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## Pylons and Pipelines

THE conspicuous network of high tension cables which is being spread criss-cross about the countryside may serve to remind us of the far greater ramifications of gas pipes and cables underground. Indeed, the streets of the cities of the world are as busy transporting material below the surface as above it, whilst in some lands, notably in America, pipelines carrying natural gas run across the countryside for great distances.

To-day there is increasing competition between gas, electricity and raw coal as sources of heat: all three use the product of the mine as their starting point. In the gas industry selected coals are carbonised so as to give a maximum yield of gas and a solid fuel—coke. In the electrical industry, low grade coal is burnt in highly efficient boiler plants and the steam produced converted in turbines into electrical energy. The domestic user of forty million tons of coal per annum burns specially large or lump coal mined for the purpose, the smalls, so-called slack, being burnt under industrial boilers. By means of pipes and cables, gas and electricity are carried directly into every room of the consumer's house; he only has to turn a tap or pull a switch to obtain service from them: the advantage over coal is overwhelming. It is not necessary for him to keep stocks of either: there are no ashes to be removed by hand: they produce neither dirt within the house nor smoke without. On the other hand, coal has to be transported by train to the local depot, by cart to the house cellar, by hand in buckets to the room, and it is applied again by hand to the fire at irregular intervals. Gas fire and electric stove burn regularly and at constant efficiency: the coal fire burns with very variable efficiency.

For water heating, central heating, and similar purposes coal is replaced by coke, a product of the gas industry which, now that it is made under close supervision and delivered as a high-class material, low in ash and moisture content and regular as to size, has proved to be admirably adapted for the purpose: stoves fired with it require a minimum of attention. Such heating can also be done with gas or electricity, working under thermostatic control, the economics of the operation depending on their price.

A serious competitor of the three methods of heating based on coal is imported oil, firing by which is likewise automatic in its operation. Both for industrial boilers and for public and private

central heating, oil fuel is continually making headway.

The use of raw coal is in fact unscientific and 'unmodern': it also brings with it all the evils of the smoke nuisance, dirty and dismal cities, and consequent ill-health. Many would abolish it by legislation, yet somehow the coal fire survives, partly for psychological reasons, partly because of the capital cost of replacing it, and partly also because, to the man who burns it in anything like an efficient grate, it is still the cheapest source of heat.

Gas and electricity are still too dear in most parts of Great Britain, not because of any lack of technical efficiency, leading to high production costs in either industry, but to the high cost of all that is comprised under distribution charges. Although both industries are making progress, and must continue to do so as they are continually modernised, the price factor is still the determining one in their more general utilisation. Users economise with them and do not use them as freely as their value merits. With more reasonably priced fuel there would be far less parsimony and better health. By his invention of the steam turbine the late Sir Charles Parsons halved the cost of generating electricity: the cumulative inventions of this century in the gas industry have probably had nearly the same effect.

In the coal trade likewise the distribution costs are far too high: in no other basic commodity does the price at the source bear so small a proportion to the price delivered to the householder. Some day perhaps house to house deliveries by one firm only in a given street on a particular day will become obligatory, as it should be with the essential food services. We add enormously to the cost of living by neglecting such elementary economies.

The coal industry could do much to help the situation. Never was any policy more short-sighted than the decision taken when statutory coal prices were fixed, to mulct the gas and electricity companies in extra charges because they were able to pay the same. It is senseless to seek to establish permanence for a price from gas companies which is higher than that got from other users of precisely the same brand of coal. It would be far more to the interest of the mines to give minimum rates to these industries, with the certainty that at lower prices they could greatly increase their sales and hence their consumption of coal.

The fight between home coal and imported oil is becoming very acute: it is certain, for example, that another coal strike would nearly eliminate coal from factory boilers. The coal industry must realise that the day of raw coal, either on land or at sea, is passing and coal must largely be burnt in such a manner that the energy in it reaches the former customer in a more up-to-date form. The whole technique of mining requires re-examination from this point of view: it should generally be possible to mine a coal of the best size for a particular use, and not add to the mining costs by specially bringing large coal to the surface.

A dangerous competitor of the coal industry for the generation of electricity is water-power, though fortunately for the mines this is as yet but little developed in Britain. It has been calculated that in Europe the progressive expansion of water-power is annually displacing 5 million tons of coal, whereby annually 5000 miners become superfluous.

Fortunately again for the coal industry, we have practically no natural gas in Britain—this now substitutes 78 million tons of coal in the United States. Of the 100,000 miles of pipelines in that country 65,000 miles are used to convey natural gas, individual lines being upwards of 1000 miles in length.

There has developed very rapidly in the United States a use for the propane and butane fractions which can be scrubbed out of natural gas and are sold liquefied, either in cylinders or in pressure tank cars. Propane is used in individual farms and houses where towns gas is not available. The sales of the liquefied gas have increased at a very rapid rate: they were 18 million gallons in 1930 and 28 million gallons in 1931, and the number of customers served with propane was 117,000 in 1930, as compared with 55,000 in 1929 and 20,000 in 1928. The use of the butane fraction has developed along the lines of establishing central stations in communities too small to support a gas works. Butane is mixed with air, and the resulting mixture distributed and metered to residents in the settlement in the same way as towns gas. In this way the remote countryside has all the advantages of gas enjoyed by the dweller in the city and at a comparable price.

The development of the use of gas in cylinders has brought to the front again the question of gas as a motor fuel: in Britain important experiments are in progress to this end. On the test bench, the maximum power output of a standard low compression engine when running on towns gas as

compared with petrol is 88 per cent, and by either increasing the compression ratio or enriching the gas with benzol, it will be possible to raise the maximum power when running with gas almost to that obtainable with petrol. A test vehicle is being run on the road with special steel cylinders of light construction, containing gas at a pressure of 3000 lb. per square inch: these are well within the range of metallurgical technology, and their construction can no doubt be cheapened when the occasion arises. Even more progress in trying out gas has been made in France with satisfactory results.

Should these experiments be successful a new era in motoring would arise in Britain, with an equally great repercussion on the gas industry. The organisation of a chain of compressing and filling stations would not present any insuperable difficulties. In particular, the makers of gas of high calorific power would come into their own, as this would afford additional mileage without refilling, though probably some agreed standard gas would have to be furnished throughout the country, so as to avoid the necessity of adjusting the proportion of gas to air supply on engines of motor vehicles. Undoubtedly also, engines burning gas could be so designed as to give complete combustion, thus avoiding the large proportion of carbon monoxide which is at present produced from petrol.

The running of motor vehicles on gas made from British coal would have a profound effect on the gas industry, which with the increased make would be able to lower its price for gas to the householder. The railways, too, would once more have a large quantity of coal to transport. Surely the effort to solve this problem is worth making by all parties, including the mines. If, as at present, they continue to hold gas and electricity up to ransom, they are eventually doomed.

Equally useful to the mines would be the solution of the motor car fuel problem on quite other lines, for example, the discovery of a dry cell of large capacity which could be quickly recharged at local filling stations. Such an invention is by no means beyond the bounds of possibility.

Dr. A. E. Dunstan, in his brilliant summary of fluid fuels to-day and to-morrow delivered before the Society of Chemical Industry, considers that the coal era will be succeeded first by an oil era, then by a gas era, and finally by an electricity era, coal of course being the primary basis for the two latter. To-day coal is still responsible for seventy per cent of the power produced in the world. Great Britain has coal but no oil; the use of oil to-day is outstripping that of coal. It will continue to increase as the Diesel engine is perfected, unless more coal is burned in the modern way.

We, at all events, must rush through the oil era and reach that of gas without delay. Let our pylons and pipelines be significant of the will to do this, otherwise tank farms will replace winding shafts on the landscape.

## Large Molecules

*Die hochmolekularen organischen Verbindungen—Kautschuk und Cellulose.* Von Prof. Dr. Hermann Staudinger. Pp. xv + 540. (Berlin: Julius Springer, 1932.) 52 gold marks.

PROF. STAUDINGER'S book on "Large Organic Molecules" is based upon a series of sixty-nine papers on "Highly-polymerised Compounds" and thirty-nine papers on "Isoprene and Caoutchouc" which have been issued during the period 1920–26 from Zurich, and during the period 1926–32 from Freiburg, as a record of researches carried out under the inspiration and control of the author. No attempt has been made to cover the whole field, and in particular the large molecules of the proteins have not been considered. Nevertheless a very clear general idea emerges from the detailed experiments of which a summary is now given. The author is in fact a real organic chemist, who believes in real bonds, and is prepared to extend indefinitely the conception of homopolar molecules, in which *all the atoms are held together by normal covalences.* This idea follows logically from his observations on the progressive polymerisation of compounds such as:

(i) Polyoxymethylene,

$$CH_2O \longrightarrow -CH_2-O-(CH_2-O)_x-CH_2-O-$$

(ii) Polystyrol,

$$\begin{matrix} C_6H_5 \\ | \\ CH{=}CH_2 \end{matrix} \longrightarrow \begin{matrix} C_6H_5 & C_6H_5 & C_6H_5 \\ | & | & | \\ -CH-CH_2-(CH-CH_2)_x-CH-CH_2- \end{matrix}$$

(iii) Polyvinylalcohol,

$$\begin{matrix} OH \\ | \\ CH{=}CH_2 \end{matrix} \longrightarrow \begin{matrix} OH & OH & OH \\ | & | & | \\ -CH-CH_2-(CH-CH_2)_x-CH-CH_2- \end{matrix}$$

(iv) Sodium polyacrylate,

$$\begin{matrix} COO'Na^{\cdot} \\ | \\ CH{=}CH_2 \end{matrix} \longrightarrow \begin{matrix} COO'Na^{\cdot} & COO'Na^{\cdot} & COO'Na^{\cdot} \\ | & | & | \\ -CH-CH_2-(CH-CH_2)_x-CH-CH_2- \end{matrix}$$