

ANIMAL BIOLOGY AND THE MEDICAL SCIENCES DISCUSSED IN MEXICO

Exploitation by scientists of the variety and versatility of radioactive tracers as a research tool has been compared to the wide applications of the microscope in the solution of technical problems. In September 1960, IAEA and UNESCO sponsored the Copenhagen Conference on the application of such tracers, commonly called radioisotopes, in the physical sciences and industry. In November 1961 the Agency, together with FAO and WHO, sponsored the Mexico Conference on the use of radioisotopes in animal biology and the medical sciences.

The purpose of the conference, held in the Centro Medico Nacional, Mexico City, 21 November-1 December, was to make medical scientists more fully aware of the potentialities of radioisotope techniques in general physiology and biochemistry, and at the same time to acquaint biologists with problems relating to the physiology of disease and with clinical uses of radioisotopes. The scope of these techniques of life science research was illustrated graphically in the US Public Health Service estimate that 50 per cent of all fundamental and related biological research in the United States now involves the use of radioisotopes.

The meeting was the Agency's first scientific conference in the Western Hemisphere. The scientific secretariat successfully introduced two innovations: delivery of special lectures by four outstanding scientific authorities; and the scheduling of six special panels after scientists in attendance had selected topics most pertinent to problems in their own laboratories.

All told, nearly 170 scientists from 32 nations attended, to give, hear or discuss 70 scientific papers. The President of Mexico, Adolfo Lopez Mateos, attended the opening ceremony. José M. Ortiz Tirado, Chairman of the Comisión Nacional de Energía Nuclear, host organization for the event, spoke at both opening and closing ceremonies, sharing the latter platform with Bernhard Gross, Director of IAEA's Division of Scientific and Technical Information and formerly a member of the scientific committee which advises both IAEA and the United Nations.

Programming Research, and Fighting Disease

One of the animal biologists attending, C. L. Comar, of Cornell University, Ithaca, New York, USA, said that many of the conference papers demonstrated that considerable progress had been made in life science research in the previous year in a dozen or more countries. He described the use of radio-

isotopes in biology and medicine as the "future" which will enable scientists to extend knowledge far beyond that achieved by classical methods of research. He added that radioisotopes make it possible to understand the dynamics of life processes, both normal and diseased, while these processes are actually going on.

A. A. Kudriavtsev of the Veterinary Research Institute of Moscow, USSR, said that the papers given during the conference demonstrate the progress and determination of scientists throughout the world to win the battle against serious diseases in man and animal, such as cancer, leukaemia and nutritional deficiencies.

The work reported by Mexican and Venezuelan physicians in the diagnosis and treatment of thyroid

Former IAEA Director General Sterling Cole; Mr. Adolfo Lopez Mateos, President of Mexico; and Dr. Nabor Carrillo of the Mexican Comisión Nacional de Energía Nuclear (left to right) leaving the Centro Medico Nacional in Mexico City following opening ceremonies of the Conference on Uses of Radioisotopes in Animal Biology and the Medical Sciences



patients by means of radioactive iodine was praised by Lorentz Eldjarn of Oslo University, Norway, as an important extension of classical studies pioneered in Western Europe in the 1890's. By taking advantage of advanced techniques being applied in Latin America, where thyroid diseases are prevalent, physicians in Europe and elsewhere can attack similar problems in patients in their own countries, he indicated.

S. K. Mazumdar, from India, said that many techniques described in papers on clinical medicine can immediately be applied in his own clinic and elsewhere in Asia. He added that the special panel on training in radioisotope techniques had convinced him of the importance of consolidating in a single educational programme the disciplines of nuclear physics, radiobiology, nuclear hygiene, and the applications of ionizing radiation in the medical sciences.

Studies of Farm Animals

Examples of the usefulness of radioisotopes in discovering new information about the life processes of farm animals were given in a special lecture by Dr. Kudriavtsev. He and a colleague at the Institute, A.I. Vertunov, had prepared the paper.

Soviet scientists are using compounds labelled with phosphorus-32 to study the mechanism of mineral disorders in lactating cows, caused by an excess of proteins in the diet. Investigations using chlorophyll labelled with carbon-14 have produced new information on the synthesis of haemoglobin in cows. Carbon-14 is also used to investigate the processes by which the shells of eggs are formed in laying hens. Likewise, radioactive sulphur-35 has been used to shed light on the factors involved in the process by which lambs grow wool.

Dr. Kudriavtsev also reported on the development of methods for using radioisotopes to diagnose disorders of the endocrine glands in animals, and to trace deficiencies in minerals in various life processes. Other recent studies, he added, deal with gastrointestinal processes, blood disorders and immunology.

"Practical methods have been developed for the prevention of various diseases in domestic animals, and various applications of radioisotopes are being made in veterinary surgery", he said. "Worthy examples include the knitting of bones and the transplanting of tissue."

Farm animals also were discussed in a lecture on the use of radioisotopes in biochemistry, given by R. F. Glascock, of the National Institute for Research in Dairying, Shinfield, Reading, United Kingdom. He cited a decade of research in various countries with copper-64 in studying the important effect which copper has on the rate of growth of pigs and cattle. Similarly, he added, three different radioactive isotopes of cobalt have been used to investigate the role of cobalt as an essential constituent in the diet of cattle. He attributed pioneering work with both metals to C. L. Comar, of Cornell University.

Dr. Glascock added that cobalt-60 has been used to study the metabolism of vitamin B¹² in the intestines and blood systems of rats. A variety of radioisotopes of carbon have been used to study the pathways of different elements in the building up of animal tissues.

Applications in Physiology and Medicine

The special lecture on use of radioisotopes in physiology was given by D. Harold Copp of the University of British Columbia, Vancouver, Canada. After describing the earliest tracer experiments, he discussed recent refinements in methods for measuring continuously the level of radioactivity present in animals or human beings. He described present methods, including "whole-body" counters capable of sensitive measurements of tiny amounts of given radioisotopes present, as being particularly useful in studies of respiration, and of measurement of blood. (Such counters were the subject of discussion by a special panel at the conference, and, earlier in 1961, of a symposium in Vienna).

Radioisotopes, he concluded, have provided "new eyes for research, and a new dimension in investigation", without disturbing the equilibrium of life processes under study.

Uses of radioisotopes in medicine were described in the special lecture by John H. Lawrence of the Donner Laboratory of the University of California at Berkeley. He told about the first use of radioisotopes in the treatment of blood diseases a quarter of a century ago. He also described current collaboration with Prof. Hurtado of Morococha, Peru, in investigating the more rapid rate of production of red cells in persons living in the Andes mountains compared with those at sea level.

Dr. Lawrence predicted that physicians will make increasing use of radioisotopes which lose their radioactivity very quickly, and therefore need not bombard a patient internally for a long period. He indicated that experiments will begin soon with oxygen-15, which loses half its radioactivity in two minutes. The California scientist indicated after the lecture that this radioisotope can be produced by pumping normal air through a pipe in a nuclear reactor, or high energy accelerator of nuclear particles, so that nuclear bombardment can make some of the stable oxygen atoms radioactive. The air can then be piped directly into a nearby room, to be breathed by a patient. Measurement of the amount of radioactivity present in the patient at differing time intervals sheds light on the use being made of the oxygen in the patient's metabolic processes.

Special Panels

Maurice Fried, of IAEA's Isotopes Division, chief of the scientific secretariat of the Mexico conference, posted a list of suggestions for subjects of special panel discussions. Six panels were scheduled on the topics in which scientific attendees expressed most interest.

One of the panels was on the subject of the availability and applications of new radioisotopes. One of the participants, S.A.R. Söremark, of the Royal School of Dentistry, Stockholm, Sweden, described experiments with iodine-125, used as a small source of radiation contained in a small silver capsule, slightly larger than a man's thumb. Gamma rays given off by the capsule can be used in place of X-rays where no source of electricity is available. He suggested using the device in remote areas or on ships.

Other panel subjects were: methods of calibration and standardization of the absorption of radioactive iodine by the thyroid gland; techniques for applying radioisotopes in blood studies; progress of methodology; comparative metabolism in farm animals; and radioisotope training programmes.

General Physiology

The first three regular scientific sessions were devoted to papers on general physiology. One series of papers described new information on processes by which a cow "manufactures" milk. North American scientists described an experiment in which carbon-14 was used to explain the synthesis of amino acids, which make up proteins in the udders of cows, and the role of fatty acids in the metabolic processes by which milk is produced. An Italian paper dealt with the use of calcium-45 in studies of lactation in rats. W.J. Visek (USA) presented a study relating to the overall growth of birds and mammals following the addition of anti-bacterial agents in their food.

Other papers described new investigations of components of the living cells. One of the components is called DNA (deoxyribonucleic acid), which is part of a basic genetic substance, the chromosome. Reports at the conference dealt with evidence that DNA passes on genetic characteristics to RNA (ribonucleic acid) and at the same time provides a template used in self-reproduction. Radioactive hydrogen (tritium) is used with increasing frequency to trace the series of biochemical and genetic processes involved in the life process of the cell, which is the building block for all living things.

Studies with carbon-14 of the less efficient utilization of oxygen in cancer cells as compared with that in normal cells were reported by Dr. Ramon Naranjo of the University of Guadalajara, Mexico.

The growth of wool in sheep, the origin of cancer in mice and the production of sperm in man were the subjects of papers by scientists from France, the UAR, and Israel, respectively.

Blood Studies

Incomplete understanding of the mechanisms which control the absorption of the physiologically important element, iron, in the blood prompted the scheduling of a session on haematology. A paper by Romulo Pieroni and his colleagues of the Sao Paulo Institute of Atomic Energy, Brazil, reviewed the use



Dr. F.N. Andrews (right) shown with colleagues at Purdue University, USA, next to a cylinder where animals exposed to radiation are placed so that detectors can measure the radiation present. Dr. Andrews described experiments using this equipment at the Mexico City conference

of radioisotopes of iron and other metals as tracers in diagnosis of blood diseases. The tracers make possible such measurements as blood volume, length of life of basic components of blood, the pathway of iron compounds, the location of production and destruction of red cells, and the absorption of vitamin B¹².

J.E. Varela and collaborators at the Hospital Rivadavia, Buenos Aires, Argentina, were authors of a paper on simultaneous studies (in patients and in rats suffering from polycitemia vera) of the role of iron in the metabolism of blood plasma.

Glandular Function

Studies of the function of the thyroid gland were the subject of several reports. P.H. Sorensen of the Danish Institute of Agriculture and Veterinary Studies, Copenhagen, described experiments which show that secretion of thyroid hormones decreases with an increase in weight in cattle, the reverse of the situation in a cow during milk production. He and his co-worker, J. Moustgaard, also determined temperatures most favourable to thyroid function. Other aspects of thyroid research utilizing radioactive iodine were reported by scientists from Argentina, France, the Philippines, Venezuela and the USA.

Mineral Metabolism

In the two sessions on mineral metabolism, French scientists told about rates and amounts of strontium-90 which concentrate in the organs of rats. A West German investigator reported on relationships between fatty tissue in hens and the elements calcium and phosphorus, identified through radioactive isotopes of these elements. Canadian scientists labelled

vitamin D with first one, and then another, of seven different radioactive elements; resultant data shed light on the role of the vitamin in calcium metabolism.



Dr. A.A. Kudriavtsev (left) of the Union Institute of Veterinary Research, Moscow, shown before his lecture on the use of radioisotopes in animal husbandry and veterinary medicine in the USSR. Right is Dr. Ribeiro Pieroni of Brazil, who introduced Dr. Kudriavtsev. Centre is Dr. Maurice Fried of the Agency's staff, chief scientific secretary of the Conference

Lactation and Ruminant Metabolism

The first paper in the two sessions on lactation and ruminant metabolism, given by Dr. Comar, had as co-authors W. Moore, Jr. and R.H. Wasserman, all three members of the Department of Physical Biology, Cornell University, Ithaca, New York. Other papers were given by scientists from Denmark, Italy, West Germany, United Kingdom and USA. The introduction to the Comar paper stated the general goals and specific research methods of related radioisotope research:

"In the general field of mineral metabolism there has been strong motivation for research during recent years because of the need to understand the behaviour of certain fission products in the animal body, in addition to the equally important need for knowledge of the normal metabolism of essential minerals

"This paper deals with three specific subject areas: gastrointestinal absorption of caesium-137; foetal transfer of caesium-137; and effect of dietary calcium levels on strontium-90 concentrations in

milk. These studies will also serve to illustrate some of the more recent techniques that are found of advantage, as for instance:

"(a) Use of radionuclides that have not generally been available until recently, such as calcium-47, iodine-125, strontium-85, magnesium-28; (b) application of multiple tracer techniques using various combinations of radionuclides and stable elements; (c) use of fall-out strontium-90 as a tracer;

"(d) Artificial maintenance of blood levels of certain radionuclides and other substances by continuous intravenous drip methods; (e) employment of isolated gut sacs and intestinal loops for controlled studies of absorption and secretion from blood to the gastrointestinal tract; (f) use of whole-body counting to study kinetics of assimilation and retention of minerals in preference to older methods of collection and measurement of excretions."

Clinical Studies

The use of iodine-131 to label albumen in studies of rate of blood flow through the compartments of the heart of patients suffering from cardiac diseases was described in a paper by C. Giunti and colleagues of the University of Pisa, Italy. Other blood studies were reported by scientists from Argentina and the USA, and thyroid studies by a group from the Sao Paulo Atomic Energy Institute in Brazil.

Five scientists from Hospital de la Raza, Mexico City, reported on their extension of a new method now being applied in different laboratories for using chromium-51 and iodine-131 as a means of establishing the degree and rate of penetration of anti-cancer drugs into cancerous tissue. Work with dogs preceded work with patients. A University of California scientist described the use of rubidium-86 in studies of cirrhosis of the liver.

Summing Up

In his closing speech, Dr. Gross said that the papers presented during the conference "have provided us with a well-balanced picture of achievements in the advanced and the developing countries alike and given proof of great advances made by the latter" in the field of the application of radioisotopes in biology and medicine.

Speaking on behalf of the three sponsoring agencies, WHO, FAO and his own, IAEA, Dr. Gross said that within the field of nuclear energy, the application of radioisotopes, particularly in biology and medicine, played a special role. "While nuclear power is still in the developing stage and so far regionally limited", he said, "isotope applications already bring enormous benefits to mankind on a truly international scale."