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EDITORIAL

Cancer: What Should Be Done?

Within the next decade or two, cancer is likely to become the leading cause of death in the United States. This macabre honor might have been avoided and need not be permanent. In 1981, Doll and Peto served notice that the bulk of cancer should be preventable because most of its causes are avoidable.* What are those causes and what prospects do they offer for the prevention of cancer?

Cigarette smoking is presently blamed for one-third of all cancer deaths in the United States. The use of tobacco is a dispensable indulgence, but it is also an addiction that is not easily shed. The bitter lesson here has been that demonstration of grievous risk can fail as deterrent, particularly among the young and in the face of vigorous marketing on behalf of the offending agent. What more should be done against smoking remains a matter of controversy, steeped in political and economic connotations.

Dietary factors have been incriminated in another third of cancer deaths in the United States. The Western diet is thought both to contain a surfeit of potential carcinogens (animal fat and red meat are especially culpable) and to be deficient in natural preventives (fresh fruits and vegetables are especially rich sources). But the particulars are far from certain. Pending a better understanding of why diet affects our risk of cancer, we can opt for a culinary version of Pascal's wager: There can be no harm in restricting red meat and fat, while gorging on fresh fruits and vegetables. It is worth noting that preventive measures involving smoking and diet are conveniently similar for cancer and cardiovascular disease (one exception is alcohol—a risk factor for the former, a preventive for the latter; oenophiles can here make a wager of their own).

A variety of infectious agents have been implicated in human cancers, including two hepatitis viruses (liver cancer), several papilloma viruses (cervical cancer), Epstein-Barr virus (certain lymphomas and nasopharyngeal cancer), a herpesvirus (Kaposi's sarcoma), and the bacterium *Helicobacter pylori* (stomach cancer). Together these agents account for more than 15 percent of cancers in developing nations and somewhat less in affluent nations. Vaccination against hepatitis B virus is now in progress, and hope abides that prophylactic measures can be devised for the other infectious causes of cancer. Ultraviolet radiation in sunlight causes skin tumors in great abundance, although the majority of these are not life threatening. The minority exception is melanoma, whose rising incidence in the United States has been attributed to the cosmetic craze for tanning.

What of environmental pollution? Although we have badly fouled our planetary nest, with woeful consequences, it is by no means clear that our profligacy has as yet greatly changed the incidence of cancer. Conventional estimates attribute perhaps 5 percent of cancer in the United States to occupational exposures and another 2 percent to environmental pollutants. But some observers place the numbers much higher. The two sides in this highly polarized debate should reserve their energies for the hard work required to obtain more certain evidence.

Not all of the causative agents of cancer are extrinsic to our bodies. For example, the sustained effect of reproductive hormones has been implicated in breast, ovarian, uterine, and prostatic cancers. Strictly speaking, hormones may be facilitatory rather than causative; there appear to be other precipitating factors whose identities we simply do not yet know. Nevertheless, the role of reproductive hormones in tumorigenesis has made them targets for both therapeutic and preventive measures.

Critics of our national research effort on cancer have complained that it favors therapy over prevention.† So it is only fair to note that the National Cancer Institute is taking steps to energize its research on the cause and prevention of cancer.‡ One point of departure will be our newfound knowledge of the genetic maladies that appear to underlie all cancers (see the related articles in this issue of *Science*). Application of that knowledge will bring the once disparate disciplines of epidemiology and molecular biology into a fecund mating. The offspring should be a new era, in which prevention will take its rightful place as the premier means by which to control cancer.

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*R. Doll and R. Peto, *The Causes of Cancer* (Oxford Univ. Press, New York, 1981). †J. C. Bailar III and H. L. Gornik, *N. Engl. J. Med.* **336**, 1569 (1997). ‡B. S. Kramer and R. D. Klausner, *ibid.* **337**, 931 (1997).