he discovered that carbon dioxide can be used as a gas in a proportional counter, provided it is extremely pure. Carbon dioxide counters are now used in almost every carbon-14 laboratory. Their greatest advantages over counters with solid carbon are their much higher efficiency, which makes possible the use of much smaller samples, and the fact that they can be filled easily and accurately. Further, de Vries developed methods of purifying the gas in little more than one hour. His thorough analysis of the background of the counter led to effective measures for its reduction and to a correction for fluctuations in its intensity. Much attention was always given to the chemical pre-treatment of the samples. Especially in old samples, the possibility of contamination with recent carbon was always carefully investigated. Very often de Vries went to dig out his samples himself, even to North America, in order to be absolutely certain that the samples were not, through injudicious treatment, contaminated by recent carbon.

De Vries contributed to many investigations of archeologists and geologists, not only by dating their samples but also by actively engaging in their research. His own particular interest, of late, lay in the chronology of the climate of the last glacial period. He published many new facts about this in the last year of his life.

Besides his study of the "macro"-climate, de Vries discovered a remarkable correlation between "micro"-climate (that is, temperature fluctuations within a period of about 100 years) and fluctuations of ± 1 percent, with respect to the average, in the carbon-14 activity of the last 400 years. Although this made many datings of more recent samples less reliable, on the other hand it did explain some serious discrepancies.

De Vries often saw his scientific work as a game, but he played this game with the utmost concentration, its rules being the laws of nature. He used these laws in a way which clearly demonstrated how they had become a part of him. His ways of dealing with physical problems provided an example worth more than many a neatly prepared lecture. He disliked all ostentation, to such a degree that in lectures he often glossed over his own achievements. His untimely death is a great personal loss to many scientists all over the world.

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Science in the News

Radiation Standards: Testimony at Congressional Hearings Tends To Be Reassuring

Despite some differences in emphasis there appeared to be a broad agreement among the several dozen scientists who appeared at the radiation hazard hearings ending last week that the risks involved at present levels of exposure are quite small compared either with other hazards of modern life (cigarettes, air and water pollution, and automobile accidents, to name three) or with the benefits derived from the use of radiation.

The testimony, before the Joint Committee on Atomic Energy, emphasized that there are substantial uncertainties about the amount of harm, if any, that is likely to result from the low dose rates to which people are now being exposed. Because of this the witnesses agreed that it was prudent to take steps to see that exposure is kept as far below the recommended "guidance levels" as practical. There were differences of opinion over just how much concern is justified over the probable damage stemming from current exposure rates, but none so sharp as to lead anyone to suggest that the Radiation Protection Guides proposed last month by the Federal Radiation Council need to be revised downward. These guides, it was repeatedly pointed out, do not represent danger points but only control points below which the likelihood of any individual being harmed is believed to be so small that any reasonable increased use of radiation that promises some benefit should be permitted. The current level of exposure for the general population was estimated to amount to 10 percent or less of these guidance levels, and there appeared to be little likelihood that the general level of man-made radiation would climb near the over-all guidance levels in the foreseeable future.

The guides apply to all man-made radiation, including fallout, with the exception of medical uses. These medical uses were said to account for 90 percent or more of the exposure to man-made radiation, but since their contribution to the health of the public far outweighs the most pessimistic estimates of the incidental damage from them they cannot be considered a health hazard in the sense that other exposure to radiation is so considered. In any event, whether to take a given x-ray was felt to be a matter to be decided by the physician handling the individual case. But it was pointed out that improvements in x-ray technique and equipment could probably reduce the incidental hazard for both the physician and patient by 10 percent, and perhaps considerably more, without in any way limiting the benefits. A reduction of this size would probably be equivalent to the complete elimination of all other man-made radiation.

Radiation Protection Guides

Based on statements such as the report of the National Committee on Radiation Protection which appeared in the 19 February issue of *Science*, the method for calculating the radiation guides appears to be this: You assume, first, that there is no threshold level below which radiation is harmless; second, that the probable effects are directly proportionate to the dose; and third, that the damage from chronic exposure to low dose rates will be the same as for a dose of the same total size accumulated at a high rate in a short

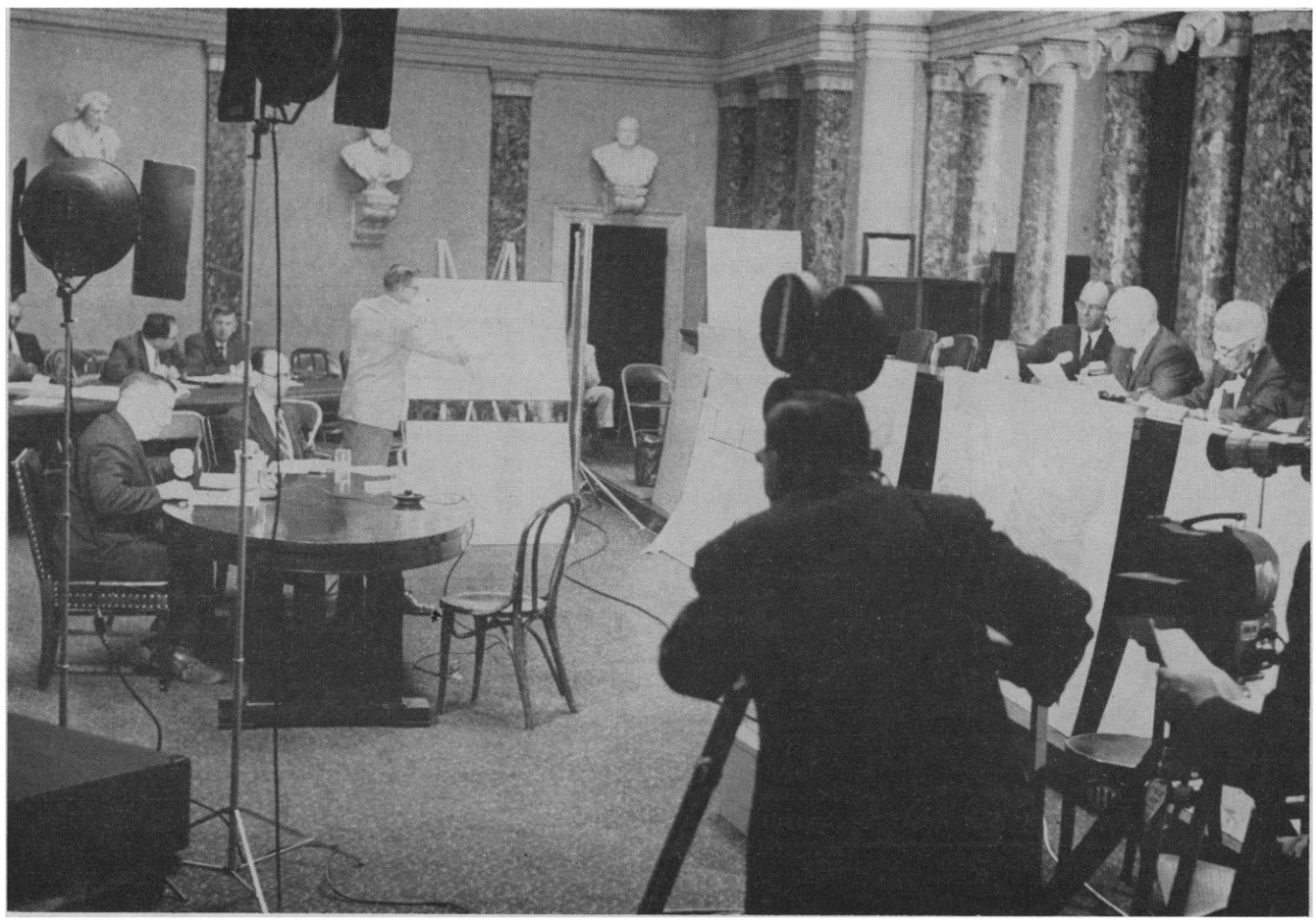
time. All of these are considered to be the most conservative reasonable positions. You then extrapolate conservatively from the available data, all of it based on high dose rates or acute doses, since studies of groups exposed to comparatively low rates have not yet turned up any clear evidence of damage. You then try to calculate a dose rate where it will be very unlikely that any given individual exposed to such a rate over a period of many years will suffer any discernible damage. You then, apparently, take this figure and compare it with the state of technology. If it is high compared to the limits of radiation that can be demanded without stunting the growth of beneficial uses of radiation, you lower it some more to add an additional margin of safety and because you do not want to encourage laxness by setting the standard so high above current levels that people are led to think there is nothing at all to worry about. You thus arrive at a number which you set as the control point for radiation workers.

To set a guide for the population at large, you divide this number by ten, partly because you do not want to expose the general population to as much risk, however low, as radiation workers are exposed to, but more importantly because there is evidence to indicate that children are more sensitive to radiation than adults, and, in any case, they have more time prior to parenthood to accumulate a genetically significant dose. All of this, much simplified, is how the guides seems to be set, and why the scientists who set them seem to be concerned lest they be misinterpreted as absolute limits which must under no circumstances be exceeded.

Problem of Research

Nearly everyone who appeared before the committee had some suggestions for further research. The difficulty was that while everyone agreed that he would like to have more precise information on the risks involved at various levels of exposure, it was also agreed that most of the desired information could be obtained only through extremely elaborate statistical studies which tend to be expensive and, unless carried out with great care and competence, of questionable value. The reference to expense, it was made clear, was not meant to be merely in terms of dollars, but also in terms of making the best use of the limited scientific talent available for this work.

The difficulty, it was pointed out, is that if you are looking for an effect that is probably going to show up only a few times in a million cases, you obviously must work with very large numbers merely to bring your probable error down below the level of your expected deviation. The committee was told, for example, that the U.N. team studying the genetic effects of the high level of natural radioactivity in Kerala, India, is doubtful whether they will come up with any clear statistical evidence of an increase in the mutation rate, despite the fact that they are working with a sample of 80,000 people whose ancestors for many generations



The Joint Committee on Atomic Energy usually holds its hearings in the Old Supreme Court Chamber in the Capitol. This photograph was taken during the earlier hearings on nuclear warfare.

have been exposed to a level of radiation of about 10 times as high as the rest of the race.

It was repeatedly pointed out that, contrary to a widespread feeling among the public, there is nothing unique about the effects of radioactivity. All of the diseases and the genetic effects known to be associated with radiation are also known or suspected to be caused by natural and by man-made contaminants as well. There is no way to tell whether any specific case of leukemia, for example, was caused by radiation. You can only try to find a meaningful correlation between exposure to radiation and some statistical increase in the effect.

Those difficulties put the scientists working in this field in an awkward position. There seems to be a substantial segment of opinion that assumes that because one group of scientists can tell you what the temperature is on a star billions of miles away that the biologists must not be doing their job very well if they can't tell you exactly how many cases of X diseases are going to result from Y amount of radiation absorbed over a 20- or 30-year period.

Federal Radiation Council

The organization officially charged with formulating a national policy on radiation is the Federal Radiation Council, but the hearings made it clear the FRC, now a year old, has yet to assume any really significant function. Its membership currently consists of the Secretaries of Labor, Commerce, and Defense, the chairman of the Atomic Energy Commission, and the Secretary of Health, Education and Welfare. But its permanent full-time staff consists of the executive secretary, and the secretary to the executive secretary. Ad hoc committees are named to study the problems that come before the council.

Its principal accomplishment to date has been to replace the term Maximum Permissible Dose with the term Radiation Protection Guide. The change is not as trivial as it may seem and may turn out to be very useful. The older term was unfortunate both because "maximum" suggested a limit that could never be exceeded without getting into an area of gross danger and because "permissible" suggested that there was no need to pay much attention to radiation below the "permissible" level. In fact, it was agreed both that radiation exposure should be kept as far below the permissible levels as possible and, at the same time, that if circumstances demanded, an individual could be exposed to considerably more than the maximum level without exposing him to any more danger than is encountered much more frequently and with much less concern in other fields of work.

Beyond this change in terms the council has yet to do much of significance. It has prepared a directive, which was issued last month over the signature of the President, setting standards for the various government agencies to use. But the standards are essentially identical with those issued by the National Committee on Radiation Protection. These NCRP standards were already accepted by the AEC, the Defense Department, and other agencies. The FRC directive merely serves to make them official rather than semiofficial. It appeared, in fact, that the FRC was formed partly out of a general feeling that the government ought to "do something" about a problem that was of general concern, and partly to resolve a jurisdictional dispute over who should set national policy between the AEC, which has most of the experience, and the Public Health Service, which feels it should have the responsibility. A need was also felt for separating the responsibility for promoting the use of atomic energy from the responsibility of preventing any development that might lead to unwarranted hazards. At present both functions are largely in the hands of the AEC.

The Joint Committee was dissatisfied with the FRC's present situation, and suggested a number of things the council could do to make itself more useful. The committee wanted the FRC to formulate clearer answers than it now appears to have to the questions of: who has the actual responsibility for determining whether any proposed increased use of radioactive materials, including anything planned by the Defense Department, will lead to benefits commensurate with the rise in radiation levels that may result, and what criteria are going to be used to make these decisions? The committee also seemed to feel that if, as it now appears, the principal function of the FRC is to reassure the public that its interest and well-being are being looked after, that its usefulness would be increased by including representatives of labor, management, and other public interests on the council.

Yet despite the questions raised, the general effect of the testimony was reassuring. Even most of the uncertainties, it was clear, were reflections of the precautions being taken to prevent radiation from developing into a major hazard rather than indications of danger. Much more is known, the committee was told, about the hazards of radiation than about any number of other sources of contamination produced by modern society, and much stricter steps are being taken to control the hazard.

Food Additives Law Nears Passage

The House Commerce Committee has approved legislation that includes the "Delaney clause " flatly barring the use in foods or cosmetics of any coloring matter that can produce cancer in man or experimental animals. The bill is expected to pass the House without difficulty, if only because it would take a very brave legislator to take a position in an election year that could be interpreted by his home district opponents as a vote in favor of cancer. A Senate color additives bill went through without the Delaney clause, and the issue will have to be settled in conference.

The issue has been a controversial one, even within the Administration. The Department of Health, Education, and Welfare has favored the clause on the grounds that the existence of a threshold dose for cancer-producing substances has not been demonstrated, and the benefits derived from the use of these color additives are not sufficient to justify running even a very small risk. The President's Science Advisory Committee, though, has come out for allowing some discretion in deciding whether a substance should be allowed, on the grounds that the Delaney clause could lead in some cases to costly restrictions without adding more than negligibly to the public protection.

New Policy on Grants to Colleges

Beginning this summer the National Science Foundation, the principal government source of support for basic research, will give colleges unrestricted grants amounting to 5 percent of their project grants during the past year.

The total amount of money involved, less than $3 million nationwide, is not large, but these "institutional grants" are viewed as an important step away from the policy of tying all grants to specific, preapproved projects.