100 YEARS AGO

Although the terms "ass" and, at any rate in Germany, "ox" (Ochs) are very generally applied to stupid persons, those who have observed the bovine and asinine genera know that this is an injustice to those animals… . A donkey that was kept here learnt to open, not only the gate of its own field, but other gates. One day, having left its own abode, accompanied by two ponies, it went to another field half a mile off, opening three gates on the way, liberated the occupants of this field, a mare and her foal, and a yearling, old friends of the donkey's, as they used to live together, and the whole party, which had been joined by a mastiff, proceeded to wander through the world. About two miles from here the horses were recognised and secured, and the donkey eventually returned with the mastiff; but after this exploit it was thought advisable to get rid of the donkey, as being too zealously devoted to the cause of emancipation.

From *Nature* 11 September 1902.

50 YEARS AGO

***Scientific Progress* of April (40, No. 158, 193; 1952) contains an interesting and informative article by Prof. H. S. W. Massey entitled "Fundamental Particles", the term which is applied usually to such entities as electrons, protons, etc. … Turning next to the classification of the fundamental wave particles, Prof. Massey shows that the particles can be loosely separated into three categories, which he aptly terms "building stones" (electron, proton and neutron), "cements" (photon and pi-meson) and "bric-a-brac" (neutrino, mu-, V-, tau- and kappa-mesons). The first two categories, as their names imply, are involved in the structure of matter, but the third, apparently, does not fulfil any important role in that respect. The properties of the various particles and the relations between them are briefly and clearly described, and it is evident that their number (now some twenty-four) is far too large for them all to be fundamental. Nevertheless, as Prof. Massey states, the discovery of new particles is still a prominent feature of modern physics, and thus, until some new fundamental advance or simplification is made on the theoretical side, not only to provide a basis for the "bric-a-brac" but possibly also to account for the more complete range of particles yet to be explored, the fundamental scheme of Nature must remain obscure.**

From *Nature* 13 September 1952.

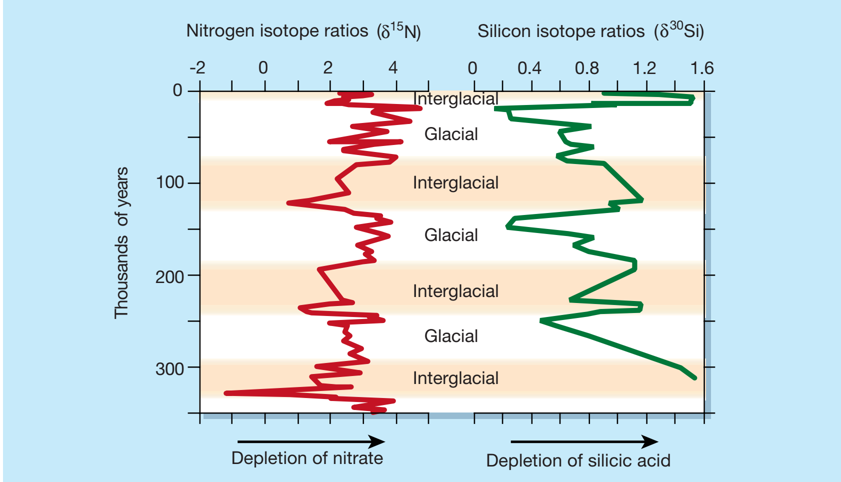

Figure 1 **Variation of nitrogen and silicon isotopes from Antarctic sediments over the past 350,000 years. The signatures show opposite trends during glacial and interglacial periods. This pattern can be explained[2,3] by the influence of changes in iron availability on the ratio of nitrate and silicic acid used by diatoms in the Southern Ocean.**

nutrient utilization and biological productivity. But the results have been puzzling.

Stable isotope ratios of nitrogen and silicon in organic and diatom remains, respectively, tell us about the nutrient status during the geological past. This is because diatoms' use of nitrate (NO_3^-) and silicic acid ($Si(OH)_4$) favours the uptake of the lighter isotopes, ^{14}N and ^{29}Si. Diatoms become progressively enriched in the heavier isotopes, ^{15}N and ^{30}Si, as the nutrients are depleted, and increased nutrient use should be reflected in their sedimentary remains as higher $\delta^{15}N$ and $\delta^{30}Si$. As shown in Fig. 1, sediment cores from the Southern Ocean have higher $\delta^{15}N$ values in the glacial intervals, indicating increased NO_3^- uptake compared to that in interglacials. But the $\delta^{30}Si$ trends are quite the opposite: $Si(OH)_4$ use appears to have been lower during the glacials. Other arguments that invoke, for example, increased ocean stratification, could account for the higher $\delta^{15}N$ but they fail to explain lower $\delta^{30}Si$ values[6]. How can we reconcile the two different pictures of nutrient status painted by these two forms of proxy data?

On the basis of experimental results, Brzezinski *et al.*[2] point out that the addition of iron dramatically alters the uptake ratio of NO_3^- and $Si(OH)_4$ by diatoms from as much as 4:1 to about 1:1. Given that ratios of these nutrients in the Southern Ocean today are 2:1, uptake with a ratio of 1:1 under iron-replete conditions, as might have occurred during glacial periods, would result in higher use of NO_3^- but relative underutilization of $Si(OH)_4$ — a view that is consistent with the isotope data. Given this revised interpretation of the sediment records, did the Southern Ocean contribute to the drop in atmospheric CO_2 during glacial periods? Brzezinski *et al.*[2] argue that it did, but not as a direct effect of CO_2 uptake in Antarctic surface waters. Rather, as Matsumoto *et al.*[3] show in their modelling study, when ocean circulation patterns are taken into account, the consequences of this peculiar nutrient biogeochemistry are manifest further afield.

The waters of the modern Southern Ocean penetrate north as far as the subtropics, mainly as subsurface flow. If the flow paths were the same during glacials, then the Antarctic region would have supplied the low-latitude ocean with water high in $Si(OH)_4$ and low in NO_3^-. This would have pushed the phytoplankton community in these regions from domination by $CaCO_3$-secreting coccolithophores to domination by opal-secreting diatoms. Brzezinski *et al.* believe, and Matsumoto *et al.* demonstrate with their model, that such an ecological shift would have had a double effect on reducing glacial CO_2. First, diatoms have higher sinking rates than coccolithophores: their dominance would have resulted in the more efficient export of particulate organic matter to the depths, thus removing CO_2 from the surface waters. Second, the lowered ratios of $CaCO_3$ to organic carbon in sinking particles would also have lowered levels of atmospheric CO_2, because the resulting excess CO_3^- (alkalinity) in surface waters would have sequestered CO_2 by converting it to bicarbonate.

But did such a shift towards increased primary production by diatoms actually occur at low latitudes in glacial times? The answer is unclear, because the telling indicator, accumulation of opal in sediments of glacial age, is not uniformly high in these regions. Increases are indeed seen in some areas[7]. Declines are evident elsewhere, however, such as in the eastern tropical Pacific[8]. This geographical variability may point to local changes in nutrient inputs as the main determinant of opal production.

The work of Brzezinski *et al.*[2] and Mat-