

Letters

Starfish Infestation: Hypothesis

Chesher's report (18 July, p. 280) describes the recent destructive infestations of Pacific coral reefs in several areas with the starfish *Acanthaster planci*. He proposes that an explanation for the extreme increase in the starfish population may be that the larvae have been provided with a specially favorable environment by "destruction of reefs by blasting, dredging, and other human activities" which destroys the natural predators of the larvae.

In view of the sites reported to have serious infestations—Australian Great Barrier Reef near Cairns, Guam between Orote and Ritidian points, Fiji, Truk, Palau, and others—it seems plausible that some kind of human activity has triggered this population explosion of starfish, since these are all areas which have appreciable modern settlements. However, if the mere physical destruction of large areas of living coral from dredging and blasting were sufficient to produce the starfish increase I suggest that a great increase should have been observed during World War II or even earlier in some of these same areas. Both Guam and Truk (especially the latter), areas only now experiencing the starfish problem, were subjected to severe bombing during World War II. In the case of Truk this appears to have been enough, along with overfishing, to deplete seriously the fish supply of the lagoon for several years, but during my stay there in 1949–50 I encountered nothing to suggest that starfish were eating the coral excessively. On the contrary, I was impressed with the rapidity with which new coral began to grow again on the disturbed areas.

Another human activity which ought to be considered as possibly upsetting the ecological balance in these areas is the widespread use of persistent insecticides in controlling mosquitoes, cockroaches, and agricultural pests. Dredging and blasting are not new in

the Pacific, but the extended use of modern persistent insecticides is. The starfish infestation in Guam began on the side of the island with the greatest concentration of civilian and military population. Chesher notes that infestations on three islands were "first noted near blasting and dredging activities." But blasting and dredging are likely to occur in areas near concentrations of human population where insecticides may be used repeatedly and in quantity. There have been reports of the concentration of DDT in predators remote from the area where insecticides are used. Such concentration seems especially likely in offshore areas near the places where the insecticides are used. Perhaps populations of *A. planci* are normally kept under control by some predator or predators which have become depleted by ingesting excessive insecticide. If this hypothesis proves correct, it should be possible to correlate existing infestations of the starfish with use of insecticide on land and it should also be possible to predict the most likely sites for new outbreaks. A permanent solution would presumably require control of the use of persistent insecticides which could get washed into the sea. I would hope that Chesher and his associates at the University of Guam will investigate the role of insecticides in starfish infestation if they are not already doing so.

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Unified Science Courses

While deploring the failure of colleges to provide suitable science courses for nonscience students, Reif very kindly noted that our project was one of the "few exceptions" ("Science education for nonscience students," 30 May, p.

1032). Our new "Introduction to Natural Science" has much in common with the Berkeley innovations, but with some substantial differences. To begin with, our "customers" were not intended to be the highly selected students of Rensselaer Polytechnic Institute. Rather, we hoped to prepare texts and teacher's guides that could be used with some success by at least 80 percent of 4-year colleges and possibly by half of the junior colleges of the country as well. For this reason our pilot classes included a wide range of student interests and capabilities and required us to make the texts and the guides sufficiently self-explanatory to avoid overdependence on the lecturer and assistants. The thought that was persistently with us as we listened to some of our own lecturers was "How can we write the text in such a manner as to get the point across *despite* this type of lecturer?" More than any other group it was the *students* who helped us to find an answer to this question. We seem to have succeeded, for part 1, *The Physical Sciences*, which is now available from Academic Press, is being read by some housewives as well as by science majors. Part 2, *The Life Sciences*, for the second-year portion of the course will appear in January 1970, together with its teacher's guide and laboratory manual. In fact we state that the main requirement for the physical scientist who teaches the first-year portion, and the biochemist or biologist who teaches the second-year portion, is that each have a *desire* to teach modern science with an integrated, multidisciplinary, philosophical approach and with awareness of social implications.

Another major difference is the time allotment for the course. We felt that attempting to cover the physical, chemical, and biological sciences in 1 year is likely to fail in its objectives with most students. There are not that many shortcuts to science. With 2 years and 12 credit hours, students, even science majors, have a better chance for achieving understanding of the atomic and nuclear science, the biochemistry, and the physiology (especially neurophysiology) that represent essential features of modern science. The 12 credit hours is also timely in that more and more states are requiring 15 or 16 credit hours of science and mathematics for teacher certification.

We agree that emphasis on historical details quickly reaches a point of diminishing returns. On the other hand,