The emphasis of recent research on AT has been on the sensitivity of these cells to various agents and their effect on DNA synthesis and repair and progress in these areas has been substantial. While these are undoubtedly important, more effort could in future be directed towards relating these areas to the defect of the immune system and the neurological disorder. Such a relationship, though surprising, must exist since the evidence that AT is due to a single autosomal recessive gene is good. □

The spruce invasion

from Peter D. Moore

ONE of the greatest weaknesses of palaeoecology is its necessary reliance upon circumstantial rather than experimental evidence. Yet it is this weakness which also opens the way to interminable speculation on the basis of the temporal correlation of events in the past. A very good example is the debate concerning the expansion of spruce (*Picea abies*) in Europe since the last glaciation.

Pollen analysis shows that, following the final glacial retreat, *Picea* immigrated into the eastern Alps very rapidly, accompanied by deciduous tree genera such as alder (*Alnus*), hazel (*Corylus*), oak (*Quercus*) and elm (*Ulmus*). It was preceded by birch (*Betula*), pine (*Pinus*) and larch (*Larix*). In Austria, for example, this deciduous forest type expanded into the south-east around 10,200 BP (Fritz *Carinthia* II **83**, 277; 1973) and by 9,500 BP it had expanded westwards in the Tyrol (Bortenschlager *Ber. naturw.-med. Ver. Innsbruck* **63**, 105; 1976). Although *Picea* was a member of the early post-glacial forests of Austria, even in the upper valley of the Inn, it is interesting to note that its immigration into Switzerland was considerably later; and it is here that scope for speculation begins.

Markgraf (*Nature* **288**, 249; 1970) collated the Swiss data concerning the movement of *Picea* into Switzerland and she found that its expansion was not very regular. Only in the south-east had it arrived by about 6,000 BP, but between that date and about 4,500 BP *Picea* pollen increased very markedly in a series of sites scattered all over the country, extending right to the western borders, north of Zurich. There remained some sites, however, even in the south of the country, in which the expansion was delayed until about 3,000 BP or even later. The expansion of spruce was often accompanied by a decrease in other tree species, including fir (*Abies*), pine and the deciduous forest genera. Also there was a simultaneous increase in herbaceous pollen, largely grasses, which suggested that the forests had been disturbed by human activity and that this provided spruce with an opportunity to establish itself where previously it had been excluded by competitive pressures. The combination of these pieces of circumstantial evidence led Markgraf to reject the earlier theories of a climatic change which provided the right conditions for *Picea* invasion into Switzerland and to propose that the tree followed in the wake of Neolithic agricultural progress.

One still needs to explain the delay in expansion between Austria and Switzerland. Here Markgraf suggested that the early invasion of *Abies, Larix* and *Pinus cembra* (the only central European member of the *Haploxylon* subgenus of *Pinus* and therefore distinguishable on the basis of its pollen) may have formed a dense canopy forest into which *Picea* could not immigrate. All three of these species were present in Austria, but either arrived later or were in lower frequency. It is claimed that such a forest may have a certain degree of inertia which renders it resistant to invasion by new species and also resilient in the face of climatic fluctuations (Smith *Proc. R. Soc.* **B161**, 331; 1965).

Spruce has also moved westwards in Fennoscandia in the latter half of the post-glacial, but here alternative explanations have been proposed. Moe (*Bot. Notiser* **123**, 61; 1970) collected the dates for the rise in *Picea* pollen in this area and showed that its expansion began in eastern Finland by 5,000 BP, reached the Baltic coast of Finland by 3,500 BP and subsequently spread through Sweden and into Norway. It has an unbroken distribution, reaching the west coast of Norway only in the central

New vistas in soil research

from Hamish Anderson

FRANCIS BACON'S assertion, that "there is nothing makes a man suspect much, more than to know little", gives an adequate summary of the present state of soil organic chemistry. Soils produce a vast array of organic and inorganic entities — many formed only in the soil environment — which resist synthetic mimicry, long accepted as the ultimate basis of structural proof. There remain few separation techniques or analytical methods which have not been used in humic substance research, and the structural chemistry of soil extractives has uncertainly advanced, mainly by degradative techniques (see Schnitzer and Khan *Soil Organic Matter* Elsevier, 1978).

Proton magnetic resonance spectroscopy is an obvious tool but initial results were beset with line-broadening problems arising from chemical shift anisotropy, even in the rare cases where samples were sufficiently soluble for examination. The advance in NMR capability has now led to the threshold of the soil organic chemist's dream, the possibility of examining humic substances *in situ* (Barron *et al.* this issue of *Nature*, page 275). The Antipodean researchers have shown that the use of cross-polarization ^{13}C NMR techniques has allowed the generation of useful spectra from whole soil samples. Conventional ^{13}C spectra of amorphous solids usually give no useful structural clues, mainly due to large dipolar interactions. The ^{13}C cross-polarization technique leads to increased sensitivity by the elimination of heteronuclear dipolar broadening, this being achieved by transferring polarization from ^{1}H to ^{13}C (Mehring *High Resolution NMR Spectroscopy in Solids* Springer-Verlag, 1976). The transfer from the more abundant and more polarized ^{1}H spins leads to a possible quadrupling of the ^{13}C spins and, more importantly, the ^{13}C spin-lattice relaxation rate now occurs at that of the proton population. Since this is usually an order of magnitude faster than the conventional ^{13}C rate, the data accumulation frequency can be greatly increased. Even allowing for this 'speeding-up' process, it is sobering to realize that the number of free induction decays collected by Barron *et al.* during whole soil spectrometry ranged from 2×10^4 to 2×10^5. One major defect of the present system is that the chemical shift anisotropies of aromatic and carboxylic carbon lead to signal broadening and loss of resolution. However Barron *et al.* are confident that the combination of the present high-field cross-polarization technique with 'magic-angle' sample spinning will resolve this problem, as has been demonstrated with isolated humic substances (Hatcher *et al. Org. Geochem.* **2**, 87; 1980).

Humic substances research has long been dogged by the uncertainty of structural alterations occurring during extraction, and the proposed techniques offer answers to this problem. Indeed, the fact that modern NMR spectroscopy offers an ever-widening scope for examining a variety of nuclei instils hope that whole soils and their physical separates can be studied, resolving the interactions between humic substances and silicates, along with the involvement of nutrients such as nitrogen, sulphur and phosphorus.

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