The Sanitary Scientist of 1970

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MAN'S environment is a thin film on the surface of the earth. Almost all living processes occur within a zone extending less than 10 feet into the earth and fewer than 10 miles into the atmosphere. In the broadest terms, the environmentalists are the ones who possess a knowledge of this film in which we live and who develop effective methods of recovery and utilization of its resources. Within their ranks can be found the agriculturalist, geologist, mining engineer, meteorologist, hydrologist, and the like.

Before commodities can be used effectively, however, man's health must be considered, and it is to the sanitary scientist that we must turn to devise and apply acceptable standards for air, water, waste disposal, food, and shelter. But this is not the complete role of the sanitary scientist. In our two-dimensional environment, additional and vital mechanisms—the biological, meteorological, and geological cycles—are at work on the reconstitution of matter.

The role of the sanitary scientist is much like that of a fireman maintaining a fire on a limited parcel of land. Once all of the firewood is scavenged and used, the fire will go out unless the operator knows how to recover the waste products of the fire and convert these to a continuing supply of fuel by sunlight and photosynthesis. If he then maintains a balance between the size of the fire and the supply of fuel, the cycle should go on indefinitely.

Are men with the necessary prerequisites for the expanded role of sanitarian being trained today? The answer is yes. Several major institutions are training men with a broad and rigorous background in the sanitary sciences at the Ph.D. level.

What subject areas and training are required to prepare a man to deal effectively with the complex cyclic phenomena of nature? Fifty years ago the working portfolio of a sanitary scientist included hydraulic tables for the design of water supply and drainage systems, along with some basic sanitation rules and practices. Today the same scientist is required to deal with water supplies, treatment, pollution, and resources; sewer system design, sewage and industrial waste treatment, drinking and receiving water standards, air pollution, industrial hygiene, radiological health, food sanitation, epidemiology, and solid wastes disposal.

As if unknown before the advent of the sanitary engineer, such topics as electrodialysis, emulsion separation, and electrochemical degradation are now included under the heading of "advanced waste treatment." We find the sanitary engineering field littered with compounded and recompounded words such as biomechanics, closed environmental biokinetics, and environics. One cannot but wonder whether those responsible for this continued proliferation are aware of the statement by Dr. Joel Hildebrand, professor of chemistry emeritus, University of California, in which he jokingly but ever so seriously defined the number of courses offered by a college department as inversely proportional to the intellectual distinction of its faculty and to the amount of knowledge within the field.

Before continued division causes any greater confusion and loss of continuity, those topics fundamental to the sanitary sciences must be delineated. I suggest that we approach the

This is an excerpt from a paper that Dr. Klock, associate professor of engineering, Arizona State University, Tempe, Ariz., presented before the 1963 annual meeting of the Western Branch of the American Public Health Association.

subject from the molecular level. Considerable fundamental information has been amassed in the presently prescribed sanitarian and sanitary engineering disciplines, but vast areas of poorly understood and virtually unused scientific facts exist. A strong preparation in the fundamental chemical, biological, and engineering sciences is basic. Additional areas of significant promise are: (*a*) physical chemistry and biochemistry, including chemical thermodynamics and enzyme and colloid chemistry; (*b*) the earth sciences, including geology and atmospheric physics; (*c*) the biological sciences, including parasitology, epidemiology, virology, and limnology; and (*d*) the social sciences, when based on factual information, not on contemporary dogma.

In keeping with the theme of fundamentality, interrelation and quantitative interpretation of these sciences require a thorough preparation in mathematics and statistics. The descriptive in contrast to the quantitative scientific approach was at one time adequate to deal with such subjects as biology and anthropology, but such once-effective methods are yielding to the more rigorous quantitative approach. Many new areas of knowledge must be included in the sanitary field if it is to prosper, but if it is to successfully fuse the various background disciplines into a science of sanitation, it cannot afford the luxury of accepting descriptive material in lieu of quantitation.

Once possessing an appropriate training in fundamentals, the student is in a position to study the direct and implied actions and reactions of the biological, geological, and meteorological cycles of nature and to these apply the concepts of health and sanitation. However, it is at this point that we must be careful not to cut these cyclic occurrences into a series of superficially unassociated subjects lest we again require a prophet to lead us out of the wilderness of academic proliferation.

Although our present interests and responsibilities in sanitation and engineering are primarily concerned with the design of entities within the natural cycles, such as water supply systems, many of our problems arise from our lack of understanding or our unwillingness to accept responsibility for the indirect consequences of our actions. For example, immediately to the south of Phoenix, Ariz., thousands of acres of irrigated agricultural land have gone out of production because of a continuous and severe overdraft of the groundwater supply. This is a case of direct cause and effect.

International relations offer abundant examples of the need for a broad knowledge of our environment. On several occasions it has been proposed that a dam be built across the Bering Straits between Russia and Alaska. The proponents sighted benefits in better international relations and a tremendous hydroelectric potential. However, the indirect effect as pointed out by a prominent hydrologist would be to convert great portions of California and other parts of the southwestern United States to an absolute desert.

Thus, in review, we find the sanitary scientist responsible for the delivery of the fundamental factors of air, water, and food to society in a form favoring man's good health and responsible for the disposition of man's wastes. To successfully return the materials to their origin and maintain a balanced environment, the sanitary scientist must have a strong preparation in the fundamental sciences and a thorough working knowledge of the biological, geological, and meteorological cycles. Unlike his predecessor, who all too often gained the status of an expert through an intimate association with a long and varied career of professional mistakes, the sanitary scientist of 1970 must achieve methods to utilize man's environment effectively through rationally derived and scientifically founded concepts.