramatist Greene, which was recalled by Prof. James Ward, of Cambridge, at the ceremony in 1914 (see NATURE, June 18, 1914, p. 406), has at length been virtually fulfilled. The Latin inscription on the tablet is as follows:—

ROGERUS BACON
Philosophus insignis Doctor Mirabilis
Qui methodo experimentali
Scientiae fines mirifice protulit
Post vitam longam strenuam indefessam
Prope hunc locum
Inter Franciscanos suos
In Christo obdormivit
A·S·MCCXCII.

+

THE College of Physicians and Surgeons, the Medical School of Columbia University, has decided to admit women on an equal standing with men. This step has been taken after long consideration, and has been hastened by a great change in woman's position in Europe since the outbreak of the great war. For many years past a large number of women have worked in the laboratories of the Department of Health of New York, and have done admirably. The laboratories in the hospitals, also, frequently employ women, and with the repeated disappearance of men owing to the draft and enlistments in the Medical Reserve Corps, many places will be vacant which can only be filled by women. The opening of the Columbia Medical School to women has been made possible by a gift of 10,000l. from Mr. G. W. Brackenridge, of San Antonio, Texas.

THE Glasgow libraries have taken a step in the right direction in publishing a detailed catalogue of all the works on aeronautics to be found on their shelves. The list is not a long one, owing to the lack of books upon the new science, but it is fairly complete, the most notable omission being the works of Eiffel, or the excellent English translation thereof by Mr. J. C. Hunsaker. The pioneer experimental work of Eiffel should certainly find a place in any aeronautical library pretending to completeness. The committee representing the public and other libraries in Glasgow announces that this aeronautical list is to be the first of a series dealing with special subjects, and that the second of the series will deal with the internal-combustion engine. Other libraries would do well to follow Glasgow's example, for the catalogues ordinarily issued are of very little use as reference lists for any particular subject, and the increasing number of technical readers has created a demand for a convenient means of reference to technical subjects.

A COPY has been received of the calendar for the present session of the Merchant Venturers' Technical College, in which the faculty of engineering of the University of Bristol is provided and maintained. Among the varied and comprehensive arrangements explained in the calendar we note the Bristol "sandwich" scheme of training for engineers. The method is optional. The total length of the course is five years, of which about half is spent in the University and the rest in a works. Fourteen months are spent in a works at the end of the first session, and these enable a student to return to the University better qualified to understand the theory of engineering and the laboratory work than if he had had no such experience. Two months of the third year and

the whole of the fifth year are also spent in a works. Some twenty-one important engineering firms in different parts of the country have already agreed to take part in the experiment, and a satisfactory trial of the plan is assured. Full details are given in the calendar as to the courses of study demanded of students desiring to graduate in engineering in the University of Bristol.

THE annual report for 1916 of the chief medical officer of the Board of Education is now available (Cd. 8746, price 1s. net). The report furnishes a record of the school medical service of the local education authorities in England and Wales carried out under the general direction of the Board of Education. Sir George Newman contributes an introduction to the report, in which he says the fact must be faced that in 1916, as in former years, the records show a large amount of ill-health, of bodily impairment, and of physical and mental defect. Of the six millions of children in attendance at school, medical inspection shows that many, though not specifically "feeble-minded," are so dull and backward mentally as to be unable to derive full benefit from schooling, that upwards of 10 per cent. of the whole are at a like disability on account of uncleanliness, and that 10 per cent. also are mal-nourished. A year ago a moderate computation yielded not fewer than a million children of school age (not children in school attendance) as being so physically or mentally defective or diseased as to be unable to derive reasonable benefit from the education which the State provides. Local education authorities do not yet understand the nature of the problem which presents itself in their areas. Each authority should have continually a clear view of the steps necessary from a medical point of view to secure the full value of the school medical service to every child of school age in its area. The irreducible minimum, Sir George states, which will yield the results the nation requires is as follows:—(1) That every child shall periodically come under direct medical and dental supervision, and if found defective shall be "followed up." (2) That every child found mal-nourished shall, somehow or other, be nourished; and every child found verminous shall, somehow or other, be cleansed. (3) That for every sick, diseased, or defective child skilled medical treatment shall be made available, either by the local education authority or otherwise. (4) That every child shall be educated in a well-ventilated school-room or classroom, or in some form of open-air school-room or classroom. (5) That every child shall have daily organised physical exercise of an appropriate character. (6) That no child of school age shall be employed for profit except under approved conditions. (7) That the school environment and the means of education shall be such as can in no case exert unfavourable or injurious influence on the health, growth, and development of the child.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 1.—M. Camille Jordan in the chair.—M. **Angelesco**: A method of summation of trigonometrical series.—W. **Sierpinski** and N. **Lusin**: A decomposition of an interval.—Q. **Majorana**: Experimental demonstration of the constancy of the velocity of light reflected by a mirror in motion.—C. **Benediks**: The thermo-electric effect by contraction in the case of mercury. The thermo-electric effect described by the author in an earlier paper may be regarded as the reversal of the Thomson effect. It is, however, open to the possible objection that the effect observed may be due to the non-homogeneity of the metal wire employed; a similar effect is now demonstrated with pure mercury, in which case this objection cannot apply.—M. **Siegbahn** and W. **Stenström**: The X-ray spectra of the isotopic elements. A comparison of the X-ray spectra of RaG and ordinary lead has proved their absolute identity.—P. **Dejean**: Martensite, troostite, sorbite. A discussion of the definition of these micrographic constituents of steels.—L. C. **Soula**: A new method of graphically recording in physiology. The method is based on the principle that if a battery, microphone, and solenoid are placed in circuit, and a magnet is put in the axis of the solenoid, any variation of resistance produced in the microphone by external pressures produces corresponding modifications of the magnetic field, and a piece of soft iron carrying a writing point placed before the magnet gives a record of the pressures.—V. **Galippe**: Parasitism in toxic seeds or seeds rich in essential oils. The presence of micro-organisms was found to be general in both classes of seeds.—Edm. **Sergent** and Et. **Sergent**: A new method for the destruction of mosquitoes by alternation of their breeding-grounds. The life of the larva of the mosquito in the Mediterranean climate is from sixteen to twenty-five days before the metamorphosis into the winged insect. In the case of a spring, around which a breeding-bed of mosquitoes is liable to form, it is sufficient to dig out two channels and every eight days to change the water from one to the other. During the week the soil dries and the larvæ die for want of water. This method has given excellent results in Algeria, requires slight supervision, and costs little.—G. **Bertrand**: The digestibility of bread and the best utilisation of wheat. A comparison of existing data for white bread (72 per cent. extraction), wholemeal bread (100 per cent. extraction), and the intermediate (85 per cent.), taking into consideration the calorific value of the digested portion and the feeding of farm animals on the wheat offal, leads to no definite conclusion from a theoretical point of view.—H. **Vincent**: Results of antityphoid vaccination in the armies during the war.—C. **Levaditi** and L. **Delrez**: The cutaneous origin of the streptococci found in war wounds.

NEW SOUTH WALES.

Royal Society, August 1.—H. G. **Smith**: The resin of the outer bark of *Melaleuca uncinata*. The author describes the resin which is the chief constituent in the outer bark of this Melaleuca. A piece of this outer bark, if ignited at one end, will continue to burn like a candle until entirely consumed, giving at the same time a considerable amount of black smoke. The inflammable material consists almost entirely of a resin, as only a very small amount of a vegetable wax, melting at 67°–68° C., was detected. It is a rare occurrence for a true resin to be obtained in quantity from any member of the natural order Myrtaceæ, and in only one previous instance does it appear that a Myrtaceous resin has been recorded. The resin, which is present in the outer bark of *M. uncinata* to the extent of 23 per cent., is of an orange-brown colour, semi-transparent, and very brittle. It is almost entirely soluble in alcohol, quite soluble in ether-alcohol, and very soluble in acetone. It is only slightly soluble in chloroform and benzene, and turpentine has little action upon it even on boiling. The acetone solution makes a splendid lacquer for brass, and is perhaps one of the best uses to which the resin could be economically put. The chief constituent of the resin is a resin acid, the formula of which is $C_{17}H_{28}O_4$. It melts at about 148°–150° C., and in alcoholic solution gives a deep-green colour and green precipitate with ferric chloride. The neutral bodies of the resin melt

at about 125°–130° C., are brittle, of a resinous nature, and do not give the green coloration with ferric chloride.

VICTORIA.

Royal Society, July 12.—Prof. W. A. Osborne, president, in the chair.—J. H. **Gatliff** and C. J. **Gabriel**: Additions to, and alterations in, the catalogue of the marine shells of Victoria. *Ischnochiton proteus*, Reeve, *I. atkinsoni*, Iredale and May, and *I.* (*Stenochiton*) *pallens*, Ashby, were recorded as Victorian species. Figures of *Dosinea grata*, Desh., from specimens compared with the British Museum type are given.—F. **Chapman**: New or little-known Victorian fossils in the National Museum. Part xxi.: Some Tertiary Cetacean remains. A fine example of the cranial rostrum of the ziphoid, *Mesoplodon compressus*, Huxley, sp., is described, together with another less perfect, both tending to prove the specific identity of the two examples described by Huxley and Owen respectively. A new species of Scaldicetus (*S. lodgei*) is described, which, as a Balcombian or Oligocene form, is the oldest recorded example of the genus. A well-preserved tooth referred to Stenochiton (*S. cudmorei*) is apparently the first discovery of this genus in the fossil state, from the Kalimnan, or Lower Pliocene, of Port Phillip.—H. J. **Grayson**: Description of a new engine for ruling diffraction gratings. The ruling engine differs from other machines in respect to the following:—The screw and ways of the ruling carriage lie in one axial plane. The screw thrust occupies a central position upon the machine bed, and the screw is free from any stress other than that due to a direct axial pull upon the nut which is connected with the ruling carriage by means of two steel rods lying parallel with the screw axis. All the bearing surfaces or ways of the machine are ground circular bars of steel or glass, the latter forming the ways of the diamond carriage. They are semi-polished and require no lubrication; the frictional resistance is therefore uniform and constant. The teeth of the ratchet wheels are ground and finished with diamond-charged cutters, by which means a high degree of accuracy is obtained and compensating devices are dispensed with. Gratings submitted to the Mount Wilson Observatory have been pronounced practically free from periodicity and diffused light. (This research was awarded the 1917 Syme prize for the most important work published in Australia during the preceding biennium.)

BOOKS RECEIVED.

Municipal Engineering Practice. By A. P. Folwell. Pp. xi+422. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 16*s.* 6*d.* net.

The Industrial and Artistic Technology of Paint and Varnish. By A. H. Sabin. Second edition. Pp. x+473. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 16*s.* 6*d.* net.

Elementary Mathematical Analysis. By Prof. J. W. Young and F. M. Morgan. Pp. xii+548. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 11*s.* net.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, February–July, 1917. Edited by R. M. Milne. Pp. 30. (London: Macmillan and Co., Ltd.) 1*s.* 3*d.* net.

Memoirs of the Geological Survey, Scotland. The Economic Geology of the Central Coalfield of Scotland. Description of Area II. By L. W. Hinxman and others. Pp. iv+92. (Edinburgh: H.M.S.O.; London: E. Stanford, Ltd., and others.) 4*s.* 6*d.* net.

The Quest for Truth (Swarthmore Lecture). By S. P. Thompson. Pp. 128. (London: Headley Bros., Ltd.) 1*s.*

Heat Drop Tables: H.P. Gauge Pressures. L.P. Absolute Pressures. Calculated by H. Moss from the Formulæ and Steam Tables of Prof. H. L. Callendar. Pp. 63. (London: E. Arnold.) 5*s.* net.

Education: Scientific and Humane. Edited by F. G. Kenyon. Pp. 32. (London: J. Murray.) 6*d.* net.

Amusements in Mathematics. By H. E. Dudeney. Pp. viii+258. (London: T. Nelson and Sons, Ltd.) 3*s.* 6*d.* net.

Letters concerning the War between an American and a Relative in Germany. March–June, 1915. Pp. 82. (New York: Privately printed.)

Greenhouses: Their Construction and Equipment. By W. J. Wright. Pp. xvi+269. (New York: Orange Judd Co.) 1.60 dollars.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 19.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—A Comparison of the Working Costs of the Principal Prime Movers: O. Wans.

TUESDAY, OCTOBER 23.

ZOOLOGICAL SOCIETY, at 5.30.—Present Knowledge of the Life-history of the Common Eel: C. Tate Regan.—A Hermaphrodite Dogfish: Miss Ruth C. Bamber.—Ant-like Spiders from Malaya: H. D. Badcock.

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