

DISPOSAL OF RADIOACTIVE WASTE IN WATER

As a result of a week's symposium on the disposal of radioactive wastes in seas, oceans and surface waters in Vienna (IAEA, 16-20 May 1966) it will now be possible to include a great deal of the world's knowledge on the subject in a single report.

Many papers were presented on the ways in which nuclides are transported in waters and their associated environments. These investigations had been carried out in many parts of the world by scientists from Austria, France, the Federal Republic of Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, USSR, UK, USA and members of the IAEA's Laboratory of Marine Activity in Monaco.

Reports on research during operating experience in France, Sweden, the United Kingdom and USA indicated that levels of radioactivity added to waters had been well below accepted international recommendations. Studies of actual effects on molluscs, several kinds of fish, fish eggs and small insects which breed in water had not, even in experiments conducted with higher levels of radioactivity than would be acceptable for effluent, revealed any markedly detrimental effects.

The general headings under which discussions took place were the physical and biological transport of radionuclides resulting from such disposals; the evaluation of the main routes of exposure to man; and possible effects on resources of seas, oceans and surface waters.

All the discussions concerned low-level wastes discharged in liquid form, these being the greatest part of radioactive disposals into waters. Delegates from twenty countries and five international organizations took part.

In general the scientists gave conclusive evidence that no measurable harm is being caused to the waters, but they also showed that there are differences of outlook. Scientists from the USSR, for instance, though agreeing that no difficulties are being caused now, show concern for future hazards. By investigations of fall-out contamination they have been able to give an estimate of water movements in the Black Sea, the Atlantic and the Indian Ocean. The Black Sea was of particular interest not only because it is a holiday resort and borders on four countries but because it is very deep and the water flow outwards is from the upper layers. It had been thought that these upper layers possibly had no contact, or exchange mechanism, with the bottom layers. Russian research found, however, that radioactive strontium and caesium (^{90}Sr and ^{137}Cs) have penetrated the deeper regions in low concentrations. There is thus some mechanism of vertical diffusion although no time scale or gross turnover has yet been discernible. From this they argue that there is no place completely free of exchange and that radioactivity put into one place is certain to move somewhere else. They also contend that the effect of low-level radiation on fish eggs will be to cause mutations and lower fertility rates.

On the latter point, W.L. Templeton (UK) had carried out extensive experiments with eggs of plaice and had not found a threshold at which results could be held to be significant. Indeed in some cases the irradiated eggs proved to be more stable. It was a disappointment that G.G. Polykarpov (USSR), with whom Templeton finds himself in friendly disagreement on some points, was engaged elsewhere and so could not present a paper on biological effects prepared by himself and colleagues.

B.G. Blaylock (USA) had been able to take advantage of an ideal opportunity to observe the results in 130 generations of insects living in the bottom sediments of White Oak Lake and White Oak Creek during 22 years in which varying quantities of waste had been discharged from the Oak Ridge National Laboratory. He found that the influence of radioactivity genetically had been very small. Mutations might have developed in each of the generations but had been recessive in character and had not been apparent in following generations. K. Bonham (USA) found that irradiated salmon proved better or more precocious than the controls.

In general the levels of irradiation in experimental work were much higher than would be tolerated in any disposal programme.

As a method of encouraging publication of environmental material the symposium will have extremely useful results. It included a fair amount of new material, as in the recording of seven years experience by the French of disposal into the Rhone from Marcoule. It was a demonstration to scientists and to laymen of the amount of investigation going on, the way in which nations are taking their responsibilities very seriously and of the amount of information being amassed. Those engaged in nuclear work involving disposal have generally started on a small scale and gradually built up their work from continuous observation of results. Another point demonstrated was that the characteristics which combine to make one environment (mineralogical, hydrological, ecological, human populations, etc.) show that each place has to be treated on individual merits. In Britain, for example, the discharges from the Windscale plant on the north-west coast are controlled by the concentrations of ruthenium in edible seaweed eaten in an entirely different location. Against this the discharges from the south coast centre at Winfrith are limited by the concentration of zinc in molluscs.

Extraction of radioactivity from waste material before the residue is disposed of by such methods as liquid effluent can be as high as 99.5%. To extract the remaining 0.5% could make nuclear programmes economically insupportable, and provides the cogent reason for exhaustive research.

In opening the symposium Professor A. Yagodin, the Agency's Deputy Director General for Technical Operations, described the subject as one that was both delicate and fraught with controversy. "It is of paramount importance," he said, "to ensure that radionuclides do not return to man in hazardous concentrations and that they should not be deleterious to natural populations of aquatic organisms."

Professor Yagodin also gave the concluding address, saying there had been much of interest in the reports they had heard, with a great deal of new material. It was clear that a massive attack was being made to try to

solve the problems of waste disposal from nuclear sources in water. The methods of research were extremely sophisticated and contained much to be admired. Research would continue, and the Agency believed it was in the interest of all human beings that it should have priority. The Agency would always be ready to assist in any ways possible.