Letters

Air Quality Standards

The Environmental Protection Agency (EPA) is now engaged in the review of state implementation plans pursuant to the 1970 Clean Air Act amendments. These are plans for the attainment, in 3 to 5 years, of the primary national ambient air quality standards. The crux of each implementation plan is a "control strategy" which must demonstrate that emissions standards and other proposed control actions are stringent enough to insure that the ambient standards are reached and maintained.

On 30 April 1971 the EPA administrator promulgated these standards, which for sulfur dioxide (SO_2) and particulates in the air, consist of annual average values and 24-hour average values, the latter not to be exceeded more than once a year. Yet most of the implementation plans submitted to EPA contain control strategies for only the annual standards for these pollutants. The proposed Pennsylvania Implementation Plan, for instance, projects an expected annual particulate concentration for 1975 of 71 to 75 $\mu g/m^3$, against an annual standard of 75 $\mu g/m^3$ (*1*).

In many cases, however, the 24-hour standard may be controlling. That is, by the application of the statistical theory of the distribution of air pollutant concentrations developed by Larsen of EPA (*2*) or by direct short-term diffusion modeling, it can be shown that many air quality control regions will need an annual average concentration significantly below the annual standard in order to attain the 24-hour standard. Our experience with the EPA review procedure now under way suggests that such considerations are receiving insufficient attention with EPA.

Congress specified the adoption of primary short-term as well as annual average standards in order to protect the public against demonstrated acute and chronic health effects. We compute that certain implementation plans imply that the attainment of the annual standard in a community will still leave it prone to 10 to 20 days per year in which SO_2 and particulate matter will be in excess of the short-term standards.

We hope that the EPA implementation plan review process, which is scheduled by statute to end on 30 May 1972, will include a thorough consideration of these points.

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1. "Pennsylvania implementation plan" (Pennsylvania Department of Environmental Resources, Harrisburg, 27 January 1972).
2. R. Larsen, "A mathematical model for relating air quality measurements to air quality standards" (Office of Air Programs, Air Pollution Technical Document AP-89, Environmental Protection Agency, Washington, D.C., 1971).

Aquatic Ecosystems

Although W. I. Aron and S. H. Smith (1 Oct., p. 13) have collaborated on an informative and useful article about ship canals and aquatic ecosystems, the applicability of their data to a prediction of the biological consequences of constructing a sea-level canal across the Isthmus of Panama has some important limitations.

The problem presented by the prospective sea-level canal across Panama is superficially similar to the Suez situation in that a continuous, saltwater passage is envisioned, but there would be two important differences. First, there would be no salinity barrier such as exists in the Bitter Lakes area of the Suez Canal. Second, the Panama Canal would link two tropical faunas, not one tropical and one warm-temperate, so there would be no significant temperature barrier. In the absence of both salinity and temperature barriers, migrations through a sea-level canal are likely to take place rapidly and on a much larger scale than has been the case with the Suez Canal.

How many species would get through a sea-level canal? We certainly don't know, but we can make an educated guess based on the available information. We know that the shallow-water marine faunas on each side of Central America are very rich. I have given very rough estimates of about 8400 species on the Atlantic side and about 5600 on the Pacific side (*1*). Since the fish species tend to be quite mobile and approximately 80 to 85 percent of the benthic invertebrates have pelagic larval stages, the potential for the migration of thousands of species through such a canal clearly exists.

What happens when a large number of species are introduced into an area that is already ecologically saturated (as most mainland shore areas probably are)? The application of known ecological principles tells us that such an enrichment would be followed by a competition among the species for the available niches. The competition would be followed by an extinction of species that would continue until the number in the area returned to about its original level. We must face the fact that large-scale migrations will eventually result in large-scale extinctions.

Because I predicted the possible loss of 1000 to 5000 species (*1*), Aron and Smith say that my outlook was extremely pessimistic. However, they extrapolate too closely from the Great Lakes and, especially, from the Suez events, where formidable barriers to the migration of marine animals have existed. Consequently, their prediction of modest, if noticeable, changes in the Atlantic and Pacific ecosystems during the next half-century is far too conservative.

When biologists find it necessary to object to some engineering projects for ecological reasons, they often find themselves in the negative position of objecting to something without being able to offer any feasible alternatives. Fortunately, in the case of the Panama sea-level canal proposal, there is an attractive, simple, and economical alternative. The Terminal Lake–Third Locks Plan, now before Congress, has several distinct advantages: (i) We would still have a freshwater canal that would prevent migrations by marine animals; (ii) capacity would be increased enough to permit 35,000 an-

nual transits, about the same number that would be permitted by a sea-level canal; (iii) no new treaties would be required since all the construction would take place in the canal zone, which is already owned and controlled by the United States; and (iv) the cost would be about $850 million compared to $2.88 billion for a sea-level structure.

Conservation-minded biologists and other informed citizens, who are concerned about the unnecessary elimination of unique species and the corresponding damage to intricate ecosystems, need to stand up and object. There *is* an attractive alternative. Let's get behind it.

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Reference

1. J. C. Briggs, *BioScience* **10**, 44 (1969).

Major contributions to the present-day fauna of the tropical eastern Pacific shores can be traced to relatively recent Caribbean origins. However, the faunas brought into contact by the Suez canal and by the Erie and Welland canals have disparate origins and evolutionary ages. One would intuitively think that the longer the duration of uninterrupted (isolated) evolution of faunas (and the subsequent appearance of organisms having increased levels of adaptation and modes of life), the more serious would be interfaunal changes and adjustments.

The extreme differences in physical conditions along both shores of Panama suggest that the exchange of inshore faunas through the proposed sea-level canal would be low. Tacit assumptions by other authors (and indirectly by Aron and Smith) without prior study, that certain faunas are "in equilibrium" or are supporting "optimal" numbers of species, are untenable. If such situations ever exist, they are ephemeral phenomena in the evolutionary and geological context.

The relative success of field and laboratory studies made prior to the construction of a sea-level canal will only appear in retrospect. Since the cases reported by Aron and Smith were not adequately studied, and the authors admit we can't predict what will in fact happen, how do biologists convince governments that the necessary data can be obtained and judiciously interpreted? Do we know what basic predictive principles to apply when major faunas meet? Do we know why there appears to be a time lag in faunal changes after first contact? Biology is still in its infancy as far as predicting effects of faunal interactions is concerned. This, not implied threats of faunal disasters, is the major reason why such studies should be made both before and after construction of a sea-level canal connecting recently isolated faunas.

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Moderation, as expressed by Aron and Smith, seems to be an endangered species. Many North Americans have loudly protested the proposed sea-level canal in Panama, the Bayano Dam, the Inter-American Highway, copper development, and the felling of Panama's forests. Many of the laments could have been written by Grant Swinger himself.

Panama, nearly as large as South Carolina, has the highest per capita income in tropical Latin America, yet a relatively low population. Progress is a magic word in Panama. It is difficult to sound the pollution alarm to a developing nation that is enraptured with engineering, yet scarcely familiar with the design-with-nature concept. Few Panamanians have learned the environmental headaches associated with progress. It is not politic to hinder progress; politicians usually decry pollution only when their constituents are crying pollution. Such is true in few, if any, developing countries. Progress, *si*; pollution control, *mañana*!

Does generosity or avarice dictate that the developed nations hinder the development of underdeveloped nations with environmental considerations? Should the land of the Welland Canal, the Tennessee Valley Authority, Copper Hill, Tennessee, and the Dust Bowl hamstring the republic that has none of these? Perhaps Panama, anticipating the economic returns of a sea-level canal, feels that sea snakes and starfish are Uncle Sam's problems.

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The process of deterioration of the Great Lakes is traced back to its beginnings in the late 1800's by Aron and Smith. Among the programs currently aimed at protecting the Great Lakes from further degradation, perhaps the most ambitious is the Pure Waters Pro-

gram of Monroe County, New York, with $0.4 billion committed to upgrading regional sewage collection and treatment and to phosphate removal. The conservation council of that county and a local science information group, the Rochester Committee for Scientific Information (RCSI), were instrumental in creating the public demand for a cleanup that made this program possible. Now the RCSI wishes to encourage the next step in the reclamation of the lake, as suggested by J. H. Hubschman (12 Feb. 1971, p. 536). The Rochester Prize for Environmental Management will be awarded in 1972 for a proposal to aid the recovery of Lake Ontario.

The prize of $1000 will be awarded to the authors of a manuscript proposing a way to improve water quality at swimming beaches on the south shores of Lake Ontario. In judging merit, the jury of scientists will favor methods that would increase species diversity in the lake, increase the consumption of algae, and lower the standing crop of *Cladophora*. A copy of an article published in a scientific journal or a manuscript of an article suitable for such publication will qualify for the competition. Entries should be mailed to the secretary of the Rochester Committee for Scientific Information at the address below and must be postmarked before 1 October 1972.

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President's Science Message

I was distressed to see Deborah Shapley (News and Comment, 24 Mar., p. 1343) take the President and his science adviser, Edward E. David, Jr., to task, and characterize the first message to Congress on science and technology as "vapid." I was impressed by the President's message. It lays the foundation for an effective teaming of the academic and industrial communities.

David, his team at the Office of Science and Technology, and James Wakelin at the Department of Commerce should be complimented for originating a practical plan that is not a multibillion-dollar handout to those who prefer to sit on their tails and bemoan the fate of science at the hands of the Philistines. Instead the message sets a note of high challenge and proposes mechanisms by which those who prefer positive thinking can take action. It deserves the support of all of us in science.

Let's stop attacking our friends in office. Soon we will wonder where they also went.

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Cans

The comment by Savas (Editorial, 22 Oct., p. 365) that the island of Jamaica is coming to be represented throughout the United States by a "layer of aluminum beer cans" is a fair statement of the case. His qualitative remarks can be easily quantified, for according to the U.S. Department of Commerce the number of "throwaway" aluminum beverage containers produced in 1969 was 3.2 billion; in 1970, 4 billion; in 1971, 6 billion; and in 1972, 8 billion will be produced. Since more than 90 percent of the bauxite used is imported into the United States, and since we have an increasingly unfavorable balance of trade, one might think that this importation could be curbed; that is a problem for the economists.

What is more important than economics is the fact that it takes 17,000 kilowatt-hours of electricity to convert 5 tons of bauxite to 1 ton of aluminum, which may then be fabricated into 40,000 cans. There is considerable lip service given today to the concept of recycling, especially of cans. According to the *Wall Street Journal* (*1*) about 3 percent of the aluminum cans fabricated last year were recycled. Industry (*2*) disputes this figure and estimates that 12.5 percent of the cans produced in 1971 were collected for recycling. Even if the collection of aluminum cans continues at that rate in 1972, there will still be 175,000 tons of aluminum reduced from bauxite and dissipated over the landscape. Put in more general terms, the electricity required would be sufficient to supply the city of Washington, D.C., for about 20 months.

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2. J. C. Dale (The Aluminum Association, 750 Third Avenue, New York 10017), personal communication.