New A-Bomb Data Shown to Radiation Experts

Conference goers are impressed with the revised picture of Hiroshima, but foresee little change in risk estimates

Minneapolis. Physicist William Loewe spoke at the annual meeting of the Radiation Research Society here on 31 May and gave the first public presentation of the work he and Edgar Mendelsohn have done at the Lawrence Livermore National Laboratory. They have drastically revised the estimates of radioactive fallout from the Hiroshima and Nagasaki atomic bombs. The most important single finding they reported was that no neutron radiation of any statistical significance was present at Hiroshima, suggesting that nearly all the bomb-related cancers were produced by gamma rays. If correct, this means there are no good human data for judging the toxicity of neutron radiation.

The audience was receptive, and several old hands said they found Loewe's work impressive. No general consensus was reached on whether or not Loewe's data should replace the old estimates of atomic radiation prepared in 1965 by John Auxier of the Oak Ridge National Laboratory.

Most of the participants agreed on one thing, however: they were unhappy with the way the news of the possible revision was reported, and they were annoyed by the interpretation given by University of Pittsburgh epidemiologist Edward Radford, who has said that it may be necessary to double or quadruple the risk figures for getting cancer after exposure to radiation (*Science*, 22 May, page 900). Speaker after speaker echoed the theme sounded early in the meeting, that not enough work has been done to permit a conclusion such as the one Radford reached. Harold Wyckoff, chairman of a task force created in 1976 expressly to review this problem for the National Council on Radiation Protection and Measurements (NCRP), said, "I would strongly disagree with anyone using this data to determine risk coefficients." It is too early to do that, he said.

Loewe agreed that it would be wrong to draw broad conclusions based on his preliminary work, but he did tell the Minneapolis *Tribune* that he thought the new data will have a negligible impact on risk figures. Others, such as Warren Sinclair, president of the NCRP and an organizer of the meeting, were stronger in their denunciation of Radford, suggesting that the new Livermore data may even make radiation look less harmful than before.

If the sponsors of the meeting were unhappy with the way Loewe's work was presented to the public, other members were as unhappy with the way the information had been circulated (or not circulated) within the community. Perhaps the most outspoken was Seymour Jablon, the National Academy of Sciences' staff officer for joint U.S.–Japanese research on late effects of atomic radiation. He is a veteran observer.

Jablon rose during the general discussion to make three points. The NCRP has known since 1976 that there might be flaws in the Japanese data, he pointed out. "Meanwhile, the EPA is busy setting [occupational radiation] standards; other people interested in standards have been making noises. It really is urgent that we get on with this job. . . . Given the unique experience at Hiroshima and Nagasaki and the tens of millions of dollars which have been spent trying to accumulate the human biological data, it really is appalling to think that we stand here, 36 years later, debating orders of magnitude in the doses." He pleaded with federal officials present to give aid to complete the research quickly and shore up the $100 million investment in Japanese data.

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Second, Jablon said, "I think it's going to be absolutely necessary in this murky situation that any dosimetry system that is finally decided upon be reasonable in terms of biological influences that we know about. . . . And since the problem is of wider scope than merely physics, perhaps it would be advisable to consider adding some biological expertise to the [NCRP] task force."

Third, Jablon said, "I think that the way this whole problem developed is very unfortunate. Most of us, certainly I, heard about the problem . . . by word of mouth. The next thing was to receive pieces of paper which were not for publication, quotation, or citation. . . . I am told the Japanese Diet is about to have a debate on the subject, and still there is nothing published that one can point to and rebut or accept or whatever."

NCRP President Sinclair responded by saying that there was already one biologist on the NCRP task force, and that he would consider adding more when an attempt is made to extrapolate health effects from the bomb data. One of the physicists who has been at work on the problem the longest, George Kerr of Oak Ridge National Laboratory, said that he thought the data had not been published sooner because they were not strong enough to stand up to peer review. (Two relevant papers have now been submitted to *Health Physics* as technical notes: "Revised dose estimates at Hiroshima and Nagasaki," by Loewe and Mendelsohn, and "Implications of new Hiroshima and Nagasaki dose estimates: Cancer risks and neutron RBE," by Tore Straume and R. Lowry Dobson.)

Radford, who is not a member of the Radiation Research Society, skipped the meeting. He expressed disappointment, however, at the attitude that "we can't say anything until we have everything in hand," as he described it. According to Radford, that attitude can be used to delay reaching any conclusion: "It's what the tobacco industry did for years with the epidemiological evidence relating cancer to smoking. They just said,

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'Well, that last study wasn't perfect, so we'll ignore it.' "

The net effect of the new research, Radford insists, is not hard to summarize: the radiation data for the two cities of Hiroshima and Nagasaki are now likely to come out looking very similar. "You can state that as a general principle," says Radford, "and I do state it. That being the case, they confirm the fact that it was primarily gamma rays that produced the cancers, and that the neutrons, for all practical purposes, contributed so little that they're not important."

Radford believes that the Livermore data strengthen his argument that a linear no-threshold model is the correct one for describing the carcinogenic effects of exposure to low levels of radiation. And if this is correct, he says, the risk estimates published by the National Academy of Sciences in its 1980 report on the Biological Effects of Ionizing Radiation (BEIR) should be restated. He thinks the risks for contracting fatal cancer from radiation should be doubled. He would fix the risk at 250 to 500 excess deaths per rad of increased radiation per 1 million people, not 100 to 250 deaths, as he says BEIR and other documents have fixed it. Radford would also like to see the risks stated in terms of cancer incidence, not mortality, so as to recognize that real injury is done by cancers which do not necessarily kill. Including these figures, Radford says, would make it necessary to further raise the main risk coefficient used in the BEIR report.

Loewe did not discuss Radford's interpretation at the meeting, except to say that he could not understand how such views could be supported. Loewe said he did not see how one could draw a straight line through the old or new radiation effects data. Indeed, two scientists from Livermore who have been working in conjunction with Loewe, Tore Straume and R. Lowry Dobson, presented a paper suggesting that the new bomb data may lower the risk estimates for low doses of gamma radiation. They, too, were skeptical of all that Radford had said.

So many variables have been cited in this controversy that it may be worthwhile explaining just which data belong to whom. Radford, first of all, has done no new research on this issue. He is an epidemiologist with strong opinions on the subject, and he has seized upon Loewe's work as fresh evidence to support his view that many documents understate the hazards of low-level radiation. Radford also says that in defending this outlook he is working against the professional bias of health physicists, which, he claims, is to minimize the dangers of radiation.

Harald Rossi is a Columbia University biophysicist who challenged Radford's views as alarmist when both were serving on the BEIR committee. (Radford was the chairman.) Rossi argued that the hazards of gamma radiation were exaggerated, and he cited the Japanese bomb data to support his case. As part of this thesis, Rossi put forward the idea that many of the fatal cancers at Hiroshima had been caused by neutrons, not gamma rays. Neutron radiation is found rarely in nature, and as a practical matter it is of concern only to people exposed to nuclear weapons and the innards of operating nuclear plants. Rossi's work prompted the NCRP to send out a special advisory to weapons laboratories warning them that their safety standards might be inadequate because neutrons might be more dangerous than had been thought. That was 3 years ago.

Loewe and Mendelsohn were swept into this debate in 1979 because they worked at Livermore, a weapons lab, and were concerned about the NCRP advisory. Livermore did not change its safety standards, but it did finance some computer work by Loewe and Mendelsohn, who attacked the evidence for Rossi's thesis. Their calculations, now made public, do not demonstrate that neutrons are safe. They simply show that neutrons were so scarce in the Japanese blasts that one cannot measure their effects with accuracy. At the same time, the Livermore work significantly *increases* the estimate of gamma radiation in Hiroshima and slightly *decreases* the gamma radiation in Nagasaki.

Using this data, Dobson and Straume have made preliminary new estimates of the toxicity of gamma and neutron radiation. Their paper concludes, among other things, that if one uses the total cancer deaths as a guide, low doses of gamma radiation look less harmful than before. (Other statistical guides produce different results.) They also suggest that it may still be possible to blame the small number of neutrons in Hiroshima for many of the cancer fatalities. Asked about this part of the Straume-Dobson paper, Rossi said he considered it just "an interesting exercise," no more. He believes that if the Livermore data are correct, they will make it impossible to say anything conclusive about neutrons in Hiroshima.

An important caveat applies to all of the recent work on radiation in Japan: it does not include corrections for changes in the shielding provided by buildings or by body tissue. According to Jess Marcum, a contractor for Oak Ridge for a review of the data, significant revisions of the Livermore dose estimates may be necessary before one can reach a conclusion on toxicity. Marcum says he has spent about 1 month researching shielding by buildings and has discovered that the estimates of gamma doses in many cases will have to be lowered. In the area of interest, 1000 to 1700 meters from the epicenter of the blast, Marcum calculates that indoor gamma ray doses will have to be reduced by a little more than 60 percent. The net effect, he believes, will be to make gamma doses for individuals in Hiroshima about the same as in the old estimates produced at Oak Ridge in 1965, while the Nagasaki doses will be lower than the 1965 figures.

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In addition, George Kerr of Oak Ridge is recalculating the shielding effect of body tissue for certain "target" organs such as the breast, thyroid, colon, and so on. Marcum reports second hand (Kerr is in Europe) that the net effect of this final adjustment may be to produce no change in the leukemia risk factors for the two cities, but to increase slightly the risk for breast cancer, bringing the latter into agreement with U.S. medical data on breast cancer caused by x-rays. If true, this is an "extraordinary conclusion," Marcum says, because it will give credibility to the research done by Loewe, Marcum, and Kerr, as well as to the Japanese epidemiological data.

One of the few things that is clear in all this is that Livermore's research has irreversibly toppled the status quo. It also seems clear that the federal government would be well advised to finance the work necessary to bring a new estimate of radiation dosimetry into focus as quickly as possible.—ELIOT MARSHALL