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Hayne Lange Assistant to Manager OAK RIDGE OPERATIONS	Steve --- Attached for your files are copies of the original press summaries by Dr. John Storer and Arthur Small. We will rewrite these here and forward them shortly. We presume the photos and biographical sketches will be forthcoming from ORNL soon.
PHONE NO. 3 4231 / DATE June 15, 1971	

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PRESS SUMMARY
Storer - Geneva Paper

INCONSISTENCIES IN RADIATION RESULTS STUDIED

Because of the required prolonged period of study, new data on the long-term effects of exposure of man and experimental animals to ionizing radiation are accumulated slowly. Because the problem is under continuing review by various scientific committees, this paper is concerned primarily with the following questions: 1) Are the data from the various human populations consistent with one another? 2) Is there general agreement between the human and experimental studies? 3) Are the methods used in interpolation to risk at low doses and dose rates both internally consistent and consistent with well-established principles of radiation biology?

Studies of the Japanese survivors of the bombings, patients who were irradiated for ankylosing spondylitis in Great Britain and Northern Ireland, and radiologists and their technicians give evidence that is somewhat conflicting. The reasons for this lack of consistency should be considered.

On the basis of animal experiments one would expect life shortening in irradiated human populations, as in all the studies where high radiation doses have been employed, the animals have shown a loss of longevity. It is not clear then why the data for effects of radiation on longevity in man are conflicting.

The effect of low total doses has not been extensively investigated because the sample sizes needed are so large that the experiments are not feasible. There are some cases where it appears that certain cancers may be increased by doses of a few hundred rads, but the yield to date is insufficient to make a risk estimate.

The anticipated effects of radiation in the low dose range are based on an interpolation between the observed effects at high doses and the control or zero dose incidence. Retrospective studies have also been performed on the relation between prenatal exposure to low x-ray doses and childhood tumors, and have usually suggested a positive association. Prospective studies, however, have

1125431

been negative. Furthermore, retrospective studies performed on the prenatal children mentioned above were entirely incompatible with similar studies performed on the Japanese bomb victims. It seems fair to say that the issue is in doubt at present, and further work is needed.

The Japanese studies lead to the conclusion that for gamma rays delivered at high dose rates the dose-response curve must be curvilinear with increasing slope at increasing doses, since the low doses yield a smaller proportion of multihit injury.

Certain general principles have emerged from animal experimentation that are consistent with the data for human populations. Among them are: Not all tumor types are radiation-inducible; there is usually a marked decrease in effectiveness of gamma rays when the doses are protracted; the various radiation-inducible tumors have quite different dose-response curves; neutrons tend to be more effective on a dose-for-dose basis than gamma rays; and immature animals may be more sensitive than adults.

It must be noted that in the methods used by committees that recommend exposure standards there are two principal inconsistencies: The first concerns dose rate effects. Radiation protection guides are given in terms of dose rate, i.e., so many millirem per year. Yet, in deriving upper limit estimates of risk for late effects, no credit for dose rate is admitted. A second inconsistency arises from assigning high values of relative biological effect (RBE) to high linear energy transfer (LET) radiations. If risks increase linearly with dose of low LET radiation, and there is no dose rate effect, then it follows that the relevant injury is produced principally by single-hit events. If this is true, then the RBE for high LET radiations should be less than unity, since most of their ionizations would be wasted. The inconsistency is the assumption of linearity at high dose rates and no dose rate effect for low LET radiation.

In the case of both of these inconsistencies, some modifications of the conflicting premises would seem to be indicated.

1125432

TWO LEADING RESEARCH REACTORS EVALUATED

In a survey of two of the world's leading high-neutron-flux research reactors, A. H. Snell, associate director in charge of basic physical sciences at Oak Ridge National Laboratory, stated that in the five years since they were built, both reactors have demonstrated that high-flux reactors can provide otherwise unobtainable information for a great deal of research in the transuranic elements, in nuclear physics, and particularly in solid state physics.

The two reactors under discussion are the High Flux Beam Reactor (HFBR) built at Brookhaven National Laboratory in 1965, and the Oak Ridge High Flux Isotope Reactor (HFIR) which went critical in 1966.

In the past year, Snell said, the HFIR has produced a record amount of 20- mg of californium-252, establishing Oak Ridge as the principle provider of this isotope.

In evaluating their first few years of performance, Snell differentiated between the two facilities by saying that the Brookhaven Reactor uses its high neutron output primarily for external beams, in which solid state and low-energy physics research is mounted. The Oak Ridge reactor, with its extremely high (up to 1.2 $n/cm^2/sec$) neutron flux directed toward its center target area, was designed primarily to produce transplutonium isotopes. Both reactors operate by burning uranium-235, in a fuel cycle of about 19 days.

The HFIR began in its early years bombarding targets made of plutonium-242 provided by the Savannah River Laboratory. Recently it has started using curium-244. In creating new elements and new isotopes, HFIR provides a basis for research in many sciences and many laboratories. As sources of neutrons, the HFIR isotopes constitute research materials of wide usage and application, Snell pointed out.

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One of the neutron beams from the Brookhaven reactor is rich in neutrons with energies above the most common thermal energies. This beam is sent through a thick, slotted rotor, so that it is chopped into successive pulses of neutrons. After a flight path of some meters, the neutrons are sorted as to energy by their time of arrival at a remote detector. This arrangement furnishes a wealth of experimental information for resonance capture studies when appropriate samples are interposed. Combined as it is with the modern technological innovations of on-line computers and high resolution radiation detectors, it offers a highly sophisticated arena of study for nuclear physicists.

Sources of slow neutron beams, said Snell, are of great value to the study of solid-state physics, i.e., the study of the atomic structure of high-purity crystals. Three characteristics of these beams made this so: First, the neutron wavelengths are comparable to crystal lattice spacings, enabling the neutrons to be used for structure analysis. Second, their energies are comparable with the atomic binding energies in crystals, enabling them to excite characteristic lattice vibrations. And third, the magnetic moment of the neutrons permits interaction with atoms of paramagnetic, ferromagnetic and antiferromagnetic substances, revealing magnetic structures and lattice dynamics associated with magnetic activity.

Both of the research reactors make use of triple-axis spectrometers, in which the neutrons are first intercepted by a monochromating crystal which selects only those of a specific energy; the selected neutrons then impinge on the sample under study, situated on the second axis. As they scatter from this sample, they are analyzed for both direction and energy by a third crystal on still another axis. The intensity of the beams, Snell pointed out, permits useful counting rates even after triple scattering.

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