Overall, however, the volume serves as a good example of the current status of stone tool analysis and its exciting potential for the reconstruction of past human behavior.

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Processes within the Mantle

Seismic Tomography and Mantle Circulation. R. K. O'NIONS AND B. PARSONS, Eds. Royal Society, London, 1989. viii, 152 pp., illus. £37.50. Reprinted from *Philosophical Transactions of the Royal Society* A, vol. 328 (1989). From a meeting, London, U.K., April 1988.

The gradual motions of the uppermost parts of the earth, "plate tectonics," have become increasingly well understood in the last 25 years. It is generally agreed that the process is a complicated form of thermal convection. Hot material rises beneath mid-oceanic ridges, moves horizontally and cools within oceanic plates, and returns to the interior as subducted slabs beneath island arcs. The upper mantle of the earth, down to the 670-kilometer depth of the deepest earthquakes (in slabs), is clearly involved in the circulation. However, there has been much speculation and little agreement about what happens below that depth. The key question is, Does a chemical discontinuity that is a barrier to vertical flow exist between the upper mantle and the lower mantle?

The organizers of the Royal Society meeting on which this book is based highlighted the field of seismic tomography in the title because this method has recently provided direct information about the lower mantle, thus simulating research in other fields in the earth sciences. The method is basically similar to medical tomography but more difficult in practice. The mathematical analysis of seismic tomography is more complicated. The origin time and location of earthquakes are unknown and are determined along with the velocity structure of the earth. Velocity variations are sufficiently large in the earth that the ray paths are not known in advance. In addition, much of the earth's interior, especially the upper mantle beneath ocean basins, is not traversed by ray paths. For these reasons, tomography is used in conjunction with other seismic methods, such as the study of very-long-wavelength seismic waves (free oscillations), which more evenly sample the mantle.

The book contains contributions from workers in seismology, mantle convection, gravity, geomagnetism, high-pressure mineral physics, and geochemistry. The involvement of the latter four fields warrants some comment. Pressure variations associated with mantle convection cause dynamic topography on the core-mantle boundary and on the free surface. Gravity anomalies are modeled by calculating the mass of the dynamic topography, varying the viscosity structure and chemical discontinuities, and including density structure obtained from seismic studies together with the knowledge that slabs exist beneath island arcs. Dynamic topography of the core-mantle boundary affects short-term variations in the earth's magnetic field and the coupling of the solid mantle and the liquid core during slight variations in the earth's rotation. High-pressure mineralogists have studied the phase change to a more dense silicate structure that occurs between the upper and lower mantle. It is necessary to account for this phase change when examining seismic data for evidence of a chemical discontinuity. Their studies are also relevant to physical properties in the mantle and to the temperature of the liquid core of the earth, as well as the basal temperature of the mantle. Geochemical studies provide evidence for the long-term persistence of chemical heterogeneities within the mantle as well as direct constraints on the amount of radioactive heat generation in the Earth.

Overall, *Seismic Tomography and Mantle Circulation*, consisting of 10 papers (and one abstract) by 16 authors working in the United States and Germany, as well as in Britain, succeeds in describing the approaches of the various fields and the areas of agreement and disagreement. Continued interaction of these fields will lead to further progress.

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Cell Adhesion

Leukocyte Adhesion Molecules. T. A. SPRINGER, D. C. ANDERSON, A. S. ROSENTHAL, AND R. ROTHLEIN, Eds. Springer-Verlag, New York, 1990. xvi, 287 pp., illus. $84. From a conference, Titisee, F.R.G., Sept.–Oct. 1988.

Cell adhesion binds the microscopic cells into the macroscopic tissues of the multicellular organism. In addition, it is an essential determinant in a variety of dynamic processes such as the directed cell motility of embryonic morphogenesis, tumor invasion, and wound repair and several of the processes performed by blood cells, such as hemostasis, inflammation, phagocytosis, and target cell killing. Recent advances in the identification and characterization of the molecules involved in cell adhesion have made it possible to address questions about molecular regulation of directed cell motility and adhesive cell recognition. Nowhere has the problem of adhesive recognition been more important than in the understanding of cellular processes in immunity and inflammation. Adhesive recognition, as displayed by nucleated blood cells, includes the discrimination of self from non-self and the selective adhesion to and phagocytosis of non-self particles. Recognition is also important in the margination and diapedesis of neutrophil leukocytes and monocytes at sites of inflammation. The circulating inflammatory effector cells adhere selectively to capillary and venular endothelium adjacent to sites of inflammation and largely ignore the endothelium of vessels servicing healthy tissue. Finally, the elaborate patterns of lymphocyte recirculation present exquisite examples of selective adhesive recognition.

Leukocyte Adhesion Molecules contains much useful information on the identification and characterization of the adhesion systems involved in leukocyte function. The review by Kishimoto *et al.* of the leukocyte integrins, also known as the CD11/CD18 complex, is timely and authoritative. Different members of this class of adhesion receptors contribute to the adhesion of leukocytes and lymphocytes to each other and to a variety of other cell types and to the attachment of complement-coated particles during phagocytosis. Investigation of the CD11/CD18 complex has been facilitated by the discovery that the fatal congenital condition leukocyte adhesion deficiency syndrome is a result of genetic defects in one of the key peptides of this complex.

In contrast to the thorough presentation of recent studies of the CD11/CD18 adhesion molecules, the important and well-investigated system of lymphocyte homing receptors, which mediate the elaborate patterns of lymphocyte recirculation across specialized portions of the endothelium, is under-represented in this volume. The sole chapter on this subject, by Jutila *et al.*, is altogether too brief and specialized to do justice to this fascinating problem and is more useful to the well-informed reader than to the novice in search of an introduction to the subject. A detailed series of reviews of the lymphocyte homing receptors and their complementary ligands on the endothelium would have been a welcome complement to the excellent coverage of the CD11/CD18 adhesion molecules.

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