not represent a consensus among the chairmen of the various disciplines. It is stacked for space astronomy," he adds.

Unhappiness with the first draft does not end there. "They laid out scientific criteria by which to judge each program, and then failed to apply the criteria to the programs," says Dr. Murray. Had they done that, he says, the Grand Tour would have come out on top. "Compared to the Mariner program [fly-bys of Venus, Mercury and Mars], the total data return from the Grand Tour will be greater, the diversity of the planets studied greater, and our a priori ignorance is greater," says Dr. Murray.

The overriding philosophy of the planetary panel that reported to the executive board and to the over-all NAS Space Science Board "was that the outer planets should be studied much the same way as the terrestrial planets have been—with a broad brush approach," says Dr. McElroy. This would mean fly by, observe as much as possible and then later return to concentrate on the unusual, such as is planned with the flights to orbit Mars in 1971 and the Viking Mars landers in 1976. The cost for four Grand Tour flights is estimated in 1970 dollars at about $900 million, compared with the eight Mariner fly-bys of Mars, Venus and later Mercury, which cost about $130 million each.

This year debate will begin on the President's fiscal 1972 budget; it is the first budget in which NASA will request funds for flights to the outer planets. There is little doubt about NASA's desire to do a Grand Tour, and of the President's support, but compromises may have to be made. These may involve the number of flights (maybe two or three instead of four or five) and the type of spacecraft (whether to go with TOPS, to alter it to give it the additional ability to orbit planets, or to begin study of simpler, Pioneer-type spacecraft).

Some scientists and engineers believe a spacecraft like the TOPS will have to be used. For the tour, a craft must be able to function 15 years or more and send back data from billions of miles. The subsystems must be able to handle data, identify and correct problems automatically, relay and receive communications from earth, and control spacecraft attitude as well as monitor the planets. Caltech's Jet Propulsion Laboratory has not only developed such a model but also built a computer called STAR, for self-testing-and-repairing (SN: 4/6/68, p. 322), to go with it. The STAR computer would check each spacecraft system and subsystem and also check itself out through redundant systems and disconnect faulty monitoring units. □

NEW STANDARDS

Another round on radiation

A little radiation is a dangerous thing—at least when it comes to provoking public policy debates. Whether a little radiation is also dangerous to public health is what the debate is about.

Up to now, United States Government policy has been based on the assumption that a little bit of man-made radiation in addition to the natural background that nobody can stop would not present a grave threat to public health and ought to be tolerated in view of the benefits supposed to accrue from the installations that produce it.

In the United States at present, the maximum allowable average per capita dose of man-made radiation per year is 170 millirems. Dosages to individuals working with radioactive substances are allowed to go a good deal higher than that. Dosage for people living near nuclear installations could go as high as 500 millirems per year.

This policy has come under attack in the last year or so, most especially by Drs. John W. Gofman and Arthur R. Tamplin of the Lawrence Radiation Laboratory at Livermore, Calif. At first they called for a 10-fold reduction of the permitted maximum; now they say no level is safe. (SN: 3/28/70, p. 311).

This week the National Council on Radiation Protection and Measurements (NCRP) issued a series of recommendations for new radiation standards that result, it says, from a 10-year review of the field. The NCRP is a committee of 65 scientists chartered by Congress to give advice to the Federal Government in these matters.

The new NCRP recommendations do not advise many significant changes from previous standards. They simplify and consolidate some of the items, especially those relating to permitted dosages to specific organs. The general population dose of 170 millirems per capita per year remains the same. The major change is the recommendation that the radiography of pregnant women amount to no more than 500 millirems over the whole gestation period. There had been no special regulation on this before. (The dosage received by the average nonpregnant person from diagnostic X-rays runs around 55 millirems a year.)

The current NCRP report, says NCRP President Dr. Lauriston S. Taylor, "is in no way a response to current controversies." He stresses that the report was essentially complete by April 1969, before Drs. Gofman and Tamplin began to speak out.

Nevertheless there is something of a controversy between the NCRP and Drs. Gofman and Tamplin. The NCRP spokesmen say that Drs. Gofman and Tamplin have extrapolated from the most frightening and not necessarily the most accurate data. Of the NCRP recommendations Dr. Golman says: "Of course they'd say that. They're paid to say that. I have no respect for the organization." He accuses NCRP members of having vested interests in the nuclear industry.

Dr. Taylor replies to this criticism by reading a breakdown of NCRP membership to show that 33 are in universities, 4 in government agencies and 12 in government contract laboratories, to make 49 out of 65 who are presumably not heavily invested in the future of the nuclear industry. Yet the council's recommendations seem to be made with the assumption that the nuclear industry will continue. Drs. Gofman and Tamplin would like to shut it down.

Both sides use the same data to reach their opposite conclusions. One of the points at issue is whether there is some threshold dosage below which particular biological effects do not happen. If there is such a threshold, then dosages below it would not be dangerous at all.

Those who oppose the threshold idea believe that any dose is dangerous although a higher dose is more dangerous than a lower one. This is called the linear hypothesis because it consists of extrapolating the data on biological damage from doses in the hundreds of rems to zero rems by drawing a straight line.

Drs. Gofman and Tamplin believe that recent data indicate the linear hypothesis is true and that any amount of radiation is dangerous. The NCRP says that at the moment nobody knows whether the linear or the threshold hypothesis is true, but for safety's sake they are going by the linear too.

The NCRP says, therefore, that permissible maximum doses should be lowered to the minimum practicable amount. That means balancing the risk of damage against the cost of shielding and preventing escape of radioactive substances.

Dr. Gofman rejects this as being for the convenience of the polluters. He sees so many alternatives to nuclear power—clean fossil-fuel plants, geothermal deposits, thermonuclear fusion —that he doesn't think the benefits of fission-reactor plants justify any risk at all.

Whether the recommendations of the NCRP will have any effect on Federal policy remains to be seen. Dr. Taylor says that in the past the Federal Radiation Council, which had authority to make rules in such matters, followed NCRP recommendations fairly closely. Now, however, the FRC is in the process of being reorganized into the Environmental Protection Agency, and Dr. Taylor is not sure what will emerge. □