QSOs which seem to be physically associated with galaxies. In some such associations, the QSO has a redshift much larger than that of the galaxy with which it is associated, although such an association would imply that both objects are at essentially the same cosmological distance and should thus, on a simple cosmological model, be receding at the same velocity.

Interest in this situation is now heightened by the discovery of a blue stellar object which is probably a member of the BL Lac family and seems to be associated with the galaxy NGC 2992 (Burbidge *et al.*, *Astrophys. J. Lett.*, **178**, L43 ; 1972). NGC 2992 has already been noted as part of an unusual system ; Burbidge *et al.* reproduce the illustration from Arp's *Atlas of Peculiar Galaxies* (see figure) which shows the distortion of this galaxy and its neighbour NGC 2993, and the bridges of luminous material which not only seem to link the two galaxies but also extend in the direction of Weedman 2, a BL Lac type object. As Burbidge *et al.* point out, "If a physical connection could be established between Weedman 2 and NGC 2992, it would be of great importance in establishing the nature of the QSOs and/or the BL Lacertae type of object".

Like the other eight very blue stellar objects appearing near galaxies which were catalogued by Weedman (*Astrophys. Lett.*, **9**, 49 ; 1971), No. 2 was chosen because it is blue (the spectrum shows an ultraviolet excess), brighter than 19 mag on the blue plates of the Palomar Sky Survey, and close to a galaxy with a maximum diameter greater than 1 arc min. Weedman 2 is the only object which this search found near to one of Arp's peculiar galaxies ; it is also interesting that Weedman's criteria are so restrictive that many known QSOs would not qualify for selection under them.

Burbidge *et al.* have found that the continuous spectrum of Weedman 2 is very similar to that of many QSOs. Short of 6,000 Å, there is a slow rise towards higher frequency, roughly a power law with index ~ 0.3 ; at longer wavelengths there is a steep negative slope, index ~ -4. There are, however, no discrete spectral features. Weedman 2 is, then, a QSO without spectral lines, or a BL Lac object. Both the nearby galaxies are highly excited systems, showing strong emission in the Balmer lines, some oxygen lines, and other features. They have much the same redshift. Is Weedman 2 physically associated with NGC 2992?

If all three objects are at the distance implied by a straightforward cosmological interpretation of the galaxies' redshift, then the distance from Weedman 2 to the centre of NGC 2992 is only 22 kpc, roughly the same as the diameter of our Galaxy. There is no doubt that gaseous material could extend out to this distance from NGC 2992, and the luminous matter seen in the direction of Weedman 2 might well be being excited by radiation from that object to make it the prominent feature visible on the plates. The energy which Weedman 2 must be emitting, if at the distance implied by the redshift of NGC 2992, is 5×10^{42} erg s^{-1}, typical for a bright spiral and so both adequate to account for the radiation from the luminous bridge and small enough to be plausible.

GLACIATION

Argentinian Chronology

from our Geomagnetism Correspondent

ALTHOUGH the delineation of the geomagnetic polarity-time scale for the past few million years has played an important part in defining global concepts and processes, geologists and geophysicists have recognized for many years that in the longer term the scale should be no less useful in elucidating more local stratigraphic problems. This is likely to be the case particularly where radiometric dating is not possible or where precision in dating is difficult to achieve, although even where accurate radiometric dating is technically feasible the use of palaeomagnetic techniques may be quicker and cheaper, especially where there is some advantage to be gained from the study of many individual rock units. Even in cases where the statistical problem is less acute, however, there may still be some benefit in employing palaeomagnetism, whether or not independent radiometric ages are available.

A good example of the combined use of palaeomagnetic and radiometric dating is provided by a recent study of late Pliocene and early Pleistocene glaciation in southern Argentina, carried out by Fleck *et al.* (*Earth Planet. Sci. Lett.*, **16**, 15 ; 1972). The site investigated was on the Cerro del Fraile, a hill about 200 km south of Lago Argentina which comprises Cretaceous sediments capped unconformably on its western face by about 180 m of late Cainozoic basalt lava flows with interbedded glacial and fluvial deposits. The stratigraphic sequences studied by Fleck and his colleagues are more adequately represented pictorially but can simply be described as (starting at the base) cobbles–sand–1–A–cobbles–B–2–C–3–D–4–E (not sampled)–5–F–G–6–H, where the letters refer to basalt lava flows and the numbers to till layers.

Huntite makes a Brighter White

IN next Monday's *Nature Physical Science* (January 8), Veen and Arndt describe for the first time the occurrence in soils of the mineral huntite, $CaMg_3(CO_3)_4$. But huntite has an alias, pahn-jahn, and this makes their report of more than mineralogical interest alone.

Huntite was first described about twenty years ago from magnesian limestones in Nevada. Since then it has been found in evaporites along the Persian gulf and in secondary carbonate deposits in limestone areas. Now it has turned up in some Australian soils.

The soils in question are vertisols, or cracking clay soils, formed over basalts near Katherine, Northern Territory. Vertisols are almost exclusively found in those parts of the tropics with a marked dry season. Their name derives from the heaving of the soil layers, caused by the presence of clay minerals like montmorillonite which swell on wetting.

During the dry season there is an upward movement of moisture caused by evaporation losses from the ground surface. As the result of the concentration of dissolved salts by evaporation, carbonates, sulphates or chlorides of Ca, Mg, Na and K may be precipitated, the relative amounts of the various ions determining what minerals form.

In the case considered by Veen and Arndt, the dominant mineral would be expected to be dolomite, $CaMg(CO_3)_2$. But, perhaps because the basalts are rich in magnesium, huntite and aragonite (a variety of $CaCO_3$ not often found in soils) have formed instead. Veen and Arndt think that the explanation lies in the ability of small amounts of Mg ion to inhibit the formation of calcite layers, common to both dolomite and calcite crystals. The amount of Mg^{2+} present is, however, insufficient to allow the formation of magnesite ($MgCO_3$), and under these conditions the stable carbonates are huntite and aragonite.

Alias pahn-jahn, huntite powder is a white pigment which the Aborigines prefer to kaolin-based paint for personal and other decorative purposes. The reason for this preference, Veen and Arndt suggest, is the greater lustre and reflectivity of carbonates as compared with clay minerals generally. In the particular case of huntite, the effect may be enhanced by the occurrence of the mineral as minute but perfectly oriented crystals.

Assuming that awareness of the colouring properties of pahn-jahn dates from the distant past, one might infer that discovery honours for the mineral in soils should really go to the Aborigines. But at the very least, Veen and Arndt have now provided a chemical gloss for the term.