THE ECONOMIC ASPECTS OF STATE GEOLOGICAL SURVEYS*

BY

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THE old fashion belief that a State Geological Survey was more ornamental and academic than practical and useful has, I think, nearly disappeared as a result of the work carried out by the Russian Geological Survey under the drive for industrialisation by the Soviet Government. In the Union of Socialistic Soviet Republics, scientific training and equipment has not been spared in the continent wide search, exploration and exploitation of ore deposits and mineral occurrences for materials for the metallurgical and other industries in Russia. However, elsewhere in Europe and in America there remains a considerable difference of opinion as to whether a Geological Survey should extend its operations into the sphere of experimental investigation to demonstrate, on a semi-commercial scale, processes for the treatment and the preparations of ores and minerals.

In the case of the Russian Geological Survey, the work covers the entire field from routine mapping, care of the museums and educational details for training personnel to prospecting and development operations, to advisory appointments, for problems of engineering geology, metallurgical matters, questions of oil research, geophysical investigations and experimental work. In the United Kingdom, the Geological Survey of Great Britain has less to do with practical mineral development, but specialises in field mapping, questions of water-supply and in exhibiting beautiful mineral and similar collections. Similarly, the Mines Department in Great Britain is almost entirely used for the administration of the Mining Rules for effecting safety in working the mines.

The Department of Mines in Canada contains two branches—(*a*) the Geological Survey branch based on the English pattern, and (*b*) the Bureau of Mines branch which is essentially an experimental research organisation. In the case of the United States of America where they have two separate organisations—(*a*) the Geological Survey and (*b*) the Bureau of Mines, both on an even far more elaborate plan than their equivalent organisations in Canada—(*a*) and (*b*) are controlled from two different Departments of the United States Government. The Geological Survey of the U.S.A. has a special Hydrographic Branch and also include the Topographic Survey in addition to its work on mineral surveys and museum collections.

The Geological Survey of India has its nearest counterpart in the Russian Geological Survey, which existed before the Soviet Government assumed control and expanded its activities to include all the work which is conducted by the Canadian Department of Mines, and much more besides. From its initiation in 1846, the Geological Survey of India has operated for the purpose of developing the mineral resources of this country, and has operated mines as well as conducted investigations on minerals, ores and related substances with a view to their utilisation. Previous to 1902, mining and metallurgical specialists were recruited for the Geological Survey of India to enable this Department to carry out its operations in field geology as well as in mineral developments.

In 1902, the mining and metallurgical specialists of the Geological Survey of India were utilised to be a nucleus to the newly formed Bureau of Mines Inspection, which is the Indian Mines Department and based on the English model chiefly as an Inspectorate. The Geological Survey of India was thus robbed of the mining engineers and metallurgists who provided the experts for actual mineral development after the exploratory surveys had located the minerals of economic value. Although the loss of this mining personnel was painfully evident when the Indian Munitions Board came into being in 1917, this defect in the cadre of the Department was not remedied, when a post-war re-organisation was carried out in 1922. Indeed the Geological Survey of India was almost brought into line with its opposite number in Great Britain.

The two steps, that of creating the Mines

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Department in 1902 on the English model, and that of not introducing a true Bureau of Mines on the Canadian pattern when the re-organisation was made in 1922, reduced the Geological Survey of India from an organisation for mineral development as its objective to a department whose chief objective was to complete the geological map of India. This was equivalent to having an architect to prepare drawings of a new building or a new city, without having the plans and estimate passed and engineers engaged for the actual constructional work. Some effort was, however, made to help in mineral development, but the Geological Survey was not staffed nor properly equipped for any serious work of this kind and when mineral development became a Provincial subject in 1937, no corresponding field parties were formed for special assistance to the local Governments.

With the threat of war in Europe quite evident in 1938, and the lack of a technological organisation on the lines of the Canadian Bureau of Mines keenly felt, an effort was made to at least restore the Geological Survey of India to the position it held previous to 1902. This was partly effected in 1939 and 1940, and improved somewhat in 1941, when the sulphur operations at Sanni and in Koh-i-Sultan were initiated and other explorations were undertaken in Madras and elsewhere. The establishment of an Utilisation Branch of the Geological Survey of India in 1942, however, completely restored the position of the Department, and permitted operations to be undertaken with specially recruited mining engineers and metallurgists. The chief exploration in progress is that of re-opening one abandoned lead-zinc ore mines at Zawar, Udaipur, Rajputana.

It is necessary to point out at this stage that no provision has yet been made for an experimental or demonstrational, technical organisation which might be the equivalent of the Bureau of Mines in Canada or that in the U.S.A. It is quite erroneous to consider the Utilisation Branch of the Geological Survey of India as in anyway the initiation of an organisation even resembling the Canadian Bureau of Mines. In its present form the Utilisation Branch is simply an expansion of our prospecting operations, so that we are proving the sulphur deposits in Baluchistan, exploring the lead-zinc ore lodes in Udaipur, operating some mica mines in Monghyr, encouraging the search for rare minerals and endeavouring to procure wolfram from discouragingly small occurrences. A start has also been made to examine certain old tin and copper mines.

Except for beginning a geophysical investigation of a manganese ore deposit and continuing this kind of exploration to the mica-bearing pegmatites, there has been no organised experimental research. Personal efforts have been made for refining the Baluchistan sulphur rock, but this is now regarded as outside the scope of the Utilization Branch. I have conducted a research on the electrical properties of the muscovite micas of Bihar and Madras, and continuing these investigations in examining the sparking plugs and electrical condensers, using mica, in our aircraft. In the past few months we have also experimented with the preparation of tungsten trioxide from wolfram, the conversion of non-caking into coking coals, the production of smoke haze screens, the use of various coloured earths and ochres for camouflage, etc. However, all these are individual rather than departmental researches.

I think it can be safely said that the activities of the Utilisation Branch are more closely connected with the normal operations of an energetic Geological Survey than those which might be expected from an established Bureau of Mines. It would, in my opinion, be a folly as great as that of 1902, if the working of the present Utilisation Branch was separated from the Geological Survey. There is no doubt that mining operations should be conducted by qualified mining engineers, just as drilling for oil should be carried out by the most skilled drillers. This does not separate oil-drilling from oil-geologists. I think every oil company of any importance recognises that their success depends on the guidance of their geologists. To believe anything different in the case of ore or mineral explorations is to court trouble to say nothing of unnecessary expense.

I am the first to admit quite frankly that there is an immediate need for an organisation like the Canadian Bureau of Mines in India, but it will be prudent to establish it as a new institution and later make adjustments between this Minerals Research Branch and the Utilisation Branch of the Geological Survey. I agree also that the Minerals Research Branch of the Bureau of

Mines can be quite separate from the Geological Survey, but this is not true of the Utilisation Branch as it is at present. It is actually a part of the Geological Survey and no adjustment can be made until a properly planned Bureau of Mines or Minerals Research Branch is operated. The geologist may take a back-seat when a mining engineer drives, but the driver will often require guidance and even instructions from the back-seat geologist. The responsibility always lies with the geologist, while praise usually goes to the engineer.

It is of interest to know that the number of geologists on the staff of the Burma Oil Company in Burma was about three times that of the Burma Geological Department. There were reported to be no less than 6,000 geologists in the employ of the Soviet Government in 1937, indeed the number was given to me as roughly 10,000 geologists. On a comparative estimate the Geological Survey of India should have about 600 geologists but even on the basis of one geological officer to every district in India, the number is roughly 300 as against about 60 at present employed, many of whom are on a temporary understanding. It is difficult to convince the Government of India that even 150 official geologists are actually necessary for a thorough search of India for minerals which are now regarded as of economic importance. If, however, sanction was accorded for this number of suitably qualified geologists, it would be practically impossible to procure them in India.

There is already difficulty in recruiting Indian geologists who have experience enough and the requisite qualifications to undertake responsible work. Indeed we have had to resort to the expedient of employing post-graduate scholars, fresh from various colleges, etc., as Geological Assistants on a nominal salary and give them field training and experience under special officers. The problem of future recruits is so serious that I recommend it should be taken up with the various centres where geology is taught in India in order that some arrangement is made with the advice of the Geological Survey of India for meeting the demand which already exists. As a further measure of prudence, I would advise the employment of at least 12 experienced European geologists, who are in India as evacuees, on the Geological Survey in order that young Indian geologists may work under their guidance. This is because we are so short handed.

In conclusion it may help to an understanding of the position if I show that since 1846 there have been about 120 geologists on the staff of the Geological Survey of India and that the average field service of these men has been about ten years, while the annual work done by each geologist in mapping is roughly 500 square miles. This means that an area of about 600,000 square miles should have been surveyed in fair detail in India and Burma in the past ninety-seven years, or about one-third the total area involved. Although there are extensive areas of alluvium, there are also areas in which the geology is very complex, so that an average of 500 square miles is not to be misunderstood. It is a question therefore whether it is not better to search the country quickly and thoroughly by employing a larger staff or simply going on in our present rather old fashion way.

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SCIENTIFIC DISCOVERY

IF there is one fact which stands out more than any other in the history of science, it is the remarkable extent to which great discoveries and youthful genius stand associated together. Scores of instances can be quoted in support of this proposition. The fact of the matter appears to be that, other things being the same, the principal requisite for success in scientific research is not the maturity of knowledge associated with age and experience, but the freshness of outlook which is the natural attribute of youth. The conservatism which develops with increasing age is thus revealed as a factor which militates against great achievements in the field of science. The principal function of the older generation of scientific men is to discover talent and genius in the younger generation and to provide ample opportunities for its free expression and expansion.—From a broadcast by SIR C. V. RAMAN. (Courtesy of *Indian Listener*.)