Rotation of the Iberian Peninsula

Jones and Ewing (*1*) have presented seismic profiler data from the Bay of Biscay which allows a 12° anticlockwise rotation of the Iberian peninsula between Eocene and Middle to Upper Miocene times. They refer several times to the fact that this value is appreciably less than a rotation of 22°, which they believe resulted from our paleomagnetic study of the Lisbon Volcanics (*2*).

We must point out that in our paper (*2*) a post-Eocene rotation of 22° was not our unequivocal interpretation of the paleomagnetic data (*3*). As emphasized several times (*2, 3*), both graphically and otherwise, the accuracy of the paleomagnetic method is inherently limited. Therefore such precise interpretation (*1*) of our data is unwarranted. As stated in our abstract (*2*) and elsewhere, our conclusion is restricted to a belief that the rotation of the Iberian peninsula, which had previously been proposed by several authors using totally independent reasoning, may have occurred in part in post-Eocene times. This conclusion has been strongly challenged by Van der Voo (*4*), whose position is based on a large amount of paleomagnetic data from Paleozoic and Mesozoic rocks from Spain and Portugal. He and others prefer to think that the rotation ceased at the end of the Cretaceous period.

We have reaffirmed our belief in the possibility of some post-Eocene rotation (*5*), but this has been repeatedly dismissed by Van der Voo (*6*). It would, therefore, appear to be more appropriate at this time to emphasize the relevance of Jones and Ewing's result (*1*) to resolution of the above controversy rather than to attribute, prior to its comparison with the seismic implications, a precision to our paleomagnetic work, which is unfortunately both unfounded and misleading.

As we have suggested (*5*, p. 551), marine geophysics of the Bay of Biscay has contributed to a resolution of our debate with Van der Voo: The 12° wedge of crust, which is possibly younger than Cretaceous but older than Upper Miocene (*1*), is quite consistent with our Eocene paleomagnetic data. Finally, it appears that our prediction (*7*) of a fan-shaped anomaly pattern reflecting in part a post-Eocene rotation and a history of geomagnetic polarity existing in the Bay of Biscay is now quite feasible. Matthews and Williams (*8*) have presented a map of linear magnetic anomalies which are fan-shaped and which radiate out from the southeast corner of the Bay of Biscay; the Jones and Ewing result (*1*) will now allow these anomalies to be interpreted as post-Eocene in part.

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2. N. D. Watkins and A. Richardson, *Geophys. J. Roy. Astron. Soc.* **15**, 287 (1968).
3. For example, the 95 percent confidence intervals are added to the paleomagnetic declination (*2*, figure 8) and the 95 percent confidence oval is included with the resulting mean geomagnetic pole position (*2*, figure 7). These results indicate that the magnitude of possible post-Eocene rotation of the Iberian peninsula may have been as little as 10°, although as shown diagrammatically (*2*, figure 8) the mean result is a 22° rotation.
4. R. Van der Voo, *Geophys. J. Roy. Astron. Soc.* **16**, 543 (1968).
5. N. D. Watkins and A. Richardson, *ibid.*, p. 549.
6. R. Van der Voo, *Tectonophysics* **7**, 6 (1969); "Paleomagnetic studies relating to development of the Bay of Biscay," *Upper Mantle Committee Symposium on Structure of the Crust and Mantle beneath Inland and Marginal Seas*, General Assembly, International Union of Geodesy and Geophysics, Madrid, 5 September 1969; R. Van der Voo and J. D. A. Zijderveld, *Verh. Ned. Geol.-Mijnbouwk. Genoot.* **26**, 121 (1969).
7. N. D. Watkins and A. Richardson, *Geophys. J. Roy. Astron. Soc.* **15**, 302 (1968). We should also point out the agreement between the distribution of possibly younger crustal material, as defined by Jones and Ewing (*1*), and our prediction of its possible existence (*2*, p. 304). This was put forward by us as one possible manifestation of a post-Eocene rotation, which would still accommodate the existence of a Cretaceous seamount in the Bay of Biscay [E. J. W. Jones and B. M. Funnell, *Deep-Sea Res. Oceanogr. Abstr.* **15**, 701 (1968)].
8. D. H. Matthews and C. A. Williams, *Earth Planet. Sci. Lett.* **4**, 315 (1968).
9. Contribution No. 15 of the Geophysical Fluid Dynamics Institute, Florida State University. Supported in part by ONR contract N00014-68-A-0159.

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Sea Urchin Population Explosion in Southern California Coastal Waters

The alleged population "explosion" of coral-eating sea stars (*Acanthaster planci*) in the west tropical Pacific (*1*) may be comparable to the apparent population "explosion" of herbivorous sea urchins (*Strongylocentrotus franciscanus* and *S. purpuratus*) along the coast of southern California. Many luxuriant kelp beds, supporting a rich association of other organisms, have all but disappeared during the past few decades, and in the place of the holdfasts are barren areas supporting extremely dense populations of the urchins (*2*). Up to more than 50 urchins per square meter dominate the rocky bottoms off Palos Verdes Peninsula. The high urchin numbers have persisted, and they have effectively prevented the reestablishment of kelp beds by cropping the young sporophyte plants. Removal of the urchins from an area is immediately followed by the appearance of kelp and other vegetation. Quicklime effectively controls urchins (*3*); it also can control sea stars (*4*) and probably could be used successfully on *Acanthaster.*

The persistence of the high densities of sea urchins, long after they had eaten most of the food, has been puzzling. It seems unlikely that either the urchins or the coral-eating sea stars became "over efficient" as Chesher suggested (*1*). The urchins, and probably the sea stars, seem to be responding to unexpected and, with present knowledge, unpredictable events that follow environmental change by man. In the case of the urchins, the persisting high population densities may be the result of (i) destruction of their main predator, sea otters, during the close of the last century, (ii) depletion of an important competitor, abalone, during the past few decades, and (iii) enrichment of coastal waters with sewage effluent [amino acid enrichment from sewage adds significantly to the nutrition of urchins (*5*)].

Before large-scale attempts are made to control *Acanthaster,* pilot experiments are needed to demonstrate that destruction of this animal would not create other, perhaps greater, ecological difficulties. If quicklime were used, as we have suggested, experiments must be conducted to ascertain what other organisms might be injured by use of the chemical on coral reefs.

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