centration of DDT of 4·0 p.p.m. (range 1·0–11·1 p.p.m.) in samples of human depot fat in England in 1964. No evidence of any significant change was found during 1962–65.

Table 4. RELATIVE RETENTION VALUES (Rx) OF RESIDUES (DIELDRIN = 100)

DC-200 column Residue		Sample	*DC*-200/*QF*-1 column Residue		Sample
PCB	= 68·5	68	PCB	= 68·5	70
p,p′-DDE, Dieldrin	= 100	100	p,p′-DDE	= 84	83·5
PCB	= 121	125	Dieldrin	= 100	100
p,p′-TDE	= 129	128	p,p′-TDE	= 121	121
PCB	= 148	149	PCB	= 123	122
p,p′-DDT	= 170	171	PCB	= 146·5	—
PCB	= 174	175	p,p′-DDT	= 147	147
PCB	= 205	205	PCB	= 234	231
PCB	= 282	287	PCB	= 282	278
PCB	= 339	338			

The seals and porpoises from the east coast of Scotland were usually more seriously contaminated than those from the north and west coasts. This, at least in respect of seals, may be because, as is believed, the populations in the two areas come from different breeding sites. The seals south of Aberdeen breed principally on the Farne Islands, off the north-east coast of England, while the seals of north and west Scotland are primarily from the breeding grounds of the Orkney Islands in the north, and other islands off the west coast of Scotland. The sea off eastern Scotland is also likely to receive more contamination from estuarine discharges than that off north and west Scotland. Similarly, the two separate seal populations sampled off the east coast of Canada may inhabit areas with different levels of contamination. Pups contain pesticide residues in concentrations only slightly lower than in the parent population. Common seals in Holland have been found with concentrations of residue similar to those of seals on the Scottish east coast[13].

While the residue concentrations in subcutaneous fat are high, those of other tissues and organs are found to be much lower. This suggests that there is no risk of physiological effects, unless the metabolism of much of the fat in times of stress leads to a considerable increase in the concentration of the residue in circulating lipids, and thus in residue concentrations in other organs or tissues.

Grey seals on the coast of the Scottish mainland feed primarily on salmon (*Salmo salar*) and cod (*Gadus morrhua*)[14]. The highest concentrations of pesticide in salmonids in the marine environment have so far been found in sea trout (*S. trutta*) on the east coast with up to 0·2 p.p.m. (dieldrin + total DDT) in muscle tissue[15], and salmon from the same area would probably have similar contents. Cod examined from the east coast have contained up to 0·35 p.p.m. (dieldrin + total DDT) in muscle tissue (mean 0·12 p.p.m.) and from the west coast up to 0·56 p.p.m. (mean 0·22 p.p.m.), while cod livers contained up to 4·0 p.p.m. and 12·0 p.p.m., respectively. Grey seals are estimated to eat about 15 lb. of food daily, and thus an adult seal could consume its own weight in food in 20–30 days. Assuming a high proportion of the pesticide intake to be stored in body fat rather than to be excreted or metabolized, an increase of two orders of magnitude in pesticide concentration from food to body fat within a few years is feasible. This degree of accumulation of residue in an environment not deliberately contaminated, and in species ecologically far distant from the target organisms of persistent pesticides, underlines the impossibility of confining such chemicals to the areas of application.

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1 *Rep. President's Sci. Adv. Comm.* (US Govt. Printing Office, Washington, 1963).
2 Tatton, J. O'G., and Ruzicka, J. H. A., *Nature*, **215**, 346 (1967).
3 Moore, N. W., and Tatton, J. O'G., *Nature*, **207**, 42 (1965).
4 Robinson, J., Richardson, A., Crabtree, A. N., Coulson, J. C., and Potts, G. R., *Nature*, **214**, 1307 (1967).
5 Department of Agriculture and Fisheries for Scotland, Fisheries of Scotland. Report for 1965.
6 Department of Agriculture and Fisheries for Scotland, Fisheries of Scotland. Report for 1966.
7 De Faubert Maunder, M. J., Egan, H., Godly, E. W., Hammond, E. W., Roburn, J., and Thomson, J., *Analyst*, **89**, 168 (1964).
8 Jensen, S., *New Scientist*, **32**, 612 (1966).
9 Holmes, D. C., Simmons, J. H., and Tatton, J. O'G., *Nature*, **216**, 227 (1967).
10 Simmons, J. H., and Tatton, J. O'G., *J. Chromatog.*, **27**, 253 (1967).
11 Holden, A. V., *Ann. Appl. Biol.*, **50**, 467 (1962).
12 Robinson, J., and Hunter, C. G., *Arch. Environ. Health*, **13**, 558 (1966).
13 Koeman, J. H., and van Genderen, H., *J. Appl. Ecol.*, **3** (Suppl.), 99 (1966).
14 Rae, B. B., *Mar. Res.*, No. 2, 39 (1960).
15 Holden, A. V., *J. Appl. Ecol.*, **3** (Suppl.), 45 (1966).

The North Pacific: an Example of Tectonics on a Sphere

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Individual aseismic areas move as rigid plates on the surface of a sphere. Application of the Mercator projection to slip vectors shows that the paving stone theory of world tectonics is correct and applies to about a quarter of the Earth's surface.

THE linear magnetic anomalies[1,2] which parallel all active ridges can only be produced by reversals of the Earth's magnetic field[1] if the oceanic crust is formed close to the ridge axis[3]. Models[4] have shown that the anomalies cannot be observed in the North Atlantic unless most dyke intrusion, and hence crustal production, occurs within 5 km of the ridge axis. The spreading sea floor[3] then carries these anomalies for great horizontal distances with little if any deformation. The epicentres of earthquakes also accurately follow the axis and are offset with it by transform faults[5,6]. The structure of island arcs is less clear, though the narrow band of shallow earthquakes suggests that crust is consumed along a linear feature. These observations are explained if the sea floor spreads as a rigid plate, and interacts with other plates in seismically active regions which also show recent tectonic activity. For the purposes of this article, ridges and trenches are respectively defined as lines along which crust is produced and destroyed. They need not also be topographic features. Transform faults conserve crust and are lines of pure slip. They are always parallel, therefore, to the relative velocity vector between two plates—a most useful property. We have tested this paving stone theory of world tectonics in the North Pacific, where it works well. Less detailed studies of other regions also support the theory.

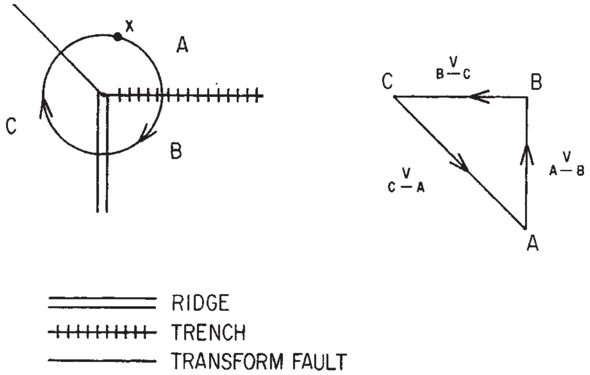

Fig. 1. The circuit and its vector diagram show how a ridge and a trench can meet to form a transform fault.

The movement of blocks on the surface of a sphere is easiest to understand in terms of rotations. Any plate can clearly be moved to a given position and orientation on a sphere by two successive rotations, one of which carries one point to its final position, a second about an axis through this point then produces the required orientation. These two rotations are equivalent to a single rotation about a different axis, and therefore any relative motion of two plates on the surface of a sphere is a rotation about some axis. This is Euler's theorem, and has been used to fit together the continents surrounding the Atlantic[7]. If one of two plates is taken to be fixed, the movement of the other corresponds to a rotation about some pole, and all relative velocity vectors between the two plates must lie along small circles or latitudes with respect to that pole. If these small circles cross the line of contact between the two plates, the line must be either a ridge or a trench depending on the sense of rotation. Neither of these structures conserves crust. If the line of contact is itself a small circle, then it is a transform fault. This property of transform faults is very useful in finding the pole position and is a consequence of the conservation of crust across them. There is no geometric reason why ridges or trenches should lie along longitudes with respect to the rotational pole and in general they do not do so. The pole position itself has no significance, it is merely a construction point. These remarks extend Wilson's[8] concept of transform faults to motions on a sphere, the essential additional hypothesis being that individual aseismic areas move as rigid plates on the surface of a sphere.

There are several points on the surface of the Earth where three plates meet. At such points the relative motion of the plates is not completely arbitrary, because, given any two velocity vectors, the third can be determined. The method is easier to understand on a plane than on a sphere, and can be derived from the plane circuit in Fig. 1. Starting from a point x on A and moving clockwise, the relative velocity of B, ${}_Av_B$ is in the direction AB in the vector diagram. Similarly the relative velocities ${}_Bv_C$ and ${}_Cv_A$ are represented by BC and CA. The vector diagram must close because the circuit returns to x. Thus:

$$ {}_Av_B + {}_Bv_C + {}_Cv_A = 0 \qquad (1) $$

The usual rules for the construction of such triangles require three parameters to be known, of which at least one must be the length of a side, or spreading rate. Transform faults on both ridges and trenches are easy to recognize, and they determine the direction, but not the magnitude, of the relative velocities. The magnetic lineations are one method of obtaining ${}_Bv_C$, though this value must be corrected for orientation unless the spreading is at right angles to the ridge. Then the triangle in Fig. 1 determines both ${}_Av_B$ and ${}_Cv_A$. This method is probably most useful to determine the rate of crustal consumption by trenches. Equation (1) must be used with care, because it only applies rigorously to an infinitesimal circuit round a point where three (or more) plates meet. If the circuit is finite, the rotation of the plates also contributes to their relative velocity, and therefore these simple rules no longer apply.

Equation (1) is easily extended to the corresponding problem on a spherical surface because angular velocities behave like vectors[9]:

$$ {}_A\omega_B + {}_B\omega_C + {}_C\omega_A = 0 \qquad (2) $$

The sign convention takes a rotation which is clockwise when looked at from the centre of the sphere to be a positive vector which is pointing outward along the rotation axis. By adding more terms, equation (2) can be extended to circuits crossing more than three plates and applies to all possible circuits on the surface. ω diagrams for three plates are no more difficult to construct than those for v, because the third vector must lie in the plane containing the other two. This result does not apply

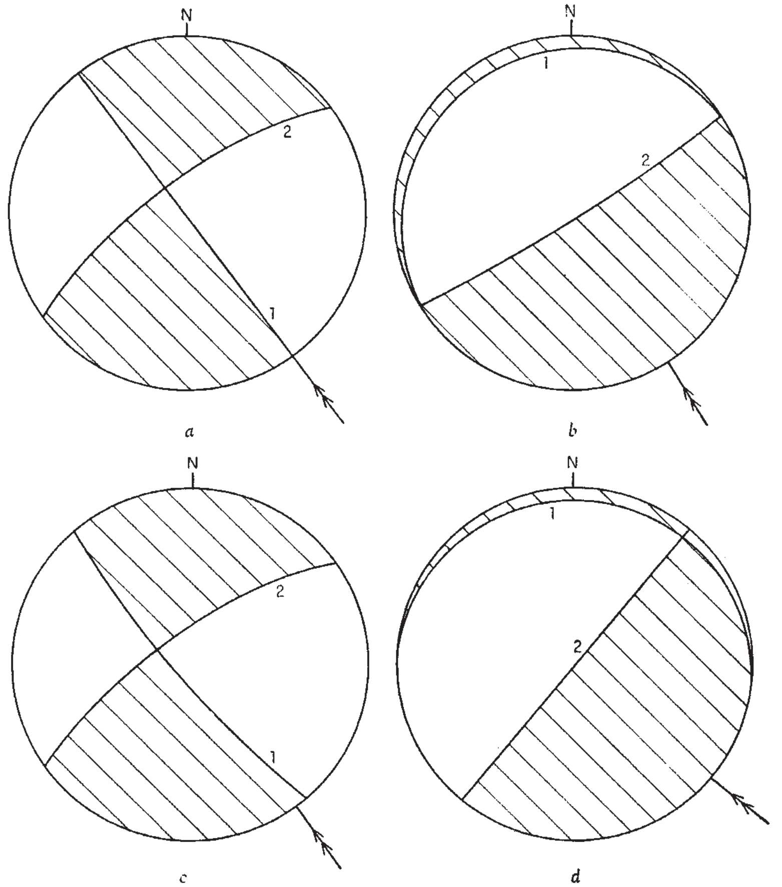

Fig. 2. Mechanism diagrams for four circum-pacific earthquakes. The lower half of the focal sphere is projected stereographically on to a horizontal surface, and the rarefraction quadrants are shaded. The horizontal projection of the slip vector in plane 1 is marked with a double arrow. (*a*) June 28, 1966, Parkfield[15], strike slip. (*b*) September 4, 1964, Alaska[16], overthrust. (*c*) June 14, 1962, Near and Aleutian Islands[14], strike slip. (*d*) October 20, 1963, Kurile Islands[17], overthrust.

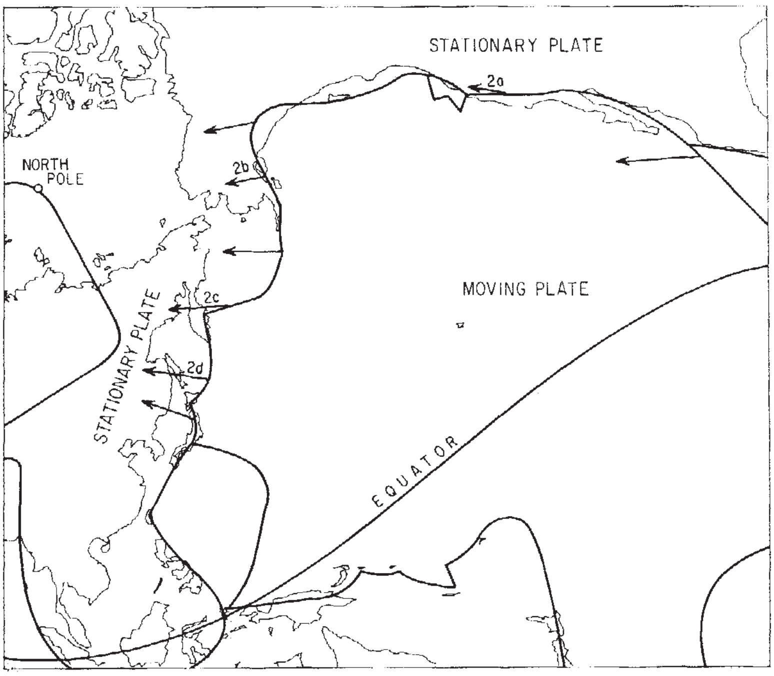

Fig. 3. A Mercator projection of the Pacific with a pole at 50° N., 85° W. The arrows show the direction of motion of the Pacific plate relative to that containing North America and Kamchatka. If both plates are rigid all slip vectors must be parallel with each other and with the upper and lower boundaries of the figure. Possible boundaries of other plates are sketched.

to diagrams for four or more plates, which are three dimensional and therefore less easy to draw.

These geometrical ideas can now be applied to the North Pacific. There are many fault plane solutions for earthquakes in the area, and these are used in a new way in order to determine the direction of the horizontal projection of the slip vector. Unlike the projection of the principal stress axes, that of the slip vector varies in a systematic manner over the entire region. This is clearly a consequence of spreading of the sea floor, which determines the relative motion, not the stress field.

The North Pacific was chosen for several reasons. The spreading rate from the East Pacific rise is the most rapid yet measured[2], and should therefore dominate any slight movements within the plate containing North America and Kamchatka[10]. The belt of earthquake epicentres which extends from the Gulf of California to Central Japan without any major branches[10] suggests that the area contains only two principal plates. Also, the belt of seismic activity between them is one of the most active in the world and many fault plane solutions are available[6,11–17]. It is an advantage that the trend of the belt which joins the two plates varies rapidly over short distances, because this illustrates the large variety of earthquake mechanisms which can result from a simple rotation (Fig. 2). It is also helpful that the outlines of the geology and topography of the sea floor are known.

Fault plane solutions which were obtained from the records of the world-wide network of standardized stations now give excellent and consistent results[6,16]. The directions of principal stress axes, however, which were determined from first motions, vary widely over short distances (Fig. 2) and are therefore difficult to use directly. The concept of spreading of the sea floor suggests that the horizontal projection of the slip vector is more important than that of any of the stress axes, and Fig. 2 shows that this is indeed the case. The examples which are illustrated are stereographic projections of the radiation field in the lower hemisphere on to a horizontal plane[16]. The direction of the projection of the slip vector in plane one is obtained by adding or subtracting 90° from the strike of plane two if the planes one and two are orthogonal. The slip directions which are shown give the motion of the oceanic plate relative to the plate containing North America and Kamchatka. For each case in Fig. 2 there are two possible slip directions, but, whereas one changes in direction slowly and systematically between Baja California and Japan, the other shows no consistency even for earthquakes in the same area. The ambiguity is therefore unimportant in this case. If all the earthquakes between the Gulf of California and Japan are produced by a rotation of the Pacific plate relative to the continental one, any pair of widely spaced slip directions can be used to determine the pole of relative rotation. The two which are used here are the strike of the San Andreas between Parkfield and San Francisco, and the average slip vector of all the aftershocks in the Kodiak Island region[16] of the 1964 Alaskan earthquake. A pole position of 50° N., 85° W. was obtained by construction on a sphere. If the paving stone theory applies, all slip vectors must be parallel to the latitudes which can be drawn with respect to this pole. Though this prediction could be tested by tabulating the disagreement with the observations, a simpler and more obvious test is to plot the slip vectors on a map of the world in Mercator projection, taking the projection pole to be the rotation axis (Fig. 3). The Mercator projection has two advantages; it is conformal, which means that angles are locally preserved and slip vectors can be plotted directly, and also all small circles centred on the projection pole are parallel. Because the upper and lower boundaries of Fig. 3 are themselves small circles, the theory requires all slip vectors to be parallel both to each other and to the top and bottom. This prediction was tested on eighty published[6,11–17] fault plane solutions for shallow earthquakes during and after 1957. Of these, about 80 per cent had slip vectors with the

Fig. 4. An orthonormal projection of the North Pacific centred on the Mercator Pole. Slip vectors are tangents to concentric circles about the centre.

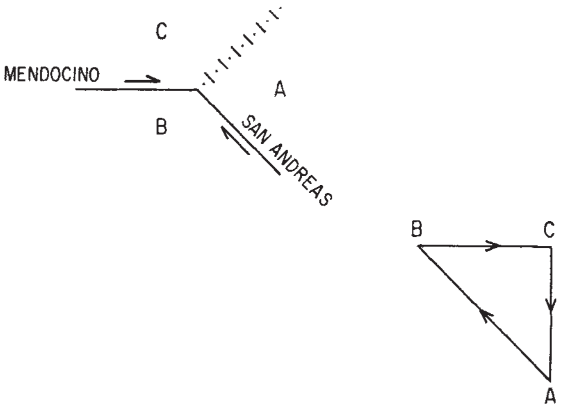

Fig. 5. Both the Mendocino and San Andreas faults can be strike slip if there is a trench to the north or east.

correct sense of motion and within $\pm 20°$ of the direction required by Fig. 3. Most of the fault plane solutions for earthquakes before this date also agreed with the sense and direction of motion. Representative slip vectors in Fig. 3 show the motion of the Pacific plate relative to the continental one, which is taken to be fixed. The rotation vector is therefore negative and points inward at 50° N., 85° W. The agreement with theory is remarkable over the entire region. It shows that the paving stone theory is essentially correct and applies to about a quarter of the Earth's surface.

The disadvantage of the Mercator projection is the distortion it introduces around the poles. It is therefore difficult to use Fig. 3 to estimate spreading velocities. For this purpose an orthonormal projection is more useful (Fig. 4), for the spreading rate is then proportional to distance from the centre if this is taken at the pole of rotation. In this projection, which is simply a vertical projection on to a plane at right angles to the rotation axis, rigid rotations of the two plates on a sphere become rigid body rotations on the plane, and all slip vectors must be tangents to concentric circles about the centre of projection (Fig. 4). This projection is useful if spreading rates, rather than angles, are known. There are as yet few such measurements in the North Pacific.

The large active tectonic areas of the North Pacific are now clear from Fig. 3. The fault systems of the San Andreas, Queen Charlotte Islands and Fairweather form a dextral transform fault joining the East Pacific rise to the Aleutian trench. The strike slip nature of these faults is clear from field observations[18–20] and from the fault plane solutions (for example, Fig. 2*a*). In Alaska the epicentral belt of earthquakes changes direction[10] (Fig. 3) and follows the Aleutian arc. The fault solutions also change from strike slip to overthrust[16] (for example, Fig. 2*b*), and require that the islands and Alaska should override the Pacific on low angle ($\sim 7°$) faults. Though the direction of slip remains the same along the entire Aleutian arc, the change in strike changes the fault plane solutions from overthrusting in the east to strike slip in the west (Fig. 2*c*). A sharp bend occurs between the Aleutians and Kamchatka (Fig. 3). Here the fault plane solutions change back to overthrust (Fig. 2*d*). This motion continues as far as Central Japan, where the active belt divides (Fig. 3) and the present study stops. Thus the North Pacific contains the two types of transform faults which require trenches[8], and clearly shows the dependence of the fault plane solutions on the trend of the fault concerned.

The variation of trend also controls the distribution of trenches, active andesite volcanoes, intermediate and deep focus earthquakes[10]. All these phenomena occur in Mexico, Alaska, the Eastern Aleutians, and from Kamchatka to Japan, but are absent where the faults are of a strike slip transform nature. This correlation is particularly obvious along the Aleutian arc, where all these features become steadily less important as Kamchatka is approached[10], then suddenly reappear when the trend of the earthquake belt changes. Though it is clear from these remarks that the paving stone theory applies to the North Pacific region as a whole, there are some small areas which at first sight are exceptions.

The most obvious of these is the complicated region of the ocean floor off the coast between northern California and the Canadian border[21]. The difficulties begin where the San Andreas fault turns into the Mendocino fault. Fig. 5 shows that the change in trend of the epicentres is possible only if crust is consumed between *C* and *A* (or created in *B*, which is unlikely). The earthquakes along the coast of Oregon[22] and the presence of the volcanoes of the Cascade range, one of which has recently been active and all of which contain andesites, support the idea that crust is destroyed in this area. In the same area two remarkable seismic station corrections which possess a large azimuthal variation[23] also suggest that there is a high velocity region extending deep into the mantle similar to that in the Tonga–Kermadec[24] region. These complications disappear when the ridge and trench structures join again and become the Queen Charlotte Islands fault.

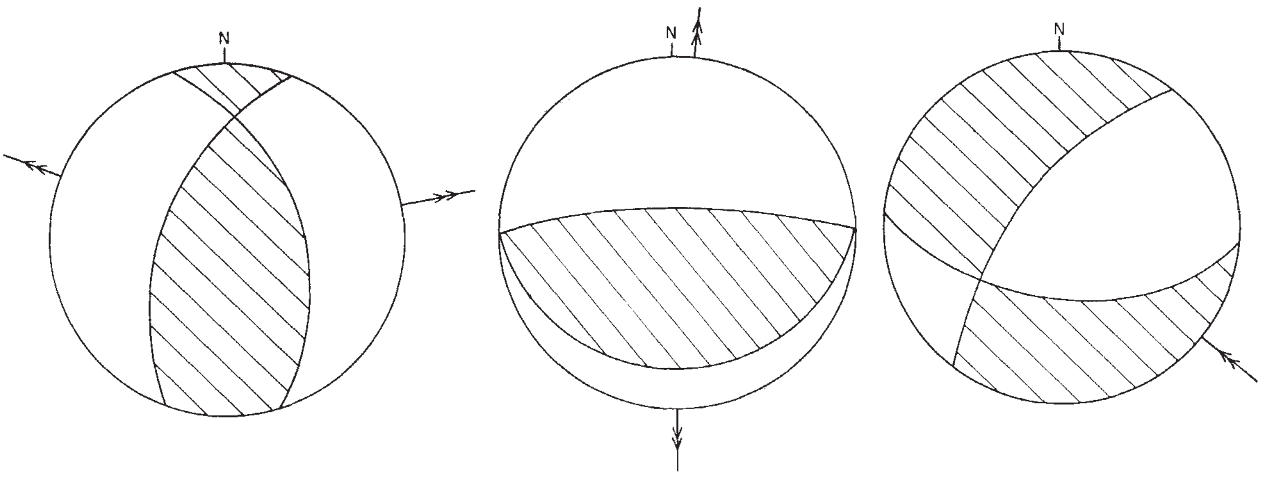

Fig. 6. Mechanism diagrams drawn as in Fig. 2 for three earthquakes in the Kurile Islands. (*a*) September 15, 1962 (ref. 14), extension by normal faulting. (*b*) November 15, 1963 (ref. 17), extension by normal faulting. (*c*) May 22, 1963 (ref. 17), island arc overthrust from the Pacific side.

Another complicated area is in Alaska between 147·5° W. and the north end of the Fairweather fault[16]. In this same area the local uplift after the 1964 earthquake suggested that several faults were active[16], and therefore the tectonics cannot be understood without more fault plane solutions.

The third area is in the Kurile Islands where two fault plane solutions (Fig. 6*a* and *b*) require dip slip faulting and crustal extension. This motion is completely different from most of the solutions in the area, which agree well with the rest of the North Pacific. Both earthquakes occurred beneath the steep wall of the Kurile trench on the island arc side, and are consistent with gravity slides down into the trench. The terraces which would result from such slides are common features of the trenches of both Japan and the Aleutians[25,26]. There is also one fault plane solution which requires that the Pacific should be overthrusting the Kurile Islands (Fig. 6*c*), though the crustal shortening is consistent with the regional pattern.

The two ends of the North Pacific belt may also be discussed with the help of vector circuits. The end in Central Japan gives the trivial result that two trenches can join to give a third. The other end at the entrance to the Gulf of California is the circuit in Fig. 1, and shows how the East Pacific rise and the Middle America trench combine to become the San Andreas transform fault.

The North Pacific shows the remarkable success of the paving stone theory over a quarter of the Earth's surface, and it is therefore expected to apply to the other three-quarters. It is, however, only an instantaneous phenomenological theory, and also does not apply to intermediate or deep focus earthquakes. The evolution of the plates as they are created and consumed on their boundaries is not properly understood at present, though it should be possible to use the magnetic anomalies for this purpose. The other problem is the nature of the mechanism driving the spreading. It is difficult to believe that the convection cells which drive the motion are closely related to the boundaries of the plates.

One area where the evolution is apparent lies between the plate containing the Western Atlantic, North and South America[10] and the main Pacific plate. The transform faults in the South-East Pacific are east–west; therefore the ocean floor between the rise and South America is moving almost due east relative to the main Pacific plate. The motion of the Atlantic plate relative to the Pacific is given by the San Andreas, and is towards the south-east. If the motion of the Atlantic plate is less rapid than that of the South-Eastern Pacific north of the Chile ridge, then the crust must be consumed along the Chile trench. The faults involved must have both overthrust and right-handed strike slip components. The present motion on the San Andreas is not in conflict with the east–west transform faults of the North-Eastern Pacific if there was originally a plate of ocean floor between North America and the main Pacific plate joined to that which still exists to the west of Chile. This piece of ocean floor has since been consumed, and therefore the direction of spreading in the Pacific appears to have changed in the north but not in the south. This explanation requires changes in the shape of the plates but not in their relative motion, and therefore differs from those previously suggested[2,6]. This study suggests that a belief in uniformity and the existence of magnetic anomalies will permit at least the younger tectonic events in the Earth's history to be understood in terms of sea floor spreading.

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1 Vine, F. J., and Matthews, D. H., *Nature*, **199**, 947 (1963).
2 Vine, F. J., *Science*, **154**, 1405 (1966).
3 Hess, H. H., in *Petrologic Studies* (edit. by Engel, A. E. J., James, H. L., and Leonard, B. F.) (Geol. Soc. Amer., New York, 1962).
4 Matthews, D. H., and Bath, J., *Geophys. J.*, **13**, 349 (1967).
5 Sykes, L. R., *J. Geophys. Res.*, **68**, 5999 (1963).
6 Sykes, L. R., *J. Geophys. Res.*, **72**, 2131 (1967).
7 Bullard, E. C., Everett, J. E., and Smith, A. G., *Phil. Trans. Roy. Soc.*, A, **258**, 41 (1965).
8 Wilson, J. T., *Nature*, **207**, 343 (1965).
9 Goldstein, H., *Classical Mechanics* (Addison–Wesley, 1950).
10 Gutenberg, B., and Richter, C. F., *Seismicity of the Earth and Associated Phenomena* (Princeton University Press, 1954).
11 Stauder, W., *Bull. Seism. Soc. Amer.*, **50**, 293 (1960).
12 Stauder, W., and Udias, A., *Bull. Seism. Soc. Amer.*, **53**, 59 (1963).
13 Udias, A., and Stauder, W., *Bull. Seism. Soc. Amer.*, **54**, 2049 (1964).
14 Stauder, W., and Bollinger, G. A., *Bull. Seism. Soc. Amer.*, **54**, 2198 (1964).
15 McEvilly, T. V., *Bull. Seism. Soc. Amer.*, **56**, 967 (1966).
16 Stauder, W., and Bollinger, G. A., *J. Geophys. Res.*, **71**, 5283 (1966).
17 Stauder, W., and Bollinger, G. A., *Bull. Seism. Soc. Amer.*, **56**, 1363 (1966).
18 Tocher, D., *Bull. Seism. Soc. Amer.*, **50**, 267 (1960).
19 Hill, M. L., and Dibblee, jun., T. W., *Bull. Geol. Soc. Amer.*, **64**, 443 (1953).
20 Allen, C. R., *Phil. Trans. Roy. Soc.*, A, **258**, 82 (1965).
21 Wilson, J. T., *Science*, **150**, 482 (1965).
22 Berg, J. W., and Baker, C. D., *Bull. Seism. Soc. Amer.*, **53**, 95 (1963).
23 Bolt, B. A., and Nuttli, O. W., *J. Geophys. Res.*, **71**, 5977 (1966).
24 Oliver, J., and Isacks, B., *J. Geophys. Res.*, **72**, 4259 (1967).
25 Ludwig, W. J., Ewing, J. I., Ewing, M., Murauchi, S., Den, N., Asano, S., Hotta, H., Hayakawa, M., Ichikawa, K., and Noguchi, I., *J. Geophys. Res.*, **71**, 2121 (1966).
26 Gates, O., and Gibson, W., *Bull. Geol. Soc. Amer.*, **67**, 127 (1956).

Solar Oblateness and Magnetic Field

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It has been suggested that the observed Solar oblateness may be caused by a gravitational quadrupole moment. The answer may not be so simple, however, because of magnetic stress and differential rotation between the radiation layer and the core.

THIS article deals with the interpretation of the experiment recently reported by Dicke and Goldenberg[1], which shows that certain optical observations of the Sun indicate an oblateness $\Delta = (R_{eq} - R_{pole})/R_{\odot}$ of $(5 \pm 0{\cdot}7) \times 10^{-5}$, corresponding to $R_{eq} - R_{pole} \approx 35$ km. This exceeds by 27 km the oblateness attributable to the mean apparent solar rotation. Dicke and Goldenberg suggest that this is evidence for a gravitational quadrupole moment caused by a core flattened by rapid rotation, and that this weakens the agreement between the implications of Einstein's gravitational theory and the otherwise unexplained residual advance of the perihelion of Mercury.

This inference from the observations involves a number of assumptions about processes and conditions in the

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