



SATURDAY, JUNE 28, 1924.

CONTENTS.

	PAGE
Fuel and the Future . . . . .	917
Psychology. By Dr. Millais Culpin . . . . .	919
Low Temperature Carbonisation . . . . .	920
The Teaching of Palæontology. By Dr. F. A. Bather, F.R.S. . . . .	922
Our Bookshelf . . . . .	923
Letters to the Editor :—	
Collisions between Light-quanta.—H. Bateman . . . . .	924
An Experimental Effect of Light on the Sponge, Oscarella.—Dr. J. H. Orton . . . . .	924
The Theory of Hearing.—Prof. E. W. Scripture . . . . .	925
Darwin and Evolution.—Sir Oliver Lodge, F.R.S. . . . .	926
A Method of increasing the Effective Sensitiveness of Galvanometers, etc.—J. H. Shaxby . . . . .	926
Comparison of Wave-lengths with a Fabry and Perot Etalon.—Prof. John K. Robertson . . . . .	926
On the Centroid of a Circular Arc.—H. S. Rowell . . . . .	927
Einstein and Mach.—Prof. Bohuslav Brauner . . . . .	927
Approximate Integration.—H. V. Lowry . . . . .	927
Chemical Research in India. By Prof. Jocelyn F. Thorpe, F.R.S. . . . .	928
Problems of Muscular Receptivity. ( <i>With Diagram.</i> ) By Sir Charles Sherrington, O.M., G.B.E., P.R.S. . . . .	929
Obituary :—	
Dr. R. M. Walmsley . . . . .	932
Mr. F. Merrifield. By J. J. W. . . . .	933
Capt. W. F. Caborne . . . . .	933
Current Topics and Events . . . . .	934
Research Items . . . . .	937
A Temple of Science. ( <i>Illustrated.</i> ) . . . . .	940
Annual Inspection of the Rothamsted Experimental Station . . . . .	943
Association of Teachers in Technical Institutions . . . . .	944
University and Educational Intelligence . . . . .	945
Early Science at the Royal Society . . . . .	946
Societies and Academies . . . . .	947
Official Publications Received . . . . .	948
Diary of Societies . . . . .	948
Recent Scientific and Technical Books . . . . .	Supp. v

Fuel and the Future.

THE World Power Conference to be held at Wembley on June 30-July 12, and the Empire Mining and Metallurgical Congress held on June 3-6, cover between them a very wide field in the production, distribution, and utilisation of power. If we ignore the fascinating but remote possibilities of the utilisation of atomic energy, the future of power production in Great Britain means the future of coal production and utilisation. The great increase in the cost of coal during the last decade has brought the question of its more efficient utilisation into prominence, and the present is an appropriate time to review the situation, in order to see what scope exists for economy.

Increased economy in the use of coal does not necessarily imply that less will be used, but that more of the energy latent in our coal-fields will be usefully employed. Some of the coal raised is used for the purposes of the colliery, the rest either with or without further treatment is transported over the country; then it is either burned in the raw state or converted into other fuels by some system of carbonisation, with or without the recovery of by-products. Each process of treatment and each transportation entails the expenditure of energy; the fuel remaining contains less of the latent energy of the coal, but is in a form giving it greater availability.

Coal as mined consists of a mixture of coal and inorganic matter. The large lumps of both coal and dirt are easily separated, but in the past the finer sizes of coal, which often contain a high percentage of ash, have been largely wasted. Improvements in mechanical stokers, and later in the use of pulverised fuel, have made possible the economical use of fine coal even when it has a large ash content. The ash content may easily amount to 10 per cent. or even to 20 per cent. or more, and this not only may cause trouble in the furnaces and in the disposal of the ash, but also necessitates transporting several hundredweights of waste material in every ton of fuel. The importance of this depends on the distance the fuel is moved before burning; if the coal is to be burned at the colliery, it may not be worth incurring the cost of separation, but if it is to be used at a distance, the cost of treatment may be much less than the cost of transporting the ash to the furnaces, heating it up, and carting it away.

For many purposes the presence of impurities such as sulphur or phosphorus is most deleterious, and the problem of their removal is a part of the general question of coal purification. The attention now being paid to this question should lead to a smaller proportion of fine coal being left in the mine and a larger proportion of the coal raised being usefully employed.

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Some 40 per cent. of the coal consumed in Great Britain is burned in the raw state under boilers, and the average efficiency of the boiler plants leaves much to be desired. This point was discussed in a recent issue of *NATURE* (June 7, p. 810); it is unnecessary to go into details here, but there is certainly room for great improvement in this direction, and this will come when users realise the importance of efficient supervision in the boiler-house and efficient maintenance of the plant.

There are two large industries dealing with the carbonisation of coal, and there is much talk of a third being started. The oldest of these is the metallurgical coke industry, which is of vital importance to our iron and steel manufacturers. Here, too, great advances may be hoped for in the future. Old as is the industry, there is still much to learn concerning the essential differences which make one coke more valuable than another for metallurgical purposes, the properties required in the coal for the production of good coke, and the best methods of production with due regard to blending and the conservation of the by-products. The second carbonising industry is concerned primarily with coal-gas production, but yields also important by-products in coke and coal-tar. The Gas Regulation Act of 1920 gave a great impetus to the more economical manufacture of gas; the benefits resulting from the Act and from the experiments of the Fuel Research Board and others will become increasingly evident as time goes on.

The third industry, which may become of great importance in the future, is that dealing with low temperature carbonisation, where the products are a smokeless solid fuel for domestic and industrial purposes, a comparatively large yield of tars which in turn yield fuel oil and motor spirit, and a comparatively small but not negligible yield of gas. The advantages and difficulties of this process are discussed at some length elsewhere in this issue (p. 920).

There remains for consideration the steadily increasing use of liquid fuels—heavy oils for steam raising, and both heavy and light oils for internal combustion engines—mostly for transportation purposes. The advantages of fuel oil for steam raising at sea are that it makes for ease and speed of bunkering, is easy of stowage, there is a reduction of labour all round, ready control and great flexibility, the results being that oil fuel has almost replaced coal in the Royal Navy and the tonnage of vessels on Lloyd's Register which are fitted for burning oil fuel has increased nearly twelve-fold between 1914 and 1923. The possibility of producing from coal an appreciable proportion of the oil required is one of the main reasons why low temperature carbonisation would be of great national importance if developed on a large scale.

There are, however, other means by which liquid fuel may conceivably be obtained from coal; the possibilities indicated by recent work on hydrogenation of oil and coal should be given serious consideration.

These processes all result in the conversion of the coal into forms of fuel of higher availability, but some of the original energy is necessarily dissipated in the process. The availability of any form of fuel depends on both the efficiency and the ease with which its energy can be applied and controlled, and this again depends on the purpose for which it is used. The availability is reflected in the prices which consumers are prepared to pay for a unit of energy in the various forms. A treatment or conversion will not be economically sound unless the price obtained for the products covers the cost of the energy, labour, and plant used in the process as well as the cost of the raw material.

One of the important problems awaiting solution is how to avoid the smoke nuisance which results from the burning of raw coal, more especially in domestic grates, in the smaller industrial plants, and in certain metallurgical furnaces. Dr. Ferranti remarked recently that the ideal solution of this would be to abolish the burning of any fuel in populous areas, and to supply all the necessary power, heat, and light from large electric generating stations on the outskirts. From many points of view this would be excellent, and so far as the supply of power and light are concerned it might prove economical; but as regards heat it would mean that, at the outside, 20-25 per cent. of the energy of the coal burned would be available, while it is easy to get three times this efficiency for such purposes as heating water when coal or coke is burned direct. The conversion of the energy of the coal into electrical energy without the intervention of a heat engine might lead to an efficiency of conversion which would make the use of electricity practically universal, but the possibility of this appears almost as remote as the utilisation of atomic energy.

A more probable line of development would seem to be one which confines the burning of raw coal, elsewhere than at the collieries, to large and efficient power stations, and converts the remainder to coke of sorts, liquid fuels, or gas. At the same time the coal as produced would be carefully cleaned, graded, and blended so that the different qualities of coal would be used for the purposes for which they were best fitted, with a minimum of waste. For this ideal to be reached much investigation is still necessary. Far more knowledge is required as to the properties of the coal in the various seams, the relative quantities of the different classes which are available, and the most appropriate treatment for each class, and all speed should be made in pursuing these inquiries.