eral? J. Mayo Greenberg (Huygens Laboratorium, Leiden) emphasized the importance of the organic molecules that were delivered to the early Earth by comets and meteorites. Remarkably, circularly polarized light from neutron stars can probably yield, in interstellar dust, enantiomeric excesses of ten per cent or even higher — this agrees with the degree of chirality of amino acids in the Murchison meteorite[7].

Although nucleic-acid-like molecules receive a lot of attention, G. Wächtershäuser (Munich) argues that the first replicators with limited heredity were much smaller molecules, with analogue rather than digital replication. Whereas analogue replication proceeds piecemeal, digital replication is a modular process. It was recently found that an archaic, reductive citric-acid cycle could have been primed in an 'iron–sulphur' world — co-precipitated NiS and FeS can convert CO and CH_3SH into an activated thioester (CH_3-CO-SCH_3) at hydrothermal temperatures (100 °C)[8]. The next, eagerly awaited step is the experimental demonstration of a functioning cycle.

So could life have originated at high temperatures? Phylogenetic analyses indicate that the last common prokaryote ancestor was a hyperthermophilic organism[9], presumably growing chemolithoautotrophically on CO_2 (K. O. Stetter, Univ. Regensburg). But it is not yet clear whether hydrogen-driven ecosystems in deep granitic rock aquifers[10] are relevant to the origin of life. In fact, it is frustrating that the extremely poor rock and fossil records of the Archaean (3.8–2.5 billion years ago) do not tell us anything about the nature of the primordial atmosphere, impact frustration or the existence of an RNA world (J. W. Schopf, CSEOL Geological Building, Los Angeles).

How far the analogue replicators could have evolved before the advent of digital replicators is an open problem[1,6], both experimentally and theoretically. The lambda and other calculi (which can handle the operations of functions on other functions in the most general way) have been applied to reflect some basic principles of chemistry and, although there were serious shortcomings in this approach[6] a few years ago (for example, with interchangeability of reactants and conservation of matter), they have partly been eliminated. The potential now lies in modelling chemical organization and evolution *in abstracto*[11].

The last common prokaryotic ancestor had ribosomes, so it must have translated proteins using a genetic code. It would have been advantageous to introduce amino acids into an RNA world (as coenzymes for ribozymes), and 'coding' oligonucleotide handles, linked to the amino acids, could have helped the ribozymes to recognize them — reminiscent of present-day aminoacyl-tRNA[1]. (Note that various 5-substituted uracils can arise under prebiotic conditions[12].) So the genetic code may have been a pre-adaptation for translation, and this idea is experimentally testable.

The origin of eukaryotes was a later development, the most controversial aspect of which is the origin of microtubules and cilia by symbiosis with spirochaetes (L. Margulis, Univ. Massachusetts). Ultimately, the gene sequences of ciliary proteins should be decisive; the location of DNA (whether in the basal bodies or in the nucleus) is of secondary importance. J. T. Bonner (Princeton Univ.) called attention to a conspicuous pattern in the many independent origins of (prokaryotic and eukaryotic) multicellularity — aquatic forms arise by the division and sticking-together of cells, whereas terrestrial forms arise through aggregation (with the exception of the actinomycetes).

I expect that considerable experimental and theoretical advances will now be made in studies of autonomous replication; synthesis of biologically important chemical supersystems; and the transition from RNA to the nucleic acid and protein worlds; and that there will be a deeper understanding of the origin of multicellular eukaryotes. □

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Corrections

● In the obituary of Edward M. Purcell by Nicolaas Bloembergen (*Nature* **386**, 662; 1997), Purcell's lecture on the locomotion of bacteria in fluids was cited as *Life at High Reynolds Number*, rather than correctly as *Life at Low Reynolds Number*.

● The figure in David Jablonski's News and Views article ("Progress at the K–T boundary": *Nature* **387**, 354–355; 1997) was misattributed. It was modified, not from reference 17, but from ref. 15 (Marshall, C. R. in *The Adequacy of the Fossil Record* (eds Donovan, S. K. & Paul, C. R. C.) (Wiley, Chichester, in the press). Thanks are due to Charles Marshall for helping to prepare the modified version of the figure.

Daedalus

Pure liquid sound

In the hi-fi world, solid-state electronics is in retreat. Valves (vacuum tubes) are displacing transistors and integrated circuits. More curious still, strange new passive components are being recommended — silver, titanium or carbon wires and cables, gold foil capacitors, ultra-linear potentiometers, and so on. Suspiciously, all these components are vastly expensive. But, says Daedalus, they may have some basis in physics. One claim is that ordinary copper cable has rectifying tendencies, as exploited in the old copper oxide rectifier. Indeed, any soldered joint or impure metal may rectify, or generate thermoelectric voltages, or fail to obey Ohm's law. Test instruments may not be able to detect these tiny imperfections, but the ears of dedicated enthusiasts can.

So Daedalus is abandoning the solid state. He recalls that the nineteenth century standard of resistance was a column of liquid mercury. Being isotropic, it had no rectifying properties. In the 1960s, a sodium cable sheathed in polythene was tested for power transmission. Overloading it melted the sodium in its sheath, when the rise in resistance limited the current.

DREADCO's new liquid-state amplifier takes this technology to its logical conclusion. Its conductors are sodium–potassium alloy, which is liquid at room temperature (mercury would never pass the safety regulations). The whole circuit, including the transformer windings which get power into the system and the speaker coils which take it out again, uses polythene tubes filled with the alloy. Resistors and potentiometers are produced by squeezing the tubing with a clip to reduce its cross-section. Capacitors are twin narrow chambers of the alloy separated by a very thin polythene septum. No soldered joints or dissimilar junctions are needed at all.

The amplifying components will be based on the old mercury-arc rectifier, with its liquid electrodes. DREADCO physicists are inventing sodium–potassium alloy arc rectifiers and valves. Sadly, the valves need at least one solid-state component, a wire grid; but Daedalus hopes that a sufficiently expensive metal, platinum say, will prove adequate.

The liquid-state amplifier will transform hi-fi. It will sweep away all solid-state imperfections in a torrent of flawless sound. Its cost will be as chilling and its heat as warming as that of any valve amplifier. The sodium glare from its arc rectifiers will even light the room.

David Jones