evidence, such as that which might be produced by an epidemiological study. Existing studies for the most part showed no positive evidence that saccharin might be a carcinogen, but it was thought that larger or more carefully conducted studies would produce more conclusive results. What Congress apparently neglected to observe was that, because of the inherent limitations of these studies, none would be sufficiently sensitive to detect whether or not saccharin is a weak carcinogen.

Congress has chosen to take the three new epidemiological studies as confirming the previous negative results, but here it parts company from the weight of scientific opinion on the issue. The generally unappreciated fact is that the new studies must be interpreted in conjunction with the results of the best available animal tests. These suggest that exposure to saccharin increases the risk of bladder cancer in man by a range centering around 4 percent. But the most elaborate of the three new studies, that conducted by the National Cancer Institute, would detect no change in cancer incidence smaller than 15 percent. Officials at the FDA and NCI thus knew in advance that detection of a positive effect of saccharin on bladder cancer was highly unlikely. The chief purpose of the study was to determine if the cancer rate was much higher than expected, as had been suggested by a single questionable epidemiological survey. The answer was that it was not, which is a far cry from being proof of no effect.

The NCI study, conducted by Robert Hoover and colleagues, surveyed 3000 bladder cancer patients and 6000 control subjects. No significant correlation between cancer and exposure to saccharin was detected as far as the total patient population was concerned. But the study did pick up a correlation in particular small subgroups, such as heavy smokers and heavy users of saccharin (two or more diet sodas daily or six packets of sweetener daily) which might have been only random fluctuations in the data. Despite this uncertainty, the authors say the results "can all be interpreted as consistent with the results of animal experimentation." Hoover observes that "Nothing in this study, or the other two, is inconsistent with saccharin being a weak carcinogen."

The other two studies, by Ernst Wynder and Alan Morrison, included fewer patients than the NCI's, and were thus even less likely to detect evidence of saccharin's carcinogenicity. Neither did.

Hoover concludes that few if any cases of bladder cancer to date have been caused by saccharin, but that does not mean that continued widespread usage might not cause such cases in the future. "The evidence is that little, if any, current bladder cancer is due to the consumption of artificial sweeteners, at the doses and in the manner in which sweeteners were commonly used in the past," he wrote recently in the *New England Journal of Medicine*. He and others have noted that the three new studies failed to address the maximum risk situation pointed to by the animal studies, that of exposure to saccharin in the womb and childhood, which is now common. Hoover concludes that when all the evidence of toxicity is weighed against the lack of any evidence that saccharin actually helps people lose weight, "any use by nondiabetic children or pregnant women . . . and excessive use by anyone is ill-advised and should be actively discouraged by the medical community."

Others in the scientific community also urge caution in the interpretation of the studies' negative results. Jere Goyan, Kennedy's successor as commissioner of the FDA, notes that "none of the studies is sufficiently robust to pick up the cancer rates predicted by the animal studies, which were, in fact, too

MX on Land or Sea?

Another chapter in the saga of mankind's greatest construction project played itself out on 25 March before a House defense appropriations subcommittee, which was trying to decide what to do with America's newest and biggest missile, the MX. The subcommittee, chaired by Representative Gunn McKay (D-Utah), wanted to know whether there was any alternative to the basing plan chosen by the Administration known as the racetrack. It will require spending 10 years and $34 billion to build a garage and road network in the valleys of Nevada and Utah. Couldn't the missile be put out to sea on small submarines instead, as suggested by defense analysts Sidney Drell and Richard Garwin? (*Science*, 12 October 1979)

The Pentagon's answer: No. William Perry, under secretary of defense for research and engineering, reportedly told the congressmen that this option had been considered and rejected because it was vulnerable to the van Dorn effect. If the Soviets were to blanket the coastal waters with a barrage of nuclear warheads, the reasoning goes, the concussion would create a tsunami wave 50 feet high, neutralizing the submarines.

There is "nothing new" in this, says Garwin; there have been all kinds of studies in the last 10 to 15 years showing that a tsunami would have a devastating effect on ships in shallow water on the continental shelf. That is precisely why his plan would keep the submarines beyond the shelf where the water is 800 feet deep, and where a Soviet attack would not have a lethal effect. The van Dorn criticism is "totally irrelevant" and a "phony issue," according to Drell. He is "damned angry" that this sort of criticism is being used against the submarine basing concept. He planned to come to Washington to talk to congressmen and set the record straight. Perry is not the source of the misinformation, Drell says.

Garwin, too, has been trying to set the record straight on this point for several months. For example, he wrote to the under secretary of the air force, Antonia Chayes, on 12 February in evident frustration at his inability to get the air force to state its position clearly. He asked Chayes to initial his letter and return it, indicating that she agreed or disagreed that the official position was that the small submarines were not threatened by the van Dorn effect. There was no reply. Some people in the Pentagon, according to Garwin, would prefer to obfuscate than come to grips with the substantive merits and faults of the submarine alternative.

Meanwhile, as the dust from that skirmish clears, the Pentagon is preparing to release a new paper on the Drell-Garwin proposal, undertaken in response to a request by Senator Mark Hatfield (R-Oregon). According to a defense spokesman, it finds the submarines inadequate because they are not fit to withstand the stresses of high seas, too small to hold the necessary strategic missile equipment, and too costly if major modifications are required. This salvo in the antisubmarine war will be fired within days, the Pentagon says.—ELIOT MARSHALL

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