magnetite is oxidized along 110 and 111 planes to thick ilmenite lamellae and contains spinel rods typical of oxidation classes IV or V. Thus there can be little doubt that the resulting palaeomagnetic data are reliable.

The mean palaeomagnetic direction from the fresh Wackerfield Dyke samples gives an ancient pole at 175° E, 22° N. This is only a few degrees from the pole obtained from Whin Sill samples by Storetvedt and Gidskehaug (*Phys. Earth planet. Int.*, **2**, 105; 1969) but is well removed from the Cleveland-Armathwaite Dyke pole reported by Giddings (thesis, University of Newcastle upon Tyne, 1969). It is true that Creer *et al.* (*Geophys. J.*, **2**, 306; 1959) obtained a palaeomagnetic direction from the Whin Sill which differed from the Storetvedt-Gidskehaug direction by 17°—and this makes the situation less clear than it would otherwise have been. Storetvedt and Gidskehaug argued, however, that the earlier result could be due to a stable, secondary post-Permian magnetization and noted that their own data agreed with other European data from samples of comparable age.

Tarling and his colleagues are clearly reluctant to arbitrate between the two Whin Sill results; but in view of the fact that the earlier direction was obtained from initial natural remanent magnetizations whereas samples used in the more recent study were demagnetized thermally and by alternating field, it is quite fair to say that the Storetvedt-Gidskehaug result is probably the most reliable. In any event, the Wackerfield Dyke pole is certainly well removed from the Tertiary Cleveland-Armathwaite Dyke pole, indicating that the Wackerfield Dyke cannot be Tertiary. And this is confirmed by a new radiometric age of 303 ± 5 million years of the Wackerfield Dyke. Tarling *et al.* thus conclude that, contrary to traditional belief, the Wackerfield Dyke is closely related to the Whin Sill. How many more such features remain wrongly identified?

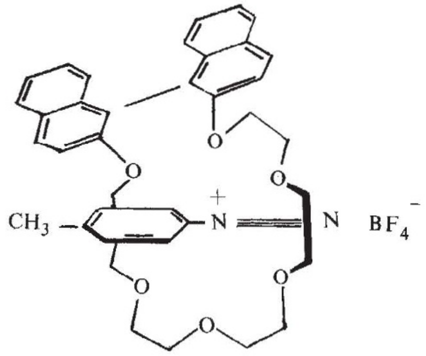
CHEMISTRY

Round Peg in Round Hole

from our Chemical Physics Correspondent

CHEMISTS have for many years been intrigued with molecules of simple but unusual shapes, and examples of boats, chairs, crowns, sandwiches and so on are well known. So too are the solid clathrate materials in which guest molecules are held prisoner in a three-dimensional cage of the host, most often hydroquinone. Now Gokel and Cram (*J. Chem. Soc. Chem. Commun.*, 481; 1973) have provided an example of what may best be described as a peg in a hole, which forms in solution.

They find that a solution of 1 mol of the crown-shaped molecule binaphtho-[20]crown-6-cyclic ether in chloroform will dissolve at least 0.9 mol of the peg, *p*-toluenediazonium tetrafluoroborate. This they attribute to the formation of the structure in the diagram. The solubility is indicative of some complex formation since the diazonium salt is normally insoluble in chloroform.



The proposed shape of the complex is supported by the finding that the slight modification of the crown to an open chain form destroys this unusual solubilizing ability. The structure is further supported by nuclear magnetic resonance findings. The uncomplexed crown molecule has four particular hydrogens in the two Ar–O–CH_2– fragments, which are equivalent, or more strictly isochronous, and give rise to a set of lines due to spin spin coupling that are all based on a single chemical shift, 4.06 p.p.m. When the diazonium salt is also dissolved these lines separate into two sets with chemical shifts of 3.89 and 4.06 p.p.m., showing that the protons are no longer all equivalent. The structure shown predicts this, as two of the protons are on the same side of the crown as the tolyl group and the other on the same side as the BF_4^- ion. The fact that the new spin-spin pattern is sharp implies that an individual peg must remain in its own hole for at least a second.

At first sight this set of plugged holes floating in the bathwater may seem to be only a curiosity. But it has already been shown that the efficiency of the solubilization process is a sharp function of ring size and peg shape, so that quite sophisticated fractional extractions might be possible.

Magnetic Properties of Exposed Oceanic Crust

IN spite of the important part played by oceanic magnetic anomalies in global tectonic theory, the nature and form of the magnetic source or sources in oceanic layer 2 remain obscure. But a little experimental evidence is available. For example, Marshall and Cox (*Bull. geol. Soc. Am.*, **82**, 537; 1971) recently showed that a layer of extrusive rock (pillow lava) less than 1 km thick could account for observed anomaly amplitudes if the high intensity natural remanent magnetizations (NRMs) found in their dredged samples were to obtain throughout the layer. High NRM intensities have also been found in samples of pillow lava dredged from the mid-Atlantic ridge, although the reduction in anomaly amplitude away from ridges suggests that high intensities are not universal, possibly because pillow lavas easily undergo low temperature oxidation. Lower NRM intensities in older oceanic crust have also been observed directly by drilling into layer 2.

But this is only touching the surface, both literally and figuratively — what is really required to solve the problem is the ability to drill right through the oceanic crust, or at least through layer 2. Such complete sampling is not yet feasible for the present oceanic crust but is possible for formations such as the Troodos ophiolite complex of Cyprus which are thought to be upthrust sections of ancient oceanic crust. Another example is Macquarie Island which was almost certainly formed during the late Tertiary at the active Australia–Antarctica ridge; and as Butler and Banerjee showed in last Monday's *Nature Physical Science* (August 20), ancient oceanic crust such as Macquarie Island can have magnetic properties quite different from those of young dredged samples.

The Macquarie materials investigated by Butler and Banerjee included pillow lavas, basaltic and doleritic dykes, gabbro and serpentinized harzburgite. The first important point to emerge from the study was that the pillow lavas had NRM intensities at least an order of magnitude lower than those of young pillow lavas. Their stability to alternating field demagnetization was also lower. These results are entirely consistent with the view that pillow lavas gradually undergo low temperature oxidation or low grade metamorphism; but whatever the cause of the lower NRM intensities, it is clear that the contribution to the observed anomalies from pillow lavas must decrease with age.

The basaltic and doleritic dykes, on the other hand, were found to be much more stable magnetically than the lavas; and their NRM intensities were high enough to suggest that they may make a significant contribution to the observed anomalies. Moreover, even the gabbroic and ultramafic intrusive layer cannot be entirely rejected as a magnetic source, for the gabbro has an unusually high NRM intensity and stability for an intrusive rock. In short, "the ability to produce magnetic anomalies is not limited to the pillow lava layer".