

Summary and Conclusions

AUSTIN M. BRUES

IT IS difficult to make a synthesis of this symposium. It was not one that revealed striking new facts or theories. As indicated in the introduction, the several speakers were allowed freedom to treat whatever aspect of the effects of low-dose radiation fell within their fields of competence. This has resulted in a document which, while it may lack continuity, indicates in a very revealing way the attitudes and the problems of persons in very diverse relations to society, but all thoughtful persons of influence.

The first two papers reflect different emphasis because of the nature of their topics. Dr. Dudley, whose assignment was to discuss man's radiation background, accordingly dealt mainly with natural, cosmic, and elemental radiation and with radiological exposures, by far the major components; and Dr. Machta, as a meteorologist, discussed mainly fallout from weapons tests and the extrapolation of this to the military employment of weapons. Two other important subtopics, namely the routes whereby globally deposited radioactivity reaches its depot in man and the meteorological aspects of reactor effluents and reactor accidents, were therefore discussed only by implication. The reader must recognize that these, too, are important areas of future research.

Dr. Green and the editor approached the problem from the standpoint of the nature, solubility, and pertinence of the questions being asked about low-level radiation effects. It appears that we both concluded that while direct experimentation may sharpen our knowledge somewhat, only an accumulation of basic information in the so far experimentally inaccessible areas of population genetics, carcinogenesis, and senescence would finally solve the implied practical problems. We also lent emphasis to the fact that

a balancing of benefits or a calculation of risks must be carried out, since even if low-level irradiation should be intrinsically harmful, exposures are usually incurred to accomplish some, more or less measurable, benefit.

Against this scientifically and factually indefinite background, those who spoke on the implications limited themselves in general to their own particular areas. Dr. Price gave a wise analysis of the responsibilities of public health organizations in relation to radiation, but said little about the fallout problem. Mr. Snider, on the other hand, gave a penetrating analysis of the public relations problems in this area, and was evidently oriented in the main to the fallout question. This talk was oriented mainly to the equating of the two-valued question—whether or not radiation is harmful—and in this way served to point up a major problem existing at present: the extent to which a many-valued scientific investigator can express himself in the media that are oriented to a popular two-valued ethic.

Mr. Holifield presented, perhaps, the most balanced paper of the series. Quite nonpartisan in its nature, it discussed freely the problems arising in the legal and legislative area. Dr. Churchman concluded with a novel approach to the dilemma of the scientist drawn into a discussion of a subject having political implications. He said, in effect, that the proper province of science is to perpetuate itself—he left open many questions, chief among which is whether the scientist should pursue a line of investigation that might bring discredit on scientists as a whole.

* * *

During the months intervening since this symposium was held, an additional body of information and opinion has accumulated. None of this material appears to alter in any important respect the conclusions of the symposium.

The United Nations Scientific Committee on the Effects of Atomic Radiation issued a report (1958) on the status of this subject. This Committee was constituted by the General As-

sembly and is composed of delegates from 15 nations. The report covers essentially the same subjects as appear here, with the addition of a chapter concisely summarizing basic radiation biology; in addition there are annexes—some voluminous—to each of the chapters. Of particular note are calculations of mean radiation dosages to the bone marrow and gonads of man and tabulations of data on human radiation injury and genetics. Under the stimulus of the United Nations Committee there has been a worldwide broadening of interest in radiation biology and of measurements of the natural and artificial radiation background. The World Health Organization and other agencies of the United Nations have shown an increased activity in this area; WHO has issued the report of a symposium on the Effect of Radiation on Human Heredity (1957), and has explored the nature and origin of emotional responses to radiation and their possible impact on the peaceful uses of atomic energy (1958). In 1959 the Subcommittee on Radiation of the Joint Congressional Committee on Atomic Energy under the chairmanship of Mr. Holifield held further hearings to update the detailed information given in its 1957 report and publication of this more recent testimony is to be anticipated shortly.

Along with further measurements of the natural radiation background there has been some amplification of studies to determine whether geographical variations are related to any determinable variations in disease patterns. The approach to this through examination of populations exposed to different levels of radium has been outlined by Marinelli (1958). Public concern about radiation has given rise to an enlivened interest in the difficult field of geographic pathology. There has also been increased activity in studies of populations subjected to radiologic procedures.

Since the symposium there has been a gradual increase in the radiation background from global fallout. This increase has sharpened since October 1958, at which time some weapons tests appear to have been held at a high latitude. This is attributed to

an increased rate of clearance of contamination from the stratosphere at such latitudes, bearing out a prediction by Machta (p. 33).

As pointed out by Dudley (p. 7), while major attention has been given to fission product irradiation resulting from fallout, power generation by nuclear fission is equally important as a potential source. The one striking instance of widespread contamination from a reactor mishap occurred at Windscale just before the symposium, and resulted in the confiscation of certain milk supplies. This accident and the resulting contamination were described in detail by Dunster *et al.* (1958) in the *Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy*. These volumes are a rich and recent source of further information on radiation biology and radiological physics.

REFERENCES

- Dunster, H. J., H. Howells, and W. L. Templeton. 1958. District surveys following the Windscale Incident, October 1957. *Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy*, 18:296.
- Marinelli, L. D. 1958. Radioactivity and the human skeleton. *Am. J. Roentgenol.* 80:729.
- United Nations General Assembly. 1958. *Report of the United Nations Scientific Committee on the Effects of Atomic Radiation*. United Nations, New York.
- World Health Organization. 1957. *Report of Study Group on the Effect of Radiation on Human Heredity*. Geneva.
- World Health Organization. 1958. *Mental Health Aspects of the Peaceful Uses of Atomic Energy*. Geneva.