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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, NOVEMBER 14, 1918.

WAR AND PEACE.

THE turmoil which has shaken the civilised world to its foundations since August, 1914, ceased with the signing of the armistice with Germany on Monday, November 11. A war which was deliberately provoked by advocates of brute force as a quick means of profitable aggrandisement has ended in the triumph of free nations allied against them. Freed from the incubus of the sabre-rattling military aristocracy of Prussia, and from the arrogance of an Emperor obsessed with the lust of conquest, the peoples of the world can again devote themselves to peaceful pursuits. Let us hope that the immoral militarism which led to the war, and sacrificed all principles of faith-keeping, justice, and humanity to attain its purpose, has been vanquished for ever, and that we have seen the last struggle of a system which has dominated a large part of mankind for centuries.

In the early days of the war the Germans attempted to justify their belief in the justice of might by an appeal to the principles of Darwinism. The doctrine of the struggle for existence and the survival of the fittest cannot, however, sanction the ruthless exertion of force and the use of knowledge in the service of egotism and German Kultur. What it should signify is a movement towards higher planes of civilisation and the progressive development of the ethical nature of the human race. Evolution embodies the idea of social ethics, and makes the welfare of the community the essential purpose of the life of the creature. The idea that Darwinism implies nothing more than personal or national mastery at all costs is a crude misconception of this great principle, contrary to the best ends of civilisation.

The execrable deeds of the German land, sea, and air forces cannot be excused by reference to any sound principle of human progress. The spirit represented by such acts as the murder of innocent and unoffending non-combatants, heartless cruelty to women and children, and destruction of priceless buildings, is unworthy of twentieth-century civilisation, and if it had prevailed in the end the sun of righteousness would have set on the world for centuries. Science and scientific principles must not be held responsible for these outward and visible signs of moral degeneration. Chlorine was used as a bleaching-powder for a hundred years before the Germans adopted it as a poison gas. Thermit was employed in the arts before it was used in incendiary bombs. Nitre is a fertiliser as well as a constituent of gunpowder. The search for truth, and the discovery of new substances and forces in Nature, must not be impeded because unworthy use may be made of the results. What has to be done is to advance moral and ethical ideas to higher levels, so that new knowledge shall benefit the human race instead of being used to destroy it. Unless this is accepted, there will be an end of civilisation, for it is possible to conceive of a time when the forces at man's disposal will be so strong that a hostile army or an enemy's city may be destroyed almost at the touch of a button.

The popular mind has associated science and specialised education with German truculence and perfidy, and has even supposed that these conditions are necessarily related to each other. The characters exhibited by Germany in the conduct of the war are not, however, the result of over-cultivation of science, but of a disastrous deficiency in moral and ethical training. The moral sense of a nation requires educating as well as the intellect; and higher civilisation demands that regard for truth and for the sanctity of a promise should be inculcated as being even more important possessions than the knowledge and use of recent discoveries and inventions. The war has shown that spiritual qualities count for much more than mere numbers. Our system of education was inefficient, but it produced a nation of young heroes. As, however, modern war is an affair of applied science—military, engineering, chemical, physical, medical, and economic—it is essential that those who take part in it should be provided with efficient scientific weapons. We have nothing to fear from making science the main axle of the educational coach instead of a fifth wheel, provided only that the right position is given to character training as well.

Though war is not an exact science, and cannot be reduced to a series of mathematical formulæ, tactics are constantly affected by the progress of science, and disaster may ensue if its effect is not correctly appreciated. A nation which lags behind, therefore, in scientific development does so at the cost of a possible loss of supremacy in times of war. Scientific discovery, mechanical invention, and a highly technical organisation, as employed by the Germans, could be beaten only by similar forces arrayed against them. The scientific resources of the British nation were not drawn upon until the formation of the Ministry of Munitions in 1915; and it is these that have provided the country with the scientific material and machinery by which, with similar efforts by our Allies, success has been achieved. If we had not had the chemists to produce the high explosives required, the majority of which are derived from coal-tar products, the noblest spirit would not have saved us from destruction.

When the Germans introduced the use of poisonous gases into warfare, immediate steps were taken by our military authorities to provide the troops with means of protection from them, and action was taken later to organise offensive as well as defensive measures. The matter was put into the hands of men of science, with the result that our gas attacks became more effective than those of our enemies. Sir Douglas Haig said in his despatch at the end of 1916: "The Army owes its thanks to the chemists, physiologists, and physicists of the highest rank, who devoted their energies to enabling us to surpass the enemy in the use of a means of warfare which took the civilised world by surprise."

Science has been successfully called into service in many other directions. The meteorological establishments of the various countries involved in the war have done their utmost to provide greatly increased knowledge of the physics of the atmosphere for the immediate benefit of the armies. Both for naval and military operations, accurate forecasts have been much enhanced in value, and it has been of the highest importance to know the behaviour of the upper atmosphere for the information of the air services, and the condition of the surface atmosphere in relation to gun-sighting and range-finding. The organisation of the medical services for the prevention of disease, as well as the treatment of wounds, has been a veritable triumph. In consequence, the health of the Army has been better in the field than in peace-time, thanks to preventive inoculation, suitable food, and careful sanitation. Typhoid and paratyphoid fevers have been almost unknown, and tetanus has been under complete control. The most gratifying aspect of the whole war is that of the efficiency of the medical services.

Now that the war is practically over, we must prepare to meet other problems. Peace brings with it difficulties to be overcome which rival in magnitude the task of completely vanquishing our enemies. Problems will arise in connection with the health and physique of the nation which will tax the resources of the country's medical services to their utmost limit. The clash of arms will be succeeded by an equally strenuous industrial competition, and the reconstruction of the appalling devastation will call for all the resources of men of science and qualified administrators. We are faced with the necessity for better organisation of science and industry, and more efficient methods of production, if we are to maintain not only our position in the markets of the world, but also our ability to meet the vast expenditure which the war has entailed. It is the duty of men of science to exert themselves to the utmost to secure due recognition and participation of science in the gigantic problems of national and international readjustment with which we are now confronted. In the United States every natural resource, every industry, and every ounce of their great power in money and in men has been made available for the national service for the certain commercial needs of peace no less than for the purposes of war. It is essential for us to make like efforts if we are to secure improvements in the industrial and commercial methods of pre-war days.

Will our people be true to the responsibility placed upon it for the future? If so, it must look to knowledge for its support, and not let itself be cajoled by the platitudes and promises of party politicians. Democracy has hitherto permitted itself to be swayed by eloquence, and has elected to be governed by men of words rather than by men of knowledge and action. The consequence is that men are entrusted with power, not because of any fitness they have shown for the offices they occupy, but because of their political influence or friendships. Scientific and technical experts have been used, but only as hewers of wood and drawers of water, while the administrative control has usually been in the hands of officials with no special qualifications for their directorships.

Much remains to be done by the State and in the city before science and other knowledge are given their full opportunities for increase and service. In originality and capacity of adapting means to ends, the British people is equal to any other in the world, but its attitude towards science is mostly indifferent, and the progress made is nothing compared with what would have been achieved under more stimulating conditions. When a new spirit prevails there will be no end to the rich gifts which science will pour into the lap of the human race. Then, if men are worthy of the fruits showered upon them, there will be an end of the night of weeping, and the advent of the morn of song which is our highest heritage. Let us do what we can to hasten the coming of this time, when men shall stretch out their hands to one another and encircle the world.

SCIENTIFIC UTILISATION OF COAL.

Coal and its Scientific Uses. By Prof. William A. Bone. Pp. xv + 491. (London: Longmans, Green, and Co., 1918.) Price 21s. net.

THIS volume, the latest addition to the already vast literature on that protean subject, Coal, is one of particular interest, as it is written from a somewhat novel point of view, the significance of which is scarcely conveyed by the title selected for it; it might have been more appropriately entitled "The Practical Uses of Coal Scientifically Considered," for the author reviews in it the technical applications of coal, whilst, to use his own words, he has "consistently endeavoured throughout to give due prominence to the underlying scientific principles." It need scarcely be said that the work is extremely well done, as might, indeed, be expected from the high reputation that the author has deservedly won in this particular field of labour. Necessarily it contains no really new matter, but gives a clear, accurate, and concise summary of the present state of knowledge regarding the nature and chemical composition of coal, the various changes that it undergoes on heating, and more especially the phenomena associated with its combustion. The use of coal as the source of a wide range of chemical compounds, which form the basis of a vast number of dyes and drugs, is barely touched upon, the author's attention being mainly concentrated upon coal as a source of energy; it is scarcely necessary to add that the utilisation of the by-products that can be simultaneously obtained nevertheless receives due consideration, although the elaboration of these by-products is not followed beyond the earliest stages.

The first third of the volume is taken up with an account of the chemical composition of coal in the light of modern research. Prof. Bone has made good use of the vast mass of material accumulated by previous workers on this subject; it is perhaps to be regretted that the work was completed just before the issue of the important monograph of Drs. Marie Stopes and Wheeler on this subject, so that Prof. Bone did not have the advantage of seeing the most recent views of these writers. Upon the whole, however, Prof. Bone inclines to endorse the views already put forward by Dr. Wheeler in his previous work, whilst admitting that there still remain many obscure points that need to be cleared up. The brief summary of the present state of our knowledge on pp. 126 *et seq.* may be instanced as an excellent example of the author's power of presenting a highly complex subject briefly and lucidly. The next few chapters are devoted to the principles underlying the combustion of coal and their applications to industrial and domestic heating, including the abatement of smoke. Next in order come the carbonisation of coal under various conditions, and the complete gasification of coal for the generation of producer-gas and water-gas. Finally, the important problems of fuel economy in the manufacture of iron and steel, and those connected with the employment of coal for the production of power, are considered. The last chapter is one on surface combustion, which, interesting though it is, does not really fit in well with the general scheme of the book.

In a work covering so wide a range, it is inevitable that all sections cannot be treated as fully as each reader might desire, though it is only fair to point out that the author can scarcely be blamed for this; his difficulty would, indeed, be to compress rather than to expand each portion. Thus it may perhaps be suggested that not enough weight is laid upon direct firing by coal-dust, a method that ought to be capable of the fullest possible utilisation of the thermal energy of the fuel. The possibility of employing the explosive force of a mixture of finely divided coal and air in some form of explosion engine has already occupied seriously the attention of various inventors, and although the difficulties presented are very great, it would be very rash to consider the problem as insoluble. In this way it should be possible to utilise the whole of the mechanical energy developed by the combustion of coal, less, of course, the amount necessarily absorbed in pulverising the coal; if much less is lost in this way than in gasifying coal, the advantages presented are obvious, and it might therefore fairly be suggested that Prof. Bone might have devoted a little more space to the problems affecting the combustion of coal-dust.

One of the most valuable sections of the book is that relating to the possible economies attainable in the manufacture of steel; Prof. Bone is undoubtedly right when he states that the reason why British ironmasters work on less economical lines in this respect than their Continental rivals is because most British ironworks were built at a much earlier date, before modern methods of steel manufacture had been devised, and that it takes time to remodel these older works and to bring them up to modern requirements. British ironmasters have always been fully alive to the need for fuel economy; in this connection it is curious to note that Prof. Bone has overlooked the early experiments of Mr. Charles Cochrane upon drying the blast supplied to the blast-furnace; these long antedated Gayley's work at Pittsburgh, which is fully discussed here.

Taking the book as a whole, Prof. Bone may fairly be congratulated upon having produced a very valuable work upon a very difficult subject, a work which is likely to be of great assistance to every one of the vast army of the industrial users of coal, and to remain a standard work upon the subject for many years to come. H. L.

CATALOGUE OF SCIENTIFIC PAPERS.

Catalogue of Scientific Papers, Fourth Series (1884–1900). Compiled by the Royal Society of London. Vol. xvi., I–Marbut. Pp. vi+1054. (Cambridge: At the University Press, 1918.) Price 5*l.* 5*s.* net.

WE congratulate the Royal Society on the fourth volume of the Author Catalogue of the scientific papers published during the seventeen years 1884–1900. The first volume (numbered vol. xiii. of the catalogue), containing a list of papers by authors whose names begin with the letters A and B, was published in June, 1914; the second volume, with authors' names from C to Fittig, in February, 1915; and the third volume (numbered vol. xv. of the catalogue), containing the author index to the end of H, in October, 1916. The volume now issued carries the indexing as far as the name Marbut. It is no light matter to have surmounted the difficulties in the production of a work of this magnitude under the conditions created by the war. Scientific workers will also recognise that the Cambridge University Press has carried out the printing with as great care and efficiency as was the case with volumes produced under more favourable conditions.

The earlier volumes were compiled and edited under the able direction of Dr. Herbert McLeod, whose zeal for accurate work is so well known. Since his retirement, in 1915, as director, Dr. McLeod has continued to help with advice as occasion demanded.

The post of chairman of the Committee of Publication was filled by Prof. Silvanus Thompson until his death. It will be agreed that no better chairman could have been found. The interest which Prof. Thompson took in the history of science and of scientific publications made it certain that he would spare no pains in ensuring that the Catalogue of Scientific Papers should be an accurate record.

The Author Catalogue, which has so far been published for names alphabetically arranged from A to Marbut, contains 222,428 titles of papers written by 39,088 authors, an average of about six papers to each author. We may perhaps assume that this number will be doubled before the end of the alphabet is reached. In that case about 450,000 papers will be indexed as published in the seventeen years 1884–1900, or about 27,000 a year. This number is, of course, only an average, being perhaps true for the year 1892. During the last twenty years there has been a great increase in the number of scientific workers and also in the number of journals in which they can publish the results of their researches, so that before the war broke out the annual output of scientific papers must have been at least twice 27,000. Reference to the volumes of the International Catalogue of Scientific Literature shows that in 1913 more than 60,000 scientific papers were published.

We may confidently look forward to the completion of this Author Catalogue. We hope that the Royal Society will also be able to finish the corresponding Subject Catalogue, in which the volumes for mathematics, mechanics, and physics have already appeared. Subject catalogues are so much more useful than author catalogues that it is very important that the publication of the remaining volumes of the series should not be too long delayed.

OUR BOOKSHELF.

A Medical Dictionary. By W. B. Drummond. Pp. ix+625. (London: J. M. Dent and Sons, Ltd., n.d.) Price 10*s.* 6*d.* net.

THIS new "Medical Dictionary" includes much more than its title may suggest, for, in addition to contents bearing closely on strictly medical subjects, we find articles dealing with subjects relating to health, such as athletics, ambulances (with a capital plate of ambulance wagons), cycling, diets, food, and cookery, health resorts, exercise, posture, psycho-analysis, sanitation, ventilation and warming, water supply, and a host of others. We have tested it and have failed to find any omission of moment.

The more special medical sections dealing with diseases give excellent summaries, including causation, symptoms, complications, treatment, and prevention. The principal tropical diseases, such as malaria, sleeping-sickness, cholera, dysentery, sprue, plague, and ankylostomiasis, have brief descriptions allotted to them. Conditions arising in connection with the war have not been omitted, and shell-shock, T.N.T. poisoning, trench-fever, trench-foot, and trench-nephritis are all alluded to. Venereal diseases are briefly dealt with, and their control by the State is discussed. Sections are devoted to anatomy and physiology, and all the commoner drugs are mentioned, their nature and dosage. Under bacteriology we find a brief description of the nature and classification of bacteria, of the part they play in Nature and how they are studied, of the germ-theory of disease, and notes on the principal disease-producing organisms, the whole being illustrated with three text-figures and two full-page plates of photomicrographs. Physical exercises are dealt with and are fully illustrated with four plates. Under drowning Schäfer's method of resuscitation rightly has the foremost place, other methods being also given. Under consumption a good account of the open-air treatment is given, with illustrations.

Sufficient has been said to show the wide and comprehensive scope of this dictionary. The author, Dr. Drummond, is fully alive to the danger of a book of this kind taking the place of the family doctor, and we think he has managed with considerable skill to avoid it. The dictionary should be of the greatest service to the layman as a book of reference on medical and cognate subjects, and to the nurse as a guide in cases of sickness, to the health visitor, minister, missionary, and others. R. T. H.

Medicinal Herbs and Poisonous Plants. By Dr. David Ellis. Pp. xi+179. (London: Blackie and Son, Ltd., 1918.) Price 2*s.* 6*d.* net.

DURING the past three or four years a good deal of interest has been taken in the collection and cultivation of medicinal plants, for the most part by persons who have not enjoyed a botanical training. As a consequence, a desire has been felt for information concerning the properties of medicinal herbs, the uses to which they are put, the means by which they may be identified, their commercial value, and so on. It is for persons thus interested that Dr. Ellis's work is intended; to make it more generally useful he has included certain poisonous plants that are not, or not at present, used medicinally. It may be said at once that his object has been attained. The descriptions of the individual plants are clear and free from undue technicalities; they are accompanied by instructive line-drawings and preceded by two short chapters dealing with the structure of flowers and the physiology of plants.

From a variety of sources the author has collected a considerable amount of information into a small compass, and the lay reader may rely upon finding sufficient information for his purpose concerning our indigenous medicinal and poisonous plants. That inaccuracies occur here and there must be admitted; they appear to be due to insufficient verification on the part of the author, and their presence is not surprising when one considers the number of conflicting statements that have been recently made on the subject. Should a second edition be called for, these might be avoided by submitting the proofs to an expert for critical revision, and blemishes thus be removed from a useful little work.

LETTERS TO THE EDITOR.

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

The Colours of the Striæ in Mica.

ON examining even the most regularly split and transparent pieces of mica by diffuse reflected light, a few fine hair-like and rather irregular lines may generally be seen running along the surface. We have found that these lines or striæ show some very interesting effects when mica is examined in a Töpler "Schlieren" apparatus. The sheet as a whole, being optically good, remains invisible, but the striæ shine out as brilliant and vividly coloured lines of light, the colours being different for different striæ, and changing in a remarkable manner as the inclination of the mica relatively to the direction of the light in the apparatus is altered. For instance, a stria at normal incidence may appear crimson and, as the mica is rotated about an axis in its own plane, become successively purple, green, yellowish-green, yellow, orange, scarlet-red, green, yellow, and red.

The phenomenon is being investigated in detail by one of us (P. N. Ghosh), but as to its general nature there appears to be little doubt. The striæ are lines at which the thickness of the mica changes in a discontinuous manner, and the luminosity is due to the radiation from the discontinuity acting as a laminar diffracting boundary. For any particular wave-length the radiation is zero if the retardation of the wave-front on either side of the discontinuity differs by an even multiple of half a wave-length, and is approximately a maximum if the difference is an odd multiple of half a wave-length. The detailed mathematical investigation would follow the general lines indicated by Lord Rayleigh in his theory of the Foucault "knife-edge" test (*Phil. Mag.*, February, 1917).

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September 5.

PROBABLY the striæ, regarded by the authors as boundaries between regions of slightly different thicknesses, are the same lines as can be seen by reflections of soda light, as described in my note on "Regularity of Structure in Actual Crystals" (*Phil. Mag.*, vol. xix., p. 96, 1910). Doubtless the Foucault method shows them in a more striking manner, and, in any case, the colour effects are novel, so far as I know, and worthy of a closer examination.

RAYLEIGH.

SELF-CONTAINED MINE RESCUE APPARATUS.

MOST people are now more or less familiar with the development of the Army respirator from its crude form of a cloth pad to the scientific and efficient "box respirator" used to-day. This is just one example of the many applications and developments of science during the past few years. In mining work the need for the construction of apparatus on scientific lines is being more and more realised, and this is especially so in the case of mine rescue apparatus. When these are employed, whether for actual saving of life, for recovery work after some serious explosion, in dealing with mine fires, or for any other use in an irrespirable atmosphere, it is imperative that the apparatus should be so constructed that the wearer may absolutely rely upon it to last for the period and work required. In the past, unfortunately, too many different types of apparatus have been put on the market without undergoing a thorough and scientific testing, and as a consequence in several cases their use has been attended with fatal results.

The "box respirator" is designed to withdraw, or render innocuous, small quantities of highly toxic gases or vapours, thus leaving the air for the wearer to breathe practically harmless. Certain gases are, however, not readily absorbed by the ordinary form of Army respirator, and of these carbon monoxide is notable. The highly toxic action of small quantities of this gas mixed with air renders the use of an apparatus of the type of a self-contained mine rescue apparatus essential, and for certain classes of work at the Front, where dangerous quantities of carbon monoxide are met with, such apparatus has been largely employed.

The recent report of the Mine Rescue Apparatus Research Committee[1] should prove of interest, therefore, not only to the mining community, but also to many members of his Majesty's Forces. In May, 1917, the Advisory Council for Scientific and Industrial Research appointed Mr. W. Walker (Acting Chief Inspector of Mines), Dr. H. Briggs, and Dr. J. S. Haldane as a Committee "to inquire into the types of breathing apparatus used in coal mines, and by experiment to determine the advantages, limitations, and defects of the special types of apparatus, what improvements in them are possible, whether it is advisable that the types used in mines should be standardised, and to collect evidence bearing on these points."

Recent advance in our knowledge of the physiology of breathing, largely due to the work of Dr. Haldane, and the latter's practical tests on various types of mine rescue apparatus at Doncaster during the past few years, together with those carried out by Dr. Briggs (for the Research Committee) at Edinburgh, have given the Committee a sure foundation upon which to build its report.

1 First Report of the Mine Rescue Apparatus Research Committee. (Published for the Department of Scientific and Industrial Research by H.M. Stationery Office.) Price 1*s.* 9*d.* The illustrations which accompany this article are reproduced from the Report by permission of the Controller of H.M. Stationery Office.

As a result of these and other experimental tests, and of visits to various mine rescue stations throughout the country, the Research Committee is able to make a number of valuable suggestions and recommendations in the first report, with the object of increasing the safety and efficiency of both apparatus and wearer.

In the report attention is directed to the serious defects in existing apparatus, and the lines along which improvement is desired are indicated. Tribute is paid to the pioneer work of Mr. H. A. Fleuss, the designer of the first oxygen mine rescue apparatus. The photo of which Fig. 1 is a reproduction shows Mr. Fleuss and a group of miners equipped with this apparatus, and it is of especial interest in that it records the first application of such apparatus in mining. The photo was taken at the time of the underground fire which followed the explosion at Seaham Colliery, 1880–81. The excellent work of Sir W. E. Garforth (designer of the "Weg" apparatus), Sir John Cadman, and others, in increasing the efficiency of oxygen apparatus, is referred to, and also that of Col. Blackett and Mr. Mills, of Newcastle, in connection with liquid-air apparatus.

FIG. 1.—Henry A. Fleuss and group of miners, equipped with earliest Fleuss apparatus and oxygen lamps. Seaham Colliery, 1881.

Only the so-called two-hour types of apparatus have been dealt with. These may be divided into three classes:—(1) Those in which the oxygen supply is derived from a cylinder of the compressed gas; (2) those in which the oxygen is derived from the evaporation of liquid air; (3) those in which the oxygen supply is produced by the chemical action of water vapour and carbon dioxide on oxylith ($KNaO_3$).

The report shows that the compressed oxygen type is most favoured in this country, there being 1720 apparatus of this type in use compared with ninety-six of the liquid-air type, whilst class 3 has hitherto not been employed here. For those who are not acquainted with mine rescue apparatus a description of a compressed oxygen type may be of interest. The apparatus about to be described is the "Proto" (which is the development of the original Fleuss apparatus). The description is quoted from the report:—

The apparatus has the merit of simplicity. The circulation is dependent on the lungs of the wearer, breathing being entirely through the mouth. The cylinders B together hold 280 litres of oxygen under a pressure of 120 atmospheres. The reducing valve C (Fig. 4), when correctly adjusted, allows a constant flow of oxygen of 2 litres a minute to pass into the breathing circuit. The makers also supply reducing valves, which can be set by the wearer to give discharges ranging from between 0·6 and 3 litres per minute. The oxygen passes through a flexible tube F running over the wearer's left shoulder, and enters the bag at N, where it joins the air being drawn into the lungs. Light mica valves are fitted in the tubes at M and L to control the direction of the flow of the air. The breathing-bag, which is of rubber, is divided into two compartments by a partition reaching nearly to the bottom, and in the bottom of the bag is placed a charge of caustic soda weighing 3 to 5 lb. Either stick-soda is employed or coke nuts coated with caustic. The air, in travelling from one compartment of the bag to the other, has thus to find its way through the soda, and in doing so the carbon dioxide is absorbed. By shaking the bag from to time, new surfaces of the absorbent are exposed to the air, and the absorption of carbon dioxide is facilitated. A saliva trap Z is fitted under the exhaling tube. The pressure gauge, which is carried in a pocket in front of the bag, is connected to the oxygen supply by means of a highly flexible metal tube W. The wearer can thus read his own gauge. A relief valve, operated by the wearer, is placed in the bag at K. Fig. 4 shows how, by means of a strong steel neck, the main valve wheel H is brought to the front within reach of the wearer.

A by-pass short-circuits the reducing valve C. Oxygen can be discharged through the by-pass by opening the cock I. V is the pressure-gauge valve. It is opened only when the gauge is to be read. The weight of the apparatus is about 36 lb. Needless to say, the heavy oxygen cylinders are responsible for the greater proportion of this.

Other types of compressed-oxygen apparatus differ considerably in detail from the "Proto" apparatus just described. For example, in the Draeger (German) and Meco (English) an artificial circulation of air through the apparatus is produced by admitting the oxygen through an injector nozzle at a constant rate, an air circulation of from 50 to 60 litres a minute being thereby induced, independent of the lungs.

Face-masks, in place of the mouthpiece shown in the illustrations of the "Proto" apparatus, are sometimes supplied. Experimental tests on these have shown that they are a source of grave danger to the wearer, when in a poisonous atmosphere. Consequently the Research Committee in its report advocates the complete abolition of such in favour of the mouthpiece. With a "face-mask" or "half-mask," the injector principle, of having a good artificial flow of air always passing the mouth, is essential. Otherwise an excessive amount of carbon dioxide soon accumulates in the mask, with the result that the efficiency of the wearer is seriously affected. Various other minor advantages have been claimed for the injector type, but it has so many dangerous drawbacks that the Research Committee strongly advocates the complete abolition of the injector in any apparatus.

All the main types of apparatus, with their advantages and defects, are discussed at length in the report. The difference in method of purification of the expired air may be referred to briefly here. In the case of most compressed oxygen apparatus the purification is effected by passing through a metal cartridge or purifier containing granulated soda, potash, or both. The expired air thus passes through the purifier before reaching the breathing-bag. Considerable heat is developed by the action of carbon dioxide and moisture upon the regenerating agent, and in the case of the "Proto" apparatus, in which the alkali is actually contained in the breathing-bag itself, the heat produced is not easily dissipated, owing to the non-conducting character of the rubber bag. The temperature of the inspiratory air becomes then, under certain conditions of working, almost unbearable. The trouble, however, with the average cartridge that has been put on the market in the past is that it has been totally inadequate to perform the work claimed for it by the makers, and in consequence lives have in many cases been endangered by the use of such apparatus.

To give an example of an apparatus coming under class 2—*i.e.* where the oxygen supply is derived from liquid air—the description of the "Aerophor" may be quoted from the report. There are quite a number of these apparatus in use in the United Kingdom, and with further research and improvement they should be capable of doing very good work. The "Aerophor" is shown in Figs. 5 and 6.

FIG. 2.—Proto apparatus, front view.

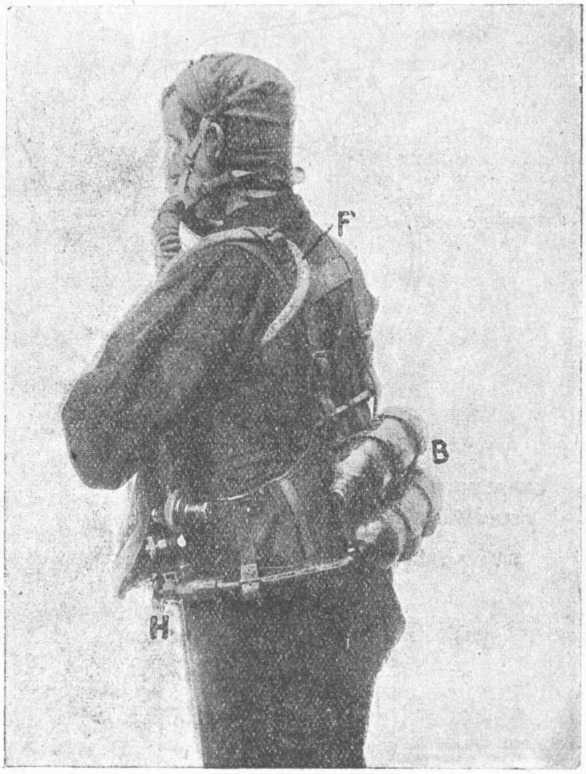

FIG. 3.—Proto apparatus, side view.

The receptacle A, holding the charge of 8 lb. or 10 lb. of liquid air (which in practice always contains more than 60 per cent. of oxygen), is carried together with the purifier U on the wearer's back, while the breathing-bag B is at the front. To prevent the wearer being affected by the extreme cold of the pack, the canvas jacket which supports the apparatus is padded at the back with felt, and an air-space is left between the padding and the pack. At the Northumberland and Durham stations the half-mask is employed, while at the Rotherham station—where the accompanying photographs were taken—the mouthpiece is used. The absorbent material within the metal receptacle is asbestos wool. To charge the apparatus liquid air is poured in from a large Dewar storage bottle into the pack, and a spring balance from which the pack is hung measures the charge. The receptacle is insulated by kieselguhr, felt, and a final cover of leather. The insulation permits the penetration of sufficient heat to volatilise the liquid air at the required rate. During the earlier part of the period of use the volume of volatilised air passing out of the tube from the pack is more than enough to supply the wearer's requirements. The current at this stage divides at J (Fig. 6), one part going to the lungs and the other passing to waste through U (the purifier) and the automatic relief valve R. The exhaled air also discharges through R. Later in the period, when the evaporation is less rapid, the lungs can only get the volume they call for by re-breathing a portion of the exhaled air. The flow in the purifier now reverses; the apparatus becomes a regenerator, and the purifier removes the CO_2 and moisture from that part of the expired air returning to the bag. In the Newcastle model the purifier is larger than that illustrated. An attachment is provided consisting of a length of flexible tube ending in a mouthpiece and relief valve. By connecting this tube to R, it may be possible during the first part of a two hours' interval to supply air to another man. This apparatus, weighing about 30 lb., is somewhat lighter than most of the compressed oxygen types.

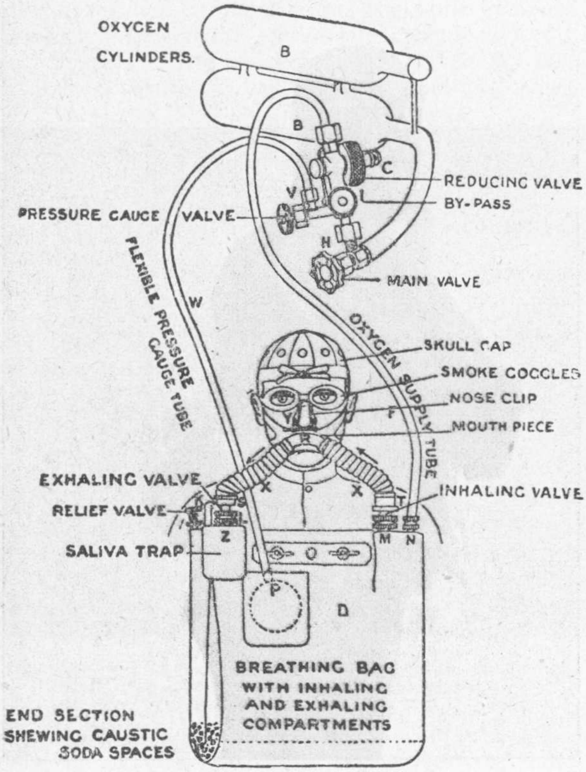

FIG. 4.—Proto apparatus, flow diagram.

The third class of rescue apparatus is unlike any of the others. In this case the oxygen is produced, and the air regenerated, by causing the products of expiration to pass through a cartridge of oxylith (potassium-sodium peroxide). This substance is attacked by carbon dioxide and water vapour with the liberation of about the same volume of oxygen as the carbon dioxide and water contain. The apparatus has hitherto not been successful, owing to its excessive resistance and the heat developed. Its small weight (about 15 lb.) is its chief advantage.

Another interesting point brought out in the report is the necessity for the use of pure oxygen. To the average man it would seem that oxygen showing 90 per cent. of purity should be amply sufficient for breathing purposes. One must remember, however, that in a self-contained apparatus the oxygen is being consumed, whereas the impurities—mainly nitrogen—tend to accumulate. For example, if a "Proto" apparatus is being used in which the oxygen contains 10 per cent. of nitrogen, and the wearer is doing work necessitating the consumption of 2 litres of oxygen per minute—the "blow off" valve not being used—then after about three-quarters of an hour the percentage of nitrogen in the breathing-bag will have increased to about 90 per cent., the oxygen being only 10 per cent. The wearer persisting in his work would quickly become unconscious. The purity of the compressed-oxygen supply is therefore of great importance, and the Research Committee lays stress on the necessity for having every


FIG. 5.—Aerophor apparatus, front view.

cylinder of oxygen arriving at a rescue station sampled and analysed. It advises, for use *underground*, only such cylinders as contain 98 per cent. or more, and for surface work (practices, etc.) such as contain more than 97 per cent. The danger of hydrogen in electrolytically prepared oxygen is also pointed out.

The Committee recommends the prohibition of the use of any breathing apparatus in mines under the Coal Mines Act unless the apparatus be "of a type for the time being approved by the Secretary of State." The necessity for this is very evident to anyone who has had practical knowledge of the very serious condition in which some apparatus is supplied, and for which the makers are entirely responsible. The Committee also proposes that an inspector should be appointed "to

FIG. 6.—Aeropnor apparatus, back view.

advise the Chief Inspector of Mines as to the safety of these apparatus," and to see that the regulations regarding rescue operations are properly carried out.

Many other interesting and valuable recommendations are made; the dangers of existing apparatus and means for overcoming these are pointed out, and the training of rescue brigades, methods of signalling, etc., described. The report is most instructive and interesting, and will well repay time spent in its perusal.

In most districts the rescue teams are composed of volunteers from each pit—men who are willing to risk their lives in the work of rescue or recovery in the event of any form of mine disaster. Work in our coal mines at the best is always attended with a certain amount of risk to life and limb. After an explosion or fire this risk is increased considerably. It is only just, therefore, that the construction of the apparatus itself should be such as to involve the least possible risk to the wearer, and that claims made by makers for their apparatus should be capable of complete justification.

The work of the Mine Rescue Apparatus Research Committee and the publication of its reports will be one of the best means of realising this aim.

J. I. G.

INTERCHANGE OF UNIVERSITY STUDENTS.

WHEN in March last Mr. Balfour proposed that a mission consisting of representatives of the universities of the United Kingdom should be sent to the United States, he did the cause of university education notable service. To the members of the conference convened at the Foreign Office, Mr. Balfour described, on the basis of his own recent experience, the influence which university opinion carries in all matters of policy, whether domestic or international, of our great Ally. He then laid emphasis upon the need for the creation by British universities of opportunities of corporate expression. He advocated the establishment of a representative body which would be able to speak for the universities as a whole.

To the conference which had already been called for the next day by the Universities Bureau of the British Empire was remitted the responsibility of selecting a group of men and women to visit the United States. The "Balfour Mission" reached the far side of the Atlantic some two or three weeks ago. Accounts of its proceedings and of the distinguished welcome which the delegates are receiving in all the chief universities of the American continent on both sides of the border have appeared in the papers from time to time.

Acting upon Mr. Balfour's suggestion that our universities should find means of giving expression to their collective views, a Standing Committee, consisting of all their executive heads—vice-chancellors or principals, as the case may be—was appointed by the conference for purposes of consultation and mutual counsel. Whether in constitution this committee remains as at present, or whether in the future some other and more direct method of selecting its members be devised, the universities have, through the delegates whom they sent to the conference, agreed to the institution of "a Senate of the Senates," to use a phrase adopted by Mr. Balfour. They have taken a step which is likely to have a profoundly important effect upon their usefulness and prestige.

One of the main objects of the mission is to promote interchange of students. In the Middle Ages a student was free to migrate from one university to another in search of the most eminent teachers of the faculty of his choice. Like his professors, who had by graduation secured their *jus ubique docendi*, he was matriculated in the

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minor and major examinations he occupied several positions on the staff, and carried out research on the alkaloids of aconite. While acting afterwards for five years with the firm of Messrs. Brady and Martin at Newcastle, he successfully used his leisure to prepare for the B.Sc. degree of London University. The next six years were spent as head of the analytical department of Messrs. Burroughs Wellcome and Co. In 1905 he went into partnership in a school of pharmacy, but finally took up the independent practice of consulting and analytical chemistry. He was an eminent specialist in the analysis of drugs and medicinal substances, and as analyst to the British Medical Association made nearly all the analyses of proprietary articles which were revealed in the two publications "Secret Remedies" and "More Secret Remedies," a service of immense value to public health and public economy that has scarcely yet, for well-known discreditable reasons, been given a chance of realisation.

Col. Harrison was a fellow of the Institute of Chemistry, and published a number of papers on his special province of the science. His process for estimating the diastatic strength of malts is now in general use. He was active both as a student and a past student in the life of the Pharmaceutical Society's School, in which he was most highly regarded, and to which as his *alma mater* he was loyally devoted. He was a member of the board of examiners, and last year he delivered a thoughtful and valuable address at the inauguration of the session. For three years he conducted the practical chemistry competition maintained in the weekly *Pharmaceutical Journal*. His professional life was, indeed, in the highest degree strenuous.

As soon as the war broke out Col. Harrison was impatient to join the forces. After being refused several times on the ground of age, he became a special constable and a volunteer in the Inns of Court Reserve Corps. Later he succeeded in entering as a private in the Sportsmen's Battalion of the Royal Fusiliers. It was by an accident that he came under the notice of the first head of the anti-gas service at home, Col. Sir W. H. Horrocks, R.A.M.C., who with some difficulty succeeded in securing his services. He was given the rank of lieutenant on the general list, and from that time devoted himself to the anti-gas service. It was only in the present year that his duties were extended over both branches of the gas service. Of Col. Harrison's personal contribution to the invention, design, and manufacture of the appliances necessitated by gas warfare it would not be proper to speak at present in any detail. It is to be hoped that some day the story may be told. It is enough to say that his services were of inestimable value.

The type of chemical training and of experience which Col. Harrison brought to bear was of great value in the design of appliances, on the problem of securing and testing supplies, and of translating laboratory experiment into large-scale operations. This is well brought out in the following extract from a letter which has been received from Lord Moulton: "It is only those who were brought into intimate contact with his work who are able to estimate rightly how great a loss to the country was his death. He was an extraordinary compound of the theoretical and the practical mind. His knowledge of all that bore upon chemical warfare was extensive and profound, but it was accompanied by an overriding practical sense—a sense of proportion—which gave him quick and sound decision and enabled him to give to our armies in the field the full benefit of the researches made by us and our Allies promptly and in the most useful form. I do not see how his place can be filled. I hope, however, that events will show that he lived long enough to finish the work before him. He died at the moment of victory. I fear that his death was due to his having exhausted his strength in his devotion to his country."

Col. Harrison's talent for organisation was, however, dominant above everything. The amount of work he got through was amazing. He was in no way tempestuous or violently masterful, but with indomitable will, intense concentration, and few words he went straight to the heart of things—one thing after another—without confusion, clear-headed, terse, lucid, and suggestive, even when most weary and worn by incessant toil. He was invariably patient and imperturbable; no problem, however suddenly presented or however vast, daunted him, no mischance dismayed him. Emergency seemed to be his natural element; he seemed constantly on active duty. The mention of rest, leisure, or leave raised a smile, as for something incompatible or, perhaps, for the pleasant thought of bygone days.

One could not but wonder what this man might not have done in the arts of peace if only he had been discovered earlier. The war brought him his chance. Suddenly the bonds of an artificial world were released; he put on his armour and fought for four strenuous years, to die an acknowledged leader of men in a vast campaign, and worthy indeed of the full military honours and of the sorrow eloquent on the faces of troops of friends, amid which he was laid to rest. A. S.

NOTES.

INASMUCH as it provides for the bringing together, under one Minister, of the Local Government Board, the Insurance Commissioners, and other bodies performing health duties of a more or less definitely preventive kind, the Ministry of Health Bill will be welcomed by all interested in improving the national health. The welcome, in all probability, will be a little less warm than it might have been, because, though the Bill may, as Dr. Addison, the introducer, said, "represent a common measure of agreement," it nevertheless contains evidence that much in the way of compromise was necessary before agreement was reached. One of the chief signs is the provision with regard to the taking over from the Board of Education of the medical inspection and treatment of school children. This, it is stated, is to come under the Ministry of Health and its Minister only "as and when it is desirable." There is probably no more important piece of health work than this in the whole realm of public health; no more important duty for a Minister of Health who desires to lay a sound foundation for an A1 nation; and many will consider it a misfortune that the new Ministry is to be formed only on condition that the Board of Education is allowed to continue to carry on health functions, in addition to those which it is regarded as being particularly fitted to perform. Because of this separation of work on behalf of children from that done for other sections of the population there will still be overlapping; the hands of the Health Minister will be, to an extent, tied, and there will be unnecessary expenditure of energy and public funds. Another provision in the Bill likely to interfere with the feelings of satisfaction experienced in certain circles is that relating to the formation of "consultative or advisory councils." To a strong Minister they need not prove a source of weakness; may, indeed, be a source of inspiration and strength; and if Sir Auckland Geddes, who has taken over the Presidency of the Local Government Board, becomes the first Minister of the first Ministry of Health, it is certain that there will be at least a strong Minister. More than this, however, there will be a capable Minister, and one who, on account of his medical and administrative training and experience, can quickly grasp the needs of the health situation and himself assist in the solution of the many problems that fall to be dealt with. With him at the head it seems unlikely that the powers of taking over the health functions of the Board of Education will long remain in abeyance, or that the "consultative councils" will have many opportunities, even if they desire to take them, of going over the head of the Ministry.

INFLUENZA in London has caused 4165 deaths during the four weeks ending November 2, the Registrar-General's returns for the several weeks giving the deaths directly attributable to the complaint as 80, 371, 1256, and 2458. Of these 48 per cent. have occurred between the ages twenty and forty-five, whilst below forty-five years the deaths have been 80 per cent. of the total, and above forty-five years only 20 per cent. Comparing the deaths from influenza at the several ages with the deaths from all causes at the corresponding ages, between the ages 0–5 years the percentage of influenza deaths is 34; 5–20 years, 63; 20–45 years, 64; 45–65 years, 32; 65–75 years, 17; and above 75 years, 8 only. In the corresponding four weeks the deaths are for pneumonia 1127, and for bronchitis 481; the percentage of deaths on those from all causes being for influenza 43, pneumonia 12, bronchitis 5. There has been no influenza epidemic half so severe in London during the last seventy-four years—since 1845 at least. Since 1845 there have only been three influenza epidemics with more than 2000 deaths. These are 1891, April 26 to July 18, with 2056 deaths; 1891–92, December 27 to March 26, with 2101 deaths; and 1899–1900, December 3 to May 12, with 2050 deaths. The deaths in London from influenza during the present epidemic are almost as numerous as the total deaths in London from the complaint in the forty-six years from 1845 to 1890, the deaths during that whole period being 4690. In ten epidemics from 1909 to 1917 the total deaths in London were 4329, which shows the exceptional virulence of the present attack.

THE leading resolution adopted by the Inter-Allied Conference on International Scientific Organisations held in London on October 9–11 last (see NATURE for October 17, p. 133) was to the effect that it is desirable that the nations at war with the Central Powers should withdraw from the existing conventions relating to international scientific associations as soon as circumstances permit, and that new associations be established by the nations at war with the Central Powers, with the eventual co-operation of neutral countries. The application of this resolution was left to the consideration of a committee of inquiry which will meet in Paris shortly. Among the subjects referred to the committee of inquiry is the organisation of the publication of bibliographical works in all branches of science. It is felt that the scientific world has hitherto relied too much upon "Centralblätter" and "Jahresberichte" for information upon recent additions to knowledge. These publications quite naturally give undue prominence to work done in Germany, while work published in other countries is not infrequently ignored. It is therefore important that complete abstracts and bibliographies of science should be published in the Allied countries, without regard to any similar works that may be appearing in Germany. It cannot, however, be expected that the income to be derived from the sale of these works of reference will defray the cost of preparation and publication, and it would therefore appear that such work would require Government subsidies. In planning new work the committee should not overlook existing undertakings, such as the International Catalogue of Scientific Literature. It ought to be possible to arrange that work of this magnitude should be continued without a break even though Germany and Austria no longer co-operate in its production.

THE first general meeting of the National Union of Scientific Workers was held on October 27, and was attended by representatives of eleven branches with more than five hundred members. The constitution of the union was determined, subject to slight alterations in redrafting the rules. It was agreed upon by the meeting that the objects of the union should include:—(1) To advance the interests of science—pure and applied—as an essential element in the national life; (2) to regulate the conditions of employment of persons with adequate scientific training and knowledge; and (3) to secure in the interests of national efficiency that all scientific and technical departments in the public service, and all industrial posts involving scientific knowledge, shall be under the direct control of persons having adequate scientific training and knowledge. Special objects deal with obtaining adequate endowment for research and advising as to the administration of such endowment, setting up an employment bureau and a register of trained scientific workers, and obtaining representation on the Whitley industrial councils. An applicant is qualified for membership if he or she has passed the examination leading to a university degree in science, technology, or mathematics, and is engaged at the time of application on work of a required standard, though certain other qualifications are regarded as equivalent to university degrees and admitted in lieu thereof. A resolution was carried unanimously that a special advisory committee should be appointed to deal with questions arising in connection with the promotion of research. At the close of the meeting the officers for the ensuing year were appointed as follows:—*President:* Dr. O. L. Brady (Woolwich). *Secretary:* Mr. H. M. Langton (miscellaneous). *Treasurer:* Mr. T. Smith (National Physical Laboratory). *Executive:* Mr. G. S. Baker, Dr. N. R. Campbell, Dr. C. C. Paterson (N.P.L.), Mr. R. Lobb, Mr. J. W. Whitaker (Woolwich), Dr. H. Jeffreys, Dr. F. Kidd (Cambridge), Dr. C. West (Imperial College), and Dr. A. A. Griffith (Royal Aircraft Establishment). The address of the secretary is Universal Oil Co., Kynochtown, Stanford-le-Hope, Essex.

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council for the ensuing year at the anniversary meeting on November 30:—*President:* Sir Joseph Thomson. *Treasurer:* Sir Alfred Kempe. *Secretaries:* Prof. Arthur Schuster and Mr. W. B. Hardy. *Foreign Secretary:* Prof. W. A. Herdman. *Other Members of the Council:* Sir George T. Beilby, Prof. V. H. Blackman, Mr. C. V. Boys, Sir James J. Dobbie, Sir Frank W. Dyson, Dr. M. O. Forster, Prof. F. W. Gamble, Dr. J. W. L. Glaisher, Sir Richard Glazebrook, Sir Alfred D. Hall, Sir William Leishman, Prof. W. J. Pope, Dr. W. H. R. Rivers, Prof. E. H. Starling, Mr. J. Swinburne, and Prof. W. W. Watts.

THE court of assistants of the Salters' Company has appointed Dr. M. O. Forster, F.R.S., to be the first director of the Salters' Institute of Industrial Chemistry referred to in NATURE of October 24. Since July, 1915, Dr. Forster has been chairman of the technical committee of British Dyes, Ltd., and was, until recently, a member of the board of directors.

IN view of the urgent necessity for incurring certain preliminary expenditure for afforestation purposes, an interim authority has been set up to carry out the necessary work pending the passing of legislation setting up permanent machinery for the purpose. A supplementary estimate of the sum of 100,000*l.* has been made for this authority.

WE regret to learn of the death at Utrecht, on October 21, of Prof. H. E. J. G. du Bois, well known to physicists by his numerous valuable contributions to the knowledge of magnetism and related subjects. Prof. du Bois was just beginning his work in the new Bosscha Laboratory which the Dutch Government had built for him at Utrecht.

THE death of Mr. Edward Bennis is announced in the *Engineer* for November 8. Mr. Bennis was born in 1838, and was educated at the Quaker College of Newtown, in Waterford. He will be remembered for his inventions of mechanical stokers, and for his work in connection with problems of smoke abatement.

ON Wednesday, November 20, the opening address of the 165th session of the Royal Society of Arts will be delivered by Mr. Alan A. Campbell Swinton, chairman of the council. The subject of the address will be "Science and the Future." The chair will be taken at 4.30.

AT the students' meeting of the Institution of Electrical Engineers, to be held on Friday, November 22, at 7 p.m., at King's College, Strand, an address on "The Permeability of Faintly Magnetic Materials," illustrated by experiments, will be given by Prof. Ernest Wilson.

THE following have been elected officers of the Cambridge Philosophical Society for the ensuing session 1918–19:—*President:* Mr. C. T. R. Wilson. *Vice-Presidents:* Dr. Doncaster, Mr. W. H. Mills, and Prof. Marr. *Treasurer:* Prof. Hobson. *Secretaries:* Mr. A. Wood, Mr. G. H. Hardy, and Mr. H. H. Brindley. *New Members of the Council:* Prof. Baker, Prof. Newall, and Dr. Fenton.

DURING the coming session the meetings of the British Association Geophysical Committee will be held on the third Tuesdays of November, January, February, March, May, and June at the Royal Astronomical Society. At the meeting on November 19, at 5 p.m., Mr. R. D. Oldham will open a discussion on "The Constitution of the Earth's Interior." The subjects to be dealt with at the January and later meetings will be seiches, seismology, terrestrial magnetism, geodesy, and atmospheric electricity.

AT the anniversary meeting of the Mineralogical Society, held on November 5, the following officers and members of council were elected:—*President:* Sir William P. Beale, Bart. *Vice-Presidents:* Prof. H. L. Bowman and Mr. A. Hutchinson. *Treasurer:* Dr. J. W. Evans. *General Secretary:* Dr. G. T. Prior. *Foreign Secretary:* Prof. W. W. Watts. *Editor of the Journal:* Mr. L. J. Spencer. *Ordinary Members of Council:* Mr. H. Collingridge, Mr. T. Crook, Dr. G. F. Herbert Smith, Dr. H. H. Thomas, Mr. H. F. Collins, Mr. J. P. De Castro, Prof. H. Hilton, Lieut. A. Russell, Dr. A. Holmes, Miss M. W. Porter, Mr. R. H. Rastall, and Sir J. J. H. Teall.

THE council of the Chemical Society has arranged for three lectures, bearing on the ultimate constitution of matter, to be delivered during the present session. The first lecture, entitled "The Conception of the Chemical Element as Enlarged by the Study of Radio-active Change," will be delivered by Prof. F. Soddy at the ordinary scientific meeting to be held at Burlington House on Thursday, December 19, at 8 p.m. Four informal meetings of the society will be held during the present session. The object of these meetings is to give fellows greater facilities for social intercourse than are afforded by the ordinary scientific meetings. The first will be held at Burlington House on Thursday, November 21, at 8 p.m., when the following exhibits will be on view:—Specimens illustrating the manufacture of saccharin (Boots Pure Drug Co., Ltd.), optical glass (Chance Bros. and Co., Ltd., and the Derby Crown Glass Co., Ltd.), tungsten products (Ediswan Electric Co., Ltd.), photographic chemicals (Ilford, Ltd.), fine chemicals (T. Morson and Son, Ltd.), and apparatus (Silica Syndicate. Ltd.).

WE regret to record the death of Sir James William Restler on November 4. Sir James was born in 1851, and was chief engineer to the Metropolitan Water Board. From an account of his career which appears in *Engineering* for November 8, we learn that he completed his education at King's College, London, and received his professional training with the firm of Messrs. John Aird and Sons. In 1883, as chief engineer to the late Southwark and Vauxhall Water Co., he carried out works of considerable magnitude, including the construction of reservoirs having a capacity of 1,750,000,000 gallons, and filter-beds covering twenty-three acres. Sir James designed the Honor Oak reservoir, which was opened in 1909. He frequently gave technical evidence before Royal Commissions and at Parliamentary inquiries. He was a member of council of the Institution of Mechanical Engineers, and had been elected a member of council of the Institution of Civil Engineers for the current session.

PROF. G. BRUNI, of the R. Istituto Tecnico Superiore, Milan, writes to suggest that now the Dardanelles are occupied by British and Allied forces, a monument to the memory of H. G. J. Moseley should be erected at the place where he died. "A call for a subscription to this end would be enthusiastically answered, not only in Great Britain, but also through all the Allied countries." While fully appreciating Prof. Bruni's suggestion, some of Moseley's friends are not much in favour of the erection of a monument at such a distant and inaccessible place. No doubt inclusive memorials will be erected by the various Governments to those who fell at the Dardanelles, and it would be a little invidious to pick out one of so many brave men for special recognition. What would be most suitable would be for the Royal Society or some other body to name a research scholarship in Moseley's honour, and it is to be hoped that ultimately something in this direction will be done. We understand that as soon as his friends on active service return to this country a Moseley memorial meeting will be held in the laboratory where he did his great research, with the view of erecting a tablet there, though this is not exactly the type of memorial which Prof. Bruni has in mind.

THE *Times* publishes an official report from Capt. Amundsen to the Norwegian Consul-General at Archangel, sent from Dickson Island by wireless telegraph on September 4. The *Maud* took a week to cross the Kara Sea, which in August was impeded with heavy ice, but Capt. Amundsen reports that, so far as he could judge, the ice conditions north of Siberia seem to be favourable. The beginning of September is rather late to pass Dickson Island, but Dr. F. Nansen, in an interview with the *Times* correspondent, expresses the hope that the expedition passed the New Siberia Islands early in November. In this case the ship should by now be beset in the pack and have begun her transpolar drift. Capt. Amundsen, however, has a difficult coast to navigate. He may quite possibly have been caught west of the Taimir Peninsula, and have had to seek winter quarters on the coast. The coast in the vicinity of the Nordenskjold Archipelago affords several suitable harbours. Nansen in August, 1893, and Vilkitski in September, 1914, had difficulties with ice in this region. Even if Cape Chelyuskin is safely rounded, heavy ice may possibly be found between that cape and the Lena delta—a region which has a bad reputation. Possibly in that case Capt. Amundsen will attempt to winter in the little-known Nicholas Land. The expedition reports having fifteen sledge-dogs on board, and to have loaded 105 barrels of oil at Dickson Island.

IN *Mind* (n.s., Nos. 107 and 108) W. M. Thorburn discusses the rights and wrongs of a person in language which is more vehement and impelling than is usual in philosophical papers. He contends that, in spite of the teaching of astronomers and biologists, men will persist in looking upon the "bimanous biped" as the apex of all creation, the highest possible evolutionary form, and, as a corollary, estimate the life of any man as of more intrinsic value than the life of any animal. The quantity and not the quality of the human species is too commonly taken as the ideal. The result is a maudlin sentimentality which fears to face the problem of retribution as the necessary result of wrong-doing, and a futile belief that, by an adjustment of environment, equality among men can be maintained—a belief which is disproved by all the analogies of Nature and the lessons of history. Science is the fruit of leisure, and men of science can have the necessary leisure only if others less gifted are prepared to undertake work which is often called menial. The author's conclusion is a plea to consider whither democracy is leading. The whole discussion is provocative and stimulating, supported by a wealth of literary and scientific allusion, and will be valuable to thinkers in many fields of activity from speculative philosophy to the most practical science. Many will disagree with his conclusions, but his point of view is one which ought to be realised and honestly faced.

IN the *Journal of Hellenic Studies* (vol. xxxviii., for 1918) Prof. Percy Gardner publishes an account of a valuable addition to the Ashmolean Museum in the shape of a female marble figure of great beauty, which lay unnoticed at Deepdene, and was purchased at the sale of the Hope collection in July last. It is not a mere portrait, but a portrait of a woman in the guise of deity, women in Greece being seldom honoured with a statue unless they were more or less deified. It dates from the period 460–440 B.C., corresponding with the active period of Pheidias, and there is good reason to believe that it is a portrait of Aspasia as Aphrodite, and it may account for the accusation of impiety which we know to have been brought against her. The article is fully illustrated by examples of the same type, and the Ashmolean Museum is to be congratulated on an acquisition of singular interest and value.

THE Sultanieh Geographical Society, Cairo, has recently published an attractive programme of its future operations. It proposes to undertake an ethnographic and geographical survey of Egypt, the results of which will be published in periodical bulletins and memoirs; to provide for lectures, a museum, and the conservation of archives connected with this work. The special subjects to which attention will be directed are a monographic survey of the Siva oasis, an outpost of Egypt which has been little studied; an examination of the three groups of Egyptian gipsies—the Beledi, Ghagar, and Nawar—of whom little is known; a study of irrigating devices, with comparison of ancient models; and basket-making. On these subjects monographs will be prepared, and documents, sketches, and photographs collected. The society is undertaking a valuable work which deserves the support of anthropologists.

THE *Indian Journal of Medical Research* for July (vol. vi., No. 1) contains an excellent summary by Lt.-Col. Clayton Lane on methods, old and new, for the detection of hook-worm (ankylostome) infection. Concentration of the ova of the parasite in the dejecta may be effected by straining and centrifuging, and also by a "levitation" method. In the latter the centrifuged deposit is placed on a slide in a little water and allowed to stand for five minutes. At the end of this time the slide is carefully immersed in water and then taken out. By this procedure particulate matter is largely removed, but the hook-worm ova are sticky and adhere to the slide. The exact technique is described, and the method is applicable for parasitic ova other than those of the hook-worm.

A BRIEF summary of the present position of the kelp industry appears in *California Fish and Game* (vol. iv., No. 3). In 1910 the Bureau of Soils of the United States proposed to exploit the vast beds of giant kelp, fringing much of the west coast of America, for the purpose of using these plants for the manufacture of potash and other fertilisers; and the scheme has proved a most fruitful one. The commonest of these plants is the ribbon-kelp (*Macrocystis pyrifera*), which forms enormous beds, usually in places where there is pronounced wave action. The beds of Macrocystis with which the Californian kelp industry is concerned extend from San Diego to Point Conception, and they have been divided up and rented to various companies, which last year harvested nearly 400,000 tons of kelp. It has been found necessary periodically to close the beds for recuperation after harvesting, and to regulate the time of cutting in order that the beaches should not be interfered with during the summer months, nor with unprotected beaches during the winter. From observations so far made, there is no evidence that the fishing industry is in any way injured by this removal of the terminal fronds of the weed, though adjustments are found to be necessary to prevent friction between kelp-harvesters and fishermen desiring to use the beds at the same time.

ATTENTION may be directed to a paper on the anatomy of the potato plant, with special reference to the ontogeny of the vascular system, by E. F. Artschwager, published in vol. xiv., No. 6, of the *Journal of Agricultural Research.* The study was undertaken primarily to serve as a basis for work on that obscure disease—or group of diseases, possibly—to which the name "leaf-roll" has been given; and there can be no doubt that a serious scientific investigation of the nature and causes of this trouble is one of pressing importance for all countries where the potato is grown. The paper referred to will be found very useful as a convenient summary of previous work on the anatomy of the potato plant, and in some directions it throws new light on points which were formerly not altogether clear. The importance of the development of secondary phloëm is emphasised, and it is shown that the increase in size of the tuber is due more to the formation of new tissue in the perimedullary zone than to growth of the pith, as was formerly supposed. It is clearly shown that the skin of the tuber is composed of periderm derived to some extent from the original epidermis, as well as from the hypoderm. The paper is illustrated by twenty-one plates of excellent photomicrographs, as well as by a few text-figures.

IN the Journal of the Washington Academy of Sciences for October 4 Messrs. P. D. Foote and T. R. Harrison, of the Bureau of Standards, in a paper on some peculiar thermo-electric effects, point out that the production of a thermo-electric current in a homogeneous wire by heating it unsymmetrically was known to Franklin and Cavendish a hundred and fifty years ago. It continues to be "rediscovered" once a decade, but up to the present time not one of the many causes which have been suggested for the effect has proved satisfactory. The authors state, however, that in the special form of the experiment in which a hot and a cold piece of the same metal are brought into contact, the direction of the current generated is connected with the sign of the Kelvin effect in the metal.

MR. L. B. ATKINSON gave the Kelvin lecture to the Institution of Electrical Engineers on November 7. He chose as his subject "The Dynamical Theory of Electric Engines," and began by quoting a formula for inductance or "electromagnetic capacity" which Kelvin gave in the 1860 edition of Nichol's "Cyclopædia" (see Thomson's "Reprint," p. 443). He suggested that this formula and the equally well known theorem for the mutual action between electric circuits when their currents are maintained constant had been overlooked by electricians, who merely considered what may be called the statical theory of the dynamo. Mr. Atkinson then developed an analogy between the cycle of an electromagnetic engine and the cycle of a reciprocating engine, deducing what appeared to us to be very curious formulæ for the efficiency of the various cycles. He excused his neglect of the resistance of the windings of the electric machines by pointing out that in the future some material of very small resistance may be discovered from which they can be made. Nothing was said either about hysteresis or armature reaction. In order that Kelvin's theorem might apply, Mr. Atkinson had to suppose that the currents in the coils were absolutely constant. Various triple integral formulæ well known to mathematicians were given for the energy stored up in the field, but we could not follow what use he made of them. It is difficult to see how the method developed can be of any practical use. It may be pointed out that the dynamical theory of the dynamo has been developed by Lyle, Russell, and several French electricians, who have based solutions on the conservation of energy and inductance formulæ on the lines laid down by Kelvin. Their results take cognisance of both resistance and armature reaction, and are in close agreement with experiment. As in all other theories, however, the assumption is made that the iron has constant permeability.

AMONG the books mentioned in the new announcement list of *Messrs. Longmans and Co.* we notice the following:—"Boiler Chemistry," J. H. Paul, with diagrams. "The Natural Organic Colouring Matters," Prof. A. G. Perkin and Dr. A. E. Everest; "Catalysis in Industrial Chemistry," Prof. G. G. Henderson; and "Plantation Rubber," G. S. Whitby (Monographs on Industrial Chemistry). "The Rare Earth Metals," Dr. J. F. Spencer, and a new edition of "Osmotic Pressure," Dr. A. Findlay (Monographs on Inorganic and Physical Chemistry). "Naval Architects' Data," J. Mitchell and E. L. Attwood; "Experimental Education," being a new and enlarged edition of "Introduction to Experimental Education," Dr. R. R. Rusk; and "Economic Reconstruction," J. Taylor Peddie.

THE following additions will shortly be made to the series of "Military Medical Manuals," edited by Sir A. Keogh (*Hodder and Stoughton*):—"Commotions and Emotions of War," Prof. A. Léri, edited by Sir John Collie; "Disabilities of the Locomotor Apparatus, the Result of War Wounds," Prof. A. Broca, translated by Capt. J. R. White and edited by Sir Robert Jones; "Electro-diagnosis of the War," Prof. A. Zimmern and P. Perol, translated by L. P. Garrod and edited by E. P. Cumberbatch; "Mental Disorders of the War," Prof. J. Lépine, edited by Dr. C. A. Mercier; "Wounds of the Pleura and Lungs," Prof. R. Grégoire and Dr. A. Courcoux, edited by Lt.-Col. C. H. Fagge.

OUR ASTRONOMICAL COLUMN.

BORRELLY'S COMET.—This comet is now quite an easy object in a moderate telescope. Mr. R. L. Waterfield observed it at Cheltenham with a 4-in. refractor early in November. It was brighter than 9th magnitude with central condensation, but no stellar nucleus, diameter about 2′. The brightness will continue to increase throughout November, and the increasing north declination will facilitate observation.

ORBITS OF TWO SPECTROSCOPIC BINARIES.—Further interesting investigations of spectroscopic binaries are recorded in Bulletins Nos. 314 and 315 of the Lick Observatory. In the case of p Velorum, magnitude 4·1, Class F2, the spectra of both components are exhibited, and Dr. R. F. Sanford finds that the mass ratio is 1·23. Adopting Russell's average mass for F stars of three times that of the sun, the inclination of the orbit would be 27°. With this inclination the semi-major axes of the two orbits would be 10,880,000 km. and 13,340,000 km. respectively. The period is 10·210955 days, and the eccentricity 0·541. From some of the best spectrograms Messrs. Adams and Joy find the absolute visual magnitude to be +1·9 and the parallax 0·036″.

The star σ Scorpii, magnitude 3·1, class B1, has been investigated by Dr. F. Henroteau, whose value of 0·246834 day confirms previous conclusions as to the extreme shortness of the period. The semi-amplitude of each velocity curve has the constant value of 41·2 km. per second, but the velocity of the centre of mass is variable, as if a third body were present.

The centre of mass describes an elliptic orbit in a period of 34·08 days, with a semi-amplitude of 33 km. per second. The spectral lines vary in width, and are broadest near periastron. Some of the peculiarities of the star may be due to its being actually involved in the nebulous matter by which it appears to be surrounded.

A REMARKABLE HELIUM STAR.—A notable exception to the rule that the helium stars are usually characterised by small parallax, small proper motion, and low radial velocity has been found by Mr. J. Voûte in the star Boss P.G.C. 1517 (*Astrophysical Journal*, vol. xlviii., p. 144). The investigation was undertaken at the suggestion of Prof. Kapteyn, who had suspected that this star might be found to have the unusually large parallax of about a tenth of a second. Mr. Voûte's result is $+0·069'' \pm 0·006''$, in good agreement with Prof. Kapteyn's supposition. For the proper motion Mr. Voûte has found $+0·235'' = 0·0185$s., but this is greatly in excess of the value $-0·0001$s. given in Boss's catalogue, and needs further confirmation. The radial velocity of the star is also exceptionally large, amounting to +83 km. per second. The position of the star for 1900 is R.A. 6h. 0m. 37s., decl. $-32° 10' 12''$, and the magnitude 5·6.

THE ORBIT OF SIRIUS.—The results of a new determination of the elements of the orbit of Sirius are given by Dr. R. Aitken in Lick Observatory Bulletin, No. 316. The elements with their probable errors are:—

$P = 50·04$ years $\pm 0·09$ year	$i = +43° 31' \pm 0·25°$
$T = 1894·133 \pm 0·011$ year	$\omega = 145·69 \pm 0·38$
$e = 0·5945 \pm 0·0023$	$\Omega = 42·71 \pm 0·33$
$a = 7·570''$	

Dr. Aitken concludes that the available micrometric and spectrographic data give no evidence of departure from undisturbed elliptic motion. It will be observed that the period given above is in close agreement with that of 50·02 years recently deduced by Jonckheere.

PRODUCTION IN THE SEA.[1]

A HIGHLY interesting report by Dr. C. G. J. Petersen describes the methods and results of recent work on the evaluation of the bottom fauna and flora of the sea in the Kattegat, Limfjord, and elsewhere. Abandoning the use of the dredge, as affording misleading ideas of the abundance of life on the bottom, the author invented his "bottom-samplers," which are apparatus that can lift up a sample of the sea-floor with its contained animals and plants. The area of bottom lifted varies between 0·1 and 1 square metre, the smaller apparatus being used at the greater depths. By a process of washing, the organisms are removed, counted, and weighed. The plates represent typical results, all the organisms found being drawn, in actual size, on paper ¼ square metre in area, which is then reduced to ⅔ in. linear.

Very often the bottom deposit consists of a "black, malodorous mass of sulphurous mud," and it was difficult to imagine that animals could utilise this as food. Sampling this by means of a glass tube thrust down into it, it was, however, seen that there was a thin surface layer of quite different composition, grey or brown in colour, and charged with vegetable remains. Oysters and other bivalves and demersal worms do not feed on the black mud or on the plankton in the water, but "literally stuff themselves with this upper layer of fine detritus." "The great bulk of the bottom animals are, and must necessarily be, herbivorous." They mostly burrow in the mud, but a large number are attached to solid objects, stones, and shells. These constitute the bottom epifauna.

The bottom fauna in general may be divided up into "communities," each characterised by one or more predominant forms; thus the author describes the bottom in the deeper parts of the Kattegat as inhabited by communities of *Amphilepis pecten, Brissopsis sarsii, B. chiajei,* and *Echinocordatum filiformis,* the typical forms present in each case being indicated by the systematic names.

The survey being a quantitative one, an attempt is made at an actual estimate of the mass of life in the whole Kattegat. There are about 24,000,000 tons of Zostera, 50,000 tons of plaice, 6000 tons of cod, 7000 tons of herrings, 25,000 tons of starfishes, 50,000 tons of predatory Crustacea and Gastropods, 10,000 tons of small fishes, with, of course, much else. These estimates are based, not only on the results of bottom-samples, but also on fishery statistics, the very probable assumption being made that the fish stock is practically constant, so that the fraction taken in commercial fishing represents the production.

No attempt is made to compare density of life on sea-bottom and land. "Strange as it may seem," says the author, "there does not exist any survey of the animal communities on land based upon quantitative investigations of the commoner species." J. J.

[1] Report of the Danish Biological Station to the Danish Board of Agriculture. "The Sea Bottom and its Production of Fish Food." By C. G. Joh. Petersen. Pp. 62+10 plates+chart. (Copenhagen, 1918.)

MILITARY EXPLOSIVES OF TO-DAY.[1]

THERE have been no epoch-making discoveries in explosives such as, say, the discovery of nitroglycerine for many years. Nitroglycerine, discovered in 1846, still remains the most powerful explosive in practical use. Many useful advances have been and are being made, but new explosives are merely new mixtures of old materials, given fancy names. The nations at war use practically the same explosives, and no one can be said to be ahead of the others.

The following table gives a comparison of some of the most typical explosives in use:—

Name of Explosive	Volume of gas per gram in c.c. = V	Calories per gram = Q	Coefficient = Q × V ÷ 1000	Coefficient G.P. = 1	Calculated temperature $= \frac{Q}{C}$. Assuming C = 0·24 C = Specific Heat of Gases
	c c.				° C.
Gunpowder	280	738	207	1	2240
Nitroglycerine	741	1652	1224	6	6880
Nitrocellulose (13 per cent. Nitrogen)	923	931	859	4·3	3876
Cordite, Mk. I. (N.G. = 57, N.C. = 38, Vaseline = 5)	871	1242	1082	5·2	5175
Cordite M.D. (N.G. = 30, N.C. = 65, Vaseline = 5)	888	1031	915	4·4	4225
Ballistite (N.G. = 50, N.C. = 50, Stabiliser = 0·5)	817	1349	1102	5·3	5621
Picric Acid (Lyddite)	877	810	710	3·4	3375

The coefficients correspond fairly well with the results obtained in practical use.

Detonating substances are called *high explosives*, and their immense shattering effect is due, not only to the volume of gas and quantity of heat, but also to the velocity of detonation and density of the explosive. Shattering power is proportional to

Volume of gas per gram × cals. per gram × velocity of detonation × density.

[1] From three Cantor Lectures delivered before the Royal Society of Arts in April last by J. Young, Chief Instructor in Science, Royal Military Academy, Woolwich.

Detonation is more easily started in powder or crystals, probably because there is a smaller mass to take the initial shock; but the wave travels slowly, and may die out in a loose powder. Advantage is taken of this fact in detonating shells. Detonation is first set up in crystals or pellets, and transmitted to the dense filling.

Mixtures of high explosives which require different waves are always difficult to detonate.

Amatol, a mixture of T.N.T. and ammonium nitrate, is more difficult to detonate than pure T.N.T.

Ammonium Nitrate Mixtures.

Ammonal.—One of the best known and most used of the ammonium nitrate mixtures is ammonal, in which use is made of the great heat given out by the oxidation of aluminium. A mixture of aluminium powder with the theoretical amount of ammonium nitrate for complete oxidation would contain 81·6 per cent. of NH_4NO_3. It would yield 1578 calories per gram—nearly as much as nitroglycerine—and 682 c.c. of gas. But such a mixture is difficult to detonate, and charcoal was added to make it more inflammable.

All cartridges must be hermetically sealed to preserve them from moisture, which quickly ruins ammonal. The velocity of detonation is about 4000 metres per second, and the effect intermediate between that of gunpowder and that of dynamite. Its power is three to four times that of gunpowder.

Sabulite.—This is an explosive resembling ammonal, but calcium silicide, Ca_2Si, an electric-furnace product, takes the place of the aluminium. Its composition is as below:—

	Per cent.
Ammonium nitrate	78
Trinitrotoluene	8
Calcium silicide	14

It is detonated in the same way as ammonal, and has about the same power.

Amatol.—This is a mixture of ammonium nitrate and T.N.T. in various proportions, which is now of great importance. T.N.T. does not contain enough oxygen for its complete combustion, and although the addition of ammonium nitrate increases the weight of the charge, the increase of the heat given out more than compensates for this.

The higher the proportion of ammonium nitrate, the greater the difficulty of detonation, and the difficulty increases when the ammonal is melted and cast into solid blocks or slabs, as is necessary for shells. Hence the higher proportions are used in the form of powder for bombs, grenades, and mines, and detonated by fulminate detonators. The others, used for shell-filling, are detonated by special methods, and will be referred to later.

All varieties of amatol are powerful high explosives. The velocity of detonation is about 4500 metres per second. All are spoiled by moisture and must be waterproofed, and all are practically smokeless.

Chlorate Mining Explosives.

All the older chlorate explosives are much too sensitive for use in large quantities in military operations. But a discovery made by Street in 1897, that if the chlorate mixture contained oils or fats its sensitiveness was greatly decreased, initiated an entirely new set of blasting explosives.

Blastine.—This is the most important military chlorate explosive, and vast quantities have been used in the present war. There are several varieties, but a typical military blastine has the following composition:—

	Per cent.
Ammonium perchlorate	60
Sodium nitrate	22
Trinitrotoluene	11
Paraffin wax	7

It is made in the form of a soft, yellowish, granular substance, which can easily be compressed.

Permite.—This is a mixture intermediate between ammonal and blastine, and may be looked on as ammonal in which the expensive aluminium is replaced by zinc powder, the consequent diminution in power being compensated for by using ammonium perchlorate instead of the nitrate. It is made in several varieties.

All the chlorate explosives require fulminate detonators, and for this reason, besides being too sensitive, are unsuitable for use as a high-explosive shell-filling. The rate of detonation is 4000 to 5000 metres per second.

Mixtures of ammonium perchlorate and paraffin wax with combustibles such as aluminium powder or wood-meal are also used, and are powerful high explosives.

Thermit, now an important munition of war, is in a class by itself. It is used for charging incendiary bombs, and sometimes in a kind of shrapnel. A small explosive charge scatters the contents, which rain down bits of blazing iron, which will instantly set fire to anything capable of burning.

Nitrocellulose, containing 12·5 per cent. of nitrogen and soluble in alcohol-ether, or at least completely gelatinised by it, is now made on an enormous scale, and constitutes 99·5 per cent. of nitrocellulose smokeless powders, as well as being used in the new cordite.

Guncotton was formerly used exclusively for torpedo warheads, marine mines, etc., but has now been largely replaced by T.N.T. and ammonium nitrate and chlorate mixtures.

There are two varieties of smokeless military powders in use at present: (1) *Nitrocellulose powders,* which consist of 99·5 per cent. of gelatinised nitrocellulose, and 0·5 per cent. of a preservative; and (2) *nitroglycerine powders,* which are gelatinised mixtures of nitroglycerine and nitrocellulose, with a few per cent. of a stabiliser.

American nitrocellulose powder (N.C.T.) is typical of the first class. It is made from soluble nitrocellulose containing about 12·5 per cent. of nitrogen.

N.C.T. is a good powder, and fairly stable. It is the weakest of the smokeless powders. Charges must be about 10 per cent. heavier than with cordite to give the same muzzle velocity.

N.C.T. is now much used in our Service for guns and howitzers, the charges being adjusted to give the same muzzle velocity as cordite M.D.

Cordite Mk. I. is a very powerful propellant, but owing to the high temperatures produced it is very erosive, and as a result of the South African War a modified cordite, "Cordite M.D.," was introduced. It has the composition: guncotton 65, nitroglycerine 30, mineral jelly 5. Its power is about 10 per cent. less than that of Mk. I., but the guns last three times as long. Cordite M.D. is the standard British propellant, although others are used at present.

In a new modified cordite soluble nitrocellulose is used instead of guncotton, and alcohol-ether is used for the gelatinisation instead of acetone. It contains a larger percentage of nitroglycerine than cordite M.D., but is very similar, although not quite so powerful.

High Explosives for Shell-filling.

A high explosive, in order to be suitable for shell-filling, must possess special qualities not necessary when it is used for other purposes, even in bombs and torpedoes.

None of the shell high explosives possess all the desirable qualities. Those now in use have little more than half the shattering power of blasting gelatine. All are products derived from the distillation of coal.

In spite of its great merits, picric acid has now been largely replaced as a shell-filling by trinitrotoluene and amatol.

Given that the picric acid is pure and proper precautions have been taken, it is quite safe and the most powerful shell-filling in use. It is also unaffected by high atmospheric temperatures, unlike T.N.T., and is specially suitable for tropical climates.

Trinitrotoluene ($C_6H_2(NO_2)_3CH_3$).—Usually called T.N.T., this substance, at present the most important of the shell high explosives, is known in the Service as trotyl. When heated to about 300° C., T.N.T. ignites and burns with a hot, but very smoky, flame. When a large mass is involved, the heat given out will invariably raise the temperature to the detonating-point. It is fully detonated by fulminate, except when in the form of cast slabs untamped, when the addition of a little lead azide to the fulminate is necessary. Fulminate detonators are used in bombs, torpedoes, and grenades. T.N.T. can also be detonated by less sensitive substances, such as picric powder and tetryl, and these are used in shells. The velocity of detonation in its densest form is about 7000 metres per second. The power is less than that of picric acid, about in the proportion of 91 : 100. Owing to the inferior velocity of detonation, the shattering effect (brisance) is proportionately still less, about 87 : 100.

When an amatol shell detonates there is only a little grey smoke, and no definite indication as to whether detonation has been complete or not. For observation purposes a packet of smoke producer is put in. The power is a little greater than that of pure T.N.T., but the velocity of detonation much less—4000 to 4500 metres per second, so that the local shattering effect is much less. For some purposes this is even an advantage.

Amatol is the most used of all the shell high explosives at present.

Tetranitromethylaniline ($C_6H_2(NO_2)_3NCH_3NO_2$).—This substance is known in the trade as tetryl, and in the Service as C.E. (composition exploding). It is readily detonated by a very small charge of fulminate, such as that used in shell detonator caps, is very powerful, and has a velocity of detonation of more than 7000 metres per second. It is an excellent initiator of detonation in other less sensitive explosives. In powder, pellets, and cylinders it is used in the gaines or detonators for T.N.T. and amatol shells, with which it is very effective.

Detonation of High-explosive Shells.—The problem of the detonation of a high-explosive shell is difficult. The shell is subjected to an enormous shock in the act of firing, the detonating charge must be in intimate contact with the filling, and if fulminate were used there would be a great risk of this being detonated by the shock. The problem seems to have been solved by the introduction of the gaine method.

The Gaine.—The gaine is a metal tube screwed to the fuse, which enters a cavity in the filling and makes good contact with it. This is very necessary. It contains a chain of substances, about four, of decreasing order of sensitiveness, starting from the fuse, and increasing order of violence of explosion. Use is made of the fact that a substance in powder is more easily detonated than when in compressed pellets, and pellets than a cast, dense solid. The actual substances vary with the shell and nature of the filling, but always start with gunpowder, which is very certain in action. Thus we may suppose the chain to consist of (1) gunpowder, (2) tetryl powder, (3) tetryl pellets, and (4) T.N.T. pellets.

The action is started by a fulminate cap in the fuse, which fires the gunpowder. This partially explodes and partially detonates No. 2, which detonates No. 3, which in turn detonates No. 4, and this detonates the main filling. With fuse and gaine in good condition there are very few failures now.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

ABERDEEN.—Lord Cowdray has been elected Rector of the University in succession to Mr. Churchill, who has occupied the position for the last four years.

THE Mercers' Company has given 125*l.* towards the maintenance fund of the Cancer Investigation Department of the Middlesex Hospital.

THE sum of 1000*l.* has been given to the City of London School by Prof. Carlton Lambert for the foundation of a science scholarship.

A RESEARCH fellowship of the annual value of 150*l.* has been founded at Guy's Hospital in memory of the late Lieut. R. W. Poulton Palmer and his sister, the late Mrs. E. H. A. Walker, the object of which will be the investigation of obscure diseases in man.

THE London County Council has arranged a series of addresses to London teachers on various aspects of the problem of national reconstruction after the war. The first two addresses will be:—November 22, "The British Commonwealth," by C. Grant Robertson; and December 11, "Hours of Labour," by Lord Leverhulme. Sir Cyril Cobb, chairman of the Education Committee of the Council, will preside at these lectures. Other lectures in connection with reconstruction will be given on the following subjects:—Economic Recovery, Housing, Agriculture and Rural Life, Women's Employment, Adult Education, Food Supply, International Relations, India, and National Health. The lectures are arranged for London teachers, but other persons can be admitted if accommodation is available. Applications for tickets should be made to the Education Officer, L.C.C., Education Offices, Victoria Embankment, W.C.2, marked H. 45. A stamped addressed envelope should be enclosed.

ONE of the main matters to which Sir J. J. Thomson's committee on the position of natural science in the educational system of Great Britain gave attention was the provision of courses intended to stimulate interest in natural facts and phenomena and their human aspects. The appearances and movements of the heavenly bodies are particularly suitable for observations and instruction of this kind, yet few pupils leave school with any knowledge of them, and most people go through life without an intelligent understanding of the simplest facts of astronomy. Sir Frank Dyson, the Astronomer Royal, in an address to the British Astronomical Association on October 30, urged that the claims of astronomy should be borne in mind in any schemes for the broadening of science teaching in schools. A certain amount of valuable work in this direction is done already in connection with the practical geography lessons; and the British Association Report on Science Teaching in Secondary Schools contains, in one of the syllabuses, much useful guidance to such observations. Sir Frank Dyson rightly lays stress upon the educational value of work with terrestrial and celestial globes, the latter in a simplified form and showing the position of the sun in the ecliptic on, say, the first day of each month. He suggests also that an orrery should be used to make clear the transference from the geocentric to the heliocentric point of view, and that a 4-in. telescope should be provided wherever possible to observe sun-spots, the lunar surface, Jupiter's satellites, and the phases of Venus. Such observations, together with simple lessons on the applications of spectroscopy to elucidate the composition of the sun, stars, nebulæ, etc., illustrated by some of the excellent astronomical photographs now available, should do much to remove the reproach that nothing is done in schools to encourage pupils to lift their eyes to the heavens and learn something of the universe around them.

THE endowment fund now being raised for the establishment of a University College in Swansea has been augmented by donations of 25,000*l.* from Mr. F. Cory Yeo and 10,000*l.* from Mr. W. T. Farr, retiring directors of the Graigola Merthyr Co., Ltd., 5000*l.* of the former donation to be devoted to scholarships "in the first place for Graigola boys, and, if any after, for open competition." The University College scheme originated in a movement to secure for the Swansea Technical College recognition in the faculties of science and technology as a constituent college of the University of Wales. The governors and staff were of opinion that for a full development of the higher work of the college University recognition and association were essential. To this end the governors approached the recent Royal Commission on University Education in Wales, asking for a direct recommendation that the college should find a place in at least the above-mentioned faculties in the reorganised University. A proof that the application was backed by the community was the establishment in the course of a few weeks before the end of 1916 of an endowment fund exceeding 65,000*l.*, in addition to which the Swansea Town Council undertook to provide all necessary land and buildings. The Royal Commission reported very favourably, but laid down that the new University College must make provision for work in the faculty of arts. To assist in fulfilling this condition, the Swansea Council has agreed, subject to the consent of the Board of Education, to bring in its Training College for Teachers as part of the scheme. This will enable full provision to be made in the faculty of arts, science, and technology, but necessitated an appeal for a much larger endowment fund, a minimum of 150,000*l.* being the present aim. Messrs. Cory Yeo's and W. T. Farr's donations are the first-fruits of this appeal, and brings the gifts or promises well above 100,000*l.* The college has also received notice of a bequest of the residue of the estate of the late Mr. T. P. Sims, assayer, of Swansea, the bequest being subject to a life-interest. The value of the residue is estimated at more than 10,000*l.*, and the income is to be devoted to scholarships in chemistry, metallurgy, and modern languages.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 7.—Sir J. J. Thomson, president, in the chair.—Prof. G. E. **Hale**: The nature of sun-spots.—E. O. **Hercus** and T. H. **Laby**: The thermal conductivity of air.—T. K. **Chinmayanandam**: Haidinger's rings in mica.

Aristotelian Society, November 4.—Dr. G. E. Moore, president, in the chair.—Dr. G. E. **Moore**: Some judgments of perception. The question of the real nature of material things is approached by asking what we are judging when we make such judgments as, "This is a coin." Two things seem to be certain, viz. (1) that we are always making some assertion about an immediately given object—an object which has sometimes been described as "the sensation which mediates our perception of the coin in question," and which will be called the sense-datum which is the subject of our judgment—and (2) that what we are asserting about the sense-datum is not, in general, that it is itself a coin. What is doubtful is whether we may not be judging that the sense-datum is itself a part of the surface of a coin, in a sense in which this can only be so if it is identical with "this part of the surface of this coin." This is only possible if, when we seem to perceive that a sense-datum is of a certain size, shape, etc., we really only perceive that it seems to be so, in a sense in which it may seem to be so without being either judged or perceived to be so. Failing this, either (1) there must be some relation such that we are judging "The thing to which this sense-datum has this relation is part of the surface of a coin," and it seems doubtful whether there is any such relation, or (2) we must take some view of the type of Mill's.

CAMBRIDGE.

Philosophical Society, October 28.—Prof. Marr, president, in the chair.—Prof. L. J. **Rogers** and S. **Ramanujan**: Proof of certain identities in combinatory analysis.—S. **Ramanujan**: Some properties of p (*n*), the number of partitions of *n*.—Miss D. M. **Wrinch**: The exponentiation of well-ordered series.—A. E. **Jolliffe**: Certain trigonometrical series which have a necessary and sufficient condition for uniform convergence.—H. W. **Turnbull**: Some geometrical interpretations of the concomitants of two quadrics.—H. B. C. **Darling**: Mr. Ramanujan's congruence properties of p (*n*).—B. **Sahni**: The correct generic position of *Dacrydium bidwillii*, Hook. f. This species, and by inference probably also *D. kirkii* and *D. biforme*, hitherto regarded as forming an interesting transition to the genus Podocarpus, are really species of the latter genus. At least in *D. bidwillii* the epimatium is not entirely free from the integument, nor the integument from the nucellus. The integument, moreover, contains two vascular strands exactly in the same position as in *Podocarpus ferrugineus*, but not quite reaching the level of the equator. In view of the dry epimatium and other features, it is proposed provisionally to place all these New Zealand species of Dacrydium in a new and distinct section of the genus Podocarpus, allied to section Stachycarpus.

PARIS.

Academy of Sciences, October 21.—M. Léon Guignard in the chair.—E. **Picard** and A. **Lacroix**: The Inter-Allied Conference of Scientific Academies in London.—H. **Sebert**: Notice on M. Marcel Deprez.—C. **Richet**, P. **Brodin**, and Fr. **Saint-Girons**: Temporary and definite survival after serious bleeding. In previous papers it has been proved that in the case of dogs, after grave loss of blood, injection into the veins of suitable fluids would prolong life, but after three or four hours the improvement in the condition of the animal disappears and death ensues. The survival is only temporary. Summarising the results communicated in this and previous papers, the authors conclude that the only efficacious treatment after heavy loss of blood appears to be transfusion.—P. **Appell**: Addition to the note on an ordinary differential equation connected with certain systems of linear and homogeneous partial differential equations.—H. **Douvillé**: The geology of the neighbourhood of Argeles and the Pic de Gez.—P. **Termier** and W.

Kilian: The composition of the Miocene conglomerates of the French sub-alpine chains.—L. **Jouane**: The elasticity of pure cement. Measurements were made of the flexion of small test pieces of cement when submitted to small forces, no permanent deformation resulting. The strains were proved to be proportional to the stresses applied, and the modulus calculated from various test pieces was constant within 1 per cent.—H. **Guilleminot**, H. **Cheron**, and R. **Biquord**: An X-fluorometer with radio-luminescent standard.—P. **Georgevitch**: Study of the sexual generation of a brown alga.—H. **Agulhon** and R. **Legroux**: Contribution to the study of the vitamines utilisable in the culture of micro-organisms. Application to the influenza bacillus (*B. pfeiffer*).—Sir Almroth E. **Wright**: The production of non-specific bactericidal substances by means of anti-staphylococcic and anti-streptococcic vaccines *in vivo* and *in vitro*.—R. D. de la **Rivière**: Is the poison of influenza capable of passing through a filter? Blood from influenza patients was defibrinated and filtered through a Chamberland filter (L_3). A portion of the filtrate injected under the skin produced influenza symptoms in the author, which are described in detail. A second injection ten days after the first gave rise to no morbid symptom.—C. **Nicolle** and C. **Lebailly**: Some experimental ideas on the virus of influenza. The bronchial expectoration in cases of influenza collected during the acute period is virulent. The ape is sensible to the infection.—J. **Nageotte** and L. **Sencert**: The utilisation of dead grafts for the surgical repair of tissues of a conjunctive nature.

BOOKS RECEIVED.

The Illinois and Michigan Canal: A Study in Economic History. By Prof. J. W. Putnam. Pp. xiii+213. (Chicago: University of Chicago Press.) 2 dollars.

The Student's Handbook to the University and Colleges of Cambridge. Seventeenth edition, revised to June 30, 1918. Pp. vi+717. (Cambridge: At the University Press.) 6*s.* net.

The Iron and Steel Institute. Carnegie Scholarship Memoirs. Vol. ix. Pp. iv+169. (London: E. and F. N. Spon, Ltd.)

State of Connecticut. Public Document No. 24: Forty-first Annual Report of the Connecticut Agricultural Experiment Station. Pp. xvi+510. (New Haven, Conn.)

University of London. University College. Abridged Calendar. Session 1918–19. Pp. cxxx+250. (London: Taylor and Francis.)

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 14.

ROYAL SOCIETY, at 4.30.—A. Mallock: Sounds produced by Drops falling on Water.—G. H. Hardy and S. Ramanujan: The Coefficients in the Expansions of certain Modular Functions.—Hon. R. J. Strutt: The Light Scattered by Gases; Its Polarisation and Intensity.—Dr. F. Horton and Ann C. Davies.—An Investigation of the Ionising Power of the Positive Ions from a glowing Tantalum Filament in Helium.

OPTICAL SOCIETY, at 8.—T. Smith: Some Generalised Forms of an Optical Equation.—H. S. Ryland: The Manufacture of Binoculars.

MATHEMATICAL SOCIETY, at 5.—Annual General Meeting.—Prof. H. M. Macdonald (Retiring President): Presidential Address.—Prof. M. J. M. Hill: The Use of a Property of Jacobians to Determine the Character of any Solution of an Ordinary Differential Equation of the First Order, or of a Linear Partial Differential Equation of the First Order.—Prof. H. J. Priestley: The Roots of a Certain Equation in Spherical Harmonics.—J. Hodgkinson: A Detail in Conformal Representation.—T. A. Broderick: The Product of Semi-convergent Series.—Dr. W. P. Milne: A Simple Condition for Co-apolar Triangles.

FRIDAY, NOVEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—*Adjourned Discussion*: Prof. C. A. Edwards and F. W. Willis: A Law Concerning the Resistance to Penetration of Metals which are Capable of Plastic Deformation, and a New Hardness Scale in Fundamental Units.—R. G. C. Batson: The Value of the Indentation Method in the Determination of Hardness; and Dr. W. C. Unwin: The Ludwik Hardness Test.—T. T. Heaton: Electric Welding.

MONDAY, NOVEMBER 18.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Exhibition of Captured War Maps.

TUESDAY, NOVEMBER 19.

BRITISH ASSOCIATION GEOPHYSICAL COMMITTEE (Royal Astronomical Society), at 5.—R. D. Oldham: The Constitution of the Earth's Interior.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 5.30.—W. R. Ormandy: The Motor Fuel Problem.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—R. B. Joyner: The Tata Hydro-electric Power-supply Works, Bombay.

ZOOLOGICAL SOCIETY, at 5.30.—The Secretary: Report on the Additions to the Society's Menagerie in the Month of October, 1918.—Miss K. Lander: Exhibition of Skeletons, prepared by the "Trypsin" Method.—E. Hatschek: Notes on Investigations into the Forms of Drops and Vortices of Gelatin in Various Coagulants.—Dr. D. M. S. Watson: Seymouria, the most primitive known Reptile.

WEDNESDAY, NOVEMBER 20.

GEOLOGICAL SOCIETY, at 5.30.—R. Hansford Worth: The Geology of the Meldon Valleys, near Okehampton, on the Northern Verge of Dartmoor.

ROYAL SOCIETY OF ARTS, at 4.30.—A. A. Campbell Swinton: Science and the Future.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL METEOROLOGICAL SOCIETY, at 5.—R. DeC. Ward: The Larger Relations of Climate and Crops in the United States.—Capt. C. J. P. Cave and J. S. Dines: Soundings with Pilot Balloons in the Isles of Scilly, November and December, 1911.

THURSDAY, NOVEMBER 21.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: W. Stiles and Dr. F. Kidd: (1) The Influence of External Concentration on the Position of the Equilibrium attained in the Intake of Salts by Plant Cells; (2) The Comparative Rate of Absorption of various Salts by Plant Tissue.—G. Marinesco: Récherches Anatomo-Cliniques sur les Névromes d'Amputations douloureux: Nouvelles Contributions à l'Etude de la Régénération nerveuse et du Neurotropisme.

LINNEAN SOCIETY, at 5.—E. S. Goodrich: A Fatherless Frog, with remarks on Artificial Parthenogenesis.—Miss Muriel Bristol: A Review of the Genus Chlorochytrium, Cohn.—A. S. Kennard and B. B. Woodward: The Linnean Species of Non-marine Mollusca that are represented in the British Fauna, with Notes on the Specimens of these and other British Forms in the Linnean Collection.

ROYAL SOCIETY OF ARTS, at 4.30.—Sir Everard im Thurn: The Present State of the Pacific Islands.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—R. R. Kahan: Refining Gold Bullion with Chlorine Gas and Air.—A. Yates: Effect of Heating and Heating and Quenching Cornish Tin Ores before Crushing.—R. J. Harvey: The Development of Galena Flotation at the Central Mine, Broken Hill.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—J. H. Shaw: The Use of High Pressure and High Temperature Steam in Large Power Stations.

INSTITUTION OF MINING AND METALLURGY, at 5.30.

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