50 & 100 YEARS AGO

50 YEARS AGO

Current theory tends to emphasize the importance of interference in forgetting and to minimize the role of time lapse in the decay of the memory trace. Conrad, however, has recently shown that the immediate recall of eight-digit numbers is better when the numbers are presented and reproduced by subjects at a fast rate than when they are presented and reproduced at a slow rate ... I tested two groups of subjects for their ability to retain eight-digit numbers when presented and reproduced at different rates. Group *A* consisted of 26 teachers, aged 18–29, drawn from different regions of Canada. Group *B* consisted of 26 teachers, aged 30–55 ... [T]here is no significant difference between the two groups in the proportion of digits recalled at the fast rate, but there is a significant difference between the two groups ($P = 0.05$) in the proportion of digits recalled at the slower rate ... [I]t appears that the span of immediate memory is the same for the two age groups, but that the rate of decay of immediate memory tends to increase with age.

From *Nature* 25 October 1958.

100 YEARS AGO

Dr. F. A. Dixey pointed out that when Fritz Müller put forward, in 1879, his theory of common warning colours, or the assimilation of one distasteful form to another for the sake of mutual protection against insectivorous enemies, he recognised the probability, or even certainty, that the approach would not necessarily be one-sided, but might be convergent, each form in some respects advancing to meet the other. This suggestion, however, was never developed by Fritz Müller ... Dr. Dixey showed that there is much evidence that such reciprocal approach, or interchange of obvious characters ... does actually occur, and he exhibited some cases of mimicry the peculiar features of which are difficult to explain on any other hypothesis.

From *Nature* 22 October 1908.

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change in the oxidation–reduction potential of the fluid Earth — the oceans and atmosphere — was captured in the geological record around 2.4 billion years ago[7]. The rise of oxygen can, in principle, be understood in terms of the proximal evolution of cyanobacterial oxygenic photosynthesis (and thus of oxygen production). But the molecular fossils called for an earlier origin of cyanobacteria, again some 300 million years before the rise of oxygen. This gap is approximately two orders of magnitude too large for standard geochemical thinking to accommodate, and much effort has been expended in developing models in which the time lag can be explained by first-order changes in chemical interactions between the solid and the fluid Earth[9]. But given Rasmussen and colleagues' results[5], are such models required?

The biggest analytical challenge for those undertaking Archaean biomarker studies is contamination by younger hydrocarbons. Although Archaean rock samples may contain up to several per cent organic carbon by weight, biomarker compounds are present at only trace concentrations — parts per billion or less — and potential sources of contamination are ever-present in our petroleum-filled world. It was difficult for Brocks *et al.*[3,4] to show with certainty that the extracted biomarkers were indigenous and syngenetic (that is, the timing of their synthesis corresponded to the age of the rock), but the biomarker abundance and distribution made a reasonable case against contamination.

However, one piece of evidence was at odds with an indigenous interpretation. The carbon isotope ratios ($^{13}C/^{12}C$) of the extracted lipid hydrocarbons did not match those of the solvent-resistant, macromolecular, residual organic carbon — termed kerogen — present in the rocks. Late Archaean kerogens are unique in the context of Earth history in that they commonly have carbon isotope ratios several per cent lower than those of organic carbon found in younger sedimentary deposits[10]. The kerogens analysed by Brocks *et al.*[4] contained this unique isotopic signature, whereas the lipid biomarkers did not. Two hypotheses are compatible with this relationship. The first interprets the lipid biomarkers as younger contamination. The second posits that the biomarkers are indeed indigenous, but that the lipid hydrocarbons (oil) released during geological burial and heating of the sediments were derived from a different source from that which produces the bulk of the residual kerogen, and therefore would not share the same isotopic composition. This latter view was taken by Brocks *et al.*[4].

The outstanding question, then, is whether the oil generated by these organic-rich sedimentary rocks was derived from a different isotopic source from the kerogen. Rasmussen *et al.*[5] have addressed the problem by making use of new technology, the NanoSIMS ion microprobe (secondary ion mass spectrometry with 50-nanometre resolution). The advantage offered by NanoSIMS over standard, bulk-rock analytical methods is the ability to assay, *in situ*, the carbon isotopic composition with a spatial resolution fine enough to resolve isotopic differences between micrometre-scale textures present in the rock.

Working on organic-rich samples from one of the Late Archaean sedimentary deposits in Western Australia from which the lipid biomarkers were first reported, the authors measured carbon isotope ratios of micrometre-sized particles of kerogen and pyrobitumen (residues of solidified petroleum). The pyrobitumen fraction, which represents indigenous petroleum, carries essentially the same unique carbon isotopic composition as the kerogen, not the heavier isotopic ratios of the extracted lipid hydrocarbons. This result reveals that the molecular fossils extracted from these samples probably came from contamination that was introduced some time after these rocks experienced their peak metamorphic temperatures about 2.15 billion years ago.

So does this study[5] nullify the lipid-biomarker evidence for oxygenic photosynthesis some 300 million years before the rise of atmospheric oxygen, and does it close the gap between the morphological and molecular-fossil records of the evolution of eukaryotes? Not yet. Since the appearance of the papers by Brocks and colleagues[3,4], there have been other reports of lipid biomarkers — including hopanes and steranes — in sedimentary rocks deposited in other parts of the world before the rise of oxygen[11–13]. The rocks concerned have very different geological histories, and there are insufficient data to say whether contamination also affected these studies.

The creative breakthrough offered by Rasmussen *et al.*[5], however, is an analytical approach that seeks to link the isotopic composition of extracted lipid biomarkers with that of indigenous pyrobitumen. Perhaps by serendipity, the unique isotopic composition of Late Archaean sedimentary organic matter will provide an exceedingly useful screen for contamination in future investigations of ancient molecular fossils. ■

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