EVOLUTION IN THE PETROLEUM INDUSTRY

IN a paper on the above subject read before the Royal Society of Arts on January 21, Mr. James Kewley did not restrict the term 'evolution' to its purely biological sense of adaptation of species of organisms to changing conditions of environment. Rather he gave to it an added significance and power to embrace not only spontaneous changes, but equally predetermined policies designed by man to meet, or even anticipate, commercial and economic demands. Thereafter he proceeded to determine the measure of success achieved within the industry by citation of facts which by their very baldness proclaim the power of such man-made evolution.

In 1895 the deepest well drilled was 1,200 ft. Then came the cry for greater production of crude oil. To meet this, deeper and deeper wells were drilled until in 1940 the record was held by one sunk to a depth of 15,000 ft., or 2·8 miles. In 1859 the demand was for a reliable and cheap illuminant to replace the vegetable oils then in use. Kerosine fulfilled the demand and remained the chief product of petroleum for nearly forty years.

The next landmark in evolution of the petroleum industry was the incidence of the internal combustion engine, which presented the twofold problem of adequate supply of motor spirit and economic utilization of other crude oil products. Statistics show that in 1915 there were 15·8 tons of crude oil available per automobile registered, and in 1935 only 4·9. Nevertheless the demand for motor spirit was met by increasing its volatility and at the same time the yield of this product from the raw material. Hydrocarbons available in the natural gas from the casing heads of wells and in the gases or uncondensed vapours from distillation plants, for example, pentane and butane, were incorporated in the motor spirit fraction, thus increasing its volatility. Increase in yield by this method, however, was small compared with the impetus given to the industry by development of the cracking process, which proved to be a highly flexible technique both from the point of view of control of yields and character of products obtained. In fact, largely owing to the influence of the cracking process the yield of motor spirit from crude oils has been increased fourfold. In 1910 a yield of 13 per cent was obtained, while in 1940 the estimated figure was 55 per cent.

At this stage parallel evolution in the motor engine industry, involving higher compression ratios, created a demand for motor spirits of higher anti-knock value. That the petroleum industry met this demand is evinced by figures relating to the octane numbers of motor spirits in the United States. In 1931 the anti-knock value expressed in terms of octane-number and related to a standard C.F.R. engine was 58; in 1933 it was 67; and in 1940, 73. It so happened that crude oils produced from fields of younger geological age than those first discovered yielded motor spirits of higher octane number and also that cracking processes produced spirits of better anti-knock value, but whether this had been the case or not, evolution in the petroleum industry would not have been seriously retarded. Large-scale development of dopes, particularly tetra-ethyl lead, would have met the contingency.

Having solved the problem of production of high-quality motor spirit, refiners were faced with the difficulty of commercial utilization of the other components of crude oils. Consumers had to be convinced of the practicability of using fuel oil as an alternative to gas, which was in fact much easier to handle. Persistence was rewarded and when the Diesel engine came upon the scene suitable fuels were already available.

Study of figures for sales of Diesel engines (expressed in horse-power) in the United States indicate how great was the demand for this type of fuel:

1915	...	...	86,000
1925	...	...	536,000
1935	...	...	1,200,000
1939	...	...	2,726,000

The so-called space-heater for domestic purposes created a demand for a distillate intermediate in character between kerosene and gas-oil. The use of asphaltic bitumens for road-making, waterproofing, impregnating and a variety of other purposes became an established fact, and methods of blowing or oxidizing bitumens to suit them for particular applications were gradually perfected.

Then came the call for more and more aviation spirit, a product which had hitherto been considered of negligible importance and the small demand for which had been met by a volatile motor spirit. To-day it is a complex mixture of carefully selected components made by a variety of processes, and refiners are concerned not only with its production in vast quantities, but also in maintaining a high standard of purity.

In the early days of the industry there was a deplorable wastage of natural gas. Now it is harnessed for use in a variety of ways. The dry gas is used as a gaseous fuel in refineries and for industrial purposes, also for the manufacture of hydrogen by thermal decomposition and the production of carbon black by incomplete combustion. Ethane is cracked into the reactive unsaturated hydrocarbon ethylene from which by interaction with iso-butane is obtained neo-hexane, a valuable component of aviation spirit. "Bottled-gas" is produced by liquefaction of butane and propane by pressure at ordinary temperatures and is distributed in steel bottles for domestic cooking and lighting.

Finally, brief mention was made by Mr. Kewley of the ever-increasing number of special oils of the lubricating class, of the numerous new applications of paraffin waxes in the electrical and waterproofing industries, and of the uses to which are put the waste products from various refining processes, for example, naphthenic acids and cresylic acids.

All these data are amassed in support of the main theme of the paper, which is to demonstrate how successfully the petroleum industry has adapted itself to current demands and at the same time to adduce evidence pointing to the maintenance of this process of evolution in all its intricacies.

THE LIGHTNING DISCHARGE

AN official communication (Ref. *S/T* 18*a*) from the British Electrical and Allied Industries Research Association upon this subject has been published by C. E. R. Bruce and R. H. Golde (*J. Inst. Elec. Eng.*, Pt. II, Dec., 1941). The contribution is an important one, and it presents several new theses. It is considered that the potential required to cause a lightning discharge is only a small per