DOSAGES FROM NATURAL RADIOACTIVITY AND COSMIC RAYS

THE radiation dosages that people receive from the natural radioactivities and cosmic rays have been calculated and listed by W. F. Libby in an article reported in *Science* (1955, **122**, 57).

The dosages in milliroentgens per year for exposures directly over ordinary granite, typical sedimentary rock, and open oceans vary from 50 to 150. For comparison purposes, it is interesting to note that in the United States, the average exposure rate from total fallout from atomic tests on 1 Jan. 1955 was about 1 mr./yr. The total dose during 1954 probably averaged about 15 mr, principally because of the Pacific tests in the spring.

The dosage resulting from cosmic radiation was calculated from ionization chamber data, and from these the dosages were calculated at altitudes up to 20,000′ and at the latitude of 55° N. (geomagnetic) as well as at the geomagnetic equator. The cosmic ray dosage at sea-level varies from 33 to 37 mr./yr. It should be mentioned that the biological effects per unit energy may be larger for cosmic radiation, because it consists of high-energy particles rather than gamma radiation.

The natural radioactivity in the human body also contributes an appreciable dosage. A value of 19 mr./yr. is due to potassium; carbon contributes 1·5 mr./yr., while the minute amount of radium present in the human body produces a dosage of more than 50 mr./yr. It is estimated that the hard gamma rays of potassium contribute about 2 units out of the 19. This leads to the interesting result that in a packed crowd the radioactivity from the potassium in one's neighbours' bodies contributes an additional dosage of 2 mr./yr.

It is found that various ordinary, but somewhat unusual circumstances in normal living produce exposures far in excess of the quantities mentioned above. A wrist watch worn 24 hr/day that has a luminous dial assumed to have 1 microcurie of radium per watch—a figure perhaps slightly larger than the average—would give the central body including the sex organs, a dosage of about 40 mr./yr. An airplane pilot flying a 24-hour-day with an instrument panel consisting of 100 dials with 3 microcuries of radium each would receive, at an average distance of 1 yard, a dosage of 1300 mr./yr

Dr. Libby has also checked whether the dosages calculated and listed by him are essentially correct by comparing them with some direct measurements reported by various observers. It is interesting that the variations in natural dosage are large, and that under certain conditions the natural dosage may be nearly 100 times higher than the minimum—the dosage of sea-farers. The fallout dosage rate in the United States on 1 Jan. 1955, namely, 1 mr/yr., was only 2% of this lowest natural dosage rate. Of course, during a test period when bombs are fired, the fallout dosage rates may approach, or somewhat exceed, the natural dosage rate for a few days before decay, but weathering processes will reduce them in a few weeks to rates that are small percentages of the natural background.

ATOMIC POWERED X-RAY MACHINES

ATOMIC-POWERED X-ray machines, which require no electric power for operation, developed at the U.S. Army Medical Research Laboratory, Fort Knox, Kentucky, were described at the Geneva Conference on Peaceful Uses of Atomic Energy.

Recent advances have made a 22 lb. unit possible. The new unit is powered by a tiny pellet of radioactive thulium metal, smaller in diameter than a pencil eraser, and only about 2 mm. thick. Thulium is refined into pure metal and then activated in a modern reactor. A small opening in the lead shield permits the rays to come from the machine when a thin gold shutter is released. The rays from the unit are available 24 hours a day and the tiny pellet is good for about one year, after which it can be reactivated in a reactor.

A second type uses radioactive strontium. The beta particles emanating from it are directed toward a metal disc or target, where they are converted to X-rays. Work in this field is presently directed toward designing a machine weighing less than 10 lb. and usable for about 20 years without recharging.

Pictures taken with present atomic X-ray machines are without doubt inferior to those taken with modern X-ray machines that require electric power. However, tests show that the isotopic X-ray machines are good enough at present to locate bone fractures and any foreign bodies such as pieces of metal. Considering the rapid strides that are taking place in atomic research, the future of the atomic X-ray machine looks very promising.