existing industries, but may also indicate new markets. Thus a study of the physical structure of coal can give assistance in coal mining and coal breaking problems, in the dedusting of fine coal and in coal cleaning. It has already been shown that the nature and extent of the bands, partings and cracks in lump coal can be examined radiographically before and after the adsorption of lead salts, and that a study of microstructure can aid in the selection of coals for the production of active carbons in which the original structure of the coal is retained.

Dr. King pointed out the importance of the changes which occur in coal on heating, to the carbonization and other industries, and admitted that we are still very ignorant of the true meaning of these changes. A greater knowledge, he said, would greatly help coal blending and the precise selection of coals for special purposes such as complete gasification and the motor-lorry gas producer. Although research on the chemical constitution of coal has not yet achieved its object, Dr. King feels that new lines of attack should be tried; previous work has already indicated new processes such as the production of ash-free coke by the Pott-Broche process and the production of base-exchange agents by the action of sulphuric acid. The paper stimulated a lively discussion in which many and diverse points were touched upon. It seemed to be generally agreed that the proper utilization of coals would be furthered by the close definition of their fundamental properties.

The paper sponsored by Prof. A. C. G. Egerton detailed one important aspect of the properties of coal, namely the part played by its sulphur content. Since the utilization of high-sulphur coals may be one of our future problems, it is desirable to know now how the sulphur can be controlled. Mr. Armstrong (research student from South Africa) detailed experiments on the partial elimination of sulphur from coke by passing various gases through the coal during carbonization in the presence of inorganic substances. The reductions are quite marked in some cases with steam, hydrogen or ammonia; but inert gases have little effect.

The sulphur problem attracted some discussion from the steel technologists present, it being pointed out that a decrease of 0·1 per cent in the sulphur of coke would represent a saving of 1*s.* per ton in the cost of pig iron.

On account of the high cost involved, the production of motor-spirit and oil from coal has not greatly increased in Great Britain, but considerable strides have been made in the technical sphere. Dr. R. Holroyd described some of the important advances which Imperial Chemical Industries Ltd. have made in connexion with the control of the chemical composition and octane number of the motor-spirit. Three types of catalyst are now available for the vapour-phase stage of the process so that cracking, hydrogenation and isomerization reactions can be controlled to give motor-spirit of the composition necessary for high knock rating. Thus spirit can be made with a very high aromatic and low normal-paraffin content; this has a high octane number (80) but a low susceptibility to lead tetraethyl (4 ml. per gall. raises the octane number to 86–7). Alternatively, spirit rich in branched-chain paraffins and low-boiling naphthenes can be made; this has a lower octane number (75–6) but a much higher susceptibility to lead tetraethyl, since 4 ml. per gallon raises the octane number to 89–90. Dr. Holroyd said that when similar control has been established over the liquid-phase stage the hydrogenation process will have more control over its products than the oil industry.

Although not the last paper of the evening, Captain J. G. Bennett's paper really constituted a final word on coal utilization. By assessing the items influenced by the type of fuel, such as overheads, maintenances, repairs, etc., he was able to demonstrate mathematical relationships between the "figures of merit" for fuels, these figures of merit being technical efficiency, economic efficiency and psychological merit. For the three types of energy, coal, gas and electricity, a ternary diagram may be constructed. Although his proposals are still not fully developed, Captain Bennett was able to show how this diagram can be used for the analysis of statistical and operating data referring to fuel problems; the trends in costs can be followed and the appropriate fuel chosen for any particular purpose. The proposals attracted considerable interest, although it was thought that the large number of variables would make the calculation difficult and might impair accuracy.

Scientific Research and Industrial Needs in Canada

IN a recent address to the Canadian Chamber of Commerce, Major-General A. G. L. McNaughton dealt with those activities of the National Research Council that serve to enlarge the demands of industry for the produce of farms, fields and factories. At present, Canadian industry draws about 12 per cent by value of its raw materials from agriculture, or about one third, if forests be included. He referred to recent progress in the United States, where four large research institutes, each endowed with an annual revenue of a million dollars, have been established; and he laid special stress upon German progress in the same direction under the four-year plan. Whereas about 45 per cent of the annual cut of wood was formerly used for low-grade fuel, now 95 per cent is consumed by industry, and Germany is striving to replace iron and steel for construction work by synthetic resins derived from wood and agricultural products. If Canada is to survive, said General McNaughton, she must follow the same path, for the old-time one-product system of farming is becoming unremunerative in view of the growth of national self-sufficiency in Europe.

At the same meeting, Dr. C. Y. Hopkins outlined some of the chemical problems now being studied in Canada with the above object in view. China wood oil has of late been replacing linseed oil in varnishes and enamels, and the production of flax-seed in Canada has much diminished; hence efforts are being made to find a satisfactory alternative either by chemical modification of China wood oil or by breeding a new variety of oil-seed that could be cultivated in Canada. A home-grown substitute for the vegetable oils now largely imported for soap-making is also

being sought. Among the *faits accomplis* of Canadian chemists may be mentioned standardization of tests for honey, improved maple products, a method of drying apples and other fruits with better retention of flavour, and a wax mixture for use in plucking poultry.

Dr. N. H. Grace dealt with projects and achievements in the field of biology. Growth-promoting substances are now added to the dusts used for disinfecting seeds. The development of rust-resistant varieties of wheat is estimated to have saved the prairie provinces about 38 million dollars this year. Research is proceeding on the factors that determine the malting quality of barley with the view of growing more barley of better quality. In 1937, some 80,000 tons of bacon were sent to Britain, prepared in twenty-six plants, each using its own method; research is now being directed towards improving both quality and uniformity.

Methods have been developed for altering the heritable characters of plants by heat and chemical treatment, and progress in producing a drought-resisting and soil-binding forage crop for western Canada has been effected by crossing a Russian grass with the best Canadian wheat varieties. From poplars and conifers it is hoped to produce, by crossing, rapid-growing varieties of trees possessing hybrid vigour and disease-resistance that may be vegetatively propagated with the aid of 'plant hormones'.

Admiralty Laboratories at Sheffield

THE new Admiralty Laboratories at Janson Street, Sheffield, were opened on December 15 by Sir William Bragg, president of the Royal Society.

These laboratories, which have been constructed to cope with the ever-increasing amount of Government work, are designed in such a fashion as to incorporate all recent developments in laboratory architecture. The two large analytical laboratories, for ferrous and non-ferrous analysis respectively, embody many unusual features. One was struck with the arrangements which have been made for the conducting of chemical analysis on a large scale; indeed the expression 'mass-production' might be used with respect to the systematizing of analytical methods, certain benches, for example, being given up solely to determinations of one particular element. The carbon combustion room was particularly intriguing in its lay-out, containing several combustion apparatus all set in a line and arranged for rapid analysis of carbon in steel. A particular feature is made of spectrographical analysis, for which purpose Hilger quartz spectrographs are used. This method of analysis has been brought to a high state of efficiency, and complete reliance can be placed on the results obtained.

One was particularly impressed not only by the orderly and systematic arrangement of plant and apparatus, but also by the system with which the work is carried out; even the chemical store is a model of order and forethought. The heat-treatment laboratory, containing Birlec and Wild-Barfield high-temperature furnaces with temperature control devices, supplies all that is required for experimental heat-treatment purposes, and it is understood that a high-frequency furnace is shortly to be installed. One of the most pleasing features is the lighting, the lower half of the windows being of Thermolux glass, which provides insulation from both heat and from the glare of the sun, whilst the walls of the laboratories are of a very pleasing tone of semi-glazed fireclay tiles. The air-conditioning system is novel, and no signs of fumes can be detected anywhere in the laboratories.

These new laboratories are capable of turning out all the work that is necessary, and their constructional arrangement has considerably speeded up the rate of analysis. They are most pleasing premises to work in, and those in authority are to be congratulated on this new development, which is significant of the scientific progress in metallurgical work for which the Admiralty has been responsible in the past.

J. H. A.

British Institute of Radiology

Annual Congress

THE twelfth Annual Congress of the British Institute of Radiology was held in the Central Hall, Westminster, on December 7–9, and in connexion with the Congress there was an exhibition of apparatus organized by the British X-ray industry. The Congress was opened by the president, Mr. W. E. Schall, the opening address being followed by the nineteenth Mackenzie Davidson Memorial Lecture, delivered by Dr. G. Shearer on "X rays—Their Influence in Pure and Applied Science". In the course of this lecture, Dr. Shearer noted that twenty-five years have elapsed since Moseley first observed the regularities in the K and L X-ray spectra of the elements which pointed to the general similarities in the internal structures of various atoms and led ultimately to a fairly complete understanding of atomic structure and to the placing of electrons in their appropriate energy levels. This same series of observations has also led to the use of X-rays in the study of the solid state, with results of great practical and industrial importance. From the study of simple crystals by W. H. and W. L. Bragg, the work has advanced to such an extent that complex molecules such as the proteins can now be studied, and the results, incidentally, linked up with the work of the organic chemists. Another phase of X-ray work