

A SURVEY IN LATIN AMERICA

An eight-member mission of the International Atomic Energy Agency visited Brazil and Venezuela last summer to survey their atomic energy needs and the conditions that may have a bearing on the fulfilment of these needs.* The head of the mission and two members also visited Argentina to make a study in a more restricted sphere. While the mission's work in Brazil and Venezuela covered all aspects of atomic energy development, the investigations in Argentina were concerned specifically with the exploration, mining and processing of nuclear raw materials.

The members of the mission held extensive discussions with the national authorities in charge of atomic energy development who acquainted them with their plans and the progress of work already undertaken. The IAEA experts also visited different centres of work to gain a first-hand knowledge of conditions and needs. They were thus able to advise the national authorities on lines of further development and assist them in formulating requests for technical assistance from the Agency. The information contained in the mission's reports may serve as a broad guide to the present state and future needs of atomic energy development in the three countries.

Raw Materials

One of the important subjects studied by the mission was the availability of nuclear raw materials and plans for their exploitation. As already indicated, the mission's work in Argentina was concerned primarily with this problem.

After six years of prospecting for raw materials and three years of pilot plant experience, Argentina is contemplating the construction of a large uranium ore-processing plant. However, her reserves and resources are not known with sufficient accuracy, and detailed surface investigations and mining explorations are therefore required. Work has already been undertaken for the production of uranium concentrate and metal. Uranium concentrate is produced at two

plants at Malargüe in Mendoza Province and at Córdoba in Córdoba Province, the combined capacity of which is of the order of 15 to 20 tons uranium oxide per annum. The concentrate from both plants is further refined at the Córdoba plant to uranyl nitrate and the nitrate is shipped to Ezeiza near Buenos Aires where it is refined to nuclear grade uranium metal. The capacity of the plant at Ezeiza is approximately eight tons of uranium metal per annum.

The discoveries of uranium already made and the proposed intensification of the prospecting programme make it likely that the Argentine Atomic Energy Commission will soon be called upon to start the design of a large-scale uranium extraction plant. In view of the specialized work that will be needed in this connexion, the mission has suggested that training fellowships of the Agency should be awarded to a metallurgist or chemical engineer and to a mechanical engineer so that they may later be able to supervise the design, construction and operation of a plant.

In Brazil, work in the field of raw materials is concentrated mainly on the production of thorium. Beach sands containing monazite are concentrated at two plants and approximately 100 tons per month of monazite concentrate is shipped to São Paulo where it is processed into thorium sulphate, rare-earth chlorides and sodium diuranate, which are then stockpiled. There is considerable interest in uranium production also, and at Orquima some uranium is obtained out of monazite. It is also proposed to build a plant at Pocos de Caldas to extract uranium from uraniferous zirconium ores. Investigations on isotope separation by means of centrifugation are conducted at the Technological Research Institute at São Paulo.

The IAEA mission felt that Brazil needed an expansion of its geological services with larger expert assistance in specialized aerial surveys for a better approach to a comprehensive prospecting programme. To direct and co-ordinate all activities in this field it would also be desirable for the National Nuclear Energy Commission to have on its staff a consulting engineer and a highly qualified metallurgist. There are several schools in the country offering training in metallurgical engineering, but the emphasis is on physical and pyrometallurgy. As the raw materials programme develops, there will be an increasing need for training in mineral dressing and extraction metallurgy. The Agency, the mission thought, could be of immediate help by offering fellowships to staff already engaged on the programme. In the future, it might also be able to help in expanding the programme of instruction in metallurgy and in obtaining the necessary foreign experts for the Commission's staff.

* The mission was led by Edward R. Trapnell, who was until recently Special Assistant to the IAEA Director General and has had long experience in atomic energy work in the United States. Four members of the mission, made available by Member Governments, were: André Gerstner, an experienced geologist and acting Chief of the Research Division of Vendée of the French Atomic Energy Commission's Mining and Research Department; Rudolf Höfer, expert on the medical uses of radioisotopes and head of the Radioisotope Laboratory of the Second Medical University Clinic, Vienna; D.G. Maxwell, expert on raw materials processing, consultant metallurgist to the General Mining and Finance Corporation of Johannesburg, South Africa; and Nathan Hall, specialist in the application of radioisotopes in agriculture and Director, Agricultural Research Laboratory, University of Tennessee, Oak Ridge, USA. The other three members of the mission, Joaquín Catalá, Subhas K. Dhar and Vladimir Shmelev, were from the IAEA Secretariat.



Members of the IAEA mission with Admiral Octacilio Cunha (in the centre in dark coat), President of Brazil's Nuclear Energy Commission, in the latter's office in Rio de Janeiro

In Venezuela, the Ministry of Mines and Liquid Fuels has initiated a prospecting programme and decided to assign a team of geologists to the task of starting a comprehensive survey of the Merida area of the Andes and, through aeromagnetic prospection, to test the northern boundary of the Guiana Shield.

Radioisotopes

In both Brazil and Venezuela, the mission examined the possibilities of various applications of radioisotopes. In Brazil, radioisotopes are being used in the agronomic and biochemical research programme of the School of Agriculture in São Paulo. This programme has been in operation since 1954 and two courses in the use of isotopes in agriculture were held at this school in 1955 and 1958 while a third is contemplated for 1961. The agricultural institute at Campinas has also initiated a course on radioisotopes. The Rural University of Rio de Janeiro is planning to establish a small centre for the use of isotopes in agriculture.

So far as the medical applications are concerned, there are already two excellent yearly courses, held in the Biophysics Institute at Rio de Janeiro and in the Nuclear Medical Centre at São Paulo. Apart from a considerable number of small laboratories for the routine, diagnostic and therapeutic applications of radioisotopes in medicine, larger well-equipped research units exist in Rio de Janeiro, São Paulo and Porto Alegre. As these research units are still increasing in number and size, a great many training fellowships as well as highly specialized experts will be required. In view of certain difficulties encountered in the import of radioisotopes, the mission considered it important to encourage and assist Brazil in the production of radioisotopes at the research reactor in São Paulo.

At the Institute of Scientific Investigations in Venezuela, radioisotopes are being used in a small project which has long-range agricultural implications. The IAEA mission, however, recommended

that favourable consideration should be given to any request for assistance in introducing the use of radioisotopes in the teaching programme.

Venezuela has excellent laboratories for the medical use of radioisotopes. It will be necessary in the near future to import a certain number of foreign scientists to staff the existing institutions. The Agency, the mission felt, could give immediate assistance by sending experts to help in building up research programmes and to train Venezuelans to carry on the work. Only a few fellowships will be required by Venezuela for the time being, but the number will gradually increase.

The Brazilian authorities are in the process of elaborating regulations concerning the use of radioisotopes, and the mission was of the view that great care should be taken to include every form of ionizing irradiation in these regulations. It also considered it advisable to create a centralized film badge service in the country. No radiation protection regulations exist in Venezuela at present, but it is proposed to establish them with advice and assistance from the Agency. These regulations, the mission thought, should include the setting up of a radiation protection service.

Power Situation

The power situation in Brazil since the end of World War II and especially since 1949 has been characterized by an excess of demand over supply. At present, this excess is estimated at 30-40 per cent of actual consumption. During the past decade the electricity generating capacity has grown at an average rate of 9 per cent per annum. It is estimated that a growth rate of at least 10 per cent will be necessary in the next decade to meet future needs as well as to satisfy the backlog of accumulated demand.

In 1958 the total installed capacity was 3.9 million kW, 85 per cent of which was hydro-electric. In addition, an estimated total of 1.2 million kW was scattered throughout the country in small thermal, diesel or gasoline-fuelled units. Approximately 77 per cent of the 3.9 million kW of installed capacity is located in the central-southern region, and it is mainly in this region, which is economically the most advanced, that there is a shortage of power. Efforts are being made to expand the supply of this region by installing large plants and inter-connecting the existing system. The present total of 3 million kW in this region is to be raised to 6.4 million kW by 1966, corresponding to an average growth rate of 10 per cent per annum.

It is expected, however, that by the middle of the 1960's the economically exploitable hydro-electric potential in the central-southern region will be considerably reduced. It is unlikely that the indigenous coal supply and the domestic production of crude oil will be able to contribute to the expansion of electric power. Imported fuel may therefore play a major part in the development of additional thermal capacity needed after 1965. A programme of nuclear power development, wherever conditions are favourable

may thus have a place in the rapidly expanding economy of Brazil.

As for Venezuela, the mission was of the opinion that there was no pressing need for nuclear power in the foreseeable future because of the abundance of conventional fuels and hydro resources and their even distribution, nor did there appear to be any specific situation in the country yet where nuclear power could be competitive with conventional power.

Venezuela possesses large resources of oil and gas as well as hydro power. At present, more than 95 per cent of the oil produced in the country is exported and about 10 per cent of gas is commercially used. Hydro resources, yet largely unexploited, account for less than 3 per cent of the nation's power supply. Conventional fuels and hydro resources are distributed throughout the country in a manner which makes it fairly easy to provide power to the consumption centres without the necessity of fuel transportation over long distances or construction of long transmission lines.

Power production and consumption are at present concentrated mainly in three industrial areas in the northern part of Venezuela. In 1958 the total installed capacity of steam, diesel, hydro and gas turbines was about 1 135 MW. The largest size of the power units is at present 40 MW, but there are plans to install 60 MW units in 1963 and 100 MW units in 1964 and thereafter. There is also a long-term project for a large expansion of power supply in the eastern region of Delta Amacuro Federal Territory and Bolivar State.

Reactor Programmes

In Brazil, a research reactor at the Institute of Atomic Energy, São Paulo, went critical in September 1957. This is a swimming-pool type reactor, moderated and cooled by light water, with an installed thermal capacity of 5 000 kW. It utilizes fuel elements of 20 per cent enriched uranium and has an initial load of 6 kg of U-235. The reactor is equipped with several experimental facilities and is designed to provide research and training opportunities and produce radioisotopes.

In addition, there are plans for three more nuclear installations, namely, (a) a "Triga" type research reactor, with a thermal capacity of 30 kW, which is being installed in the Radioactive Research Institute of the University of Minas Gerais in Belo Horizonte, (b) a sub-critical assembly, to be installed in the Technical Aeronautics Institute of São José dos Campos and to be used exclusively for education and training purposes, and (c) an "Argonaut" type reactor to be installed in the University of Brazil at Rio de Janeiro.

At the time of the mission's visit to Venezuela, a research reactor was under construction at the Institute of Scientific Investigations, and it was expected to reach criticality at the end of 1959 or at the beginning of 1960. The reactor, moderated by light water and fuelled by 20 per cent enriched uranium aluminium alloy, will be used for research, training

and the production of radioisotopes. During the first year, it will operate at small power level for reactor experiments and the training of operational and research personnel.

Although the mission's work in Argentina was concerned mainly with nuclear raw materials, it had an opportunity also to discuss certain general aspects of the country's atomic energy programme. The mission noted that Argentina had obtained financial resources from the United Nations Special Fund for an overall power survey in the country to be directed by the World Bank. It found that the most serious problem in the country was the lack of equipment and difficulties in procuring it from outside. This is particularly regrettable because the country has many competent scientists. The Argentine Atomic Energy Commission has, however, done a remarkable job of providing itself with some basic tools, an outstanding example of which is the construction of an Argonaut type reactor, including the fabrication of the fuel elements.

Training of Personnel

In both Brazil and Venezuela, the mission paid considerable attention to the needs for training in nuclear science and technology and the facilities available for that purpose.

Brazil has a large number of institutes and centres of research where both scientific personnel and equipment are excellent and research is of the highest quality. The mission thought the Agency's programme of assistance to Brazil should include the services of several visiting professors on such subjects as nuclear metallurgy, radiochemistry and radioisotope applications. Brazil can also utilize a large number of fellowships in the next four to five years, both in basic and in applied nuclear science and technology.

In Venezuela, technical education is geared, by and large, to the need for supplying skilled manpower for industry. There are excellent engineers and physicians, but they are generally engaged in private or governmental work rather than in research. The main difficulty is the scarcity of scientific manpower. The Faculty of Science in the Central University of Venezuela, Caracas, is slowly bringing about an improvement in the existing conditions, creating a general interest in basic scientific education and preparing students to devote themselves to pure and applied science. The new School of Physics and Mathematics at Caracas University would play an important role in this respect. The Agency could help by sending experts in several fields where the need was most urgent, such as radiochemistry.

The leading research centre in Venezuela is the Institute of Scientific Investigations. The reactor that is being installed near its main laboratories can easily keep 200 scientists and technicians busy. It greatly increases the Institute's scope and possibilities of research, as also its problems because of the shortage of trained personnel.