

able conclusions are put forward with the greatest dogmatism; perhaps there is an inverse relation between vigour and rigour.

Of all the paths toward truth, the methods of statistics are probably the most treacherous. The numbers involved may be large, the mathematics sophisticated and the design elegant, but everything depends upon the input, and in medical science the input is soft and often subtly preselected. Definitions are fluid, and death is frequently the only sure end point. Even if the input is sound and the methods are valid, their interpretation is open to subjective bias.

It would be wise to accept that some of the softer sciences are not yet sciences but literature, politics or religion. A journal of economics may present an almost impenetrable thicket of mathematical symbols that may merely be a cover-up for radical or reactionary politics. A journal of psychoanalysis may have the format of a scientific publication but contain only sterile ruminations of indefinable concepts and genuflections to the founder of the faith.

The public is ambivalent toward science and understands little of scientific method. It hungers for the practical benefits but fears the terrifying forces created by scientists, the rapid changes

brought by scientific technology and the threat to strongly held beliefs. In medicine everyone with a headache wants to undergo computed tomography but resents a physician who is a mere technician. Indeed, in our day-to-day work as clinicians we are forced to go beyond our scientific base, whose application in each case is often tentative and uncertain, whereas decision and action are imperative.

It is conceivable that the whole flowering of science might be swept away by nuclear war or by political convulsions. People, libraries and techniques might be destroyed, for they are fragile, and a new dark age might set in, bigoted and obscure; however, the search for truth is innate in man, and scientific method is its expression. Science would be born again.

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Cancer in rural areas

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On Oct. 1 and 2, 1986, the Centre for Agricultural Medicine, the Section of Respiratory Medicine, Department of Medicine, and the Department of Social and Preventive Medicine of the University of Saskatchewan, along with the Saskatoon Cancer Clinic and the Saskatchewan Lung Association, sponsored a workshop on cancer in rural areas with support from the Saskatchewan Cancer Foundation. The work-

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shop was designed to bring together investigators from the United States and Canada who were studying cancer risks associated with agricultural exposures to discuss the status of the investigations and to recommend priorities for further research.*

Despite low mortality rates for all causes combined and for a number of selected causes of death, numerous reports from around the world suggest that farmers may experience elevated risks for certain cancers.¹ Use of pesticides and contact with other potential carcinogens including solvents, fuels and oils, paints, engine exhausts, welding fumes, ultraviolet light, and zoonotic viruses and microbes raise further concerns of cancer among farmers.

Cancers that have been reported as excessive among farmers include leukemia, lymphoma, multiple myeloma, cancers of the lip, stomach, brain, prostate and skin (nonmelanotic), and soft-tissue sarcomas. At the workshop, excesses of cancer of the lung, liver, pancreas and nasal sinuses were also reported. The participants judged that the evidence for involvement of agricultural factors is strongest for cancers of the lymphatic and hemato-

poietic systems, lip, skin (nonmelanotic) and stomach. The data are less persuasive for the other cancers.

Given the relative consistency of the excess for cancers of the lymphatic and hematopoietic systems and the stomach among farmers, there is a need for analytic studies to clarify these associations by identifying specific agents in the agricultural environment that may be involved. Although the results from case-control studies of soft-tissue sarcoma are conflicting,²⁻⁵ the fivefold increase in risk associated with herbicide exposure demonstrated in the Swedish studies^{2,3} indicates that further investigations on these tumours are also needed. Studies to clarify the role of agricultural factors in the origin of the other tumours (of the brain, prostate, lung, liver and nasal sinuses) appear less promising, but unusual opportunities should not be dismissed.

Further studies should be designed to minimize limitations that existed in previously completed investigations. Special attention should be directed to characterizing the level of exposure to potentially hazardous agents. In previous studies exposure data were based on ecologic measures⁵⁻¹² or self-reporting from interviews^{1-5,13} and were thus subject to a variety of biases and limitations. In the study of soft-tissue sarcoma and lymphoma in Kansas the investigators did contact the pesticide suppliers in an attempt to corroborate the use reported by farmers,⁵ but other types of corroboration are needed. Biochemical measures of pesticide levels in blood, urine or tissue should be included in future studies for comparison with information obtained by interview. Nitrate contamination of water supplies from fertilizer applications in rural areas may provide the opportunity for creation of carcinogenic nitrosamines in the digestive tract. Hence, future studies should include sampling of water supplies.

Although neither epidemiologic nor serologic studies have uncovered associations between animal viruses such as the bovine leukemia virus and cancer in humans, new viral probes are available that are much more sensitive, and perhaps a new look at this issue is therefore warranted.

Special attention should be given to characterizing the histologic type of cancer. This is particularly important for lymphatic and hematopoietic cancers, for which subcategorization by light microscopy is exceptionally difficult. Marker studies would be invaluable for these tumours.

Epidemiologic studies of agricultural exposures have to date included only men. Although exposure among men probably exceeds that among women, farm wives may come into contact with pesticides and other factors as they support their husbands in some farm activities. In addition, they are likely to handle soiled clothing.

Because further studies should be conducted in sparsely populated rural areas, collaboration between various agencies, institutions and tumour registries will be needed to initiate studies of

sufficient statistical power. Collaboration is also needed between various disciplines, including agricultural science, oncology, pathology, epidemiology, industrial hygiene and laboratory science, for appropriate exploitation of promising new areas of research.

The workshop participants felt that the opportunity is ripe for a large collaborative study of lymphatic and hematopoietic cancers and soft-tissue sarcomas that incorporates biochemical measures of exposure and state-of-the-art definition of disease to clarify the role of pesticides and other agricultural factors in the origin of these tumours. A collaborative study of stomach cancer may also be timely, given the consistent demonstration of an excess of this cancer among farmers in several descriptive studies in North America.

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