Technical sessions were devoted to such subjects as the technical and economic aspects of the power reactor systems currently in operation or being built, and the main lines of development towards more advanced systems and development of the fast breeder. Parallel lines of development of alternative systems were also considered - some, such as organic reactors, having already been the subject of extensive trials, while others are in the conceptual stage. "Package" power plants designed for easy transport and assembly were described, as well as reactors intended to provide space heating and industrial heat and a variety of ship propulsion units.

Direct conversion of heat to electricity was discussed, together with the use of radioisotope heat sources for very small power units, the technique of separating the fissile isotope U^{235} from natural uranium and fuel enrichment, the use of research reactors, and reactor physics.

An important theme was that of integrating nuclear power stations into supply networks, including the way in which this was being done in one or two developing countries.

A theme of much interest also was the possibility of nuclear energy for combined production of electricity and desalted water. Prospecting mining and treatment of uranium and thorium were discussed, and a general session was devoted to progress in research on controlled thermonuclear fusion.

The programme provided for only limited references to radioisotopes, which had been discussed recently at a number of specialized symposia and conferences. Two general sessions were therefore devoted to survey papers describing the applications of radioisotopes in industry, the physical sciences, the life sciences and radiobiology.

During the conference, a governmental scientific exhibition was held, in which eighteen governments took part.

THE TASKS AHEAD

The President of the Conference, Professor V.S. Emelyanov, at the opening session, defined the work of the Conference in the following statement (in part).

Another six years have passed and we are gathered together here again to discuss the results of much investigation and research, to assess the experience acquired in the course of those six years in the practical application of the discovery made a quarter of a century ago and to hazard a scientific forecast of future developments.

Much has been done during the past six years. They have been years of intensive scientific research. During this period, physics and atomic technology have recorded substantial advances in all the fundamental disciplines of nuclear physics - in the fields of low-energy physics, plasma physics and high-energy physics.

In the field of low-energy physics, considerable attention is currently being given to work on the practical application of the nuclear fission reaction. In research laboratories, ways of increasing the efficiency of plant and equipment are being studied, the accuracy of specific data indispensable for engineering and design calculations is being improved, means

The Secretary-General of the United Nations, U Thant (UN photo)

of controlling radioactivity are being sought, new means of protection against radioactive radiations are being developed, and research is in progress into new materials, resistant in radiation fields. The bulk of this research is directed towards practical ends,

because the fission reaction serves as the basis for atomic power engineering, for the construction of atomic power plants. Today, there is no longer any doubt that atomic reactors can be put to practical use to generate electricity.

For several years now, electric power stations with capacities ranging from tens to hundreds of thousands of kilowatts have been operating in different countries of the world. They produce electric power and serve as a school for training specialists in this new field; they also make it possible to accumulate experience and to perfect designs, equipment and devices for controlling the fission process. Large power plants are being built in a number of countries and the construction of such plants is being planned in other countries.

President of the Conference, Prof. V.S. Emelyanov
(UN photo)

The question today is not whether or not nuclear fission can be regarded as a practical source of power. No indeed! That question has been answered. Other questions have appeared on the agenda: how to extract that energy as cheaply as possible and increase its importance in the general energy balance sheet.

Neither is there any doubt today about the outlook for the practical use of atomic energy in shipbuilding.

The atomic ice-breaker "Lenin", which went into service five years ago, is this year successfully completing its fifth cruise. It has passed all tests brilliantly in the severe conditions of the Arctic Ocean, and has shown the indisputable superiority of atomic ships of this type over vessels using organic fuels such as coal or oil.

We may also mention the successful voyage of the cargo-passenger ship "Savannah", which it is completing this year after making the long crossing from the shores of the United States to European ports.

We Must Husband Organic Fuels

I am firmly convinced that atomic power will find its way into air transport too; its advantages are too great to leave room for anything but optimism on this score.

The practical experience acquired in the designing, construction and operation of atomic power stations justifies the belief that, within the next fifteen to twenty years, such plants, based on the fission reaction and using uranium and plutonium as fuel, will be very substantially developed so that atomic power will play a vital part in the overall energy balance of many countries.

This is due to a number of factors, of which I will mention the two most important.

First, even today calculations show that atomic power stations with a capacity of 500,000 kilowatts and upwards can compete with thermal plants.

The second factor is no less important. Our times have seen significant advances in chemistry, and especially in organic chemistry. The chemical industry has assumed functions which it has never before fulfilled.

It has virtually ousted the manufacture of natural silk and replaced it by the production of artificial silk.

It is ousting cotton and wool from the textile industry and leather from the boot-and-shoe industry.

It is providing considerable quantities of the most varied materials for building, engineering and instrument-making.

The raw materials for the chemical industry, for the manufacture of plastics, fabrics, artificial leather and similar products are natural gas, oil and coal. Organic fuels provide the chemical industry with its primary materials. If we go on using oil at the present rate, all our oil will soon be burnt up, and the chemical industry will be deprived of a most important source of raw material.

At the present time, the raw material for the production of atomic power is uranium. So far, no other large users of uranium have appeared on the scene except the war industries, which use it for the production of atomic weapons, and the power industry, which uses it for the generation of electricity and heat; we must also include transport, which uses it mainly for ship propulsion. So far as we can judge, uranium can be most rationally used in the power industry and for motive power. The proved reserves of uranium are sufficient to meet mankind's power requirements for several hundred years.

Reason suggests that we must husband our organic fuels, that we must stop treating them purely as fuels and view them primarily as raw materials for the chemical industry.

We must at the same time develop work on the all-round utilization of uranium and its disintegration products. As everyone present at this Conference knows very well, the nuclear fission reaction is accompanied by the formation of radioactive isotopes and the omission of radiation. Both isotopes and radiation are finding increasingly wide application in the most varied fields of human activity, and it would be difficult to find an area where they are not at present being successfully used while, in a number of countries, the economic impact of their use, measured in financial terms, represents a substantial sum.

Wide Field for Research

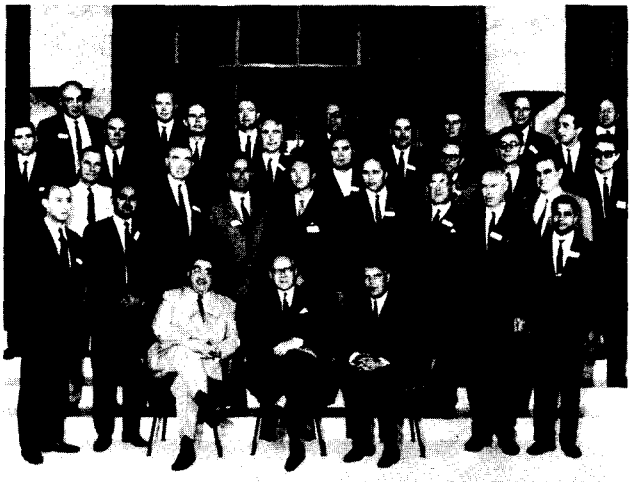
New ground is being broken in the practical application of radiation in the chemical industry, bringing about revolutionary changes in certain processes, especially in the field of organic synthesis. In all probability, this new trend in the use of nuclear radiation will make considerable headway in the years to come, and it is not impossible that some large reactors will not merely serve as sources of energy, but will also be used for process purposes in the chemical industry. Interest in the practical use of isotopes and nuclear radiation has currently increased to such an extent that many large conferences, both international and national, have already been held on the subject, at which hundreds of papers dealing with research and with the practical application of radiation have been considered.

This explains why, at our own conference, consideration of work on isotopes has been confined to survey papers. This has been done, not because there is nothing to say on this subject, but because there is too much that might be added to what has already been said. Radioactive isotopes might be described as a gold field which has begun to be successfully worked in many countries.

A second problem is the development of plasma physics, which is turning over a new page in the history of energetics. The successful solution of this problem will make it possible to harness the energy of the world's oceans and to banish the threat of the exhaustion of other sources of energy. There can be no doubt that this problem, too, will be solved. Its solution calls for a sustained effort on the part of scientists to find methods of carrying out controlled thermonuclear processes which will make it possible to put the nuclear fusion reaction to practical use.

Work in the field of high energy physics is paving the way to a fuller knowledge of the secrets of the structure of matter. High energy physics has many discoveries to its credit during the past few years. For the time being, all these discoveries constitute bricks with which we can build up new theories that will give us a more complete picture of the structure of atomic nuclei, that will enable us to study the nature of the forces acting between individual particles, that will reveal the logical arrangement of these particles and make it possible to combine all that we know about the atom into a single whole.

High energy physics is also building up a body of material relating to new processes for obtaining energy, the annihilation processes, that is, reactions in which for all practical purposes the entire mass of the material is converted into energy in the form of radiation. Even a short list of the problems of current concern to atomic science shows the extent to which work has proceeded on the study of small particles of the hitherto indivisible atom.



Conference staff at the Palais des Nations

The decision to limit the production of fissionable materials for military purposes, taken by the Governments of the United States of America, the Soviet Union and the United Kingdom, has improved the prospects for a substantial development of work on the peaceful uses of such materials.

In the announcement made by Mr. N.S. Khrushchev, Chairman of the Council of Ministers of the USSR, there is a direct reference to the decision of the Soviet Government to channel more fissionable material into peaceful uses in atomic power stations, industry, agriculture, medicine, and the realization of major scientific and technological projects, including the desalination of sea water.

Towards Cheap Power and Fresh Water

The problem of supplying the population with fresh water is becoming more and more critical as the population of the world increases, new lands are brought into cultivation, cities grow in size and those branches of industry requiring large quantities of process water are further developed. There is no life without water. This problem of water supply calls for solution in many countries. The time has come to direct the efforts, knowledge and experience of

atomic specialists towards the solution of this most important problem - the conversion of salt water into fresh water.

It is essential to channel all the energy stored up in military stockpiles in the shape of nuclear weapons into the construction of powerful atomic reactors which will produce cheap power and also desalinate water. The construction of large desalination plants is a rational method of using atomic energy.

In the light of the magnificent prospects before us in the field of atomic science and of the complexity of the problems which that science has to solve, it is essential for scientists to collaborate and to unite their forces. During the past six years, there have been many events in scientific life that have made for the development and strengthening of scientific ties.

The International Atomic Energy Agency has begun to expand its activities. It has convened a series of important scientific meetings at which many atomic problems have been discussed in detail. Conferences, symposia, seminars, and summer schools have been organized for the consideration and discussion of many questions relating to the use of radioactive isotopes and radiation, controlled nuclear fusion, the disposal of radioactive waste, etc.

All this has greatly strengthened scientific ties. The long interval between the Second and Third International Conferences has been filled with intensive activity in world scientific circles working on the problems of atomic energy. But all the conferences, meetings and symposia held during the past six years cannot replace international conferences convened by the United Nations, because the latter provide particularly striking and convincing evidence of the importance of diverting atomic energy from the path leading to war into the path of peace and progress.

THE THIRD CONFERENCE - A SUMMING-UP

Dr. Glen T. Seaborg, Leader of the US Delegation to the Third Geneva Conference, at a special evening lecture summed up the results of the ten-day meeting which, he said, brought us to the borders of the age of nuclear power and might be called the Conference of Fulfillment.

Perhaps the most impressive indication of progress, he said, was the growth in world installed nuclear capacity - from only 5 MW(e) in 1955 to 185 MW(e) in 1958. Today in 1964 there was almost 5000 MW(e). One could see that, by 1970, the total world nuclear power capacity would be about 25 000 MW(e) and by 1980 this would have increased to 150 000 or 200 000 MW(e).

The following is a slightly condensed version of his statement of the technical progress reported to the Conference.

"Many of the delegates to this Conference view nuclear power in three phases. The first is that phase reached in the past year or so - the coming of age of the three types of presently economic reactors: the graphite moderated, gas cooled reactor; the heavy water moderated, heavy water cooled reactor; and the light water moderated, light water cooled reactor.

The second phase of nuclear power is the improved or advanced converter reactors, including near breeders. These reactors run a gamut of types - including heavy water moderated, graphite moderated, light water moderated and even types using a variable moderation of heavy water and light water. This phase of nuclear power development promises to bring greater fuel utilization, preparation of fuel for breeders at a faster rate and potentially even lower cost power than today's reactor. It must be recognized, however, that continued improvement of the present reactor types will probably keep them economically competitive during most of this time.

The third and somewhat concurrent phase of nuclear progress is the development of breeder reactors. This Conference has heard considerable discussion of fast breeder reactors using the plutonium and uranium-238 fuel cycle. Perhaps less discussion than they merit has been given to thermal breeders fueled on the thorium and uranium-233 fuel cycle. In either case these breeder reactors promise to extend by an order of magnitude and more the fuel utilization of our uranium and thorium resources since they will produce more fissionable material than they consume. In essence they are our key to unlocking the