that the origin of the events may be related to deformation and fracturing occurring during periods of rapid growth of the central volcanic cone. Moreover, with one exception, for which $b=1.35$, the $b$ values for the eight swarms analysed ranged from 1.7 to 2.5. This again supports the idea that the events are shallow in that Minakami (*Bull. Earthq. Res. Inst.*, **38**, 497; 1960) has shown that high (2–3) $b$ values arise from earthquake swarms originating at depths of generally less than 1 km. In addition, shallow origins of the shocks may be deduced from the body wave attenuation patterns.

Plots of the hourly frequency of the microearthquakes generally show a diurnal peaking of activity which, for the seven high $b$ value swarms, correlates visually with peaks in the calculated magnitude of the total tidal vector. Two distinct phase relationships were observed, however, each occurring with roughly the same frequency. The slightly more frequent phase relationship involved no obvious phase shift between the earthquake activity peaks and the corresponding tidal vector peaks when observed visually, although detailed statistical analysis more accurately indicated a phase shift of about one hour with the peak microearthquake activity lagging the tidal peaks. The slightly less frequent phase relationship involved a visual lag of 5–6 h (about 5 h from detailed analysis) for the microearthquake activity. As far as the one low $b$ value swarm was concerned, no visual correlation was apparent. Detailed statistical correlation showed, however, that the phase lag of 1 h was present here also, albeit with a higher standard deviation than for the other swarms.

The swarms investigated occurred during 1971 either before or after the volcanic eruption of October 7, 1971, but no differences in the temporal variations between pre-eruption or post-eruption swarms were observed. This suggests that the discovered phase relationships were independent of the stress condition of the volcano which was presumably changed by the eruption. The phase delay of 5 h does correlate with the maximum oceanic tidal loading. Mauk and Kienle thus suggest that the microearthquake activity lagging by 1 h is the result of direct triggering by tidal stresses and that the activity lagging by 5 h is related to the time of maximum oceanic tidal loading.

QUASARS

# Nature of Redshifts

from a Correspondent

PLAGEMANN of Dunsink Observatory, Dublin, claims to prove (*Mon. Not. Roy. astr. Soc.*, **164**, 303; 1973) that the quasars with compact radio sources and flat radio spectra are distributed anisotropically on the sky. If true this would be a significant result, casting doubt on the cosmological nature of the redshifts of these objects because if the microwave background radiation is, as most astronomers believe, cosmic black-body radiation left over from the fireball, then its extreme isotropy makes it improbable that the distribution of matter can show any very severe anisotropy on the large scale. Moreover, Plagemann's claimed anisotropy takes the form of a correlation with the Local Supercluster, a disk-like concentration of bright, nearby galaxies apparently centred on the Virgo cluster. This could only mean that these quasars are very nearby indeed, within about 30 Mpc.

It is perhaps surprising that the question of the true distances of the quasars has remained a matter of controversy for so long. The trouble is that although some of the reported phenomena raising doubt have been laid to rest, others have turned up to keep the publications flowing. Little is heard now of Arp's pairs of radio sources on either side of peculiar galaxies, or of Burbidge's anomalous concentration of quasar redshifts around a value of 1.95. And three lines of work have pointed to at least some quasars with genuinely cosmological redshifts: the association of several quasars with small redshift with groups of galaxies with the same redshift, the inverse correlation of apparent radio size with redshift for the more extended quasars, and the existence of fuzziness round some small redshift quasars suggesting an underlying normal galaxy.

But like snakes from the head of the Medusa, new problems spring up to replace those already slain. The announcements last week in *Nature* by

# Curious Behaviour of Carbon Fibres

FINE fibres of highly graphitised carbon have excited much interest because they are strong, stiff and light. The high strength and stiffness both stem from the strong c-c bonds in the graphite layer planes and, since the interlayer bonds are much weaker, the graphite lattice has of necessity a large anisotropy of both strength and stiffness. Accordingly, the mechanical properties of carbon fibre must vary with the degree of graphitisation of the lattice (a 'glassy' disordered arrangement of carbon atoms implies a comparatively weak 'average bond') and with the degree and nature of preferential alignment of the graphite layer planes where these are well developed. When, in addition, the quality and degree of alignment of graphite layers are also a function of position in the fibre cross section, the number of structural variables that affects mechanical properties becomes quite disconcerting.

Evidence has in fact accumulated that carbon fibres made according to the British process by pyrolysis of polyacrylonitrile have a duplex structure with a poorly graphitised core of low stiffness surrounded by a highly graphitised and aligned sheath of high stiffness. If, as seems likely, the sheath is of fixed thickness, then a reduction of the total fibre diameter will increase the proportion of sheath material and so raise the overall Young's modulus. Such dependence of modulus on diameter has been established, and the sheath/core hypothesis was advanced to explain this dependence.

In *Nature Physical Science* next Monday (December 3), Hart and Pritchard of Kingston Polytechnic confirm the diameter dependence of modulus, and report on an attempt to test the sheath-and-core hypothesis more directly. Fibres originally pyrolysed at several different temperatures were submitted to attack by nitrogen dioxide at temperatures up to 925 K, using different pressures and periods of attack. Fibre diameters were reduced by as much as 80%. For fibres originally pyrolysed at 1,750° C, increases of modulus of up to 80% were established as the fibre diameter decreased; the amount of modulus increase depended on the conditions of attack, especially time and temperature. Fibres pyrolysed at 1,350° C showed negligible modulus changes in spite of thinning, and fibres pyrolysed at 2,750° C appeared resistant to attack.

The apparent paradox that removal of a stiff sheath leads to modulus increase is dealt with by the authors by the postulate that the attacking gas penetrates capillary pores in the sheath and preferentially attacks the poorly graphitised core. In the process, they believe that the sheath collapses onto the hollow core region and, in so doing, undergoes reformation of the graphite structure with the formation of new bonds. They believe that the inefficacy of low attack temperatures in increasing modulus is consistent with their postulate. It is not altogether clear whether the modulus increase is taken to be due to increased perfection of graphite structure, or increased alignment produced during the gas attack. The authors very properly conclude by pointing to the need for high-resolution electron microscopy to test their interesting ideas.