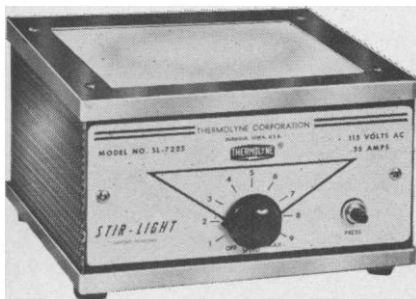


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accepted, usable methodology for evaluating, even in relative terms, "the social return commensurate with the cost of investment" of various research activities. What is actually taking place is that agencies doing pure science on a large-scale—NSF, NASA, AEC, and NIH—respond to pluralistic pressures from the various segments of the scientific community and also apply judgments on what areas of research are ripe for major investments. Inasmuch as these agencies, except for NSF, act as spokesmen for particular scientific research areas, Carey's arguments for setting priorities and for centralized decision-making may be quite legitimate.

Lacking an accepted metric for deciding, that is, between expanded lunar exploration versus high-energy physics, the Budget Bureau works with the Science Advisor, who may seek guidance on priorities from the President's Science Advisory Committee, from the National Science Board, or from the National Academy of Sciences. Perhaps it would be desirable to combine federal departments, or at least those sections that deal with pure science, with the National Science Foundation as its core, as was suggested by Science Advisor Donald Hornig at the Dallas meeting of the AAAS. The advantage would be that decisions on priorities can then be made within a single department rather than at the White House level, and that there would be a single spokesman for pure science at the level of a cabinet officer. On the other hand, there is no guarantee that Congress would approve a departmental budget as large as the sum of its components.

Regardless of whether a Department of Science is established, pure science, which has a \$2.354 billion budget for FY '69 as compared to the total R&D budget of \$18.077 billion (2), could well be set at a fixed percentage of the total R&D, and perhaps even grow at a moderate rate. [It came to 11.7 percent in FY '67, 12.5 percent in FY '68, and 13.0 percent in FY '69 (2).] The justification would be, of course, that money spent on pure science provides the basic knowledge as well as the manpower to later undertake the mission-related R&D for direct economic and social returns.

One final point: Even mission-oriented R&D cannot be expected to give an immediate return and may require a time scale of, say, 5 to 10 years. As the New York Academy points out, the

argument for long-range funding of both mission-oriented and pure research, particularly in the universities, cannot be made too strongly.

S. FRED SINGER

Office of the Secretary,
U.S. Department of the Interior,
Washington, D.C. 20240

References and Notes

1. *Report to Office of Water Resources Research* by the American Society of Civil Engineers, Urban Water Resources Research Program of Harvard University (Cambridge, Mass., February 1969). Note also that, while R & D funding is nearly all federal, the total national investment is mostly nonfederal.
2. *Federal Funds for Research, Development, and Other Scientific Activities*, vol. 17, NSF Publ. 68-27 (National Science Foundation, Washington, D.C., August 1968).

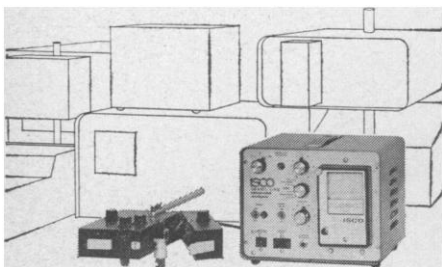
Panama Canal: Widespread Effects

The correspondence of Sheffey and Rubinoff (Letters, 20 Dec.) about the biological effects of a sea-level linking of the Atlantic and Pacific oceans brings to mind an experience I had some years ago as an explorer in the Upernivik district of West Greenland.

On an extensive sledge trip to examine a number of glaciers, I made a stop at Kigtorsak, a small winter colony whose director was a combination of dictator and sage. He was an old man among Greenlanders, but his watery eyes were penetrating and, with the help of a cane fashioned from a willow, he was as spry as a man of 20. He claimed that ice in the area became poor when the Panama Canal was opened and joined the two oceans. This, of course, had an effect upon seal hunting, and the lives of the natives thereabouts were consequently endangered. In many areas of Greenland at that time the seal was still the staff of life. Without it the native would have been unable to penetrate north of the timber line. It provided him with oil for light and heat, with meat to eat, and fur to keep him warm. Because of the lack of seals, hunting had been poor in the Kigtorsak area. Many dogs had to be killed and others kept on starvation rations. No wonder the director was righteously indignant. Two years earlier he had gone so far as to draw up a petition to have the Panama Canal closed (the petition got as far as Godthaab before being shelved).

Fortunately for me, an American, he did not know the exact location of the canal. He believed it to be in Denmark and therefore I was able to enjoy his unstinted hospitality. He entertained me

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in his home with seal meat and coffee and the conversation of his friends. On the wall of his sod hut was the picture of a child standing on the shore of a pond watching a duck. The director wondered why Danish parents were allowed to bring up their children so idly. Why wasn't the child taught to shoot the duck—a plump bird, too. On a corner shelf in the hut he had some back copies of a paper *Akuagadlutit* (Reading) that had been launched in 1861 (and today flourishes as a bilingual paper issued twice a week). It was from *Akuagadlutit* that he had read about the opening of the Panama Canal.

WILLIAM S. CARLSON

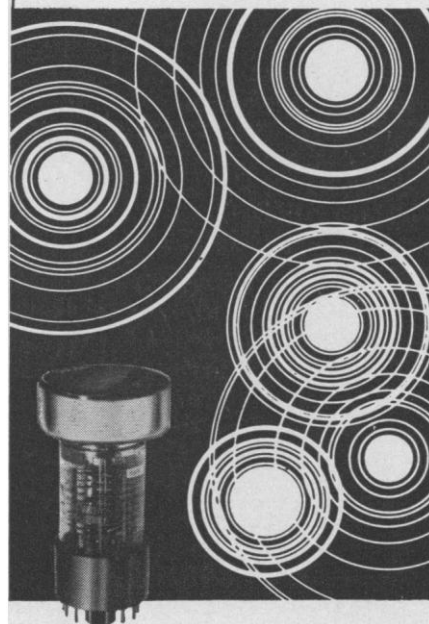
University of Toledo,
Toledo, Ohio 43606

My letter, published below Sheffey's (20 Dec.), was written independently of his, but I would like to make a specific reply to his comments. My purpose in writing my article ("Central American sea-level canal: Possible biological effects," 30 Aug., p. 857), was not to cause "alarm over the biological consequences of linking the oceans," but rather to provoke action by the scientific community to predict the probable results of permitting two separate biotas to merge, and to measure such changes as may occur when and if the canal is dug.

Such action would also allow us to evaluate Sheffey's suggestion that mixing of the biotas is already proceeding on a substantial scale and his statement that "It seems reasonable to conclude that a sea-level canal would create little or no new threat to the lower links of the ocean food chain." As far as I am aware, the few and incomplete studies which have been made in the past do not support this suggestion. And Sheffey's present assurances are all the more surprising in view of a sentence in the Fourth Annual Report of the Atlantic-Pacific Interoceanic Canal Study Commission (1968 H.R. Document No. 380, p. 8): "The Study of Engineering Feasibility includes biological evaluation of the radiological safety of nuclear excavation, but the bioenvironmental studies are not of sufficient scope or duration to permit determination of the potential effects of biota exchange and the impact of exchange of waters upon environmental resources."

There would appear to be some serious discrepancy here. Of course, intelligent persons can hold different opinions on the subject in the present state of our knowledge. But the point of the

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SCIENCE, VOL. 163

more detailed preliminary studies recommended in my article would be to remove this uncertainty or, at least, reduce it as much as possible. Any attempt to discount the biological effects of a sea-level canal on the basis of currently available data would seem to be premature.

IRA RUBINOFF

*Smithsonian Tropical Research
Institute, Balboa, Canal Zone*

World Population: Control or Crisis?

Two recent articles on the world population crisis presented the problems but offered no permanent solutions (1). Hardin said, "No technical solution can rescue us from the misery of overpopulation. Freedom to breed will bring ruin to all." Aldrich quotes W. M. Myers' estimate that "with unprecedented effort mankind can buy two or three decades before being overcome by widespread famine" but he himself concludes that "the question we leave here unresolved is how, or whether, mankind will achieve control of its population."

Man *could* achieve control of population growth, but only by drastic methods and new techniques. At the time of puberty, each girl would have a capsule containing a minute amount of progesterone inserted under the skin which would act as a chemical anti-fertility agent for 15 to 20 years. When a baby is wanted, the capsule would be removed. After the birth of the baby a new capsule would be inserted. Some restrictions might be required, such as denying parenthood to women under the age of 18 or 20, to unmarried women, and to those who had already produced three children.

If such proposals seem too drastic and dictatorial, consider some of the alternatives. Mexico, for example, has received extensive aid since 1943 from the Rockefeller Foundation and has made great progress in increasing food production. J. George Harrar of the Foundation has noted that food production there tripled while the population doubled. But if Mexico's present rate of population growth (3.5 percent) (2) should continue, her population would equal the present population of the United States in 42 years, exceed the present population of the world in less than 130 years, and increase 1000-fold in 200 years. Obviously population

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