La mer 23: 41-42, 1985
Société franco-japonaise d'océanographie, Tokyo

Article spécial n° 2

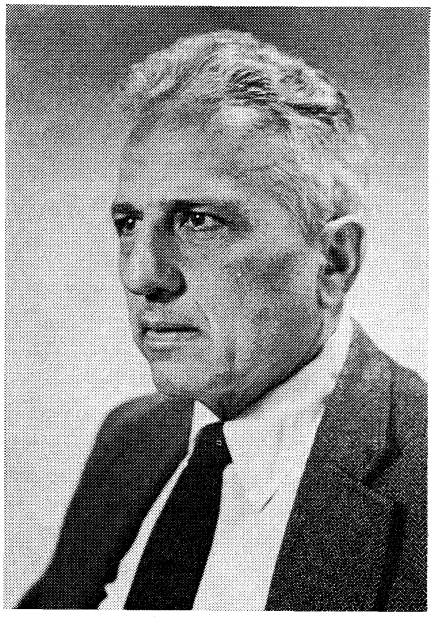
Environmental numerologies*

Edward D. GOLDBERG**

Data about our surroundings satisfy a number of needs. First, they extend our knowledge about the make-up and reactions occurring in the oceans, airs and lands. Secondly, they serve to identify resources of use to society. They can assist in protecting the environment from the deliberate or unintentional assaults by civilization. It is to this end that I address these comments, for environmental numbers can affect our health, food and energy resources, and the integrity of communities of other living organisms.

Information about the environment can be used for regulation and for litigation. In both cases it must be resistant to challenge. It must be of a high quality suitable for the user. Clearly, this does not mean that the data must be of the highest precision or of the highest accuracy consistent with modern day methodologies. Yet, at the present time one of the international scientific scandals involves the production and management of data, some of which might be of use for societal problems. Environmental measurements are entered into computer banks such as the U. S. EPA's STORET or the National Oceanographic Centers in Moscow and Washington, C. C. without any quality control, i. e., good and bad data are combined. The reliable data contaminate the unreliable data and, as a consequence, any combination falls into the category of the latter. Thus, the retriever finds the data useless other than for historic or bibliographic purposes.

I argue that it is incumbent for the marine scientific community to formulate procedures to insure the quality of data generated for environmental management purposes. So far the regulatory agencies have usually been lax in this regard. The validation of the data encompasses the entire measurement program from the collection of the data to the presentation of the results with appropriate indications of precision and accuracy.



The protocols for data assesment have been developed by parts of industry, academia and governments. There are textbooks and journals dedicated to quality control and quality assurance methodologies.

The problems under study must be explicitly stated before a rational experimental plan can be evaluated. A sampling plan must address the goals of the investigation and be statistically valid. The measurement process is validated when its performance characteristics match or exceed data requirements. Primary standards are necessary to establish the worth of an ana-

* Received November 19, 1984
** Scripps Institution of Oceanography, La Jolla, California 92093

lytical scheme. Interlaboratory comparison exercises can strengthen confidence in the results.

There is a cost to the procurement of environmental information. Clearly there should be a complementary cost to the assesment of its worth. This latter step is a vital part of any program involved with managing the ocean's resources. Too long now has the marine science research community overlooked the need for the assessment of data gathered for the decision making process. As a consequence, regulatory agencies in their inhouse and contractual work have not maintained data validation processes that are consistent with present day needs. We have data banks with useless information. We have laboratories of regulatory agencies producing irrelevant data. What are the possible tactics for altering this situation?

First of all, any organization that is gathering environmental information for management purpose should put aside a small percentage of the funding for the purposes of data validation. Clearly, a single estimate will not satisfy all situations. For continuing projects, the percentage may clearly be less than for those at the early stage of initiation. I suspect that something like one to five percent of a budget might be applied to data assessment.

Secondly, a corps of scientists should be involved on a fulltime basis in the data validation process. This group should be drawn from the population of investigators familiar with the environmental data being gathered and with its uses, i.e., they should have extensive field and laboratory experience as well as peer recognition. The protocols for data validation can be objectively formulated, yet there are occasions when subjective judgments will be needed. Thus, a substantial portion of the analysts might come from the more mature population of environmental scientists.

Finally, who should carry out the validation process? The group that generates the data or those investigators that manage the data banks? I suspect the former, inasmuch as they have an initial vested interest in the data that they have produced. But further, they often have needs to utilize comparable numbers from other institutions. Therefore, they require that all of the data that they retrieve from a data bank be of high quality. A reasonable price to pay for this is to establish their own quality control system.

I submit that these steps to produce environmental data of high quality can be of great use not only to those responsible for the management of environmental resources but also to those practicing scientists whose studies are purely of an academic nature.