lism experiments are essential in elucidating what causes tumors in the animal model. The implications to public health differ depending on whether one is dealing with a potent direct-acting carcinogen, or an opportunistic carcinogen capable of doing harm only to mammals of severely impaired resistance, or an agent providing the opportunity for ubiquitous carcinogens to become effective. The "bioassay" approach imposes a dogmatic and narrow interpretation of tumor incidences and discourages broader studies needed to advance our knowledge of what contributes to tumor formation. Only full consideration of physiological effects on a case by case basis can lead to credible risk assessment. An encouraging note is that Food and Drug Administration's advisory committees have provided flexible responses to "bioassay" data, pointing the way to more balanced risk assessments (*8*).

M. SCHACH VON WITTENAU

Safety Evaluation and Drug Metabolism, Pfizer Central Research, Pfizer, Inc., Groton, Connecticut 06340

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2. V. Riley, *Science* **189**, 465 (1975).
3. C. Peraino, R. J. M. Fry, E. Staffeltt, *J. Natl. Cancer Inst.* **51**, 1349 (1973).
4. "Maximum tolerated doses" (MTD) are generally insisted upon for inclusion in carcinogenicity bioassays, and their effects are considered relevant to risk assessment. This appears to be an inappropriate application to biology of the mass law as known in chemistry. The MTD concept can be expressed as

$$\frac{(\text{animals}) \times (\text{chemical})}{(\text{tumor})} = K$$

In chemistry the mass law in this form holds only as long as first-order kinetics prevail. As it is well known that in biology the ranges for linear kinetics are limited, and because the development of tumors in response to an animal's exposure to a chemical involves many enzymatic and other processes, application of the mass law to tumor formation seems unsound, unless linearity of the relevant reactions has been demonstrated.
5. D. S. Salsburg, *J. Tox. Environ. Health* **3**, 611 (1977). "Using the standard formulation of tests of hypothesis, it is shown that there is a 20–50% chance of having a false positive. . . ." These are irreproducible artifacts. I would like to define a reproducible artifact as one which, though real, is not relevant to the question of risk from low-level exposure. A good example appears to be NTA (nitrilotriacetic acid), a chemical useful as a detergent additive which caused bladder tumors in rats when fed in concentrations above 0.7 percent in the diet. At these dosage levels NTA concentrations are so high in the urine as to cause the formation of calculi; R. L. Anderson, "Discontinuities of dose response curves in toxicological testing," paper presented at the Soap and Detergent Association 52nd Annual Convention, Boca Raton, Fla., 25 to 28 January 1979.
6. Rigorous proof for the causal relationship between carcinogenic and mutagenic activities of chemicals is still missing. However, attractive mechanistic theories and the generally good correlation between such activities suggest that short-term mutagenicity tests are useful for the assessment (as opposed to identification) of carcinogenic risk, in that probable mechanisms of action may be defined. Since many mutagenic and tissue-transformation tests are designed to be exquisitely sensitive, positive results in such experiments are expected to be obtained with those mutagens and/or carcinogens also, which should be designated as "opportunistic," that is, capable of doing harm to cells and organisms only under the most unusual circumstances.
7. The work of R. W. Hart and R. B. Setlow [*Proc. Natl. Acad. Sci.* **71**, 2169 (1975)] suggests a greater resistance of humans to carcinogens affecting DNA because of a greater capability for DNA repair by the human cell as opposed to that of the rodent cell.
8. See the summary minutes of the Food and Drug Administration's Toxicology Advisory Committee meeting on the role of prolactin in mammary carcinogenesis (12 to 13 May 1977) and the minutes of the FDA Endocrinology and Metabolic Drug Advisory Committee meeting on clofibrate-like drugs (15 to 16 February 1979) (available from the Supervisor, Public Records and Documents, Food and Drug Administration, Rockville, Md.). The FDA Drug Advisory Committee on Pulmonary-Allergy Drugs proposed (3 to 4 May 1977) the use of a class of drugs, some of which had caused tumors in rodents, and did not distinguish between "tumorigenic" and "nontumorigenic" compounds.

Mercury in Sperm Whale Meat

Japanese whaling interests have long resisted international whale conservation initiatives. A major argument used by the Japanese to support their plunder of great whale stocks has been that the meat is needed for human consumption (even though whale meat supplies less than 1 percent of yearly Japanese protein consumption) (*1*). However, data released by Masashi Taguchi of the University of Tokyo's College of Fisheries, at the June 1979 meeting of the International Whaling Commission in London, indicates that sperm whale meat offered for sale in Japanese food stores contains unsafe levels of organic mercury. The whale meat contained mercury levels of 2.3 parts per million, which is six times the level the Japanese government considers acceptable (0.4 part per million). . . .

Because of modern industrial activity, the world's oceans are polluted with mercury. This is not so important a factor in the contamination of fish with short life-spans. However, sperm whales live for 60 years and concentrate mercury in their flesh. When humans consume contaminated whale meat, the lipid soluble methylmercury is concentrated in the cells of the nervous system and very slowly eliminated from the body, even when all intake is stopped.

It is hoped that the Japanese will act on Taguchi's data. Their action could have the double benefit of protecting public health (*2*) and preventing threatened whale species from diminishing further.

JOHN F. BEARY III

Cornell University Medical Center, New York 10021

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