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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References

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-