# ATOMIC ENERGY IN THIS CENTURY AND THE NEXT

**Much of the history of atomic energy, in which the pace of development accelerates with every year that passes, is written in what to the layman are abstruse scientific papers. Much is obvious in impressive power stations and research centres. But much more was made clear to the world at large by the reasoned survey made by five of the world's most distinguished scientists, while the tenth Session of the Agency's General Conference was in progress.**

Arguments which strangely enough contain no real difference of opinion will continue into the foreseeable future about which aspect of the peaceful uses of atomic energy bring most benefits to humanity. Whether, to take only two questions, it will be the tremendous scientific advances made with the use of radioisotopes or the immense gains derived from the discovery of a new form of fuel for power, the answer always comes that wise development has already aided the world and can offer far more to peaceful development in the decades to come. The five lectures brought this out with great force.

The speakers, who had accepted an invitation from the Director General of IAEA to present papers especially to mark the occasion of the Tenth Session, were Sir John Cockcroft (UK), Professor Louis Néel (France), Professor Alexandre Leipunski (USSR), Dr. Wlliam Webster (USA) and Dr. A.R. Gopal-Ayengar (India), this being the order in which they spoke.

Sir John Cockcroft, a Nobel Prize winner for his work with Professor Walton in the first artificial "splitting of the atom" took as his subject "The Impact of Atomic Energy on Our Society". Nuclear power, through concentrated electricity systems, would in stations now being built generate electricity at about ten per cent lower costs than from the most modern conventional stations which could be built on the same sites. With development of present types costs would certainly drop to below 0.33d (4 mils) per kilowatt hour, and he foresaw breeder reactor stations in the late 1970's producing at 0.3d (3.5 mils). His calculations took account of the most unfavourable economic factors. Then although power from fusion still looked to be at least twenty years away he agreed with Academician Artsimovich's remark in 1961 that "there can scarcely be any doubt that the production of controlled fusion will eventually be solved.". Production of fresh water from sea water by the dual-purpose use of nuclear power stations offered hope in arid regions and even for temperate zones where population was outstripping supplies. In addition to power, impetus had been given to industry and technology and the new tools for many types of scientific work has produced a great deal of knowledge in a short time.

"The world wide development of nuclear power presents some dangers through nuclear fuel becoming widely disseminated", commented Sir John, "and the Agency is playing a major role through its safeguards system in helping to reduce these dangers. The responsibilities will greatly increase."

Professor Louis Néel, of the Faculté des Sciences, Grenoble, Director of the Centre d'Etudes Nucléaires and Director of the Laboratoire d'Electrostatique et de Physique du Métal, pursued the stimulating argument that nuclear research centres had never been so live and valuable even if their original purpose had been completed. The physics and chemistry of atomic nuclei, the problems of very high energies, plasmas and fusion, solid-state physics electronics and many other studies all called for resources of the kind available in nuclear centres. Many notable discoveries had been made, but the field of research was still vast.

For reasons of safety, if nothing else, it was certainly preferable that research reactors should be administered by specialized institutions suitably organized and already acquainted with the hazards of radioactivity and the

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a. Sir John Cockcroft
b. Prof. Louis Néel
c. Prof. A. Leipunski
d. Dr. William Webster
e. Dr. A.R. Gopal-Ayengar

deliver their scientific lectures during the 10th session of the General Conference.

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means of protection. But questions of efficiency also played an important part. Very serious studies had shown, for one thing, that neutron costs decrease very sharply as reactor power increases and, for another, that in many applications it is necessary to have a neutron flux as intense as possible, if only to overcome background more effectively. Very large reactors with capacities of several tens of thermal megawatts, inside which dozens of experiments could be carried out simultaneously, were therefore necessary.

Professor Alexandre Leipunski, now Scientific Director of the Physico-Energetics Institute of the USSR State Committee of the Council of Ministers for the Utilization of Atomic Energy, gave an invigorating resumé of the possibilities of nuclear power systems. Virtually any reactor system, he declared, could be made technically and economically feasible, but he was convinced that the fast breeder reactors would in a comparatively short time provide the most economic method of using high-cost uranium. He gave the next ten years as the period during which nuclear power generation would depend essentially on systems already mastered. After that, because the success of the prototype breeder reactors of the Shevchenko (USSR) and Dounreay (UK) types could not be doubted and because such reactors could commence operating with enriched uranium rather than plutonium, it would be possible to begin their large-scale construction. They would make the best use of all the available uranium and thorium, including high-cost material such as uranium extracted from the sea. Such stations would constitute the cheapest of all power sources, supplying power at 0.30 - 0.35 cents per kilowatt-hour. He calculated that by the year 2030 the requirements of natural uranium, if water-moderated and water-cooled reactors were used, would be 40 000 000 tons annually. This figure could be halved with the use of heavy water converter systems, but with fast breeders the requirement would be only 2 000 000 tons annually.

Dr. William Webster, President of the New England Electrical System and of the Yankee Atomic Electricity Company and a member of the General Advisory Committee to the U.S. Atomic Energy Commission, devoted much of his talk on the commercial future of nuclear power to reasoned predictions of the world's overall power requirements for the rest of the century. Whether reckoned in kilowatts or in capital expenditure, the effort needed would clearly be tremendous.

"In a period of just over thirty years" he predicted "we look forward to providing a world power system that is six to eight times larger than all we have in the world to-day..... a group of systems that represent an expenditure of over one trillion dollars. This is a measure of the huge field that our developing nuclear plants are undertaking to share".

He put the nuclear share of this by the year 2000 at between 3000 and 4000 million kilowatts, over half the world capacity. It would mean a great expansion of manufacturing capacity, the development of dual purpose plants, the growth of large allied industries and other major changes. If joint desalination plants were built extensively and energy used to pump fresh water inland, the overall estimates might even prove inadequate. The fast breeder reactor,

the key to fulfilment of the full promise of nuclear power, would extend the world's fuel supply by a large factor. He related all this to the continuing use of other power systems, warned that progress might not be uniformly rapid and underlined the necessity of international co-operation. The problem of proliferation of weapons and the requirements for inspection and licensing were most important. Nuclear power problems knew no international boundaries, and he believed they would be a major force for world integration and understanding.

Dr. A.R. Gopal-Ayengar, a member of the United Nations Scientific Committee on the Effects of Atomic Radiation, a member of the Radioisotopes and Ionizing Radiations Committee of the Indian Council of Agricultural Research, and Deputy Chief Scientific Officer in the Biology Division of the Trombay Atomic Energy Establishment, gave a comprehensive and enlightening review of applications which had been made of radioisotopes and radiations. The "horrible grandeur" as he described it, of atomic energy came from its ability to be employed as a frightening weapon. Its noblest and most laudable accomplishment was derived from its capacity to fight disease, to alleviate human suffering and to unravel some of the dynamics of biological and human systems. It had found the most extensive application in the life sciences. The many examples he gave ranged over almost the whole extent of the life sciences and of research, which had already achieved impressive results, into the nature of things large and small, including man, all living creatures and plants. The great challenge of our time, he said, was the need for a time of peace when the rich harvest of human creative accomplishments in the realm of science could be utilized to the health and betterment of mankind.

Professor Luiz Cintra do Prado, last year's Chairman of the Brazilian Nuclear Energy Commission, a member of the IAEA Scientific Advisory Committee and Alternate Governor to the Agency for Brazil, acted as Chairman for the lectures. Dr. W.B. Lewis, Senior Vice-President for Science in Atomic Energy for Canada Ltd., Canadian representative in the Scientific Advisory Committee to the Secretary-General of the United Nations, and a member of the IAEA Scientific Advisory Committee, served as Moderator.

The full text of all the lectures is being reproduced in the Agency's Atomic Energy Review.