20. L. S. B. Leakey, *Proc. Nat. Acad. Sci. U.S.A.* **67**, 746 (1970); E Simons, *Primate Evolution* (Macmillan, New York, 1972); B. Kurten, *Not From the Apes* (Pantheon, New York, 1972).
21. E. M. Witkin, *Annu. Rev. Microbiol.* **23**, 487 (1969); J. E. Cleaver, *J. Invest. Dermatol.* **54**, 181 (1971).
22. We thank S. L. Washburn, B. N. Ames, and C. O. Lovejoy for helpful discussions. Supported in part by NSF grants GB-20750 and GB-13119 and by a fellowship award to A.C.W. from the J. S. Guggenheim Memorial Foundation. *Pteropus* and *Hipposideros* were collected on the *Alpha Helix* expedition to New Guinea in 1969, and *Antrozous* and *Tadarida* were collected locally by P. Leitner.
* Present address: Department of Zoology, University of Nairobi, Kenya.
21 July 1972; revised 4 January 1973

Fragile Ecosystems

In their plea for the preservation of large areas of tropical rain forest, Gómez-Pompa *et al.* (*1*) emphasize that "if we wait for a generation to provide abundant evidence [of the vulnerability of the rain-forest ecosystem], there probably will not be rain forests left to prove it." Having been interested for several years in the problem of mass extinctions (*2*), we should like to verify the soundness of their view from the paleontologist's perspective. In a sense, the documentation which they seek in order to elicit massive international action toward conserving the tropical biota has been provided by the fossil record. We have noted previously, following Sanders (*3*), that in its high diversity the tropical ecosystem is analogous to offshore marine assemblages which underwent radical reorganizations in community structure, especially at the end of Devonian and Permian time. Nearshore assemblages of lower diversity—perhaps analogous to the temperate-zone forests which have been resilient to intensive and extensive agricultural exploitation —have been much more stable throughout geologic time.

By contrast, as Gómez-Pompa *et al.* indicate in their first paragraph, neontologists have tended to believe that the more diverse a community is, the more stable it should be—at least if stability is defined in terms of resistance to the effects of fluctuations in the number of individuals of a constituent species (such fluctuations comprehending also the total disappearance of a species) (*4*). We have postulated (*2*) that mass extinctions primarily affecting species belonging to assemblages of high diversity came about because these taxa, having lived for many millions of years in a predictable environment where there was little selection for genetic or physiological flexibility, were vulnerable to changes in the physical environment, such as the shrinking of the seas during periods of mountain building (*5*). Our postulate of loss of genetic polymorphism has recently been challenged by workers who have found that species of several different phyla from the deep sea, one of the most diverse ecosystems and apparently one of the most predictable environments on the globe, show as high a level of genetic variability as do species from less predictable environments (*6*). [Other studies, however, indicate that genetic variability among species of the Class Bivalvia decreases along a gradient from less predictable to more predictable environments (*7*).] Among tropical plants, vulnerability to physical stress appears to result primarily from the loss of adaptations for dispersal and dormancy. Identification of the exact cause of mass extinctions is, however, comparatively unimportant in the present context; our primary purpose is to reiterate that, although the activities of man which destroy tropical rain forests are different from the natural forces that destroyed diverse marine biotas of the geologic past, the effects are likely to be the same. We believe that the lesson of earth history is that highly diverse ecosystems in physically predictable environmental regimes are in fact very fragile and require respect and care if they are to be preserved.

PETER W. BRETSKY
SARA S. BRETSKY
JEFFREY LEVINTON
Department of Earth and Space Sciences, State University of New York, Stony Brook 11790
DOUGLAS M. LORENZ
Department of Paleobiology, U.S. National Museum, Smithsonian Institution, Washington, D.C. 20560

References and Notes

1. A. Gómez-Pompa, C. Vázquez-Yanes, S. Guevara, *Science* **177**, 762 (1972).
2. P. W. Bretsky, *ibid.* **161**, 1231 (1968); ——— and D. M. Lorenz, *Geol. Soc. Amer. Bull.* **81**, 2449 (1970); *Proc. North Amer. Paleontol. Convention*, **E**, 522 (1970).
3. H. L. Sanders, *Amer. Natur.* **102**, 243 (1968).
4. R. H. MacArthur, *Ecology* **36**, 533 (1955).
5. R. C. Moore, *Bull. Mus. Comp. Zool.* **112**, 259 (1954); N. D. Newell, *Geol. Soc. Amer. Spec. Paper* **89**, 63 (1967); E. G. Kauffman, *Proc. North Amer. Paleontol. Convention*, **F**, 612 (1970).
6. T. J. M. Schopf and J. L. Gooch, *J. Geol.* **80**, 481 (1972).
7. J. Levinton, unpublished data.
8. Supported by NSF grants GA-25340 to P.W.B., GB-27441 to A. R. Palmer, and GA-32421 to J.L.

18 October 1972