Yugoslavia's total installed capacity at the end of 1958 was 1 860 MW, comprising 1 060 MW hydro and 800 MW thermal power. The per capita annual consumption was 404 kWh. The net hydro potential exceeds 60 thousand million kWh per annum, of which about 8 per cent has been developed so far. The coal reserves consist of 20 thousand million tons of lignite, two thousand million tons of brown coal, and 100 million tons of hard coal. The electrical power industry has grown very rapidly during the post-war period. Possessing extensive conventional resources, the country is not planning to use atomic power on a commercial scale before 1975-80. An experimental nuclear power plant is envisaged for 1970.

RADIOACTIVITY AROUND US

The growth of atomic energy has been accompanied by an understandably widespread concern over the hazards of atomic radiation. Indeed, fears have sometimes been expressed that even the development of peaceful applications may harm man's health and heredity to an extent that is incalculable at the present stage, and nothing is more potent than the dread of the unknown.

While a great deal is still unknown, enough, however, is already known to indicate that the hazards involved in the peaceful pursuit of the atom have often been exaggerated. The nature of the possible dangers is essentially clear, and if their extent and what can be called their modes of operation and specific effects are still matters of some expert disagreement and much popular conjecture, one can assert that the hazards are not such as cannot be controlled.

That the hazards exist is not denied; nor is it claimed that they can be eliminated altogether. All atomic fuel is radioactive, and the very use of this fuel creates more radioactive material. And since ionizing radiation is potentially dangerous, the production of these new radioactive substances increases the sources of radiation to which people may be exposed, and consequently the harm that may be caused.

No human ingenuity can wipe out this radiation. But what human skill and organization can perform is to eliminate as far as possible the chances of exposure and hence the possibility of harm. Of this one can be reasonably certain: that the employment of atomic energy to promote man's peaceful progress need not be attended by an impairment of his health or genetic future, that it is possible to devise and adopt adequate measures of safety.

This task has two broad aspects: to ensure that people engaged in atomic energy activities are not exposed to excessive radiation in the course of their work and to protect the world's population in general from the radiations given off by the radioactive material produced by the atomic energy industry. The first requirement has to be met by the adoption of protective measures in all atomic energy establishments and laboratories where radioactive materials are used, and an important part of the Agency's work is devoted to the formulation of these measures. Perhaps more important - at least from the public point of view - is the work to ensure the safety of people in general. And the basic aim in that respect is to see to it that the development of atomic energy applications does not lead to an increase in the levels of radiation in man's immediate environment.

It must not be forgotten that all of us are inescapably subjected to some amount of radiation from our natural background, the chief sources being the radioactive elements on the earth's surface (e.g. uranium and thorium and their daughter products), cosmic rays and substances like radiopotassium and radiocarbon present in the body. Man has always lived with this radiation and seems to have adjusted himself to its effects. Release of new radioactive material in the environment as a result of the peaceful applications of atomic energy would certainly add to this background radiation, and it is generally believed that a substantial increase in the levels of general radiation may upset the delicate balance between man and his environment. The precise extent of the increase that is likely to be harmful may still be debatable, but the aim must be to keep it well below the threshold of danger.

To achieve this aim, the main effort has to be directed towards preventing the newly created radioactive material from getting into man's environment and increasing the levels of radiation. Essentially, this is a problem of safe disposal of radioactive wastes, a problem with which the Agency is actively concerned. Aspects of it were discussed in detail at a conference in Monaco last November, and the exchange of ideas and information that took place there is being followed up with intensive research on methods of disposal which are both adequate and safe.

Contamination of Environment

Despite all safety precautions, however, a certain amount of radioactive material is likely to be released into our environment. That itself need not be a cause for concern because if the precautions are adequate the nature and amount of the radioactive material that

will be added to the environment as a result of peaceful atomic energy work will not be such as to constitute any significant health hazard. A test of the adequacy of safety measures, therefore, is the extent of the radioactive contamination of man's environment. If the amount of man-made radioactivity in the environment is large enough to pose any threat to man's health or heredity, appropriate measures must be taken to reduce the extent of contamination and keep it within safe limits.

An important task, therefore, is to keep a continuous watch on the levels of environmental radioactivity, and it is a task in which the Agency has a special interest. Several Member Governments have expressed concern over this problem and asked the Agency how it could assist them in the measurement of radioactivity in the biosphere, i.e., air, water, soil and food. The problem has also engaged the attention of the United Nations, particularly of its Scientific Committee on the Effects of Atomic Radiation. The General Assembly of the United Nations, after considering a report of the Committee last November, unanimously adopted a resolution calling for the widest possible co-operation in establishing a programme of research and analysis in this connexion. The resolution contained several references to the Agency's possible contribution to this programme and to possible co-operation between the Agency and the Radiation Committee.

The Radiation Committee is concerned with the entire problem of radioactive contamination, a large part of which is due to radioactive fall-out as a result of the testing of nuclear weapons. The Agency is concerned specifically with the peaceful applications of nuclear energy and the radiation hazards involved in these applications. It would, however, be obvious that in studying the problem of environmental radioactivity it is hardly possible in most cases to isolate the effects of the peaceful uses from those of the military applications. There is no means of determining with absolute certainty whether the presence of some radioactive material in a particular sample is due to fall-out or to the release of radioactive waste from a nuclear installation. But whatever the source of contamination, the measurements of environmental radioactivity and their evaluation would be of supreme importance in ensuring human safety in the atomic age.

A good deal of work has already been done or initiated, but most of it has been undertaken specifically in connexion with fall-out problems or occupational health hazards in nuclear installations and surrounding areas. The hazards that may affect whole populations as a result of the release of radioactive waste from reactors or from fuel processing installations deserve equally close attention and may, in fact, call for somewhat different methods for sample collection and analysis to determine trace amounts of radioactive substances in the biosphere.

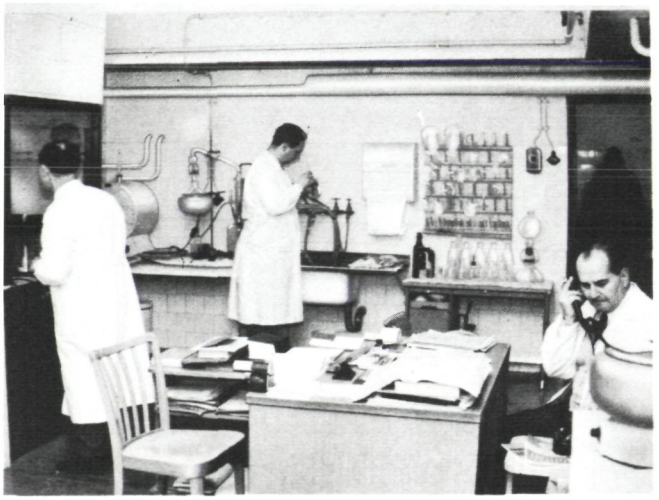
Experts' Recommendations

This was clearly recognized by an international panel of experts convened by the Agency last September. The panel, which was composed of prominent experts from Argentina, Australia, Canada, France, Germany, Japan, Sweden, the United Kingdom and the USA, unanimously recommended that the Agency should set up adequate facilities for the collection and analysis of samples to determine the extent of environmental contamination due to the peaceful uses of atomic energy, and the facilities should be available not only for the measurement of samples submitted by Member States but also for the training of scientists and technicians in order to enable them to set up and operate similar facilities in their own countries. The panel made detailed recommendations on the types of operations which the Agency should carry out. It also suggested that the Agency should undertake the development, construction and operation of equipment for measuring the levels of contamination to be expected after any accidental and potentially hazardous release of radioactive substances in the course of peaceful atomic activities, and that such equipment and the associated staff should be made available to Member States in the event of any nuclear accident.

The experts pointed out that any system that the Agency might establish for the measurement of radioactivity in the biosphere should be able to meet two basic demands. In the first place, it should be able to detect sudden releases of radioactive material quickly enough to enable the adoption of appropriate steps, and secondly it should be able to keep a continuous watch on the levels of hazardous radioisotopes in the biosphere built up by small periodic releases. In the case of accidental releases, the measurements must be carried out in those parts of the biosphere which are likely to be immediately contaminated, viz. air and surface water. For routine measurements of radiation levels, an important field of investigation would be the food chain which is one of the main channels of contamination of the human body. Again, analysis of soil samples would be useful in indicating the accumulated contamination at any particular time.

The panel emphasized the importance of establishing standard procedures for sampling, analysis and measurement. In the case of samples containing extremely small amounts of radioactive substances, special precautions would be necessary in regard to the location of the laboratory as well as the measurement procedures. For example, measurements of samples with low levels of radioactivity should be made at places which are away from obvious radiation sources.

The recommendations of the panel have been carefully examined by the Agency in the light of its scientific resources and its statutory functions. The urgency of the tasks envisaged by the panel and the Agency's role in fulfilling them have been widely recognized. Apart from enquiries from the Agency's Member



Analysis of radiostrontium contamination of milk and vegetable ashes being made in the laboratory housed at IAEA headquarters in Vienna

States, the United Nations General Assembly resolution, referred to earlier, specifically invited the Agency, as well as FAO and the World Health Organization, to consider and inform the Radiation Committee of "what assistance they might give" in connexion with the analysis of samples.

Agency Programme

It is against this background that the Agency is going to engage itself with a programme for the study of environmental radioactivity. One of the main objectives of this programme in the initial stages is to establish standard methods of sampling, analysis and measurement. The methods employed at present are not uniform, and the need for universally accepted standards is particularly important in this work, both for equipment and the techniques employed. The Agency's laboratory, now being built at Seibersdorf near Vienna, will be specifically equipped for standardization work, such as the calibration of monitoring and dosimetry equipment and the establishment of international standards in measurement techniques.

Another important feature of the programme will be the training of a limited number of scientists from Member States in the relevant techniques. Many countries are interested in establishing their own programmes of environmental radioactivity measurements but few of them at present possess the necessary expertise or equipment. Training of scientists, particularly from the less developed countries, would help in the development of a world-wide system for the collection, analysis and measurement of radioactive samples. If requested, the Agency may also provide some equipment and experts to interested Member Governments for the planning and establishment of their national programmes. The possibility can also be foreseen of immediate Agency assistance in detecting or measuring radioactive contamination due to a nuclear accident. In addition, the Agency itself will undertake the analysis and measurement of samples submitted by Member States. This will be done at its laboratory by qualified scientists representing the expert knowledge and skill of different countries.

The data collected from this work will be communicated to the United Nations Radiation Committee and will, it is expected, be of substantial use in the Committee's evaluation of the extent and effects of environmental radioactivity. The Committee is interested in obtaining the fullest possible data on radiation levels, measurement methods, fundamental radiation biology and the somatic and genetic effects of ionizing radiation. The Agency's programme of work will yield valuable data on the levels of radiation as well as on the methods and standards of measurement. As for the biological effects of radiation, useful information will be obtained from some of the research projects sponsored by the Agency. In fact, the Agency's research programme (a separate article on which is included in this issue) covers the whole field of radiation protection and will constitute an important operational adjunct to the studies being conducted by the Radiation Committee of the United Nations.

(continued from page 5)

Mr. Cole added: "As spokesman for the Agency I want to emphasize our genuine gratitude to Mr. Nakićenović, his Government and the Boris Kidric Institute for their sympathetic consideration of this delicate matter, for their co-operation in making it possible and for their sharing of our expectation that many lessons of great value in the treatment of persons unexpectedly exposed to severe doses of radiation may be learnt."
