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,

there must be some awareness of the transition periods of science in order to develop perspective on the progress of man's society. For example, our chapter 13, "Transition from determinacy to indeterminacy," sets the stage nicely for the transition from the firm cause-and-effect attitudes of the Newtonian period to more recent developments in thermodynamics and atomic science.

We also use large lecture groups and small recitation groups, and believe that the laboratory work should be informal but involve individual effort as much as possible.

The most difficult aspect of any course has to do with clarifying concepts for the student. For this purpose, integration of concepts and topics to reveal common underlying features of disciplines is very important. We utilize several major themes, such as the probability concepts, the laws of thermodynamics, and energy conversions. By far the most effective theme for unifying and for relating natural phenomena with the personal world of the student evolves from the concepts and techniques associated with control systems. These involve feedback interrelationships and information and are more generally referred to as cybernetics. With this approach it becomes possible to *relate* situations to each other. The relationships may involve events that are in close proximity, or they may relate the past to the present and to the future. The *relevance* of things, which students complain is missing in college instruction, is brought home by this approach, for the elements and the functions that enter a situation or system may intermix mechanical gadgets and human activities. Feedback may be in the form of a mechanical thrust or an idea. When once the student learns to analyze mechanical or social situations in these terms he is not likely to regard science as outside his personal interests or capabilities.

We avoid frontal attacks on the "scientific" method, explanations, logic, or symbolism. The halo that is usually accorded the physical or "exact" sciences falls away when we discuss how poorly understood are their basic concepts. The halo is restored when we show how much has been accomplished despite this lack of basic understanding, but in the process the behavioral disciplines and the humanities also gain stature. In fact, science and the scientific effort emerge as very human activities.

We completely share the Berkeley conviction that "it is indeed possible to teach significant aspects of modern science to nonscience students and to do so in a manner that is intellectually stimulating, thought-provoking, and interesting to the students." We would add that this can be done on very many other campuses where the Berkeley-RPI campus "advantages" may not exist.

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. . . A growing number of secondary schools have been experimenting with unified science classes for the past 15 years, and there is even a group of college and high school teachers organized in a group called the "Federation of Unified Science Educators."

One of the greatest of all problems in presenting unified science courses at the secondary level is that parents do not want their youngsters to take the courses because they are worried about College Board scores. If the colleges and universities introduce courses of this nature into their own programs, perhaps this will help solve part of the secondary schools' problem.

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University Self-Government: Who Calls the Tune?

In response to Herbert J. Spiro's request for establishing self-government in the university communities (Letters, 23 May), I am reasonably sure that within the college communities the talent is available for self-government. However, his plea is rather (deliberately?) naive and Utopian: Give me what I want and leave me alone to do my own thing with no strings attached.

University self-government is certainly feasible in a small, privately funded university which may operate as a separate, independent, closed system. The problem comes about when state or federal tax money is used for operation. John Q. Public-Taxpayer is not likely to consent to a scheme of taxation without representation, and would not willingly hand over a bag of money and grant blanket authority to operate a university without also stipulating the range of responsibility and demanding that the administrators be held accountable. Whoever pays the piper calls the tune!

Within a democracy power is vested in the majority. In extreme situations of difference of opinion, 49.9 percent of the people may be dominated by 50.1 percent with the majority will expressed through the established channels of political action. Spiro recommends that various officers be elected by and held accountable to their constituents—a sound principle of political democracy, but who are these consenting constituents in his plans, where do the represented taxpayers fit in, and who are in fact being governed?

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Humanitarian Research

In Langer's report of the West Coast version of the 4 March protest (14 Mar., p. 1176), I was puzzled by various criticisms of scientific government-sponsored research at Stanford and M.I.T. One student claimed, "The purpose of the people-sniffer and the bomb is to kill people. That's what it's all about." If those critics will take a good look at the agricultural research programs, they will find few, if any, students or professors expressing discontent over the U.S. government research programs, mainly because those who are in agriculture are dedicated to increasing the production of food and fiber for mankind the world over.

I am spending 2 years in Iran helping develop livestock feed so Iran can eventually produce enough meat and milk to feed her own population. Everywhere my colleagues are striving to increase crop and livestock production, and I believe the United States is doing more than any other nation in this humanitarian effort. And incidentally, many results of research in the physical and biological sciences have been applied beneficially toward increasing world food harvests.

If American professors and students think they have grievances, let them come to foreign lands for a visit. The United States will then look like the Garden of Eden.

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