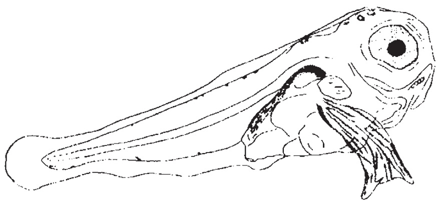
tween 1958 and 1966 has just been published (J. M. Fives, *Proc. Roy. Irish Acad.*, **70** (B), 15; 1970).

Fives has found larvae or post-larvae of sixty-eight species of fish in these samples. Thirty-nine of these have not been recognized before in the plankton of Irish waters, but because few of them are rare or unexpected fish in this region this can only be a reflexion of the lack of studies of this type in Ireland. Most of these species are the smaller non-commercial species of fish, but it is surprising to find that the larvae of pilchard and sprat have not been recognized before, for these fish are abundant off these coasts. Fives's work has considerable potential significance to the fisheries for these species, for she gives details of the seasonal variation in numbers of larvae.



Post-larval stage of three-bearded rockling, *Gaidropsarus vulgaris*, from the plankton of Killeany Bay on the west coast of Ireland. Length 5.5 mm.

Sprat larvae, for example, were found from January to June, implying a long breeding season, although Fives suggests this may be explained by delayed larval development with low salinity in some areas. Pilchard larvae, however, are not found continuously during any one season, and their occurrence can be linked with large catches of *Sagitta elegans* (the planktonic arrow worm typical of water masses from the open Atlantic). It seems therefore that west of Ireland the pilchard spawns on offshore banks and its eggs or larvae occur near the coast only through drift in water masses.

Several of the larvae recognized in the Galway survey seem not to have been described previously. Among these is the large sandeel *Hyperoplus immaculatus*, and the smooth sandeel *Gymnammodytes semisquamatus*, both abundant fish, and, with their relatives, important links in the food web of the sea. Another interesting series of larvae is referred by Fives to the blenny genus *Coryphoblennius*. Although the young of the only Irish *Coryphoblennius* species (Montagu's blenny, *C. galerita*) are well known, Fives's description of the larvae seems to be the first. Fives's twenty-two specimens measured between 4 and 8 mm and were caught between June 30 and July 13.

This study of the larval planktonic fishes of Galway Bay has thus added something to general knowledge in the description and identification of a number of larvae which had previously escaped notice. Its bearing on the spawning season and productivity of a number of commercially important fishes is considerable, and taken with the other studies on the zooplankton of the area it represents a contribution to the better understanding of inshore plankton.

CONTINENTAL DRIFT

Forceful Motion

from our Geomagnetism Correspondent

THE chief obstacle to the complete credibility of continental drift is, and always has been, the nature of the forces which drive the continents along. Before about 1950 the evidence for continental drift was more or less circumstantial; and this, combined with ignorance of a reasonable driving mechanism, produced little support for the hypothesis. During the past two decades, however, direct evidence for drift and seafloor spreading has proved utterly convincing; and conventional wisdom has adopted convection currents in the mantle as the *modus operandi* for both. But the direct evidence in favour of mantle convection remains nebulous.

Jacoby's new mechanism for drift, spreading and plate movements (*J. Geophys. Res.*, **75**, 5671; 1970) is thus of considerable interest, and seems to be as convincing, if not more so, than convection currents. Jacoby suggests that the plates are not dragged along passively by the mantle but that both the lithosphere and asthenosphere actively participate in the movements as the result of gravitational instability in the upper mantle. More specifically, the active diapirism of the asthenosphere under the mid-oceanic ridges and the sinking of the lithosphere under the island arcs each exerts forces on the plates which tend to produce motion away from the ridges. Ultimately, the plates are driven by temperature-induced density contrasts between lithosphere and asthenosphere. The motions could, of course, still be regarded as the result of convection currents; but the convection is vastly different from upper mantle convection as normally conceived.

But is such a mechanism feasible? Jacoby goes to great lengths to show that it is, using order of magnitude calculations and making many, but reasonable, assumptions. The first process he considers is diapirism under the ridges, by which he simply means the filling of the space between the spreading ridges as the mantle material rises and solidifies. Such diapirism requires, of course, an instability in the mass distribution of the crust and mantle under the ridges—a density reversal with depth, for example—which almost certainly exists. As the asthenosphere then rises diapirically it will lift up the lithospheric plates on either side of the ridge and the plates will tend to slide down away from the ridge under the force of gravity. Second, as the lithosphere descends under island arcs it will, unless the descending part is uncoupled from the rest of the lithosphere by vertical faults, exert a downward pull on the plate.

Against these driving forces must be weighed the resistances to plate movements. Material must, for example, be returned through the asthenosphere to the ridges against gravitational forces and against the viscosity of the asthenosphere itself. It is, of course, quite impossible to calculate accurately the balance between driving and resistive forces; but Jacoby's order of magnitude calculations do show that a net positive driving force is plausible. The energy to maintain this driving force would, presumably, be heat.

The model is, as Jacoby admits, greatly simplified. But it does not seem to conflict with the canons of continental drift, seafloor spreading and plate tectonics. Moreover, it has the advantage that some aspects can, in principle, be tested experimentally—for example, the necessary ridge structure, the gravity fields associated with various parts of the motions and the stress fields in the plates.

Excitation of 6300 Å Airglow

THE most naive view of the airglow used to be to regard it as a faint diffuse aurora, which might be excited by electrons. More recently, however, it has been widely accepted that the principal mechanism exciting 6300 Å was the dissociative recombination of O_2^+ ions, but now D. G. Nichol (*Nature Physical Science*, **229**, 13; 1971) has produced strong evidence that excitation by electrons is important at high latitudes. Observations at Hobart, Tasmania (invariant latitude 54° S), show the airglow intensity increasing to the south (higher latitudes) whereas the *F*-layer electron density increases to the north. Nichol also remarks on the frequent observation of simultaneous brightening of airglow from invariant latitude 50° to 65°. He finds that a flux of $\sim 10^{10}$ eV cm^{-2} s^{-1} could account for the airglow and suggests that electrons of 10–30 eV are responsible; measurements at these energies are, however, difficult. The airglow results are similar to those of B. P. Sandford in New Zealand (*Planet. Space Sci.*, **10**, 195; 1964). Theoretically a drizzle of particles over a wide range of energy should be associated with convection in the magnetosphere, and would be expected to extend from the auroral oval to the plasmapause.