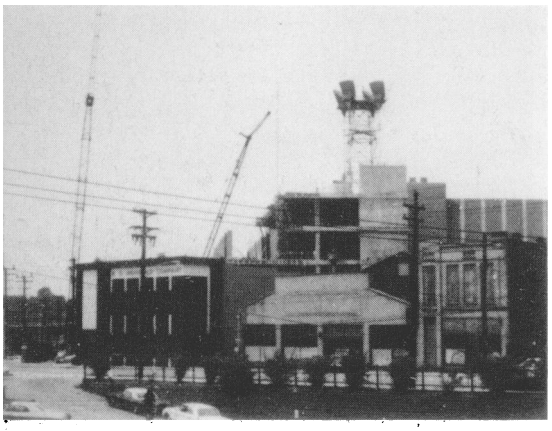
be measured directly. The challenging field of social indicators provides ample evidence of the problems involved in assigning values to the social or cultural aspects of environment such as education, public order, urban congestion, and recreational opportunities. Complexity of the environment, however, precludes complete understanding even if we restrict our definition to include only those components which



are measured directly. For example, we have no universal measure for air or water quality even though we do measure the principal contaminants. An overall index of air quality is easier to construct than one for water quality because air quality criteria are related primarily to human health, while each of the principal uses of water may involve different criteria of quality. Assignment of quantitative weighting factors to the components of any environmental index poses complex questions due to incomplete scientific conclusions on their relative detrimental effects. Even the identification of suitable criteria is difficult for some environmental insults; the undesirable effects of noise and odors, for example, are not easily characterized.

Because measures of less tangible components of environmental quality, such as urban sprawl, uniqueness of open spaces, and environmental health, cannot be devised as objectively as other measures might be, indices for them may incorporate value judgments by necessity. Obviously, the preferences of prudent men often differ, so use of personal judgments is minimized wherever possible.

Living organisms provide convenient full-time monitors of all pollutants, including their synergistic effects. Thus biological indicators, like the miner's canary, measure the actual responses of organisms or populations to environmental quality rather than predict a biological response from physical measurements. The physiological and ecological diversity of species allows a wide choice of indicator species for various environmental factors and situations. At the other end of the biological spectrum, it might be possible to utilize biochemical reactions in tests for more specific classes of contaminants. Because ability to support life is a prime characteristic of any environment, the general vigor of natural populations provides a readily accessible gauge of habitability which will be used more frequently as our ability to interpret population fluctuations increases. Systematic use of a series of biological indicators permits a more detailed description of quality.

Indices of environmental quality provide the descriptions which are necessary for effective planning and regulation—the legal and policy aspects are broad indeed. The National Environmental Policy Act of 1969, for example, requires that the President submit to Congress an annual Environmental Quality Report which shall convey the "status and condition of the major natural, manmade, or altered environmental classes of the nation" and the "current and foreseeable trends in the quality . . . of such environments." Prose alone soon will be inadequate. Regulatory mechanisms for maintenance and enhancement of our natural and man-made resources often lack the clear guidelines that allow intelligent appraisal of the effectiveness of our stewardship policies. Similarly, our courts will benefit from a system of indicators which quantitatively describe the impairment of resource quality by pollutants; indices can link scientific knowledge with legal standards for environmental quality.

The major goal in development of environmental indices is the conceptual reduction, in scientifically defensible fashion, of the many components of environment into the fewest possible terms with maximum information content. This is a truly interdisciplinary challenge which requires the merging of talents from many diverse disciplines and viewpoints. We must recognize the difficulties involved and must not hope for instant panaceas. The beneficial consequences of success are far ranging—objectivity will replace subjective guessing in assessment of shifts in environmental quality. It is in the spirit of interdisciplinary action toward achieving this goal that we organized the symposium.

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28–29 December

Mineral Elements in the Food Chain

The order of events in mineral nutrition leading to well-nourished people begins with mineral elements in rocks, their breakdown into soil, their uptake by plants, and the use of plants by animals. In some cases the plants are used directly by people, for example, cereals, potatoes, oranges, and other products. However, a large volume of plant material is converted into meats, eggs, and milk for use by people. Numerous physical and chemical processes occur in the transformation of mineral elements in rocks to the time such elements become an important part of human protoplasm. This symposium will present changing concepts in plant, animal, and human nutrition; newly identified trace elements in animals; the matter of imbalances of minerals; and possible harmful effects and a look toward the future. In addition, the story of one of the oldest agricultural organizations (1785 to the present) in the United States—the Philadelphia Society for Promoting Agriculture—will be presented.

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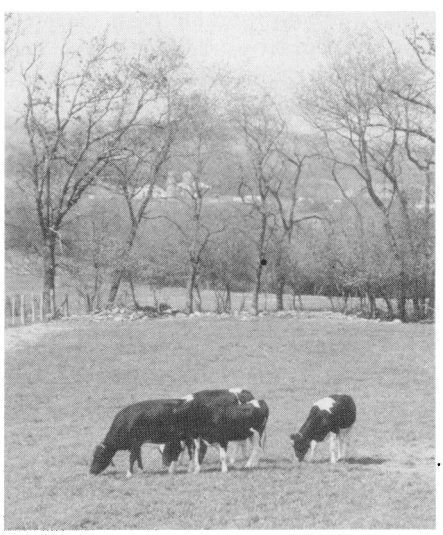

Pennsylvania State University

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