Another cancer scare . . . or is it hypochondria?

Alvin M. Weinberg, director of the Institute for Energy Analysis, turns his attention to the carcinogenicity of oxygen

WHERE will the search for environmental carcinogens end? A recent article (Commoner, Vithayathil, Dolora, Nair, Madyastha, Cuca, *Science* **201,** 913; 1978) implicates extract of cooked hamburgers; another, (Bruyninckx, Mason, Morse, *Nature* **274,** 606; 1978) oxygen at physiological concentrations. Both were found to be mutagens in the Ames test. Mutagenicity in this case is usually, though not always, associated with carcinogenicity in mammals.

Commoner *et al.* found that ground beef cooked in a home hamburger cooking appliance contained a substance that induced mutations (reversion from histidine dependence to histidine independence) in some strains of *Salmonella typhimurium*. In the *Science* article the authors are properly cautious: "If . . . these mutagens—once purified and tested on laboratory animals—are found to be carcinogens, their apparent concentration in some foods may represent an appreciable risk to certain populations." But the media were less restrained: these cautious claims were blown up in the United States into the Great Hamburger Scare of Fall 1978. Professor Commoner was widely quoted in the press and on TV, and MacDonald hamburgers' stock prospects were re-examined by alert Wall Street analysts.

The Bruyninckx *et al.* findings are even more startling. It has been known for 25 years that hyperbaric oxygen is a mutagen—but mammals are generally not exposed to hyperbaric oxygen. Bruyninckx found that exposure of certain mutants of *S. typhimurium* to 5% O_2–5% CO_2–90% N_2 induced as much as a fiftyfold increase in reversion to histidine independence compared to controls kept under anaerobic conditions. In speculating on the significance of their findings, Bruyninckx *et al.* say, "According to Fridovich oxygen toxicity is normally held in check by a balance among rates of formation and destruction of reactive forms of oxygen. This may mean that oxygen mutagenicity is improbable, but not impossible, in normal aerobic mammalian cells; but higher rates of formation of reactive forms of oxygen or lower rates of their destruction . . . could lead to significant rates of mutagenesis along with the molecular pathologies arising from mutation." Thus Bruyninckx *et al.* do not quite say that oxygen, in the form of the O_2^- radical, may be implicated in carcinogenesis—but others, notably J. Totter, former Director of the Division of Biology and Medicine of the US Atomic Energy Commission, have suggested just this.

If oxygen is dangerous, we'll have to stop breathing . . .

These two findings suggest to me that our entire approach to cleansing our environment of carcinogens may be bankrupted by further investigation. Today's environmentalism assumes that environmental agents that do harm, particularly those that cause cancer, are important causes of cancer compared to the natural environment, and also are removable. But these two doctrines have already been shaken by such findings as the presence of nitrosamines in experimental animals fed a normal diet; or for that matter, the existence of the radiation background, not to say of sunlight itself. Professor Commoner's hamburgers are almost unavoidable (though his directions for cooking mutagenic hamburgers may reduce even this exposure). But I would defy even the most ingenious environmental regulatory agency to legislate acceptable levels of oxygen!

Obviously we must get a better idea of how much cancer is attributable to agents that are in principle removable. The oft-quoted assertion that as much as 80% of cancer is caused by environmental agents that are, at least by implication, avoidable, rests on evidence that can hardly be considered compelling, a point recently stressed by Peto (*Nature* **277,** 428; 1979). To be sure, cancer maps show large fluctuations in incidence of specific cancers in different locations; but the fluctuations are much smaller if all cancers in one location are compared with all cancers in another location.

So far regulatory agencies have not raised seriously the question of how much a known carcinogen can add to the unavoidable risk of cancer. If, for example, it turned out that an all-pervasive environmental agent such as oxygen is importantly implicated in cancer, then we may be attacking the one-tenth of the iceberg that shows (the avoidable carcinogens), but ignoring the nine-tenths that is submerged (the unavoidable carcinogens). I offer this speculation to bring home the great difficulties our regulatory agencies face in trying to legislate acceptable levels of exposure.

I should think that before they outlaw MacDonald's hamburgers, or for that matter, before scientists call for a total ban on this or that carcinogen, we await further clarification of the role of all-pervasive agents such as oxygen in the etiology of cancer. We need more scientific understanding much more than we need additional regulation that is based on imperfect and fragmentary evidence.

Where does the scientist's responsibility lie—in publicising the possibility that a commonly used substance might be a carcinogen (Chicken Little), or in withholding publication until he can really assess the risk, say, compared to other carcinogens (Dr Pangloss)? Chicken Little adds to the public's growing environmental hypochondria; Dr Pangloss conceivably might fail to alert the public to a potential danger. Until now Chicken Little has been in fashion, but I hope the pendulum will swing toward Dr Pangloss. The public ought to require of scientific Chicken Littles the same norms of conduct that science itself has imposed: cautious, provable scientific assertions, and a minimum of appeals to the unrefereed public press.

If such an attitude leads to more Panglossism so be it: people will never stop eating hamburgers, let alone reduce their oxygen uptake, no matter what our scientific Chicken Littles and our regulators urge. □

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