cm³. The high electron density was chosen to represent the expanding target just as it begins to transmit rather than to reflect the 1 μ radiation. It should be noted that the reflected light will not detract from the magnetic field created by the primary beam. In fact, the field is doubled when the beam is reflected back on itself and circular polarization is maintained.

The foregoing calculation is admittedly crude, in that nonlinear effects or the field effects on electron orbits have not been taken into account. A self-consistent field calculation would be required for the latter. In any case, Eqs. 1 and 2 indicated that laser-produced magnetic fields are favored by high electron densities, and by long wavelength light as well as high light intensity. Resonance effects could enhance the field, but no laser now in use will resonate with hydrogen isotope fusion plasmas.

Polarized light is an extremely versatile source of shaped magnetic fields. If the circular polarity varies in handedness from one quadrant to the next in the cross section of a laser beam, a cusped field will be produced. If the beam diverges, the field will decrease along the beam and form a magnetic mirror. Thus, by splitting a beam and causing the two halves to meet each other on the same axis after divergence, a biconical cusped field can be produced. Since the polarity of the light can be rapidly changed (for example, megahertz modulation by electrooptic light modulators), the magnetic field can also be modulated.

It should be mentioned that ordinary, circularly polarized light will produce a magnetic field of the same strength as laser light of equal intensity. But no ordinary light sources available today are able to concentrate the light in time and space to the extent that lasers do.

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Acanthaster: A Rarity in the Past?

In "Acanthaster: A Disaster?" (*1*, *2*), two points of view were expressed. One questioned whether this starfish had been a great rarity before the observed outbreaks in 1962 and 1968 and suggested that outbreaks may have been occurring sporadically in times past on different islands without attracting attention (*1*). The other stated categorically that there was no evidence for earlier periods of abundance and that the reference cited in support of the first point of view was irrelevant (*2*).

The principal evidence offered for high population densities in the past was a comment made by the noted naturalist C. H. Edmondson (*3*). In the introduction to his book on the reef and shore fauna of Hawaii, Edmondson states: "That serious-minded investigators might know something of . . . the scarcity or abundance, and the relative accessibility . . . of marine animals available for purposes of research about the shores of Hawaii, has also been an important consideration." And then for *Acanthaster planci* he said, while not "common" in Hawaiian waters, it was "very common" (1933 edition) and "abundant" (1946 edition) about Christmas Island (Pacific Ocean) in 2 or 3 fathoms of water. Even without his introductory remarks, it seems unreasonable to infer that Edmondson could have meant that he searched the reef at Christmas Island and found only isolated clumps of a few individuals, much less just four or five specimens in one spot. To suggest that an experienced naturalist would consider an organism abundant on such a basis is incredible.

I have come upon several other remarks made by investigators decades ago that also indicate *Acanthaster* had been abundant locally. Thus it seems that the historical rarity of the starfish has been greatly overstated, and the possibility of populations having occurred sporadically but naturally in epidemic proportions on widely scattered reefs has been too summarily dismissed.

In the Philippines, Domantay and Roxas (*4*) studied the sea stars of Port Galera Bay and Sabang Cove every summer between 1924 and 1938; they observed that *Acanthaster* was "common among the corals and rocks." It has been argued (*5*) that if *Acanthaster* has been always going through cyclic or sporadic fluctuations in abundance, surely the Japanese would have noticed it during their relatively brief but intensive shallow-water studies in the Palaus before World War II. The fact is they did. Hayashi (*6*) reported the species as "very common" on rocky and sandy substrata in the Arakabesan, but rare in the Arappu region, where he collected many examples in 1934. And further, the noted Danish echinoderm specialist and field biologist, Th. Mortensen, in his report on the development and larval forms of echinoderms (*7*), stated that *A. planci* "was found rather commonly on the coral reef at the little island Haarlem off Batavia, near Onrust, crawling over the top of the madreporarian corals on which it feeds, sucking off all the soft substance, leaving the white skeleton of the corals to show where it has been at work."

Clearly then, population densities of *Acanthaster* varied widely in the past, without undue importance being attached to periods of abundance. The question now is whether the situation is any different. If not, and reefs are as adapted to such catastrophic events as are certain terrestrial communities to fire (*8*), more harm than good could result from indiscriminate use of control measures. If the situation is significantly different, and the activities of man are actually perturbing the environment in certain reef situations so as to precipitate the apparent epidemics, we should find out what the factors are so that they can be intelligently regulated. Even if *Acanthaster* epidemics are not an entirely new phenomenon, the possibility exists that human disturbances are increasing their frequency by generating epidemics in areas where they might not have occurred naturally in the foreseeable future. To resolve the problem will require intensive field and laboratory research.

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References and Notes

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