volume of data has already been accumulated. Simultaneously, recent developments in measuring techniques, such as fluorine bomb calorimetry and Knudsen effusion technique, have greatly increased the accuracy of thermodynamic data.

Accomplishments and Tasks

The discussions at the Vienna symposium showed that the determination of the thermodynamic properties of uranium oxides with the help of the newly developed experimental and measuring techniques had been largely accomplished, but there was still a great deal of work to be done on carbides. The data on uranium carbides presented at the symposium showed that different values had been obtained at different laboratories and intensive further investigation was necessary to resolve these differences.

Considerable interest was evinced in the vaporization processes of nuclear materials, especially because of their bearing on the development of high-temperature reactors. Besides, there was an extensive discussion on how the principles of thermodynamics could be applied to practical problems in nuclear technology. For example, it was shown how the composition of alloys, which are often used as reactor materials, could be theoretically predicted from thermodynamic data. Development of this method would obviously save a great deal of experimental effort on the part of metallurgists.

At an informal session of the symposium, the participants discussed in general the need for a critical evaluation and compilation of thermodynamic data on important nuclear materials. It was apparent that in view of the increasing volume of data being developed through research in thermodynamics at various centres, there was a growing need for the pooling and comparison of these data and for the dissemination of the evaluated results for use in nuclear technology throughout the world.

The following scientists presided over the individual sessions of the symposium: C. W. Beckett (USA), O. Kubaschewski (UK), T. Mukaibo (Japan), H. Nowotny (Austria), F. Reshetnikov (USSR), S. Varsano (Italy), R. F. Walker (International Union of Pure and Applied Chemistry), and F. E. Wittig (Federal Republic of Germany). The informal session was presided over by K. Schäfer, Chairman of the Commission on Thermodynamics and Thermochemistry of the International Union of Pure and Applied Chemistry.

ANNUAL REPORT TO ECOSOC

The development of the work of the International Atomic Energy Agency during the past year is outlined in the Agency's latest annual report to the Economic and Social Council of the United Nations (ECOSOC). The report covers the period 1 April 1961 to 31 March 1962.

The report gives an account of scientific and technical work in the three principal fields of interest to the Agency, namely (i) nuclear power, reactors, fuels and materials, (ii) radioisotopes and radiation, and (iii) protection against radiation. The programmes and activities are then summarized in three sections representing the three principal forms of the Agency's operations, namely (i) technical assistance, (ii) exchange of information, and (iii) research and development. Some of the main points of the report are reproduced in this article.

Nuclear Power, Reactors and Fuels

Member States have shown increasing interest in the possibilities of undertaking nuclear power projects with the Agency's help. In June 1961, an Agency mission made a preliminary survey of the possibility of establishing a demonstration power reactor in Yugoslavia, which might be designed, built and operated as an international enterprise. The mission's preliminary assessment of the technical aspects of the project was favourable. Another mission visited Pakistan in January this year to evaluate the prospects of nuclear power in that country and to review a study of the subject made by the Pakistan Atomic Energy Commission and its engineering consultants. (The findings of this mission are reported in a separate article in this issue of the Bulletin.) The report of an earlier mission, which studied the prospects of nuclear power in the Philippines, was published during the year. (See Bulletin Vol. 3, No. 4.)

A number of Member States have indicated difficulties in making full use of research reactors that have recently come into operation or are now under construction. A major difficulty is the lack of adequate scientific and technical personnel to make full use of the reactors, operate them safely, and plan programmes for reactor experiments. The Agency is trying to help overcome such difficulties through its training and technical assistance programme, and by organizing scientific meetings on the problems involved.

The Agency has continued to promote advanced nuclear research by collecting and publishing information and holding scientific meetings. It has also arranged for scientists from both developing and technically advanced countries to undertake advanced reactor physics research through participation in the NORA research project, organized jointly by the Agency and the Norwegian Government.

Four new projects for the supply of reactors and fuel were approved during the year. They were for the transfer of three small research reactors and their fuel from the United States to various institutions in Yugoslavia and of a 5 MW swimming pool reactor from the United States to Pakistan. Member States have also offered to supply further quantities of source and fissionable materials to the Agency.

Radioisotopes and Radiation

The Agency has continued to give special attention to promoting the uses of radioisotopes and radiation, especially in the medical and agricultural fields which are of immediate practical interest to the developing countries.

In 1961, in addition to granting 42 individual fellowships for training in the medical applications of isotopes, the Agency held a regional training course on this subject in the United Arab Republic. Experts on medical applications were working in ten developing Member States, and medical investigations under seven research contracts have been in progress in six Member States. The research programme on the production and use of calcium-47, which is of particular medical importance, has continued. Special attention is now being paid to research on tropical or sub-tropical diseases, on which the World Health Organization (WHO) has been asked to give advice.

Medical subjects have also been discussed at scientific meetings organized by the Agency as well as by groups of consultants called together to examine specialized problems.

A special isotope mission visited institutes in Greece, Iran, Iraq, Sudan, Turkey and the United Arab Republic, to promote co-operation in their work on radiation therapy with cobalt units and in treating certain types of diseases common to the area. The Agency is also trying to promote the standardization and calibration of measurements of radioiodine concentration in the thyroid gland, as one of the most widespread clinical uses of radioiodine is in diagnosing and treating disorders of the thyroid.

The Agency's technical assistance and research programmes on the agricultural uses of isotopes and radiation have grown in variety and scope during the year. Fellowships were awarded to 31 scientists in agricultural applications of isotopes. The Agency and the Food and Agriculture Organization of the United Nations (FAO) jointly held two international training courses in Wageningen in the Netherlands. Agency experts have been working in eight developing countries, and research under five contracts has been in progress in four countries. Most of this research is being done under the guidance of special panels of experts, in which FAO has participated.

Most of the industrial techniques for using isotopes and radiation are well-developed commercial applications, and the main work of the Agency in this field has been concerned with the preparation of two industrial surveys. The first, a systematic survey of radioisotope applications in industry, has been completed, and the second, an international survey of industrial savings through the use of radioisotopes, has begun.

The world-wide survey of the concentration of hydrogen and oxygen isotopes in rain water, undertaken in collaboration with the World Meteorological Organization (WMO), has continued, and the Agency is considering a similar survey of these isotopes in river water. Hydrological studies of ground-water resources, by means of radioactive tracers, are being undertaken in Greece and in the vicinity of Trieste on the Italian-Yugoslav frontier, and their possible use in water resources development in East and West Pakistan is being investigated. Plans have also been submitted to the Committee for the Co-ordination of Investigation of the Lower Mekong Basin for using radioisotopes to trace sand and silt movements in the Tonle Sap - the Great Lake region of Cambodia.

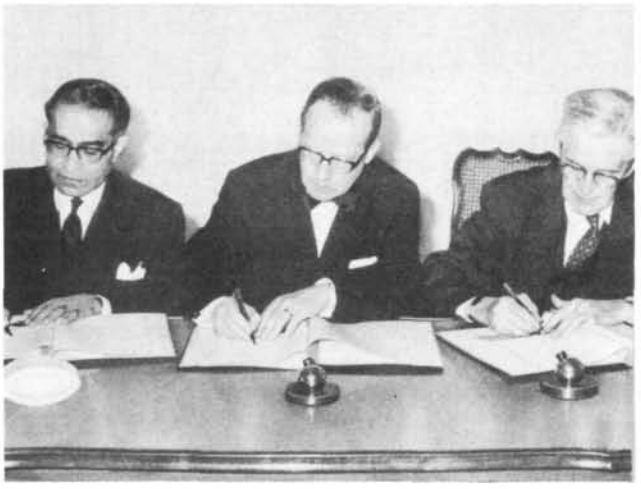
In January 1962, the Agency's Laboratory at Seibersdorf began to distribute radioactive reference sources to Member States. This service will enable laboratories, hospitals and clinics using radioisotopes for medical, biological and industrial uses to calibrate their measuring instruments. *

Protection Against Radiation

Protection against radiation hazards has remained one of the Agency's main concerns, and during the past year its work on this subject has ranged from support of research on the effects of radiation to the preparation of international conventions on the legal aspects of nuclear incidents. Plans are also being worked out for co-operation with WMO and the UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) in setting up WMO's world-wide system for reporting measurements of radioactivity in the atmosphere.

The Agency's programme of research on radiation effects is being guided by a study group of leading radiobiologists. During 1961, research was in progress under 27 contracts in institutions in 14 Member States. The main subjects of research include the mechanism of radiation damage to cells and at the sub-cellular level, means of increasing or

* *The distribution programme for 1962 covers 12 radionuclides, one to be delivered each month. Requests for more than 700 samples have been received from about 70 institutes and laboratories in 31 countries and, by the end of May, 224 samples had been delivered, as follows: January (phosphorus-32) - 31; February (iodine-131) - 46; March (gold-198) - 22; April (cerium-144) - 47; and May (sodium-22) - 78.*



The signing at IAEA headquarters in Vienna of agreements for the supply of a 5 MW research reactor and its fuel from the USA to Pakistan through IAEA. Left to right: Dr. I.H. Usmani, Governor for Pakistan on the IAEA Board of Governors; Dr. Sigvard Eklund, IAEA Director General; and Dr. Henry D. Smyth, Governor for the USA

changing natural resistance to radiation and the preservation of drugs and biosynthetic products by radiation. An advanced international training course on the biological effects of radiation was held near Rehovoth in Israel and an international course on radiation health and safety was held in Chiba City, Japan.

The Agency held a symposium on the effects of ionizing radiation on the nervous system, and contributed substantially to two other international meetings dealing with research on radiation effects. It is also co-operating with Finnish, Norwegian and Swedish experts and the Finnish Government in investigating the effects of high concentrations of radioactive nuclides in the staple diet of certain parts of the population of Scandinavia.

Research under Agency contracts on the disposal of radioactive waste has been in progress in nine countries. It is designed primarily to find cheap ways of treating such waste and to ascertain the effects of small releases of waste into the environment. Under a special three-year research programme, studies are being made at the Oceanographic Institute in Monaco on subjects such as the movement of radionuclides and their concentrates in organisms as well as their effects upon the organisms. Similar research is being supported in other Mediterranean countries.

Special radiation protection guidance and services are now being provided in many forms. The Agency's Laboratory carried out environmental contamination studies at the request of four Governments and submitted to UNSCEAR a survey of strontium-90 and caesium-137 in food consumed in Austria. The Agency's staff has advised the Sudan and the United Arab Republic on setting up equipment for measuring environmental radioactivity. Work is also going ahead on making arrangements for emergency assistance to be given to a country in the event of a nuclear accident. In addition, the Agency is making a survey of different types of reactor accidents, trying to establish criteria for the safe location of reactors and nuclear plants, and convened a group of experts in June 1961 to study the problems that will arise from the entry of nuclear merchant ships into commercial harbours.

The Agency's draft basic safety standards, which were further reviewed by a panel of experts and later by the Board of Governors, are intended to apply to operations undertaken or supported by the Agency and to serve as a basis for national regulations on radiation protection. The Agency's Regulations for the Safe Transport of Radioactive Materials were published in May 1961. The Agency is also preparing: (a) a manual on the use of film badges for personnel monitoring; (b) a manual on the design of safe radioisotope laboratories; and (c) a directory of existing whole body monitors.

Further, regulatory work has continued on the following subjects: (a) problems of disposal of radioactive waste into fresh water; (b) preparation of a manual on the safe disposal of radioactive waste by small scale users; (c) methods of monitoring waste disposal into the sea and the question of standardizing the sampling and analysis of radionuclides in sea water and in marine products; (d) international measures that might be taken concerning the disposal of radioactive waste into the sea; and (e) methods of treating radioactive wastes before storage instead of discharging them into the environment.

The draft International Convention on Minimum International Standards Regarding Civil Liability for Nuclear Damage was revised by an inter-governmental committee in Vienna in May 1961. Another draft convention, on the liability of the operators of nuclear ships, was discussed at the Diplomatic Conference on Maritime Law, held in Brussels in April 1961. The conference reached agreement on most of the articles of the draft convention and decided to convene an ad hoc session in May 1962 to complete and adopt it.

Programmes and Activities

It is noted that the anticipated growth of the Agency's technical assistance programme has been hampered by shortage of funds. Demands on the programme have continued to grow rapidly and to exceed the resources available. The wide gap between pledges of voluntary contributions to the General Fund (which is the largest single source for financing the programme) and the targets set has made it difficult even to carry out approved projects, although special contributions have alleviated this situation to some extent. The target for voluntary contributions for 1961 was set at US $1 800 000, while the amount pledged was $1 261 750 and the amount actually

available $1 015 691. An amount of $808 614 was appropriated for the year from funds made available under the United Nations Expanded Programme of Technical Assistance (EPTA). In addition, individual Member States provided cost-free fellowships to an estimated value of $748 771 and made gifts of equipment worth $110 000. Some Member States also provided the services of experts free of charge.

The Programme and Budget for 1962 sets a target of $2 million for voluntary contributions to the General Fund. By 31 March, pledges of contributions to the General Fund for 1962 amounted to $1 136 402.

Under the 1961 programme of training, 370 candidates were selected for fellowship awards as compared with 468 in 1960. After subsequent withdrawals, 344 fellowships were actually awarded. The students came from 44 Member States and were granted awards to study in 26 Member States. In addition, 11 research and special grants were made under the 1961 programme to enable advanced research workers to undertake research at leading nuclear centres or to make study tours. Nineteen visiting professors were sent to 11 Member States, compared with 17 visiting professors under the 1960 programme. Six regional or international training courses were held in 1961 as compared with two in 1960.

During 1961 the Agency's two mobile radioisotope laboratories were used for general instruction on radioisotope techniques in Argentina, Brazil, China (Taiwan), Indonesia, the Philippines and Uruguay.

Seventy-eight technical assistance experts were working on Agency projects in different Member States during the year. Equipment to the value of $161 800 was supplied to 14 countries.

Three large scientific conferences, five symposia, and two seminars were held in 1961. One conference, nine symposia, and two seminars have been planned for 1962. The Agency is studying the possibility of establishing an international centre for theoretical physics, and arrangements are being made to organize a seminar on high energy physics in Trieste, Italy, this summer.

As in the past, the Agency's scientific publications have mainly comprised reports on the proceedings of scientific meetings, recommendations, manuals on radiation protection, and other technical material produced by the Secretariat. Twelve reviews, prepared by leading scientists on various aspects of nuclear science and technology, were published.

Seventy-three research contracts, to the value of $575 944, were supported by the Agency in 1961, as compared with 69 to the value of $502 577 in 1960. The results of the first contracts awarded are now becoming available and have been published in appropriate scientific journals. The programme of research contracts was reviewed by the Scientific Advisory Committee and the Board of Governors, and it was decided that more emphasis should be placed on research on the applications of radioisotopes in agriculture, medicine and hydrology, which are likely to be of direct practical value to the developing countries.