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Thu Sep 22 09:59:46 EDT 1994
T/65 Pasteur Centenary Rio February 19-25 ff 1995
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abstract

The reconstruction of life's origin, eobiology, is the ultimate creation myth of science -- certainly it places the most stringent demands on the method of science. On the one hand, DNA and RNA are the most durable physical features of the planet: they have evolved in every detail, but their basic architecture can be inferred to have survived at least 3 billion years of terrestrial history. Every physical-geological feature of that antiquity has been far more grossly deformed. On the other, the gap between DNA/RNA and its plausible chemical precursors is so far unbridged, and the NA's must have been preceded by many simpler forms of template directed chemistry before reaching their current perfection.

The chance of chemical fossils of that antiquity is close to zero. Perhaps, were we to know how to look, we might find niches in which more primordial biochemistry had been preserved; but this would have had to be in the teeth of the formidable scavengers comprising every succeeding life form. Nevertheless a century that has seen the emergent recognition of a new Kingdom, the Archaea, may be succeeded by even greater marvels in the next one.

Three avenues remain open to us. 1) The reconstruction of plausible emulations of biopoiesis in the laboratory. 2) Observational evidence and palaetiological interpretation of geo- and cosmochemical history of organic molecules: in free space and in condensates such as meteorites and comets. 3) The search for independent evolutions of life beyond narrow terrestrial limits, for an exobiology beyond our own esobiology. There have been striking advances in technology for all three of these, from scanning field microscopes to spacecraft; and important and encouraging findings for 1) and 2). They are interconnected: I will put the argument that experiments on atmospheric condensates are too narrowly premissed, and that we should also consider cosmochemical processes as possible initials for biochemistry. I have no doubt that every amino acid will be detected as a feature of interstellar condensates: there are grave but not insuperable problems in modelling how these are transported intact to earth.

As for exobiology, our principal avenues are 1) telescopic observations from earth, or near-orbit, now mainly focussed on the substantiation of circumstellar planetary systems like our own; 2) radio-telescopic surveys for possible intelligent signals, and 3) spacecrafted instrumentation visiting the surface of nearby planets, notably Mars. 2) promised to be so IN-expensive that it was vetoed by a Congress that gladly accepted incomparably more expensive manned space missions. Fortunately, enough public interest persisted that a formidable program is in place funded by voluntary private contributions.

As to 3), little can be added to the essentially negative findings of the Viking missions (1976). These found a desert terrain on equatorial Mars far more desolate than found anywhere on earth. But other habits, and more poleward latitudes have still to be explored. Mars shows deep channels with tributaries speaking to a deluvian phase of its history: these may well bear fossils. And we may well expect to locate analogues to earth's thermal vents in the deep oceans. On Mars, these would be fumaroles providing near-surface water from melting of an extensive permafrost at high latitudes. So potential habitats for life cannot now be excluded.

These projects pose the deepest philosophical questions: how life is to be defined; how would we recognize an exobiology that might share few if any chemical details with terrestrial life forms? I will argue that wherever carbon atoms can display their uniquely "organic" chemistry, they will surely be recruited into any metabolic system. That is essentially everywhere at temperatures between 100 and 400 K. And tetravalent carbon is a sure premonitor of optical asymmetry, of a Pasteurian test for life.*

*Halpern B., Westley J.W., Levinthal E.C., Lederberg J.
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