ON THE INTERNATIONAL ATOMIC ENERGY AGENCY

Text of lecture given by the IAEA Director General, Dr. Sigvard Eklund, to the British Nuclear Energy Society on 1 May 1963

Introduction

The main concepts underlying the decision to establish an international agency to further the peaceful uses of atomic energy were born ten years ago. One basic consideration is that all countries stand to gain by co-ordination in certain atomic energy fields. I am thinking here mainly of regulations and practices in the health and safety field, legal liability questions, and of what has been termed safeguards, that is the application of the principles and methods which guarantee internationally that no assistance given for peaceful purposes is diverted to military aims. Secondly, it is in the interest of all nations that scientific and technical data are made freely accessible on a worldwide scale. Thirdly, it was also strongly felt that the potential and possibilities of atomic energy for economic and social development must not remain a monopoly or privilege of the advanced countries, but that there was a very special responsibility on the part of the international community to assist the developing countries in benefiting from this new science and technology. A fourth and equally forceful motivation was the hope that an international atomic energy organization would provide useful machinery for intensified scientific collaboration between the East and the West.

In the following account of some of our programmes, I shall first deal with activities which are of interest to our entire membership - at present 81 States - and then give an account of activities of more particular benefit to developing countries.

It is interesting to note that the initial programme for the Agency formulated by the Preparatory Commission in 1957 has stood the test of time and experience. We are just now completing work on a long-term 5-year plan for the Agency's activities and the approach in this plan, established with the help of governmental experts from many countries, does not differ greatly from that of the initial programme. Some shifts of emphasis have been found necessary, some factual premises have been brought up to date and work in certain new fields is recommended. Although this might sound disappointing to those who had hoped for new, bold and highly imaginative approaches, I think the work on the long-term plan has been a useful exercise.

Health and Safety

In perhaps no other phase of peaceful atomic energy is international collaboration more desirable than in the development of regulations, standards, codes and practices for radiation safety. The reasons for this are obvious; radioactivity does not respect national boundaries; the atomic energy industry depends to a certain extent on international commerce; the health and safety problems which face all nations engaged in atomic energy work are so similar that for reasons of economy alone it would be best to tackle those problems internationally.

Also, in view of the sensitivity of public opinion in relation to all radiation hazards matters, it is advantageous to have safety norms and codes established by an international authority.

The promulgation of two broad types of safety standards has been entrusted to the Agency: first, basic safety standards prescribing maximum permissible levels of exposure for different population groups and fundamental operating principles; and second, detailed operational standards for particular fields of application. In addition, the Agency is advising Member States on safety aspects of individual projects.

The basic health and safety standards were approved by the Board of Governors in June last year after having been carefully evolved by a panel of experts, and the comments of Member States and interested international organizations, for example the ICRP (International Commission on Radiological Protection) had been obtained and considered. In all our work on basic standards we try both to obtain and apply the best scientific advice available and to make them as internationally acceptable as possible. The basic safety standards must be kept under constant review and a complete revision might well be undertaken in the near future, at which time certain additions are planned, for instance the inclusion of a section on permissible emergency doses.

As regards detailed operational codes of practices or regulations for specific fields of atomic energy applications, one should make a distinction between those which have received the formal sanction of the Governing Board or the General Conference,

During his recent visit to the United Kingdom, Dr. Eklund was taken on a tour of the Atomic Energy Research Establishment at Harwell. With him in the picture are Dr. F.A. Vick (right), Director of Harwell, and Dr. E. Bretscher (middle), Head of the Nuclear Physics Division (Photo UKAEA)

and which may become internationally binding conventions, and those which are primarily advisory in character.

In the second group of manuals of recommended practices, I might mention the safe handling of radioisotopes, the construction and operation of research reactors and critical assemblies, and a study on radioactive waste disposal into the sea. We are continuing this series of manuals which should ultimately cover all the main fields of radiation protection.

Standards guiding the transportation of radioactive materials of both low and high specific activity were approved by the Board of Governors and the General Conference in September 1960. The need for the establishment of uniform rules is particularly strong and urgent in respect to transport, since the present divergent and sometimes complicated practices create serious difficulties to the international movement of radioactive materials.

In this regulatory work, certain considerations guide our approach. Effectiveness is largely dependent upon wide acceptance. It is therefore necessary to harmonize existing practices rather than try to enforce new ones. This can in some cases best be done by simply approving a manual for the Agency's own or Agency-assisted operations together with a recommendation that the rules be taken into account in the drafting of national legislation. This has worked quite satisfactorily in several instances. In other cases, however, it might be necessary and advisable to go further and try to give the regulations international acceptance either through formal approval by the Board and Conference or through a legal convention. This is a long and complicated procedure. These questions have recently been considered by a group of legal experts in connection with waste disposal into the sea. Their majority recommendation is that as a first step the draft regulations should be adopted by IAEA and recommended to all Member States, but that the ultimate goal should be an international convention.

Civil Liability

In the field of civil liability, international conventions are evidently necessary. The Agency has taken the initiative, together with other international bodies concerned, to establish conventions both for liability of operations of nuclear ships and civil liability for nuclear damage caused by land-based nuclear installations. The nuclear ship convention was adopted at a diplomatic conference held in May 1962 in Brussels, although some of the major powers (not the United Kingdom, however) did not approve it because of the inclusion of nuclear warships in the convention.

A diplomatic conference to consider a draft convention on civil liability for nuclear damage opened in Vienna a few days ago. The purpose is to find agreement on world-wide minimum standards governing liability for damage resulting from nuclear installations and the transport of nuclear materials. The uncertainty as to nuclear civil liability has al-

An international Convention on Civil Liability for Nuclear Damage was adopted at an inter-Governmental conference held by IAEA in Vienna from 29 April to 19 May. Photo shows the President of the conference, Mr. B.N. Lokur of India (right) talking to the Chairman of the Committee of the Whole, Mr. Allan D. McKnight of Australia

ready seriously hampered the atomic industry and we very much hope that an agreement will be found during these weeks of the Vienna conference, which will also take into account the ENEA (European Nuclear Energy Agency) and Euratom conventions regarding civil liability.

Safeguards

Safeguards against the diversion to military purposes of nuclear installations and materials pledged for peaceful aims is a matter involving both scientific, technical and legal problems.

Principles and procedures for safeguarding reactors with less than 100 megawatt thermal output, and nuclear materials used and produced in these, were approved by the Agency's Board of Governors in January 1961. The system had been the subject of long discussions, and its final acceptance was far from unanimous. This is understandable as an international system of safeguards, with the accompanying inspection, is something new and untried and something which to many might seem revolutionary and perhaps conflicting with existing concepts of national sovereignty.

Certain facts should be made clear, however, to get IAEA's safeguards system in the right perspective. The system only applies to projects assisted in some way by the Agency or to other projects voluntarily brought under the Agency's safeguards. So far it has only applied to small reactor facilities in Japan, Norway, Finland, and the Congo. It has also been tested on four small and medium-sized reactors in the United States. Seeing the size of these facilities, one might even say that so far the system has only been applied in a pro forma or experimental manner. Realism will enter the picture when we turn to large power reactors using and producing considerable quantities of fissionable materials of different grades. Only a few weeks ago, a committee of experts from governments, including all the atomic powers, met in Vienna and drafted procedures for the extension of the existing safeguards to nuclear reactors with output higher than 100 thermal megawatts. This draft will come before the Board of Governors in June and we shall then see if it will be possible to pass from the present somewhat theoretical stage into that of practical reality. There are also at present negotiations between parties to bilateral atomic agreements as to the possibility of requesting the Agency to take over the safeguarding function. It must be clear to all that the problem of a relative abundance of fissionable material inherent in the rapid growth of power reactors in the world needs some kind of satisfactory solution. Many do agree that the best answer is an international system of safeguards. But we should remember that there are other safeguards now in operation. Many, perhaps most, bilateral agreements contain safeguards clauses, and the ENEA and the Euratom countries also apply safeguards systems to projects within their co-operative arrangements. It is my understanding that technically the safeguards devised by IAEA do not greatly differ from those applied in many bilaterals or in ENEA and Euratom. All these systems base themselves on accountability and external audit of the plants and materials themselves.

In most cases, therefore, there is not a question of Agency safeguards versus no safeguards, but rather uniform international safeguards versus safeguards by one supplying country or self-inspection by a group of countries.

Of importance here is to devise a system which is flexible and practical and at the same time is laid down in well-defined principles, rules and procedures. One of the main difficulties is to strike the balance exactly between the need for practical flexibility and the need for codification. I hope that a sound compromise between these two demands will be found in the near future and that the Agency's system will soon be tested under realistic conditions.

Scientific Information

A carefully planned programme of scientific conferences and symposia is one example of an activity of value to scientists in all our Member States. In planning these conferences, which have remained at a fairly stable level of about a dozen each year, the wishes of the scientific community are of course a prime deciding factor. We try to fill gaps left open by existing international scientific unions and organizations and in some cases we join forces with them. We are also anxious not to cause any overlapping and our proposals are carefully considered by the Agency's Scientific Advisory Committee. We are now preparing for a conference on operating experience with power reactors, including nuclear super-heat reactors which will be held in Vienna in June and which might be the last major international conference on power reactors before the Third Geneva Conference, scheduled for late summer next year.

Some of the topics selected for Agency conferences will recur periodically, as it seems desirable to review certain major topics at intervals of two to four years.

In 1962 more than 1500 scientists participated in our conferences, in which I do not include the numerous panels and consultant groups convened at our headquarters to advise the Secretariat on specific topics. Of these, more than 200 came from the United Kingdom and presented 74 scientific papers out of a total of just over 600.

We have made very determined efforts to produce the proceedings of these international scientific

meetings as quickly as possible. The full proceedings, including all the papers presented, the discussions and abstracts of the papers translated into four languages, now normally appear four to five months after the holding of a conference.

I should mention that the Agency's library and documentation services receive a vast amount of scientific literature, the most important part of which probably is technical reports and documents on progress in research. Fifty thousand such reports are now available in our library, which possesses much of the world's unclassified material on different branches of nuclear science and technology. The documentation services include the compilation and publication of a series of bibliographies.

Nuclear Power

In the International Atomic Energy Agency we are naturally in touch with the plans and aspirations for nuclear power in most parts of the world. In fact, one of our main statutory obligations is to assist in the introduction of electric power from atomic energy and here, as in many other cases, we pay special attention to the needs of the developing countries. Due to its lack of financial resources, the Agency can only give advice to Member States on their nuclear power programmes, on the economic feasibility of individual projects and on problems relating to their siting and safety. The Agency might also assist in the provision of nuclear fuel and the finding of international financing. The Agency encourages and itself undertakes technical studies on nuclear power economics and organizes international scientific meetings on various aspects of power reactors.

We are increasingly anxious to approach problems concerning power needs and supplies on a broad front; conventional and nuclear power are not so much mutually exclusive alternatives as useful supplements, although a certain degree of competitiveness no doubt has a beneficial influence on the price of electricity for the consumer.

More detailed economic surveys of the power situation and the feasibility of introducing nuclear power have been undertaken in Finland, Pakistan, the Philippines, El Salvador, Thailand and Yugoslavia, and other requests are pending. It now looks likely that our work in the Philippines will be continued on a considerably larger scale by the acceptance by the United Nations Special Fund of a Philippines request for a full-scale pre-investment study on power, including nuclear power, in Luzon, for which IAEA would be the executive agent.

In Pakistan and Yugoslavia, we followed up our first economic study with siting evaluations; safety evaluations have been undertaken in Switzerland (Diorit), the Netherlands (Petten), Thailand and the Philippines.

A series of panels and international scientific meetings relating to the economics and technology of power reactors has been organized by IAEA in the last five years. I might mention two such panels that have only recently met at our headquarters in Vienna to show that the subject matters chosen for these meetings have become more and more specific and are certainly of interest also to experts from the advanced countries; one dealt with the utilization of atomic energy for desalting water, and the other with the economic aspects of the integration of nuclear power plants in electric power systems.

At the Third Geneva Conference which, as mentioned above, will be held in the late summer of 1964, a world-wide stocktaking of power reactor technology and economics will be made. We can certainly look forward to a very large assembly of experience; I am sure it will demonstrate the advances that have been made in the last few years and will indicate the possibility of a rather general and early utilization of nuclear power in some parts of the world.

Raw Materials and Fuel

Although it now seems certain that the consumption of uranium and thorium will be below production capacity for some years to come, the world market situation might change with expected growth in nuclear power installations.

In this connection a few words should be said about the Agency's role as a supplier of nuclear fuels, natural and enriched. This, as you all know, was once looked upon as one of the Agency's primary tasks. Developments, however, went in other directions. Uranium was found to be plentiful, demand weak. The rather large amounts of fissionable materials reserved for supply through the Agency have hardly been touched. It would, however, certainly be unwise, in my opinion, to discard this potential Agency function completely. As a matter of fact, IAEA is supplying nuclear fuel for reactors in the Congo, Finland, Japan, Norway, Pakistan and Yugoslavia, and it is likely that this list will be extended.

I now turn to the Agency's role in the field of isotopes and research and start with the use of isotopes in medicine and agriculture.

Medicine

Radioisotopes are more widely used in medicine than in any other field. In the programme of the Agency the use of isotopes in medicine has played a rather prominent role from the very start. In fact, the first scientific meeting organized by IAEA dealt with medical radioisotope scanning. Our programmes and activities in medicine are closely co-ordinated with the World Health Organization.

I shall mention only three specific Agency projects in the medical field.

1. Calcium-47

A better knowledge of calcium metabolism is necessary for the accurate diagnosis and treatment of certain human diseases, and would also facilitate the improvement of health and safety measures against radiation hazards. The ideal tool for such studies is the isotope calcium-47, since it has a short half-life and is a strong gamma-emitter, which makes even small quantities easily detectable. The main difficulty a few years ago was its high price of about $1400 per millicurie, which made it prohibitive in almost any medical institution. The Agency took the lead in 1958 by convening a meeting to discuss methods of producing calcium-47, it surveyed the potential world market for this isotope in order to encourage producers and it granted research contracts in the form of payment for the isotope to a number of institutes, primarily in advanced countries. After some years of work we have now reached the stage where calcium-47 is freely available, its contamination with calcium-45 considerably reduced, its price as low as $200 per millicurie. As a result, a number of institutes are now using calcium-47 on a routine basis for the diagnosis and study of certain bone diseases and for investigations of calcium metabolism.

2. Radioteletherapy

The two first radioisotope teletherapy units were installed in Canada in 1951. Now there are approximately 1400 such units, using cobalt-60 or caesium-137, operating in the world, including many in the developing countries. Apart from being much cheaper than radium and X-rays, radioactive cobalt and caesium have many other distinct practical advantages, in particular a great power of penetration. The Agency has been active from the very start in furthering the installation and use of these machines. It has published an international directory of such equipment, now produced in a variety of designs in 12 countries, and a bibliography on its application. To assist the effective utilization of these radiation sources in institutes short of trained personnel and auxiliary measuring equipment, the Agency sponsors the training of physicists and physicians in their use, provides physical data which reduces the local measurements needed, and assists directly in the installation and in the carrying out of basic physical measurements. Such direct assistance has, for instance, been given to institutes in China, Greece, Iran, the Philippines and Thailand, and an Agency expert will service the needs of the Middle East. The recommendations of an international group of experts on technical, economic, personnel and training aspects of teletherapy have been published in many languages. Co-operation between teletherapy centres in a given region has been initiated and a clearing house for dose distribution data established.

3. Whole-Body Counting

The third medical project which might be described briefly is carried out in the cellar of our headquarters building in the centre of Vienna. Among other small laboratory facilities situated there - the main laboratory is located about 20 miles outside the city - we have a whole-body counter, for which we have several specific research tasks in view. The laboratory staff is measuring and studying the levels of radioactivity in some people who many years ago were injected with thorotrast for X-ray diagnostic purposes. We hope that this study will contribute to knowledge of the effects of radiation at levels close to those considered the maximum permissible. It is also planned to use the whole-body counter for investigations on the effects of radium and strontium on persons who have been occupationally contaminated.

Agriculture

Within the general framework of the United Nations Decade of Development, particular attention is given to agricultural development as being the economic sector which can perhaps most directly alleviate existing misery in large parts of the world. Although agricultural science and technology is primarily the concern and responsibility of our sister organization, FAO (Food and Agriculture Organization), we have evolved, in full co-operation with FAO, a world-wide programme on the use of radioisotopes in agriculture.

To give an idea of this part of our programme I shall mention two specific projects which are now under way.

1. Co-ordinated Rice Research Programme

The experiments of rice breeders using classical field methods have not given unequivocal indications as to the best placement of phosphate fertilizers. If, however, superphosphate is labelled with the radioisotope phosphorus-32, it is possible to determine accurately the phosphate uptake derived from the applied fertilizer by a rice plant. Identical field experiments, designed by the Agency's specialists and supported by research grants, were carried out simultaneously in nine different locations in the Middle and Far East and Europe. Labelled fertilizers were supplied by the Agency and comparative pot studies with large soil samples from the nine sites were carried out in our laboratory at Seibersdorf. Leaf samples were taken at regular intervals and analysed either at Seibersdorf or on the spot by the contractor. The results, which indicate the best uptake from phosphate placed on the surface or worked into the surface soil, were compared and interpreted at a meeting at the International Rice Research Institute

at Los Baños in the Philippines at the end of last year, and the continued programme mapped out. This is the type of project where an international agency with relatively modest means can achieve practical co-ordination in a vital research area and also stimulate new developments of economic significance.

2. Insect Population Control

The success of the much-publicized screw-worm eradication programme in the south-east of the United States demonstrated how atomic radiation could be used particularly for biological control. It has been shown that the sterile male technique can be used successfully also with species in which the females are multiple-mating, provided dominant lethals are induced in the sperm. IAEA organized a meeting of experts in this technique - the first of its kind ever held - at the end of last year and the international group recommended intensified research on the use of this technique against such pests as the Mediterranean fruit fly, the olive fly, the tsetse fly and the leopard moth. The efforts have so far been mainly concentrated on the Mediterranean fruit fly, as both rearing and ecological information was rather well advanced on this pest. An Agency expert has been working on this project in Greece for some time and some promising progress is reported.

A symposium on the use of radiation in the control of plant and animal pests was held in Athens last week; at the end of this month we have, together with FAO, convened a Study Group in Lisbon on radiation application in olive fly control, and this autumn an eight-week laboratory course on the use of radiation and isotopes in entomology will be organized at the University of Florida.

Hydrology and Industry

In the exploration of groundwater resources, both to find the amount of water storage in a given area and the recharge rate, isotopes have been found valuable tools and permitted certain findings which were previously beyond our possibilities. Because of the importance of rational groundwater utilization for economic development in large parts of the world, the Agency has been very active in this specialized field. Actual investigations have been carried out in the Mediterranean area, Africa and the Far East, and experts have met both in Vienna and a few weeks ago at an international symposium in Tokyo. At present, precipitation is collected at some ninety stations all over the world and the samples sent to our own and other laboratories for tritium analysis, whereby the age of the water can be determined, from which flow directions and recharge rates are calculated.

As our radioisotope activities are largely directed towards the needs of developing countries, the Agency has so far not been very active in encouraging and assisting the use of radioisotopes in industry. However, a survey of all such uses has been carried out and a catalogue of literature references prepared, together with a study of estimated savings through the industrial use of radioisotopes, which should be out this year.

Research Reactors and Regional Needs

Although the Agency's mandate is most directly concerned with the introduction and utilization of nuclear power and radioisotopes, it cannot entirely neglect the fundamental disciplines of physics, chemistry and the life sciences insofar as these relate to atomic energy. There are in these fields responsibilities and opportunities particularly appropriate to an international agency, and we have already taken such action as our limited resources permit, and where "atomic energy" serves as an umbrella under which governments in developing countries are willing actively to support science and technology in general.

There are some 350 research reactors in the world today and many of these are situated in developing countries. Many of these countries have encountered difficulties in devising effective programmes for their use and some of these reactors have been and are sadly under-employed. The installation of a research reactor is often the first major step in a national atomic energy programme and it can provide an important stimulus not only to nuclear research and training, but to advances in the natural sciences and technology generally. It is therefore imperative that these reactors do not become monuments of unrealistic ambitions, but centres for scientific and technological development. Here the Agency can render considerable assistance by giving advice on research and training programmes, support such programmes through fellowships and research contracts, co-ordinate the programmes between different centres and provide information on work in progress and results obtained at such centres. The Agency organized a meeting last winter in Bangkok to discuss problems of research reactors in Asia and everyone there was struck by the need and usefulness of such regional interchange of experience and plans. Again, at the recent regional meeting in Tokyo of the countries in Asia and the Pacific for the promotion of the peaceful uses of atomic energy, it was evident that many difficulties encountered by developing countries can be overcome or eased by improved regional and international co-operation. The Agency intends to devote an important part of its resources to this task. We intend to arrange more regional meetings on specific problems, as for instance the operation and safety of research reactors or their use in the production of isotopes and biological and agricultural research. We may also send expert teams to advise individual countries on reactor utilization, etc., and

An IAEA technical assistance expert, Mr. W.C. Burch, has been advising on the construction of a research reactor at Teheran University, Iran. This picture showing the progress of construction was taken late in April

Another IAEA expert, Mr. E.C.S. Little, who served as Adviser to the Atomic Energy Agricultural Research Centre at Dacca, East Pakistan, recently helped in organizing a section depicting the agricultural applications of radioisotopes in a Science Exhibition at Dacca. Mr. Little is seen in the background explaining the display to the visitors

to establish standards of purity of isotopes for medical purposes, and provide technical assistance to centres in setting up isotope-dispensing facilities, as this shows that reactors can be used for applied science. In all its work connected with research reactors, the Agency is trying to get these centres integrated in the overall national, educational and scientific effort.

An example of regional co-operation under IAEA's auspices is the recently inaugurated radioisotope centre in Cairo for the Arab countries. In this centre specialists will be trained in the application of radioisotopes in medicine, agriculture, hydrology and industry; health physics and radiation protection personnel will be educated; research using radioisotope techniques will be undertaken in subjects of particular interest to the area, and the utilization of radioisotopes will be generally promoted. The centre is financed by the participating states and technical assistance funds from IAEA, and the Agency is providing a technical adviser.

Types of Technical Assistance

In the description of some of IAEA's activities to assist developing countries in their national atomic programmes, references have been made to the different methods used. A summary of the main types of technical assistance is: fellowships, training courses, visiting professors, expert advisers, the supply of equipment, and research contracts. In 1962 total available resources, in cash and kind, for these activities amounted to a little more than three and a quarter million dollars (research contracts given to advanced countries not included).

Of the 110 research contracts awarded or renewed in 1962 at a total cost of close to one million dollars, a little more than one half was given to laboratories and institutes in developing countries. The main fields of research supported under this programme are waste management and environmental radioactivity, health physics and radiation protection, isotopes in medicine and agriculture and radiobiology.

It has recently been suggested that the Agency should define certain areas of importance and by means of panels of experts determine if these areas are satisfactorily covered by research and development work. If not, the Agency should request appropriate institutes to start work in well defined domains. Costs would be borne by the appropriate governments. A first attempt in this direction will be made by a panel to be convened in Vienna in June to advise on the research programme on the toxicity of incorporated radionuclides.

Laboratory Facilities

The IAEA, alone among the organizations in the UN family, has its own laboratory facilities; an international laboratory, built next door to the Austrian research reactor centre some 20 miles from Vienna, has been in operation since October 1961 and some modest laboratory facilities, mainly for the work on health and safety problems, have always been functioning at headquarters itself. In addition, we are operating a laboratory for marine radioactivity in Monaco.

The laboratories are not intended for fundamental research, but as functional facilities through

which services can be rendered to Member States, and the programme activities of the Agency supported.

One of the main functions of the Seibersdorf laboratory is to supply calibrated samples of radionuclides to laboratories in Member States. The demand has been heavy and a large number of samples of one or two calibrated radionuclides are distributed each month. More than one thousand orders have been received and most of these have already been met. Quality control of special materials for nuclear technology is also carried out at Seibersdorf, as are measurements and analyses in connection with our health and safety and safeguards programme. On request from Member States the laboratory is also ready to make absolute measurements of radioactive samples and takes part in the intercomparison programme of the International Bureau of Weights and Measures. The chemical section is among other things engaged in intercomparison of trace analytical techniques and a fairly wide range of analytical services are at the disposal of Member States.

Measurements of environmental radioactivity are undertaken on a continuous basis: analyses of the tritium content in water samples are carried out under a joint project with the World Meteorological Organization, as are some of the analyses needed in connection with the international research project on rice fertilization, which I have mentioned before.

A limited number of trainees are received in the various sections of the laboratory for in-service or research training.

It is my hope and belief that the already excellent co-operation between the Austrian reactor establishment and our laboratory will be extended, especially in connection with the organization of a long-term training programme for the benefit of the developing countries, which is now under advanced preparation.

After this description of some of our major tasks, I should like to mention that there are now about 500 staff members in the Secretariat in Vienna, of which 200 are professionals, and that our annual regular budget is about $7 million. We are anxious not to overlap with other international organizations such as those in the UN family, and we co-operate with ENEA and Euratom through good personal contacts and sometimes also formal consultations.

I have tried to show the positive aspects of our work, but I think you should also know that there are difficulties and shortcomings. It is true that the Agency is a technical organization, but the fact is that an intergovernmental body must always take political considerations into account. The safeguards question is one example of such a problem with far-reaching political implications, but political aspects are also evident, for instance, in the pressure from Member States for the appointment of staff on the Secretariat. The Statute gives some guidance in this matter, as follows:

> "The paramount consideration in the recruitment and employment of staff and in the determination of the conditions of service shall be to secure employees of the highest standards of efficiency, technical competence and integrity. Subject to this consideration, due regard shall be paid to the contribution of members to the Agency and to the importance of recruiting the staff on as wide a geographical basis as possible."

However, we feel that efforts to economize on staff are not very popular with many Member Governments if their own nationals happen to be involved, although we definitely feel that the staffing should strictly follow - and not exceed - the needs of the organization's scientific, technical and administrative work, and we are constantly trying to effect reductions without impairing the technical efficiency of the organization. A considerable inefficiency is caused by the fact that there is such a rapid turnover of the scientific staff. There are very few permanent contracts for these people, and the average period of service is of the order of two to four years, one of which must be considered as a year of training and introduction into the complex organization which the Agency represents.

International organizations are expensive to operate: we have for instance four working languages and the governing bodies, the General Conference and the Board account for about nine per cent of the total regular budget; in 1962, for instance, they cost $643 000.

I have not mentioned or estimated the cost of the permanent missions which some countries maintain in Vienna, and which is a tribute to the Agency's importance.

Those of you who are familiar with management problems should realize that there are some special problems in an organization of the Agency's type. Things may happen to be known to delegations before they have been considered by the top management, and therefore misunderstandings may often occur. A high standard of loyalty to the organization is consequently demanded of the Secretariat.

But all said, I would like to assure you that being an international civil servant has its high rewards. You are brought into direct contact with the reality of growing interdependence of national states and you become aware of the fact that international organizations are only reflecting this reality. And however imperfectly they may be doing it, they demonstrate daily the need for and the necessity of international administration as an instrument of peace.

The responsibility for an international organization brings furthermore home to you the lesson that,

composed as it is of nations of widely differing cultures which are putting at your disposal a staff reflecting these differences, this staff nevertheless can form a body guided by similar principles, performing what is known as international civil service.

Finally, it gives one a deep satisfaction to meet so many personalities from different parts of the world and to try to bring about mutual understanding of common problems. But perhaps the highest reward given to us working in the Agency is the feeling that we are contributing to the breaking down of barriers and the building up of a collaboration and understanding in the scientific and technological fields. This in turn should pave the way for the practical statesmen to build international peace on firm foundations.

ISOTOPE APPLICATIONS IN HYDROLOGY

Water is a scarce commodity in many areas of the world. Because of increases in population and expansion of agricultural and industrial enterprises, water needs are rapidly mounting and many countries are now engaged on projects to develop water resources. In fact, the success of many current plans for economic development may well depend on the effective and judicious utilization of these resources. Hydrology has thus become a science of immense practical importance.

Hydrological problems, however, are not confined to water needs alone. The behaviour of water has important consequences on various kinds of agricultural and industrial activity, such as the construction of a dam or a hydroelectric power station. Hydrological studies, therefore, have many aspects and many purposes, and the relevant techniques are necessarily diverse.

In recent years radioisotopes have enlarged these techniques and in some cases made them more efficient and accurate. The use of isotopes has also made it possible to develop certain new techniques for the study of hydrological problems. A few simple examples will illustrate their role.

Isotopes used as tracers can, for example, be used to measure the rate of flow of water in canals, closed conduits and rivers. Chemicals have been used for this purpose for a long time; isotopes, though used on the same principle, are far more sensitive to detection and have hence made the measurements more convenient and accurate. Again, the tracer function of radioisotopes can be successfully employed in studying the siltation of rivers, estuaries and harbours; in fact, this has been done in many countries for a number of years. For the study of groundwater resources, which is of great importance in arid or semi-arid areas, isotope uses are opening up new possibilities not only for tracing the movement of water underground but also for assessing the amount of water in a particular groundwater body.

There are several other hydrological applications to which isotopes have been put, and many others which can be possibly developed. These current and potential applications constitute one of the major scientific areas in which the International Atomic Energy Agency can play a useful role, and the Agency has already started a comprehensive programme of work in this field.

Tritium Measurements

One of the first major projects undertaken by the Agency is a survey of the concentration of hydrogen and oxygen isotopes in water. The aims of this project are to study the circulation pattern of water vapour on a global scale and to measure the tritium concentration of rain water in different parts of the world, which is necessary for the application of environmental tritium to local hydrological problems. Tritium is produced in nature as a result of reactions in the atmosphere brought about by cosmic rays and is brought down by precipitation of water vapour, that is by rainfall. Since the amount of tritium normally present in water as a result of this process can be calculated, the absence of tritium or a lower-than-normal concentration in a particular water body would indicate the radioactive decay of the original tritium without any fresh injection of tritium from rain. In other words, this would indicate that the water is old. And since the rate at which tritium (which has a half-life of 12.5 years) decays is known, the measurement of tritium can reveal the age of a given water sample.