

## THE FUTURE OF SCIENCE IN INDIA

[IN a message to the Thirty-fourth Session of the Indian Science Congress, held at Delhi, during the first week of January 1947, Sri. C. Rajagopalachari, Education Minister, Government of India, declared :

"India has in recent times produced eminent men of science, some of whom have found places in the front rank of world scientists. Young men are working in several research institutes in India at problems of first-rate importance. We may be sure that the genius of India will once again find expression in scientific research as it did in ancient times.

In no country in the world did intuition come so near to the discoveries and hypotheses of modern science as the intuition of the philosophers of ancient India. If there is any one centre which we could treat as the earliest starting point from where systematic scientific knowledge spread to all parts of the world, ancient India is entitled to that honour. The amount of astronomical and mathematical knowledge that we find in Sanskrit books is a matter for wonderment. There are some who, instead of tracing the current of knowledge from India through Greece to Arabia and to Europe, would prefer to treat Greece as the source from which India borrowed. Even if this theory should be accepted, it would not be a small achievement for India, for it would mean that the astronomers and mathematicians and men of medicine in India of those days could accept and assimilate such a volume of knowledge from a distant country like Greece. The wave of scientific interest and the application of Indian talent in the progress of

science in the present times are, therefore, in accord with the ancient genius of India.

India's acknowledged political leaders also are scientific in their outlook and approach. Those who know Gandhiji intimately will see in everything that he does an uncompromising scientific attitude. He is impatient with inaccuracy and looseness of thought or inference. Even in what may appear to be unmodern in his activities, the true scientists would find in Gandhiji a brother-searcher of truth, who works with such tools as he has in strict accordance with scientific method.

The same is the case with Pandit Jawaharlal Nehru. It is not merely his position in Government that qualifies him to preside over the Delhi Session of the Indian Science Congress. His heart and his intellect throb in resonance with modern science. His taking the chair at the Science Congress and laying the Foundation-Stone of the National Physical Laboratory will give increased stimulus to original scientific research in India concurrent with political rebirth. It will be a source of inspiration and strength to all the young men in the universities who are devoting their talents to scientific studies.

Science, art and culture are not less important than politics. As long as a foreign Power had imposed its rule on us, and a struggle had to be carried on, politics had an inflated value. With freedom, things assume their real proportions. Henceforth politics will not be an obsession dominating and corrupting everything. Science as well as art and culture will be more important than Government or the controversies of politics."

## SCIENCE AND INTERNATIONAL CONCORD

WELCOMING the Delegates to the 34th Session of the Indian Science Congress at Delhi, Sir Maurice Gwyer, Vice-Chancellor of the Delhi University and Chairman of the Reception Committee, said :—

"Your visit this year takes place in more than usually auspicious circumstances ; first, because this is a moment of great importance in the history of India, when the eyes of the whole country are turned towards Delhi ; and secondly, because among those who are joining in our discussions is an exceptionally distinguished body of scientists from other lands ; and for these two reasons alone the present session of the Science Congress will always be regarded as a historic event.

I am told that never before have scientists from so many foreign countries met together on the soil of India. They have come from the United Kingdom and the United States, from Canada, from Russia, from France, from China, and from Australia. This is itself a very noteworthy thing, and we in Delhi, appreciate the compliment which it implies. But above all, it is the greatest proof which could be given of the essential unity of science and of the common ground on which men of science, no matter what their race or nationality, are able to meet.

That there is a sphere in which such a common ground exists is no small thing at the present day, and we may all be grateful to the scientists for affording us so inspiring an example of international concord and co-operation. It is a happy augury that it comes to soon after the U.N.E.S.C.O. meeting in Paris, at which the delegates from India, some of whom are here to-day, took so prominent and effective a part.

We have seen in Delhi this week three gatherings of learned men, we have welcomed a Congress of Philosophers, a Congress of those engaged in the study of politics, and to-day we welcome the Science Congress, which embraces them all. All these gatherings, have for their object the pursuit of truth in one form or another ; and it might be hard to say which body finds its material the most intractable. Some might say that in the case of the science of politics truth lies at the bottom of a deeper well ; but the students of that subject do not regard this fact as presenting any insuperable obstacle to their researches. And it has been an inspiring spectacle to see gatherings of so many men searching for truth in all its many-sided aspects, not for gain or glory, but because truth is to them the most important thing in all the world.



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."

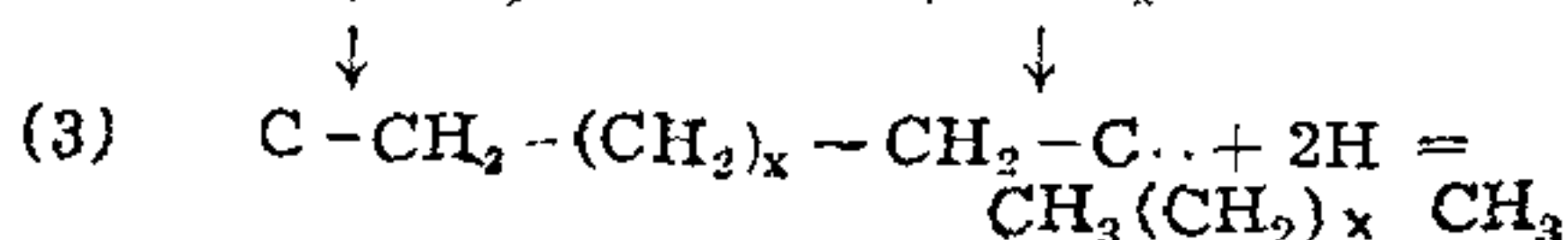
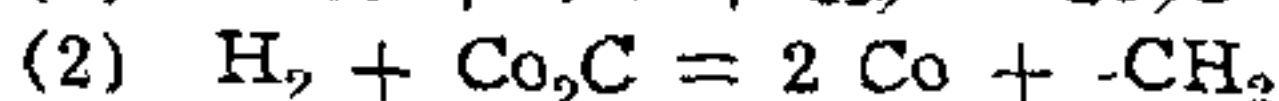
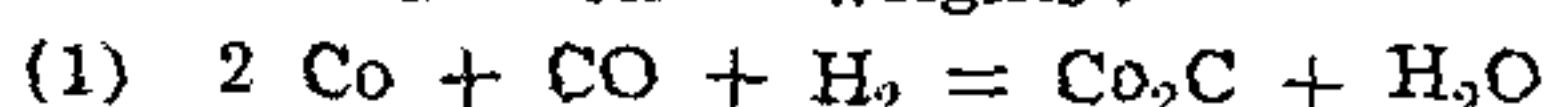
This is the true idea and conception of a university not only in India but in every land. To achieve it will be made more easy by the new attitude of the authorities here towards the universities and by the munificent grants which by a welcome change in policy they are now beginning to make.

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<sup>1</sup> 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:



This mechanism has been successful in accounting for most of the phenomena connected with the Fischer-Tropsch synthesis.<sup>1,2</sup> 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



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 prelimi-

nary 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,<sup>3</sup> 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.