WORK OF THE IAEA LABORATORY

Most of the IAEA laboratory facilities are now in full operation, and work has begun on a number of problems that can best be dealt with by an international centre. The laboratory at Seibersdorf, about 30 km from the Agency's headquarters in Vienna, started functioning in October last year, and a certain amount of work is also being done with a few facilities installed in the headquarters building. During the past year laboratory work has steadily increased and several programmes are now fully established.

The Agency's laboratory is not intended to be a centre of independent research; in the main, its scope is governed by the scientific requirements of the Agency's programmes of assistance to its Member States and its role in connection with safety and security in atomic energy work. The functions of the laboratory are thus limited to (a) measurement of radionuclides and preparation of radioactive standards, (b) calibration and adaptation of measuring equipment, (c) quality control of special materials for nuclear technology, (d) measurement and analyses in connection with the Agency's safeguards and health and safety programme, and (e) services to Member States that can be provided with the facilities established for these tasks.

Measurement and Standardization

A service for the distribution of calibrated samples of radionuclides, to be used for testing and calibrating measuring instruments, was started in January this year. Under this year's programme, samples of 12 beta and gamma emitting radionuclides are being distributed. Seventy laboratories in 31 Member States have ordered a total of about 750 samples, and the supply of the samples is being conducted according to the following schedule:

Month	Name of Radionuclide	Number of samples
January	phosphorus-32	31
February	iodine-131	46
March	gold-198	22
April	cerium-144	48
May	sodium-22	79
June	cobalt-60	106
July	strontium-90	106
	phosphorus-32	8
August	strontium-89	53
	iodine-131	9
September	iron-59	33
October	sulphur-35	45
November	barium-140	22
December	caesium-137	131

The distribution has so far proceeded strictly on schedule, and out of the total of 739 samples ordered, more than 500 have already been supplied.

Measurements of radionuclides are being carried out in the laboratory by various means, including 4-pi proportional counters, a beta-gamma coincidence arrangement, a gamma-gamma coincidence arrangement, a calibrated 4-pi ionization chamber, and an automatic micro-calorimetric system. Apparatus for the measurement of radionuclides in gaseous form and of alpha emitters will also be installed in the laboratory.

Two absorbed dose calorimeters have been constructed. These instruments will permit the standardization of absorbed dose measurements for external beams of gamma-, high energy electron-, high energy X-, and neutron radiations. The instruments form the nucleus of one of the first laboratory facilities in the world for the standardization of absorbed radiation doses by direct measurement in terms of fundamental physical units. Apparatus will also be assembled in the laboratory for the inter-comparison and standardization of other absorbed dose instruments. Subsequently, a complete cobalt-60 unit will be installed to provide a suitable radiation beam for the calibration of radiation instruments in terms of an absorbed dose standard.

Other activities of the metrology and standardization section include the preparation of reference sources, determination of nuclear data which are essential for exact measurements, and inter-comparison measurements in co-operation with the International

The automatic micro-calorimetric apparatus in the standardization section of the laboratory

Bureau of Weights and Measures and other interested international organizations. There is also provision for in-service training of scientists from Member States in the techniques of measuring radioactive sources and for the organization of theoretical and practical courses in radioactive metrology and dosimetry.

Analytical Work

In the chemistry section of the laboratory, which is expected to be in full operation this autumn, a major part of the programme of work is concerned with analytical chemistry, particularly trace element analysis. The first major technique to be developed is activation analysis, which has the advantage of being relatively simple but having wide application and high sensitivity. The necessary apparatus consists of normal radiochemical and counting equipment, and the materials chosen for analysis are moderators, cladding material and other reactor components (excluding fuels) for trace elements, such as the rare earths, chlorine, cadmium, arsenic and iridium. On request by Member States, it will also be possible to analyse other materials by this method.

In connection with the Agency's research programme on the effects of radioactivity in the sea, which is now being carried out at Monaco, it has been noted that one important piece of information that is not available is the extent to which important trace elements are evenly distributed throughout the oceans of the world and its flora and fauna. This is considered a very suitable subject for activation analysis in respect of several elements. The chemical and physical behaviour of trace elements in the sea is another field of investigation in which activation analysis may be used.

Activation analysis, however, is not suitable for certain important elements, such as boron and lithium, and standard methods for these elements will have to be developed, using calorimetric, spectroscopic and other techniques. Certain analyses of ore samples for uranium have already been made with the help of the laboratory facilities originally installed in the Agency's headquarters building, and it is proposed to extend this work to other elements and ores which are of interest in nuclear technology. The isotope analysis of uranium and its compounds and of deuterium can be done with a mass spectroscope, and inorganic micro-analysis by enriched isotopes can be a useful supplement to activation analysis. Furthermore, methods using a mass spectroscope can be used for the dating of geological samples, as has been requested by some African Member States.

The programme of activation analysis in the laboratory will also be useful for the training of scientists from Member States, who require experience in radiochemistry.

Environmental Radioactivity

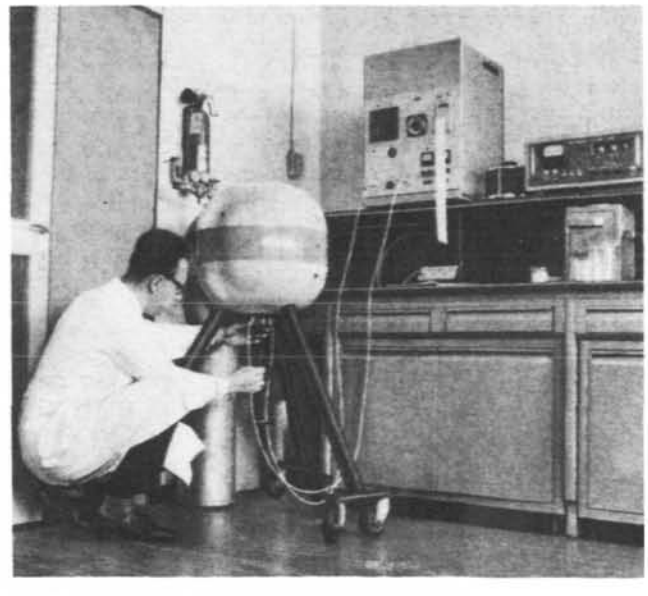
In the field of radiation safety, much of the present work of the laboratory is related to environmental radioactivity. The analyses and measurements carried out in the environmental contamination section, which are usually undertaken at the request of Member States, are expected also to help generally in the development of the Agency's health and safety programme.

The main activity of the section is the determination of trace amounts of radioactive substances in the human environment. Samples of air, water, soil and of biospheric materials, such as vegetation, food, and animal and human bones, are being analysed at the request of Member States who have not yet been able to set up their own laboratory facilities for this work. About 550 food samples, received from 17 countries, have so far been analysed. At the request of the Austrian authorities, the laboratory is making a continuing survey of radiostrontium contamination of the most important foodstuffs in Austria. Air filters have been analysed at the request of the Pakistan Atomic Energy Commission, and soil and plant ashes at the request of the Turkish Atomic Energy Commission.

Special studies are being made of the food chain transport of radionuclides from the environment to man. The environmental contamination section also gives advice to interested Member States on questions related to environmental monitoring. Besides, 13 scientists from different Member States have so far been given in-service training in environmental survey techniques. The training scheme is being continued and is likely to expand in the future.

Plans for future programmes of work to be undertaken by this section include certain special studies, such as survey of what has come to be known

A low background beta counter used for environmental radioactivity measurements. Photograph shows samples of meat from Sweden being inserted into the counter for radiostrontium analysis. The counter has been constructed in the electronics section of the laboratory



Work in the environmental contamination section on the separation of strontium-90 from yttrium-90 for inter-comparison samples for the measurement of environmental radioactivity

as "hot spots". Such spots are likely to occur in regions where the growth period of moss is approximately 80 years, and a large amount of deposited radioactivity is accumulated on the moss during this period. The activity may, in fact, reach values up to 100 times the usual plant radioactivity values. In such circumstances, it is important to investigate the transport of radionuclides from the moss to animals and then to man through the food chain, and it is expected that several Member States, which have extreme climatic conditions, may seek the Agency's assistance in this field.

Medical and Health Physics Work

Several Member States have expressed considerable interest in the determination of small amounts of radioactivity in accidentally exposed radiation workers, and the Agency has accordingly set up a low background measurement facility for whole body counting. The facility, which is installed in the Agency's headquarters building, is available for measurements on radiation workers at the request of Member States. It is also being applied to a number of problems which are of immediate interest to the Agency's own work in the health physics field.

One example of the latter type of application is the study of the radiation doses received by patients who were given thorotrast for diagnostic purposes. The results of such a study are expected to provide important data (which will supplement those obtained by examining radium dial painters) on the late effects of small amounts of incorporated radioactivity. Furthermore, an increasing number of dial painters have recently become contaminated with strontium-90 and the facility could profitably be used for whole body measurements on these people, as well as for low background measurement of isolated human tissues. Fellows from Member States for in-service training in whole body counting techniques will also be accepted.

Other activities of the health physics section include radiation protection services for the laboratory's staff, services to Member States on technically difficult or specialized health physics procedures, training in selected topics of health physics and waste disposal problems for scientists from Member States, and research on special problems of health physics techniques that may be necessary in the early stages of atomic energy programmes in Member States. It is envisaged that eventually the services provided by the section will also include personnel monitoring for external radiation exposure and internal contamination, monitoring of laboratories for radiation levels and for surface and air contamination, supervision of waste disposal procedures, and medical supervision of personnel.

Tritium Applications and Hydrology

The Agency has already started furnishing tritium laboratories in various countries with water standards in connection with its programme for a world-wide survey of hydrogen and oxygen isotopes. This is considered an urgent task in view of the wide variety of enrichment methods and apparatus being used in various tritium laboratories. For this purpose old water is required and the Agency's choice has been water from the Sabi River in Southern Rhodesia.

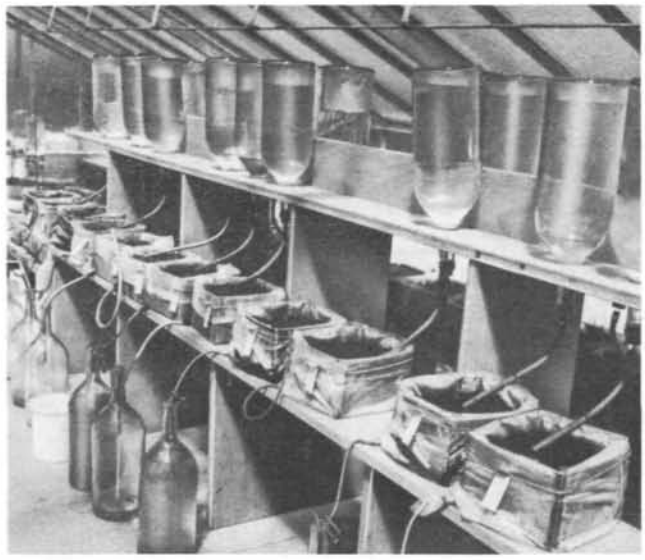
The Agency has also purchased a tricarb scintillation counter for the analysis of water samples collected from experiments in which water has been tagged with tritium. About 1000 samples have already been analysed with this instrument in connection with a ground water tracer experiment in Greece.

Small scale experiments are being undertaken, using labelled sand, to estimate the rate of bed load movement in rivers and estuaries.

Agricultural Work

Another group of problems on which a considerable amount of work is being done in the laboratory relates to the agricultural applications of radioisotopes. With the help of the laboratory facilities, scientists on the Agency's staff have prepared a laboratory training manual on soil-plant nutrition research. The manual consists of three main sections: the first dealing with the general principles and techniques of isotope applications in agricultural research, the second containing a number of laboratory exercises in soil-plant nutrition studies, and the third dealing with the planning of experiments and the calculation of experimental data. All the experiments described in the manual have been carried out in the laboratory and the experimental procedures have been checked by Agency experts.

An important part of agricultural work conducted in the laboratory relates to a co-ordinated research programme on the application of isotope techniques in rice cultivation. The Agency has awarded six research contracts for field experiments at nine



Greenhouse study on the effect of water movement on phosphate uptake by rice plants, using phosphorus-32

Study on the translocation of organic substances in bean plants with autoradiographic techniques

centres (seven in South-East Asia, one in Egypt and one in Hungary) to determine the best method of fertilizer placement in rice cultivation, using radioactive superphosphate. The analytical techniques for the determination of phosphorus-31 and phosphorus-32 in rice samples from these experiments have been worked out in the laboratory and communicated to the centres where the experiments are being conducted. At the request of some of these centres, samples are also being analysed at the Agency laboratory. In addition, to standardize the analytical procedures, the laboratory distributes standard rice samples to all the centres.

Since local conditions may interfere with the effects of experimental treatment at the various centres, comparative pot experiments are being carried out in a green-house specially constructed at the Agency's laboratory to investigate the effects of such conditions as water movement, drainage, absence or presence of oxygen in the soil, etc. The flow of water through the soil in the pots is being manipulated in such a way as to simulate various possible conditions in the field.

Arrangements have also been made for radioactivation analysis of minute quantities of soil solution extracted from normal field soils. Knowledge of the composition of the soil solution is of extreme importance because it is this composition that governs the uptake of nutrients by plants.

A start has been made with providing advanced in-service training at the laboratory to agricultural scientists from Member States.

Servicing and Supporting Facilities

The laboratory has an electronic section which is mainly a servicing unit. Some development work, especially on small but useful changes in standard equipment adapted for special purposes, has also been done in this section.

The laboratory has its own workshop and library.