CONFERENCES AND SEMINARS

CONFERENCE ON THE 30th ANNIVERSARY
OF ISOTOPE PRODUCTION AND USE IN THE USSR

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This conference was held in October 1978 in Obninsk and was concerned with the production and use of isotopes, with emphasis on the last 10 years. There were about 400 participants from various organizations under the State Commission on Atomic Energy, the Academy of Sciences of the USSR, the academies of the union republics, the All-Union Academy of Agricultural Sciences, the Academy of Medical Sciences of the USSR, various ministries and departments, and representatives of other socialist countries. There were 42 papers presented at the conference. On the first day, papers were read on isotope production and the preparation of radionuclide radiation sources, thermal isotope units, labeled compounds, and radiopharmaceuticals.

Over 160 radionuclides covering most of the elements in the periodic system are not utilized, which range from tritium to californium inclusive, which are derived by extraction from fission products ($^{85}$Sr, $^{137}$Cs, etc.), by irradiation of stable materials in nuclear reactors ($^{14}$C, $^{65}$Co, etc.), or from cyclotrons, etc. The production of $^{238}$Pu has also begun. Over 700 types of $\alpha$, $\beta$, $\gamma$, and neutron sources of radionuclide type have been produced for radiation-treatment systems, flaw detection, x-radiography, activation analysis, and various engineering monitoring instruments, in addition to about 1000 standard or reference-series sources for special purposes.

The production of heat sources based on $^{90}$Sr and $^{238}$Pu has been organized in order to meet a rapidly developing demand; also, 76 radiopharmaceuticals have been produced, which provide means of performing about 130 diagnostic tests and 20 radiotherapeutic treatments. The extension of the range of these in 1968-1978 was accompanied by a considerable increase in the volume of production, which doubled in money terms in that period or by more than a factor 2.5 by number of items, which has attained 80,000 per year.

The general use of radionuclide methods in molecular biology, biochemistry, immunochemistry, and other areas would have been impossible without the organization of production of biologically significant compounds labeled with T, $^{14}$C, $^{32}$P, and other isotopes. Some 150 new compounds labeled with these radionuclides have been produced in the past ten years, in addition to about 100 deuterated compounds; further, the volume of production has almost doubled. Major advances have also been made in the accumulation, isolation, and use of substantial amounts of the transplutonium elements, including $^{252}$Cf, which are derived from a high-flux reactor. Miniature californium sources giving neutron yields of $10^6$-$10^{10}$ neutrons/sec have been utilized prospecting for and surveying deposits of oil, gas, and other mineral resources, as well as in neutron radiography and neutron-activation analysis. Also, $^{252}$Cf sources have been used in medicine in improving the treatment of malignant tumors. Participants from abroad also gave reports on advances made in the production and use of isotopes derived from reactors and cyclotrons.

The second day was concerned with papers dealing with radiation engineering and the use of isotopes and nuclear radiations in various areas in engineering, agriculture, and biology.

These papers indicated that radionuclide methods and equipments have become a powerful means of advancing science and engineering; the following major areas have developed in radiation engineering in the last ten years: equipment design, instrumentation, and energy production. Prototype or working industrial systems have been designed or commissioned involving about 50 processes in radiation engineering. The following equipments have been designed or commissioned: The rV-1200 for the production of heat-resistant electrical insulating materials, the GUD-300 for the production of components made of modified wood, the Sterilizatsiya II and III units for industrial radiation sterilization of plastic medical items, equipments for producing wires and cables with irradiated polyethylene insulation, a series of systems for hardening coatings, the Kolos units for irradiating seeds before sowing, the Pant system for the synthesis of dibromylthiolanuclide, the Poplin system for radiation-chemical treatment of cloth, and the Plasma system for removing hydrogen from chlorine. Design work is in hand for new generations of radiation-engineering systems de-
signed particularly for chemical and biological processes, environmental protection, medical-instrument sterilization, modification of various materials, and processing agricultural and food products.

Radioisotope instruments have become a common means of monitoring and automation in industry; the demand for these increases every year. In 1968, ferrous-metallurgy plants operated about 1200 different radiation instruments, but the number almost doubled in the next five years. Some 80,000 radioisotope instruments were supplied to industry over the complete decade.

Many studies have also been performed to improve methods and means of flaw detection with ionizing radiation, particularly in monitoring materials, components, assemblies, and welded joints. These developments have met the needs of major areas in industry for methods and means of nondestructive testing. A new trend in flaw detection is the use of spatially encoded sources of ionizing radiation, which can provide three-dimensional information.

Methods derived from nuclear physics have become widely adopted in laboratories, industrial organizations, and geological bodies for the analysis of materials by means of radioisotopes. The past decade is essentially the period when these methods attained wide industrial use. One of the most promising trends in the development of analysis methods is flow monitoring, which provides a basis for comprehensive automation of many industrial processes. Detailed studies have made it possible to produce economic thermal and electrical power sources on the basis of $^{90}$Sr. Over 300 of these devices have now been manufactured and put into use, and the total working time of these is about 9 million h. Sources under the designation Beta-M are in routine production, whose electrical output is 10 W and which are used in the main to supply automatic meteorological units in areas of very harsh climate. These units have proved to be the only reliable ones for such conditions. They have also been used to advantage in navigational equipment in major areas of the Arctic Ocean, the Baltic, the Barents Sea, and the Sea of Okhotsk (radio buoys, lighted buoys, and magnetic-variation stations).

Radioisotopes and ionizing radiations have become essential research tools in various branches of agricultural science (research on the metabolism of biologically important elements in plants and animals, and research on the production of meat and milk by livestock). Radiation-induced mutations have also provided a basis for regionally adapted agricultural plants.

Considerable interest was aroused by papers on the use of stable isotopes in agriculture and on the use of radioisotopes in molecular biology. The first of them dealt with the major role of $^{15}$N in research on nitrogen fertilizers. These results have produced a radical alteration in the views of agrochemists on the practical significance of individual processes in the conversion of nitrogen fertilizers in the soil-plant system. Researches are in hand for ways of improving the return from nitrogen fertilizers. The second paper stated that some major discoveries in molecular biology had been obtained in the last ten years by means of isotope methods that could not have been made by any other method.

The state of the art and the development prospects for isotopes in medicine were dealt with extensively in papers presented by the leading institutes of the Ministry of Health, the Ministry of the Medical Industry, and the Academy of Medical Sciences of the USSR on the third day of the conference. These indicated that radiotherapy is one of the main means of treating malignant tumors. Today, radiotherapy is applied to over 70% of cancer patients as an independent treatment for the tumors. Design work has been completed on the AGAT-V1, AGAT-V2, and AGAT-V3 intracavity irradiators, which have been put into routine production, since these represent a new and progressive approach in radiation treatment. Clinical radioisotope diagnostic techniques have become essential in the proper evaluation of many diseases or functional states. In 1977, over half a million patients were examined by radioisotope means, including diagnosis of myocardial infarcts, ischemic heart disease, hypertension, malignancies, and the like. Also, radioisotope methods have begun to play a substantial part in space medicine (blood redistribution under conditions of weightlessness, shifts in calcium metabolism, and the like).

Considerable interest was aroused by a paper on the state of the art and development prospects in the use of implanted devices having radioisotope power supplies employing $^{238}$Pu. These biomedical $^{238}$Pu sources are of high specific electrical output and very high stability, and they are often the only fully acceptable power source for cardiac pacemakers. Several basic types of Soviet cardiac pacemakers now employ $^{238}$Pu sources, and dozens of them are now in use. Researches are also in hand on the use of radioisotope power supplies for other implanted systems such as artificial hearts, while there are many other applications of radioisotopes in research in chemistry, physical chemistry, metallography, nuclear physics, and techniques based on isotope analysis.