Special Feature

THE ENVIRONMENT AND DISEASE[1]

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Millennia have passed since Hippocrates, an intuitive epidemiologist, related disease to the winds, the climate, and the qualities of water. Centuries later von Pettenkofer was laughed off the epidemiologic stage in Germany when he revived the concept of disease-environment association and cause. This was at about the same time—some 100 years ago—that Hirsch mentioned gout, rickets, and cancer in his classical review of geographic pathology.

In the 1700's Percival Pott noted that cancer of the scrotum was excessively prevalent among chimney sweeps. But the epidemiologic pursuit of cancer was to remain dormant until very recent times. After World War II the evidence of occupational association with malignancies began to accumulate at an unprecedented pace. The issues had become increasingly dramatic by 1965, when the World Health Organization convened a meeting of cancer epidemiologists—a galaxy of investigators from several continents. Their final report (*1*) emphasized the need for more elaborate epidemiologic inquiry, pointing out at the same time that the meeting's observations were not intended in any degree to cover the issue of disease prevention. The latter aspect was deferred to later implementation, as findings of increasing epidemiologic validity were to become available.

In recent years the question of disease causation and prevention has come into much deeper analysis via the Canadian Government's "Health Field Concept," adopted in 1974, in which concern is focused in four areas: the health system, human biology, the environment, and people's life style. I have chosen the environment for discussion, although the other facets are equally provocative, only because it represents that area of which I am least ignorant.

What about the environment? What do we mean by the term? What do we know of its impacts and consequences on frank disease? What control measures are we prepared to take? With what risks and what benefits?

The environment, as it is now envisaged, covers a tremendously wide spectrum of impacts. They extend from those first identified in relation to communicable diseases (still plaguing hundreds of millions of people) to the esoteric carcinogenic and mutagenic resultants of a chemical age. Added to the ever-present problems of

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water, wastes, vectors, and air, we have the myriad threats of thousands of viruses and the products and by-products of an industrial era.

This broad complex of natural and man-made insults is found in a world in which the statesman, sociologist, economist, and psychologist all play a role in decision-making. In such a mélange of challenge, complexity, and scientific knowledge and ignorance, the oracles for social action have a difficult task. The exercise of their role demands deeply fundamental research and teaching, followed by the implementation and transfer of their findings into societal values. The accomplishment of these all-embracing functions requires interdisciplinary attack and synchronization. This facile assertion is more than a literary cliché. Without such cooperative effort, the results will be less than effective.

The public and its officialdom are crisis-minded and move facilely from one bandwagon of slogans to another. Some observers speak facetiously of the "Crisis-of-the-Month Club." Adjustments of the environment have not escaped this pattern. Over the last 20 years—until recently—this function died of official attrition, budgetary and otherwise, in many health departments. Today, however, a resurgence of evidence focuses on disease-environment relationships which once again should concern the health practitioner.

It would be well for us to pause and ask ourselves seriously, What are the goals and responsibilities of the environmentalist over the next decades?

The Familiar Functions

In the rush toward the new, it must be emphasized that there is still a responsibility to ensure safe water; clean air; removal of human and industrial wastes; collection, recovery, and disposal of solid wastes; and adequate, safe, and nourishing food. These necessities have not vanished, nor have they been universally provided for. As new issues appear on the horizon, the familiar and orthodox requirements of man tend to be relegated to history.

The Director of the U.S. Geological Survey reminds us that in the next 25 years the United States of America must grow, mine, transport, build, manufacture, and distribute as much in the way of material goods as it has done in all its previous history. For this vast enterprise, environmental constraints, adjustments, and control measures—all of them orthodox and familiar solutions to be recaptured from the literature and tempered by social-economic-political criteria—will be required at every step.

And so it is that, as we move to conquer new worlds of disease, the sturdy environmental underpinnings of our past successes must be maintained as part of the multifaceted effort for a continuing future.

New Environmental Challenges

We are confronted daily with an ever-widening scope of issues. As we have just seen, many are long familiar. Others, however, are new and, in their public health impacts, frequently undefined. They remain to be realistically assessed before they can be intelligently attacked and controlled. Excessive urbanization, industrialization, and population growth—phenomena of recent decades—have intensified the needs for, as well as the complexities of, sanitary measures. Conjecture about the future, rather than dangerous prophecy, is therefore the wisest course. No matter how ecologically minded we may be, it is still true that we must collect evidence about the real risks before taking fright at what might or could be. This sense of equilibrium in carving out sanitation objectives should pervade our discussions throughout.

I do not intend to run the gamut of all the diseases which are or may be environmentally caused or associated. Let me consider

only two categories of highly significant diseases—namely, the carcinomas and the cardiovascular group. In regard to the first, it has been suggested that from 60 to 90 per cent of them are due to environmental factors. The 90 per cent estimate may have a somewhat slippery foundation. Let us take the 60 per cent figure, which has been cited by the World Health Organization and other responsible authorities. Translated into absolute terms, it would mean that in the United States alone more than 500,000 cancers are caused by environmental agents in a single year.

The suggestion of a 60 to 80 per cent figure apparently had its origin in calculations made some time ago by Higginson and Muir of the International Agency for Research on Cancer in France. Their detailed tabulations, recently made available in published form (*2*), reveal important bases for many of the percentages hitherto bandied about. These numbers consider physical-chemical and "life-style" factors combined in a single environment. In the case of common human cancer incidence in industrialized and nonindustrialized countries, the etiologic factors are heavily dominated by tobacco, alcohol, betel-quid chewing, and noncircumcision. None of these would normally fall into our usual definition of the physical environment. Virtually all of them belong essentially in a "life-style" category. For preventive purposes, they offer no easy target, dependent as they are on individual rather than on mass community decision-making.

Higginson (*3*) summarizes this situation with unusual clarity in these words:

> To date, the exogenous and environmental stimuli causing between 30 and 40 per cent of human cancers have been identified in European and American industrial societies. Of those factors identified, cancers due to the cultural environment are by far the most important. These include lung cancer from cigarette-smoking, esophageal and liver cancer from excessive drinking, and skin cancer from sunbathing or open-air life such as farming. Cancers definitely identified as occupational in origin are relatively less important numerically, comprising according to various estimates between 1 and 3 per cent of all tumors in industrialized states. . . .
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> The term "general environment" covers the overall environment to which an individual is exposed, e.g. water, food, etc., and is largely conditioned by geographic and socioeconomic factors, the latter being the responsibility of appropriate governmental and other authorities. The "micro," or personal, environment includes an individual's cultural habits, e.g. cigarette-smoking, drinking and eating habits, and occupation. The degree to which the latter are under personal control varies, since the child chimney sweep described by Pott could scarcely choose his occupation, nor apparently can the confirmed cigarette-smoker readily modify his habits.

Lilienfeld (*4*) likewise emphasizes the sharp distinction between the "macro," or general, environment and the "micro," or personal, environment. He ventures the opinion that at least 40 per cent of all human carcinomas have their origin in cigarette-smoking, a prime example of personal decision-making. If the wider definition of the environment is used, "the overall available epidemiological data strongly suggest that a vast majority of cancers, approximately 75 to 80 per cent, result from etiological factors in the environment."

Paralleling these concepts, Dever (*5*) refines the definition of the environment by dividing it into "physical, social, and psychological dimensions . . . of those events external to the body." Of still greater helpfulness is his allocation of the contributing factors for each of the 13 disease categories he has selected. It constitutes one of the few existing exercises in the quantification of value judgments in this complex situation. The corresponding table, which indeed has great provocative value, is included here by way of offering a basis for specific exposition of the environmentalist's goals.

In regard to the probable determinants of

Table 1. An epidemiologic model for health policy analysis: Disease evaluation.

Percentage distribution of total deaths[a]	Cause of mortality (8th Revision, International Classification of Diseases)	Percentage allocation of mortality in terms of the epidemiologic model[b]			
		System of health care organization	Life style	Environment	Human biology
34.0	Diseases of the heart	12	54	9	28
14.9	Cancer	10	37	24	29
13.4	Cerebrovascular disease	7	50	22	21
4.2	Motor vehicle accidents	12	69	18	0.6
3.8	All other accidents	14	51	31	4
3.8	Influenza and pneumonia	18	23	20	39
2.7	Diseases of the respiratory system	13	40	24	24
2.6	Diseases of the arteries, veins, and capillaries	18	49	8	26
2.2	Homicides	0	66	41	5
1.9	Birth injuries and other diseases peculiar to early infancy	27	30	15	28
1.8	Diabetes mellitus	6	26	0	68
1.4	Suicides	3	60	35	2
0.8	Congenital anomalies	6	9	6	79
	Average of percentage allocation	11	43	19	27

[a]1973.
[b]Percentages may not add up to 100 because of rounding of figures.
Source: Dever (*5*).

the congeries of carcinomas, there appears to be unanimity of professional opinion. In the immediate future the greatest preventive benefits will depend on personal action. The entrance of new chemicals into t' ? environment must be viewed with concern, but not with alarm. Higginson, in his careful evaluation (*3*), states the scientist's caution with clarity:

> Scientists must be certain of their interpretation of the facts, that their priorities are correct, and that they are not bringing unnecessary and unjustified anxiety to many by overstatement or by expression of cancer risks in terms incomprehensible to the lay public. Unless we take these facts into consideration, legislation will be based on political and not scientific considerations.

A rush toward the wholesale elimination of chemicals from water, air, and food is contraindicated. One must be reminded that many of the carcinomas of today are the probable result of the chemicals in use for a long time—prior to 20 or 30 years ago. The assessment of the newer ones, before their universal prohibition, requires a high degree of scientific scrutiny. As deep-seated investigations are carried out, the findings should provide us with far better guidance than we now have in either policies or programs for control of the environment.

I should be remiss if I did not mention in this discussion the important point made by some thoughful investigators that blaming "life style" is a recourse to "blaming the victim." Such an approach is considered by many to be neither productive nor desirable with respect to alcoholism and cigarette-smoking. The misfortune is that in this, as in other cases, acceptable societal control strategies are not yet at hand.

When it comes to the problem of the prevention and control of cardiovascular diseases, the situation parallels in many ways the discussion already presented on the carcinomas. Dever suggests that perhaps some 22 per cent of the mortality in this cause group may be attributed to environmental factors, the rest falling into the areas of health care, life style, or human biology.

Of the environmental agents, certain constituents of potable water are regarded by some investigators as perhaps having an impact upon this group of diseases.

I have recently reviewed this situation in some detail (*6*). Allow me to repeat my findings in part:

> Investigations on this important problem gained new impetus in the work in Japan and the United States about 15 years ago. . . .
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> Both the early Japanese and United States studies dealt with ill-defined parameters of "hard" and "soft." As the inquiries were later pursued, more explicit and quantitative data began to appear in the identification of such ingredients as calcium, magnesium, zinc, cadmium, chromium, iron, nickel, and copper. Much of this evolution was caused by the discovery of a wider and wider spectrum of potential insults to man.

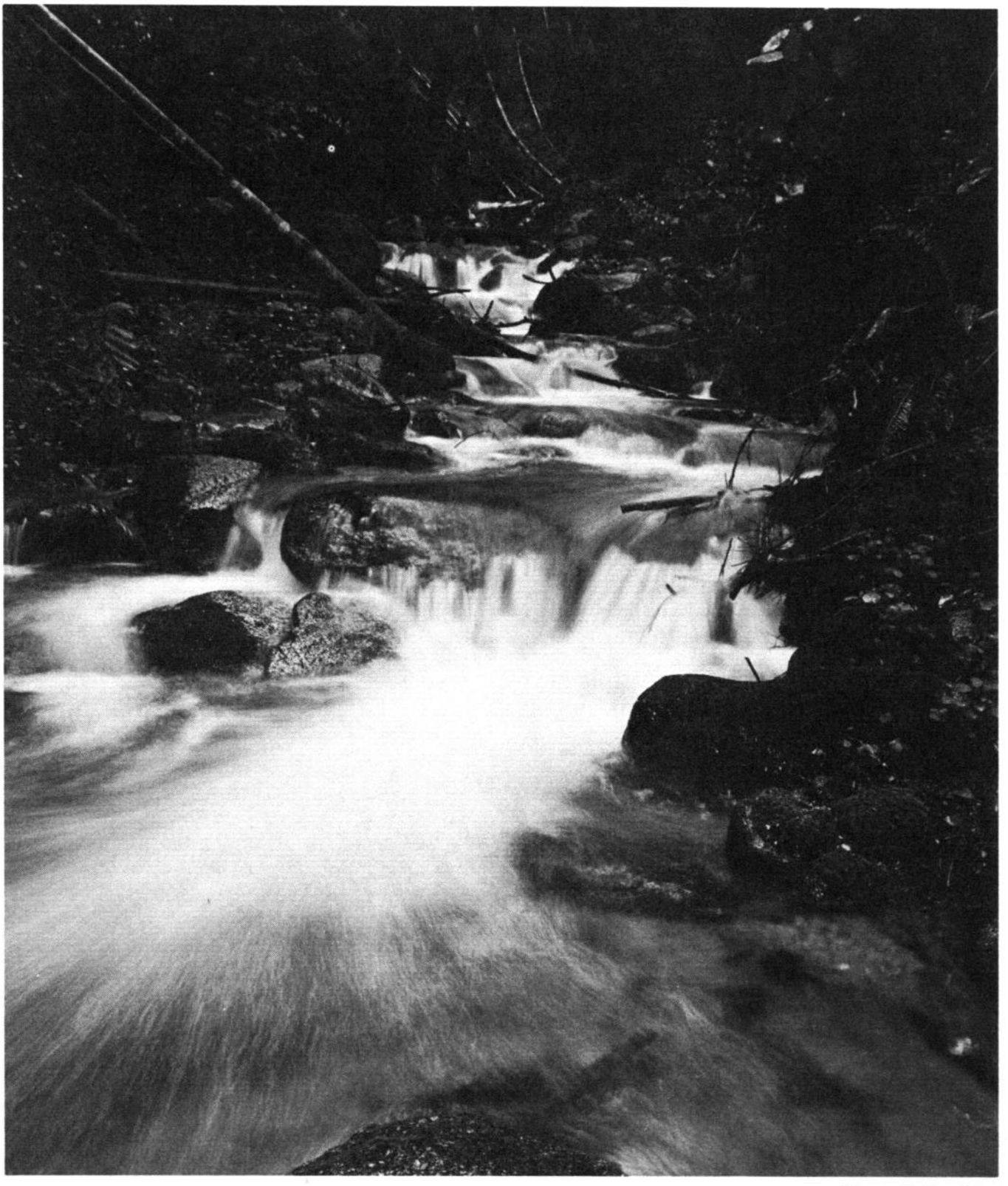

Photo: A. Donaldson

In 1964, on the basis of a review of the literature produced on the subject since 1957, it was concluded that no causal relationship has been established between the total dissolved inorganic constituents of drinking water and cardiovascular disease. Nevertheless, it was recognized that the sum total of constituents in food, water, and air makes all sources important and that studies should be carefully pursued, with uniform criteria for diagnoses and long-term periods of exposure. Unfortunately, today, more than a decade later, some of these recommendations are still being ignored. What is important, however, as I point out in my review (*6*), is to ask ourselves:

> . . ."Where are we now?" If any of the findings determine specifically that ingredients in water have been reasonably calculated to be hazardous to man, the water-supply field can, and even should, remove them from potable water. If this were the case, water treatment practice could lend itself, at a price, to such mass removal or adjustment of offending ingredients.
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> It is this author's judgment that the day of demonstrated specific causality is not at hand. . . .
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> In view of material so far presented, it is reasonable to suggest that precipitate action to abandonment, adjustment, or removal of one source of supply in favor of another should await more definitive evidence than is so far available.

Conclusion

Thus there has been a major shift in disease incidence and mortality in the United States in the last several decades, from the communicable diseases to the chronic diseases, specifically the carcinomas and the cardiovascular and stroke groups. The opportunities for prevention and control of the present threats lie less in the current health care systems than in life styles, environment, and human biology.

The environmental impacts are those inherent in the "macro," or general, environment and in the "micro," or personal, environment. In the macro environment the familiar vectors of air, water, and food remain of significance as the trends of urbanization, industrialization, and migration continue to burgeon.

The exact importance of the physical environment in the causation of carcinomas and cardiovascular diseases is under detailed and long-term study. It is too early to adopt heroic changes in air, water, and food manipulation. However, while we await the research findings, the more obvious countermeasures need not be delayed. These are few in number; they are likely to be increased as knowledge of cause and effect is developed. Concern should not be equated with public alarm.

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