

Dispersing the clouds

James F. Crow

The Children of the Atomic Bomb Survivors: A Genetic Study. Edited by James V. Neel and William J. Schull. National Academy Press*: 1991. Pp. 530. \$49.95 (hbk), \$29.95 (pbk).

As soon as the atomic bombs exploded over Hiroshima and Nagasaki, and well before this time for insiders, geneticists were concerned about the genetic effects on the survivors of the bombings. Yet no one had much idea of the possible magnitude of such defects. Most of what was known was based on experiments with the fruitfly *Drosophila*, a dubious basis for extrapolation to man. This concern prompted a large-scale study of the Japanese survivors and their children.

Planning for the project began early in 1946 and the study started in 1948. The Japanese had already begun to look for abnormal births, and from the beginning the research has been done jointly by Japanese and Americans. The original organizing commission, chaired by George Beadle and including H. J. Muller, cautiously noted that the study could well be inconclusive but argued that this unique opportunity should not be lost.

This volume contains reprints of 13 papers, originally published between 1947 and 1991, presenting the results obtained in the genetic study. To these, James Neel and William Schull have added an analytical introduction and an epilogue. A welcome inclusion is the extensive 1956 report, long out of print. The assemblage makes up a hefty tome and gives more details than most readers probably want. Yet the conclusion of the studies can be stated simply: no genetic effects were detected.

The incidence of the various indicators of genetic defects — stillbirths, infant deaths, large congenital malformations, later deaths (up to the age of about 26), cancer, chromosome rearrangements, sex-chromosome aneuploidy, and altered sex ratio and electrophoretically detected proteins — was not significantly changed, either individually or collectively. One reason is that, although some 70,000 children were studied, the radiation dose in the exposed group was not large: the average total dose to both parents was estimated as 0.36 sievert (36 rem to us oldsters). Another reason is that each indicator is affected by many

other factors, so radiation effects could be lost in the noise.

Although the data do not permit any estimate of the lower limit for genetic effects (the confidence limits all include zero), they provide useful upper limits. In one recent paper, Neel and Schull estimate the 'doubling dose' (the amount of radiation required to equal the spontaneous mutation rate per generation) as about 2 Sv for acute radiation and 4 Sv for chronic radiation (background radiation is about 0.001 Sv per year). These numbers are higher than those for mice, but, given the uncertainties, are not inconsistent.

Neel and Schull worry that early exaggerations led survivors to fear for their

dependent and -independent mutations, the doubts about the spontaneous mutation rate in female mice, and the differences between human and mouse oocyte physiology. But regardless of this quibble, the important conclusion, whether one uses mouse or human data, is clear: exposure to low doses of radiation comparable to the background radiation presents very little risk to future generations.

On reading this volume, and especially on rereading the full 1956 report, I was again impressed by the size of the effort and the great difficulties encountered by the US and Japanese scientists, and by the remarkable cooperation of the Japanese subjects. Neel and Schull

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Survivors of the atomic-bomb attack on Hiroshima queuing for treatment.

children, emphasizing as a salutary accomplishment "the dispersal of the ugly clouds which for a period were a serious impediment to the marriage of their children". It might be added that the somatic effects, although statistically real, are small relative to immediate deaths. The total number of excess deaths from cancer so far is a few hundred compared to more than 100,000 immediate deaths.

The last reprinted paper is an attempt to rationalize a seeming discrepancy between the doubling dose in man and mouse. Although the use of the spontaneous mutation rate as a convenient yardstick for describing human risk makes good sense, comparison between mouse and man is less defensible: complications arise from the much shorter life spans of mice, the differences between male and female human mutation rates, the mixture of replication-

emphasize that, contrary to recurring rumours that the US Atomic Energy Commission tried to influence the earlier studies, they were never "aware of any political pressure meant to influence the organization of the study or the way the data were analyzed". Although the book gives a great deal of the history of the project, those eager to learn more will soon be able to read a fuller account recently completed by Schull. I look forward to seeing it in print. □

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Addendum

Aids in Africa: Its Present and Future Impact by T. Barnett and P. Blakie is published in paperback by Guilford Press in the United States and Canada, price \$18.95. For review, see *Nature* **356**, 393 (1992).

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