to the Earth's magnetic field. Since there are reasonably strong grounds now for assuming that the pole does not wander, it was necessary to assume that the hot spots do. Hargraves and Duncan were able, however, to find a rotation of the mantle as a whole which reproduced their results tolerably well without the need for the migration of individual hot spots. There is thus the possibility that not only do plates move, but the material that they slide over is also in motion.

Molnar and Atwater adopt a geometrical approach which does not use palaeomagnetic evidence directly. They use the now generally agreed upon poles of rotation of plates to run the geological clock back 38 million years. They place the 38 million-year-old rocks on the Hawaiian chain over the present position of the Hawaiian hot spot and see what overlay the other hot spots at that time. None of the linear features lies on top of their presumed parental hot spots when this analysis is carried out. This implies that there must have been relative motion among hot spots in the past.

It is now necessary for geophysicists to consider these two papers very carefully. The authors do not come to identical conclusions, but this is perhaps not surprising. What they do point to fairly clearly is some sort of mobility below the lithosphere—a mobility of up to a couple of centimetres a year. How deep this mobility extends there is as yet no idea, and although it is still possible that the Morgan hypothesis that hot spots are fed by deep mantle plumes is tenable, there are now very serious doubts that such a delightfully simple model can apply. Yet more solid ground of nature is eroded. D. D.

SYSTEMATIC ZOOLOGY

Bearish Carnivores

from our
Vertebrate Palaeontology Correspondent

THE seals, sealions and walruses are normally separated from all other members of the Carnivora by being placed together in a suborder Pinnipedia. It is generally agreed that the pinnipedes are more closely related to the canoid than to the feloid carnivores, and the implication of their placement in a separate suborder is that they all had a common ancestry within the Canoidea. For some time, however, several workers have considered it likely that the otariids (sealions and walruses) whose hind limbs project backwards, and the phocids (fur seals) which can bring their hind limbs forwards beneath the body, originated from different groups of canoids. These workers believed that the otariids were derived from bear-like canoids, whereas the phocids had evolved from otter-like canoids.


Artist's conception of head of *Enaliarctos*.

Important new evidence on pinnipede origins has been published by Mitchell and Tedford (*Bull. Am. Mus. nat. Hist.*, **151**, 201; 1973), who describe a new early Miocene aquatic carnivore whose skull and dentition are morphologically intermediate between those of terrestrial ursid canoids and those of aquatic otariid pinnipedes.

The new otariid, *Enaliarctos*, is placed in its own new subfamily. Its similarities with the canoids include features of the auditory region which are fundamental in the classification of the Carnivora. This region of *Enaliarctos* is similar to that of early, Oligocene members of the Canoidea, but in several ways is most similar to that of primitive ursids, and to that of the late Oligocene aquatic form *Potamotherium*. (*Potamotherium* has previously been regarded as itself related to the late Cainozoic otters, but Mitchell and Tedford believe that it was already too specialised for aquatic life to be ancestral to them.)

Enaliarctos is also similar to ursids in having retained two quadrangular upper molars, and in the structure of its upper and lower fourth premolars. A natural cranial endocast also shows traces of the 'ursine lozenge' on the antero-dorsal surface of the cerebrum. On the other hand, the skull of *Enaliarctos* shows several similarities to that of otariid (rather than phocid) pinnipedes, and its dentition shows a stage intermediate between that of the primitive ursids and the reduced, simplified pinnipede dentition. Features which suggest an aquatic life include its broadened muzzle and enlarged narial chamber, large dorsally placed eyes and enhanced cranial blood circulation. *Enaliarctos* was also found in marine, near-shore deposits.

Mitchell and Tedford conclude that *Enaliarctos* was closely involved in the ancestry of the Otariidae, and place it in that family. Its similarity to ursids, therefore, leads them to place the Otariidae with its terrestial relatives within the superfamily Canoidea, adjacent to the Ursidae. They believe that they have demonstrated a sequence from primitive ursids to otariids that leaves little room for origin of the phocids. The earliest phocids are, like *Enaliarctos*, of early Miocene age. Unless they evolved from a stock closely related to the ancestors of *Enaliarctos*, but already committed in a divergent fashion to an aquatic way of life, there seems little doubt that the phocids are a lineage separate from the otariids. If so, the Pinnipedia is a diphyletic group, and the terms Pinnipedia and Fissipedia should no longer be used.

The Ursidae has also been enlarged recently by Sarich (*Nature*, **245**, 218; 1973), whose immunological studies of the pandas have supported the earlier work of Davis (*Fieldiana, Zool. Mem.*, **3**; 1964) in showing that the giant panda and the lesser panda are not closely related to one another. Instead, the giant panda is merely a highly specialised type of bear. The ursids and procyonids (racoons) are more closely related to one another than to any other canoid. The lesser panda seems to have a separate lineage originating from near the common ancestry of these two families, though perhaps more closely allied to the ursids than to the procyonids. Sarich's immunological studies also support the morphological studies in emphasising the comparatively conservative nature of the Ursidae.

CYCLIC AMP

Regulator of Cell Shape

from a Correspondent

THE proliferation of papers implicating cyclic AMP (3′,5′-adenosine monophosphate) as a growth regulator in animal cells is now well into the exponential phase, and even those working in the field may feel justifiably overwhelmed by the amount of new data. Moreover, much of this information is concerned with correlating changes in the behaviour of cells with changes in intracellular cyclic AMP concentrations following relatively complex manipulations, such as exposure to serum or transformation by oncogenic viruses. As more becomes known about possible interactions between different elements of the cyclic nucleotide pathways—for example, the induction of phosphodiesterase by its substrate cyclic AMP and the stimulation of at least one cyclic AMP phosphodiesterase by cyclic GMP—the problem of sorting out exactly where these complex stimuli initially interact with the cell's regulatory programme is greatly increased.

This task would be much easier if it were possible to predict the consequences of selectively altering only one