of which became extinct in the Phanerozoic, others of which are extant, also indicates a long antecedent evolutionary history before their first appearances as fossils. The same kind of evidence exists for the early Echinodermata.

When one considers the vastness of Precambrian time, during which life existed in oceanic waters, and the undoubtedly gradual change of the nature of those waters, it would be indeed strange if there were not a multitude of these ancients yet to be discovered as fossils; moreover, it would be surprising if some of these lineages were not unique to the Precambrian; thus an open mind is required in testing the oldest organisms with respect to their relevancy to the Phanerozoic biota. But arguments for such novelties should be well grounded.

We can only wish Seilacher success in his further study of the Ediacaran trace fossils and hope that this will encourage others to undertake similar studies of Precambrian deposits for organic remains. Such quests are of immense importance to an understanding of organic evolution.

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Caster misses the point when he seeks to imply that Seilacher is unaware that when soft-bodied marine organisms are fossilized they are typically flattened. What is of interest is that the evident quilted structure of many of the Ediacaran fauna indicates that these organisms were also of a generally flattened appearance in life. Hence, at least in part, Seilacher's inference of the unusual diffusional mode of nutrient and metabolite transport.—ROGER LEWIN

Acetylene on Titan

The ocean of ethane on Titan proposed by Lunine, Stevenson, and Yung (Reports, 16 Dec., p. 1229) is a fascinating idea to an organic chemist, but the suggested layer of solid acetylene (C_2H_2) 100 to 200 meters thick lining the bottom is utterly fantastic. "Don't liquefy acetylene, but whatever you do, don't freeze it!" is the advice I remember from my days at E. I. du Pont. The legendary explosive character of the liquid or solid is attested in the older literature (*1*). The unfavorable heat of formation from the elements, 227 kilojoules per mole, is more than twice the energy of explosion of an equal weight of TNT (*2*). Thus, the estimated instability of Titan is approximately 200 to 400 megatons per square kilometer of the planet's surface (*3*). Fantasies of the first space probe's triggering a spectacular detonation of the whole planet are dampened by the knowledge that meteorites have been there first, and prosaic chemical reactions such as polymerization probably never allowed the explosive solid to accumulate in the first place.

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References and Notes

1. *Beilstein's Handbuch der Organischen Chemie*, B. Prager and P. Jacobson, Eds. (Springer, Berlin, ed. 4, 1918), vol. 1, p. 233; *ibid.*, 3rd suppl., F. Richter, Ed. (1958), vol. 1, p. 895; commercial acetylene cylinders contain acetone as a diluent for safety.
2. *International Critical Tables*, E. W. Washburn, Ed. (McGraw-Hill, New York, 1929), vol. 5, p. 181; *ibid.*, vol. 7, p. 490.
3. A megaton of TNT occupies a cube approximately 100 meters on a side.

We acknowledge the rather explosive properties of pure, solid acetylene, as noted by Matteson. However, we envision the composition of the solid material underlying the ethane-methane ocean to be considerably more complicated than pure acetylene, as we suggest briefly in our report. The dissociation of methane and consequent production of hydrocarbons in the Titan stratosphere from methane must produce not only C_2 and C_3 hydrocarbons but also much heavier long-chain polymers (incorporating nitrogen), at the expense, in part, of acetylene (*1*). This material has been inferred by a number of authors (*2*) to be the source of haze layers visible in Voyager images. The base of the ocean must therefore be a collection of complex polymers, solid acetylene, and intermediate photochemical products stable as solids under the ambient conditions. The final proportions of the various products after descent through the atmosphere and the intimacy of the mixture on the ocean floor are at present difficult to quantify but of interest, since the presence of impurities can slow further polymerization of acetylene. The possibility of meteorite impacts inducing further reactions of hydrocarbons both *in* the ocean and at its base is a fascinating one; the frequency of impacts by objects sufficiently large to reach the ocean and affect the base is 10^7 to 10^8 years.

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2. D. M. Hunten *et al.*, in *Saturn*, T. Gehrels, Ed., (Univ. of Arizona Press, Tucson, in press).

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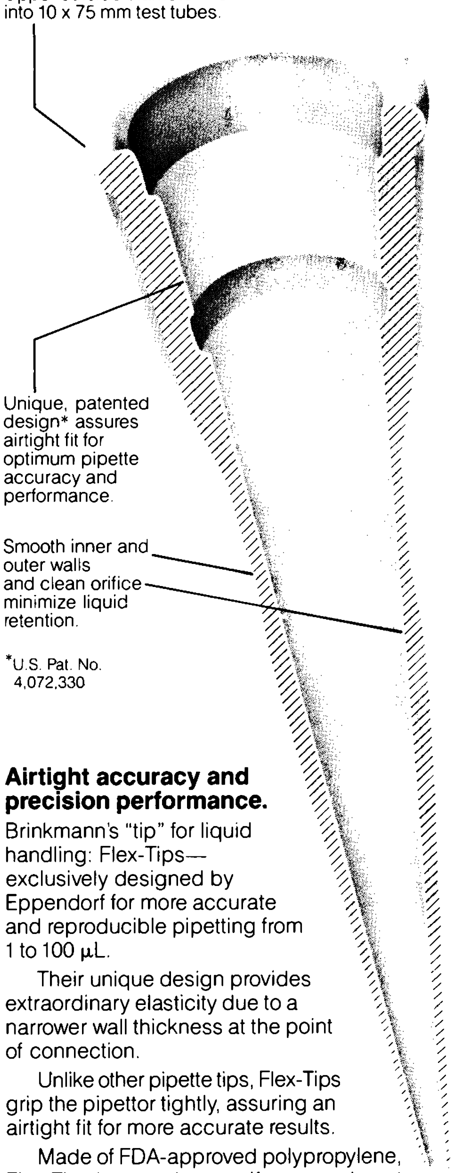

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