THE GAS INDUSTRY IN BRITAIN*

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COAL is the foundation of Great Britain's power of survival, and the gas industry is one of the instruments which the people of this country have created to use coal to the best advantage. In other lands oil and water power may take the place of coal, but Britain has neither oil nor any substantial quantity of potential water power. The liberation of energy by the fission of certain kinds of atomic nuclei has led to a great deal of speculation, but in the present state of knowledge we have no warrant to assume that this achievement represents unlimited supplies of exceedingly cheap power. Coal is likely to remain the staple fuel of Britain for very many years to come, and it is a matter of gratification to observe that during the last decade the nation has come to realize the importance of conserving its coal resources.

It is now generally realized that, if used wisely, every ton of coal can do much more work in industry and provide higher standards of comfort and cleanliness in the home.

The British gas industry treats annually about twenty-two million tons of coal and employs directly some 130,000 persons for the purpose of rendering a public service. It provides fuel in the form of gas, of coke and, to a relatively small extent, as oil fuel. With the other great fuel and power industries of coal, electricity and oil, it strives in healthy competition to serve industry and the public as effectively as possible, and it would be unfortunate if, as a result of the nationalization of the fuel industries, the healthy competition which has in the past been an incentive to progress ceased to exist. On the other hand, it would show great wisdom and prudence if the administrators of the future were to allot to each fuel industry those services which in the national interests it should best perform.

The basic processes which are operated to convert coal into gas fall into the two groups of carbonization and gasification.

Carbonization consists essentially in roasting the coal with the exclusion of air, the heat causing the coal substances to decompose with the evolution of gas and tar. Coal consists mainly of compounds of the elements carbon, hydrogen and oxygen, in such forms that the greater part of the carbon in the original coal remains behind in the carbonizing vessel as coke. This coke is carefully prepared for use in industry and in the home, or it may be used in the gas works for the production of gas by processes of gasification, employing the reactions which take place between incandescent coke and air or steam to manufacture either producer gas or water gas.

A modern works carbonizing coal for the production of gas operates with high thermal efficiency, recovering as much as 85 per cent of the heat potentially available in the coal in the form of gas, coke and other products.

Forty years ago, gas making was an art, full of tricks and intricacies learned by constant practice and enriched by ingenuity ; but the gas engineer of that time understood little of the nature of the processes he was conducting. To-day the chemist and physicist have placed these processes upon a scientific basis. In those earlier days what we now know as consumer service was a relatively simple matter. The responsibilities of the gas engineer and manager of to-day are quite different. In order that the processes of a gas undertaking may be operated efficiently and the service to the public equally efficient and reliable, the industry has built up a complex organisation with specialist sections.

The gas-holder, so familiar that it is a symbol of the gas industry, is an appliance of the utmost importance. Without gas-holders the productive capacity of the gas-making plant of Britain would have to be about five times as large as it is at present to permit the peak demands to be met. During the midday cooking period on a Sunday, the demand may be five times the average over the whole day, while at midnight the demand may fall to about one quarter of the average. The gas-holder permits these wide changes in requirements to be met, while the manufacturing process continues to operate at a uniformly steady rate throughout the twenty-four hours.

Over the last sixty years the output of gas has grown steadily year by year at an almost constant rate, although at the present time the rate of growth is about twice the average rate over that period.

There are in Great Britain about twelve million families, and as nine out of every ten already use gas it follows that the industry cannot look forward to any large increase in the number of customers. This, however, does not mean that it cannot look forward to any further increase in sales and, indeed, the present abnormally high rate of increase is taking place with almost no change in the total number of users. What is happening is that gas is being used for more and more purposes.

Although the original purpose of public gas supply was to provide artificial illumination, gas lighting represents to-day only about five per cent of the total gas sales. About one half of all the gas sold is consumed by domestic users for cooking, and these same families use a further fifteen per cent of the total for other domestic services, such as water heating, the heating of rooms, the washing and drying of clothes, and refrigeration for food storage. The quantity of heat required for these other purposes, if they are to be performed adequately, is much larger than that required for cooking, and in this fact lies the great scope for the further use of gas in the home. Commercial consumers take about twelve per cent of the total sales, and some eighteen to twenty per cent goes to industry.

The industry has in recent years given attention to the formulation of tariffs which, as nearly as may be, relate the price charged to the actual cost of supply, and it is interesting to record that domestic consumers of one large undertaking who have adopted a two-part tariff system of charge have practically doubled the quantity of gas previously used by them.

The basis of the industry's service is a scientific understanding of the principles involved. This applies not only to the manufacture and utilization of gas but also to the manufacture, preparation and utilization of such by-products as coke and tar.

Coke is to-day a carefully prepared smokeless solid fuel for which a variety of highly efficient appliances have been designed, many of them with gas ignition. For the long-period heating of rooms and for the provision of hot water in the winter months, coke is playing an important part in the efficient use of coal and the abolition of smoke.

The largest use of tar is as a waterproof binder for holding together the stone aggregate of road surfaces,

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and here a study of physical properties and methods of application has enabled the science of road construction to keep pace with the increasing severity of the demands made by traffic.

The application of science to a practical problem may be illustrated by reference to the provision of comfortable warmth in the living-room of a dwelling house. The gas fire of the past was noisy, the fireclay elements were fragile and the sensation of heat was more often one of scorching than of comfort. The continuous noise of the fire when in use arose from the aerated flame burner in which the gas and air were mixed together before they reached the point of ignition. Much was done by studying the aerodynamics of the system to reduce the noise; but complete silence in operation was not achieved until the adoption of the non-aerated burner. These burners were not in themselves novel; but, so long as gas was sold for the intrinsic luminosity of its flame, the non-aerated type of burner could not be relied upon for heating purposes because of its liability to deposit soot. To-day, when gas is sold on its heating value and mainly for heating purposes, the rich hydrocarbons—benzene and its homologues—are recovered as motor benzole. This makes an important contribution to our supplies of motor spirit and at the same time produces a gas which can be burned in a non-aerated burner without risk of sooting.

The purpose of the fireclay element in a gas fire is to receive heat from the flame, being thereby raised to incandescence and emitting this heat by radiation. It was the practice to suspend the fireclay elements in the flame itself and if they were quickly to reach incandescence they had to be light, of small cross-section, and in consequence necessarily fragile. The difficulty was overcome by developing the observation that if gas flames are confined in a fireclay box and one wall of this box is perforated or slotted to a limited extent, the internal surfaces become incandescent and shine out through the slots or perforations. As the purpose of the perforated wall is to restrain the heat from escaping too rapidly, it can be made of robust material and the problem of fragility is overcome. The perforated fret has the further advantage that the apertures can be so arranged as to alter the geometrical distribution of the radiant heat, a matter of importance in the production of comfortable heating.

The study of heat comfort has revealed the necessity of providing such a degree of background heating that the temperature of the air, walls and furniture does not fall below 55° F., and ensuring that the radiant heat employed to supplement the background heating is emitted in a broad beam shining upwards and outwards. With these requirements satisfied a gas fire produces comfortable conditions within a few minutes of lighting and, what is more, the occupants of the room may sit in comfort around the fire for any length of time. The recognition of these requirements has led to the development of the convector gas fire which, in addition to providing the radiant heat, also recovers from the flue gases heat which is employed to warm the air of the room.

The application of scientific principles, of which the foregoing example is but one, has brought us to-day to the knowledge that greatly improved standards of comfort and hygiene may be provided with less consumption of fuel. The unsatisfactory standards of the past have involved the use of five to six tons of coal by a household each year. By employing gas and coke for cooking, water heating and space heating, and electricity for lighting and power, coal is saved and living conditions improved.

The gas industry has great potentialities for further development and goes forward into the future with pride in its past traditions, skill in its present technique, and confidence in its ability to play a large part in restoring the fortunes of Great Britain.

CHROMATOGRAPHICAL STUDY OF MERISTEMATIC PLANT TISSUES

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RECENT years have seen a revival of interest in the apical meristems of plants, but little has been done on the metabolism of these regions. The lack of suitable methods for dealing with small amounts of tissue may be held accountable for this state of affairs; but the development of paper partition chromatography seems likely to provide a method of first-class importance in metabolic studies of apical meristems, or indeed of any other tissues which are available only in restricted quantity.

Paper chromatography was first described in detail in 1944 by Consden, Gordon and Martin[1] as a method for the qualitative analysis of proteins. The same workers[2] have recently adapted it to the identification of lower peptides, while others have developed the technique for the qualitative[3,4] and quantitative[5,6] analysis of sugars. The quantitative analysis of amino-acids has also been reported in outline[7,8]. Lugg and Overell[9] have described a quantitative method for organic acids, while Crammer[10] has used paper chromatography in the separation of flavine nucleotides. Further developments may be anticipated; but the existing methods already provide valuable equipment for the investigation of plant materials.

The only work yet published which deals with a systematic examination of a plant tissue by paper chromatography is that of Dent, Stepka and Steward[11], who investigated extracts of the soluble nitrogen of disks of potato tissue. In the work outlined in the present communication, examination was made of the amino-acids contained in cold 70 per cent alcohol extracts and in acid hydrolysates of the residues of various plant tissues. The solvents used in the chromatography and other details of technique were similar to those described by Dent, Stepka and Steward[11].

The initial object of this investigation was the study of the amino-acids, free and combined, of apical growing points; but as the work progressed it was considered desirable to provide a basis of comparison by examining a range of materials from some of the principal taxonomic groups of plants. The following materials were examined: thallus of *Gigartina stellata* (Rhodophyceæ); old thallus and young branches of *Conocephalum conicum* (Hepaticæ); shoot of *Polytrichum commune* (Musci); developing synangia and mature stem of *Psilotum triquetrum* (Psilophytinæ); leaf of *Isoetes echinospora* and stem of *Lycopodium Selago* (Lycopodinæ); apices of aerial shoots, nodal tissue and young induced lateral branches of *Equisetum giganteum* and prothalli of