tion experiments on the dehydrogenase-NAD system can now be assigned. There is an immeasurably fast initial change, which corresponds to the effect of the temperature rise on the NAD spectrum. Of the two second-order processes one (the slower) can now with certainty be attributed to the minor component and is absent in the purified protein. This leaves one other relaxation, the concentration-dependence of which shows it to be first order.

The NAD binding process therefore involves only one rapid second-order and one slow first-order reaction. The sequential binding scheme, with a set of consecutively different affinities, has no room in it for a first-order reaction. The concerted model on the other hand demands an intramolecular isomerization between states of high and low binding affinity ; moreover there is also as expected a sharp decrease in this first-order rate constant as the NAD concentration increases. Other criteria for an all-or-none affinity change are likewise fulfilled, and it is also found that all four subunits must participate in the cooperative process, so that models based on dimeric cooperative units can be excluded.

Although these results make possible by far the least equivocal assignment so far of a mechanism for a cooperatively interacting system, one would not of course try to generalize from this one case, and indeed Kirschner *et al.* point out that the conditions in the cell are very likely such that the cooperativity is not called into play. If this is so, the teleological argument would run, the mechanism in an enzyme designed for, rather than adventitiously endowed with, cooperativity might well be quite different.

In a companion paper (*ibid.*, 51) Kirschner has used the stopped-flow method to study the properties of the NAD-complex of the enzyme in both its affinity (allosteric) states. This is made possible by the slow rate of conversion of the apoenzyme from the unreactive state, in which under the conditions of the experiment it predominantly finds itself, to the reactive state on addition of NAD. In effect a metastable complex of NAD with the low-affinity state is formed, which endures for more than 3 s. The spectroscopic change accompanying the binding of NAD to the low-affinity state was determined, and the activity of this form, with the NAD attached, towards the substrate glyceraldehyde-3-phosphate could also be studied. This proved to be negligible. Kirschner shows that with the aid of this interesting and important fact, earlier kinetic data on the enzyme, previously apparently hopelessly complicated, can be quantitatively explained.

SELENOLOGY

Why Lunar Erosion?

from our Geomagnetism Correspondent

THE presence of soils and fines on the Moon's surface indicates that the lunar rocks have undergone extensive erosion. But what is the predominant erosion mechanism? The lack of water on the lunar surface shows that one of the most important causes of terrestrial erosion cannot apply to the Moon ; but the existence of so many lunar craters, on the other hand, has frequently led to the assumption that the principal source of erosion is meteorite impact, or at least the secondary ejecta thrown up by the impact of meteorites. From an examination of the morphology of microcraters in lunar rocks, however, Hörz *et al.* (*Earth Planet. Sci. Lett.*, **10**, 381 ; 1971) now conclude that although the occurrence of erosion by meteorite impact is not in doubt it is not a very significant process—the bulk of lunar erosion seems to take place not as a result of the impact of conventional meteorites but of primary cosmic ray particles.

To arrive at this conclusion Hörz and his colleagues carried out detailed stereoscopic microscope investigations of about 4,000 lunar microcraters larger than 0.4 mm. The samples examined were two fine-grained and three coarse-grained crystalline rocks and one breccia from the collection of Apollo 12 samples.

Precise details of the morphologies of the microcraters are to some extent dependent on the particular type of rock ; but most craters examined comprised a central pit (a glass-lined cavity in the centre of the overall crater), a surrounding halo (a concentric zone of shock-fractured minerals) with a high albedo and an average diameter 2.2 times greater than that of the pit, and a spall area (a concentric area around the pit which was removed by shock wave interaction with the free surface) which includes the halo and whose average diameter is 4.5 times greater than that of the pit. Completely fresh pits have diameter-depth ratios ranging from 2 to 5. Variations in relative diameters and depths are undoubtedly attributable to differences in impact velocities, the intensity of fracturing of the rock surface from previous impacts, the relative abundances of target minerals and errors of measurement. The point is, though, that almost all microcraters have the same morphological form.

The geometries of the microcraters are apparently similar to those of cra-

Induced Self-fertility

IN these days of technological precision it is comforting to find that results may still be obtained by accident. A case in point is the work reported by Brasier in next Wednesday's *Nature New Biology*. He has found that sex organs can be induced in heterothallic fungi when normally they will arise only when isolates of different compatibility groups are paired. Thus, sex organs were induced in an isolate of *Phytophthora palmivora* when contaminated with an isolate of another fungus, *Trichoderma viride*.

Screening of many different species of *Phytophthora* followed and the stimulus provided by *Trichoderma* was found to be effective in nearly all cases, although of the two sexually compatible groups, A^1 and A^2, only A^2 demonstrated this induction of the sex organs and the effect seems to be confined to isolates of this group.

The chemical nature of this sexual stimulus cannot yet be defined but the restriction of the stimulus to A^2 suggests that it may have affinities with substances produced by the A^1 compatibility type. Although Brasier could not induce sexuality with liquid culture filtrates or autoclaved agar cultures, he found that production of sex organs was stimulated by inverting a Petri dish of *Trichoderma* over a Petri dish of *Phytophthora* so that there was no physical contact between the two cultures. It was observed that a far higher proportion of *Phytophthora* sex organs contained mature oospores when there was no physical contact, probably because the more rapidly growing *Trichoderma viride* killed the *Phytophthora* over which it grew. It seems likely, however, that the chemical responsible for the stimulus must be volatile.

Brasier points out that observations of a similar nature have been made in the past few years for bacteria and metabolic diffusates of soil micro-organisms have also been shown to cause the sexual stimulation of some species of *Phytophthora*. His own attempts with a number of other soil fungi have so far proved unsuccessful.

Brasier's finding has important genetic and ecological implications quite apart from its obvious use of making the identification of heterothallic *Phytophthora* easier. The possibility of inducing selfing in A^2 isolates would render genetic analysis much more simple and if the phenomenon occurs in nature, where *Trichoderma* and *Phytophthora* are potentially antagonistic, the survival of some *Phytophthora* species as oospores may be considerably enhanced.