Many of us believe that the future happiness of the world rests largely in the hands of scientists, who are the modern magicians and miracle-workers; it is not their fault that others at times pervert to ignoble uses the gifts which science gives us. It is with this in our thoughts that the University offers them its greetings and its welcome to-day."

Outlining the true function of universities, Sir Maurice declared: "I hope too that this year's meeting of the Science Congress will mark the beginning of a reorientation of the attitude of Indian universities towards scientific studies. There has been, I think, too great a pre-occupation with lectures and degrees, to the prejudice of true learning and research. None denies the importance of learning and research; but there is still room for the more complete recognition of the fact that the greatest and most vital function of a university is to increase the bounds of human knowledge, to be a centre of culture in the broadest sense, to be the guardian of fundamental values and to set the standards for its generation.

This is the true idea and conception of a university not only in India but in every land. To achieve it will be made more easy by the new attitude of the authorities here towards the universities and by the munificent grants which by a welcome change in policy they are now beginning to make.

If the assistance thus generously given is not allowed to prejudice the autonomy of the universities, for that is a precious possession which they could never yield up without being false to everything for which they stand, a future lies before us incomparably greater than anything which the universities have known in the past. They will become what they ought to be, homes for original research and for the promotion of learning, wherein a true academic atmosphere in which intrigue and jealousies have no place, men may have freedom to develop all the talents which God has given them, serving faithfully their own generation and handing on the torch undimmed to the generations which come after."

THE THEORY OF THE FISCHER-TROPSCH SYNTHESIS

By M. V. C. SASTRI

IN a contribution[1] to the Discussion on "Hydrocarbon Chemistry", held in 1939 by the Faraday Society, London, Dr. S. R. Craxford of the Fuel Research Station, Greenwich, put forward a theory of the Fischer-Tropsch synthesis, depicting the formation of long chain hydrocarbons in essentially three stages, namely: (1) the formation of a carbide-surface (usually cobalt carbide), (2) the limited reduction of the carbide to form long chains of $-CH_2-$ groups on the surface, and (3) the disruptive reduction of the CH_2 chains with chemisorbed hydrogen atoms to yield hydrocarbons of suitable molecular weights:

(1) $2\,Co + CO + H_2 = Co_2C + H_2O$

(2) $H_2 + Co_2C = 2\,Co + -CH_2-$

(3) $$\begin{array}{l} \downarrow \qquad\qquad\qquad \downarrow \\ \ldots C-CH_2-(CH_2)_x-CH_2-C\ldots + 2H = \\ \qquad\qquad\qquad\qquad\qquad CH_3(CH_2)_x\,CH_3 \end{array}$$

This mechanism has been successful in accounting for most of the phenomena connected with the Fischer-Tropsch synthesis.[1,2] By employing the *ortho-para* hydrogen conversion as a tracer reaction for ascertaining the presence of chemisorbed hydrogen atoms, it was shown that oil formation proceeded only when the surface was almost completely covered by carbide. In the presence of chemisorbed hydrogen, methane was the chief product. Carbide-free surface also facilitated the water-gas-shift reaction

(4) $CO + H_2O = CO_2 + H_2$

which accounts for most of the carbon dioxide formed and is obviously an unnecessary side-reaction.

A plentiful accumulation of carbide-centres on the surface of the catalyst is, therefore, essential for maximum yield of oil and this is actually what happens during the so-called "running in" process, in which the freshly reduced catalyst is given a prolonged preliminary treatment with synthesis gas at below the reaction temperature. The importance of the surface-carbide has received further emphasis in two recent papers of Dr. Craxford published by the Faraday Society. In the first paper,[3] it is demonstrated that as the rate of passing the synthesis gas over the catalyst bed is increased the yield of oil passes through a sharp maximum. Simultaneously, the amount of carbon dioxide formed drops abruptly as the velocity is increased beyond the value required for maximum yield of oil. The explanation given is that at low gas-rates oil-synthesis is nearly completed over the first part of the catalyst bed, leaving the succeeding parts free from carbide and, therefore, able to promote the formation of methane and carbon dioxide. At the optimum gas-rate there is obtained a uniform distribution of carbide centres and the whole of the catalyst is thus actively engaged in oil-formation. At higher gas rates the yield of oil naturally falls off rapidly due to the time of contact with the catalyst surface being too short. With continued use, the catalyst deteriorates, presumably as a result of wax formation and carbon-deposition, so that the surface available for the synthesis and the side reactions alike dwindles continuously. In consequence, the length of the catalyst bed required for good yield of oil becomes greater and greater and the position of the optimum gas-rate shifts in the direction of lower values. This explains why, if the gas-rate is maintained at a steady value below the initial optimum, the yield of oil at first rises to a peak value after a few days' use and then falls off slowly—a result which is quite familiar to experimenters in this field and which is often reported mistakenly as the "rise and fall in the activity of the catalyst". The advantage of conducting the process in stages can also be appreciated in the light of the carbide theory.