ial proportional to the modified pressure. On a plane conformal map of the Earth the flow may be analyzed by the usual methods of classical hydrodynamics (Lamb 1932).

Plate edges provide boundary conditions. On a scale in which ϕ is negligible, they become discontinuities of $\underset{\sim}{u} - \frac{1}{2}\underset{\sim}{U}$, i.e. line sources or sinks. But, in addition, wherever horizontal forces act on the plate there must be equal and opposite forces on the asthenosphere. Hence we find a discontinuity Δp of pressure across a subduction zone, and so a discontinuity of ϕ. If Δp is constant along any one zone we obtain the point vortices at the ends of the world's subduction zones which are shown in Figures 1 and 2. Near each vortex the speed of the asthenospheric flow is of order $1/r$ (unless $r < \delta$), which dominates the $\ell n\, r$ contributions from line sources or sinks. Here r is the distance from the vortex. Non-uniform force per unit length at a subduction zone implies vorticity distributed along the zone rather than concentrated at its ends. This is necessary if a zone is not to curl up at the ends. The theory of aerofoils (Prandtl, 1952) shows that the speed nearby is of order $1/r^{1/2}$ and Δp is of order $r^{1/2}$. Mid-ocean ridges induce equal and opposite vortices under their two plates, which cancel out.

Observable Consequences

Some subduction zones do curl up at the ends in the required directions. Jacoby (1973) noticed the Banda and Tongan arcs, the northern end of the Andean, and both ends of the Caribbean and South Sandwich arcs. One might add the Mediterranean arc and the southern end of the Marianas. We can also picture the Fijian sea floor being distorted to its spiral shape when the New Hebrides subduction zone reversed its polarity (Gill and Gorton, 1973; Packham, 1973). and it began to move away from the Tongan arc. The same process seems to be starting in the Philippines. Wellman's (1975) deformation of New Zealand is also consistent with the direction of its vortex, as is the apparent northward push on Panama and westward push on Sulawesi (Celebes). The fast westward flow expected under Samoa may explain why that island chain, alone among many in the Pacific, has its youngest volcanoes at the western end (Holmes 1965).

Vortices close to small plates should affect their motions. The two in the Mediterranean seem well placed to push the Aegean plate south, the Turkish east and the Arabian north, but no such theory seems to work for the Bismarck or Solomon seas.

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SEISMICITY AND EARTHQUAKE FOCAL MECHANISMS IN THE NEW GUINEA SOLOMON ISLANDS REGION

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There is general agreement between plate tectonic theory and seismicity for the New Guinea Solomon Islands region. Two minor plates, the Solomon Sea and South Bismarck plates, are sandwiched within the collision zone between the continental fronts of the Pacific and India plates, and derive their relative motions from the collision. The azimuth of collision is approximately east-northeast.

Earthquake focal mechanism solutions support the theory that subduction of the Solomon Sea plate is occurring against the Pacific plate, although the dip of the seismic zone between Bougainville and the trench in the Solomon Sea is vertical. A cluster of deep focus earthquakes 100 km north of Bougainville, to the northeast of the seismic zone, may be evidence of a near dormant, earlier subduction of the Pacific plate.

Subduction of the Solomon Sea plate is occurring beneath the New Britain margin of the South Bismarck plate.

Although the sinistral shear between the Solomon Sea and Indo-Australian plates in southeast Papua required by Johnson and Molnar's (1972) plate tectonic analysis is supported by two earthquake focal mechanism solutions in southeast Papua, it is not supported by the low level os seismicity, unless the shear occurs largely by flow without the release of seismic energy. However the seismic zone which dips westward from the Huon Gulf, south of the Markham Valley, suggests a compressional contact between the Solomon Sea and India plates where the border curves onto a northwesterly trend.

Focal mechanism solutions have not clarified the tectonic processes currently occurring in northern New Guinea at the border of the South Bismarck and India plates, because strike-slip, dip-slip overthrust and dip-slip normal solutions, have all been obtained. The seismic zone dips steeply to the north from a depth of 100 km beneath the Huon Peninsula and Markham Valley, to a depth of 230 km beneath the volcanic arc, and appears to be a continuation of the New Britain inclined seismic zone. Solutions consistent with sinistral shear have been obtained for earthquakes of the Bismarck Sea seismic lineation, although the epicentres are scattered over too broad a band, or arc, for a single transcurrent fault.

The Irian Jaya seismic zone is broad and diffuse. Most earthquakes occur above a depth of 70 km. The seismic zone does not indicate a simple subduction border between the India and Pacific plates, but appears to indicate a buffer zone within the major triple junction of the Asian, Pacific and India plates.

The paper was presented with the permission of the Director of the Bureau of Mineral Resources. The earthquake focal mechanism solutions shown on the seismicity maps are taken from Ripper (1975; in preparation).

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