SCIENCE

27 OCTOBER 1989
VOLUME 246
NUMBER 4929

Technology and Environment

Engineers face the unenviable necessity of attempting to reconcile the demands of two quite different worlds, one governed by the laws of nature and the other by the laws of lawyers. To some extent, engineers have always found it desirable to factor public attitudes into their designs, but the major considerations earlier were such eternal verities as the second law of thermodynamics. Now, however, a predominant boundary condition is a frenetically changing public opinion. A design for a long-lasting facility that makes sense today can be rendered obsolete tomorrow. What can the engineering profession do to enable its members to cope with this phenomenon? How can universities prepare their students to function in such circumstances? The answers to such questions must necessarily be fuzzy. A report issued by the National Academy of Engineering is an effort to begin to address the matter.* As noted in the report, many people feel that economic, technological, and scientific developments are accompanied by ever-larger risks for environment, society, and health. The authors neither press the panic button nor conclude that this is the best of all possible worlds. However, we are reminded that it was technology that forestalled the original Malthusian vision of population outrunning subsistence and furthermore, that many environmental problems have not proven as serious as originally forecast. Mercury in swordfish and pesticides in cranberry bogs are two examples.

The media and the public have tended to view industry as a collection of pollution sources. At one time this was true, but current attitudes do not reflect progress that has been made by many companies in emissions control and waste management through redesign and recycling. The focus on industry tends to blind us to the role of individuals and their behavior. Some of the toughest issues facing us—urban air pollution, destruction of rain forests, and loss of habitat—are the result of large-scale cultural patterns, the summed effects of millions of people making individual decisions.

One of the major problems that must be dealt with fairly soon is waste management. Disposal sites are filling, and no one wants a new one located nearby. The report asks, "Can society afford to function in a 'throwaway' mode for products such as diapers, batteries, paper, and beverage containers?"

The greenhouse effect is a matter that will continue to trigger alarms when the weather is hot or dry and to be of limited concern in winter. A substantial persistent global elevation in temperature is unlikely to occur in this century. But we should develop means of limiting possible deleterious effects in the more distant future. Ultimately, a drastic decrease in global emissions of CO_2 might be sought that would require major changes in our energy system. It might be desirable to expand use of nuclear energy. The public will have to find a balance between environmental concerns and standard of living.

An example of the impact of laws on engineering designs comes from the electrical utility industry. Before 1965 there was little legislation affecting power plants. In the period from 1900 to 1965 thermodynamic efficiency of power plants increased from 8% to 42%. Cost of kilowatt capacity in terms of constant dollars dropped by a factor of 4. Since 1965 a patchwork of some 33 laws has been enacted. As a result, thermodynamic efficiency has decreased, and capital costs in constant dollars have climbed by a factor of 4.

When the lawyers legislate on technical matters the product is often ridiculous. An example cited in the report involves treatment of domestic wastes. When the effluent is to be discharged into a eutrophic waterway a super treatment is mandated. However, storm ditches which spew out filth to the waterway are left unregulated.

In the report, Victoria J. Tschinkel points out that in the past 20 years the legal system has produced an adversarial, combative climate in which it is virtually impossible for people from industry to discuss facts with colleagues in government or with the public. She further states that many knowledgeable people are constantly in litigation and constrained from using each other's talents cooperatively. She concludes that the legalistic approach has produced a staggering load of regulations. It has created a legalistic process-oriented rather than a results-oriented approach in a sector where the result, namely environmental quality, is what we seek and need.—PHILIP H. ABELSON

*J. H. Ausubel and H. E. Sladovich, Eds., *Technology and Environment* (National Academy Press, Washington, DC, 1989).