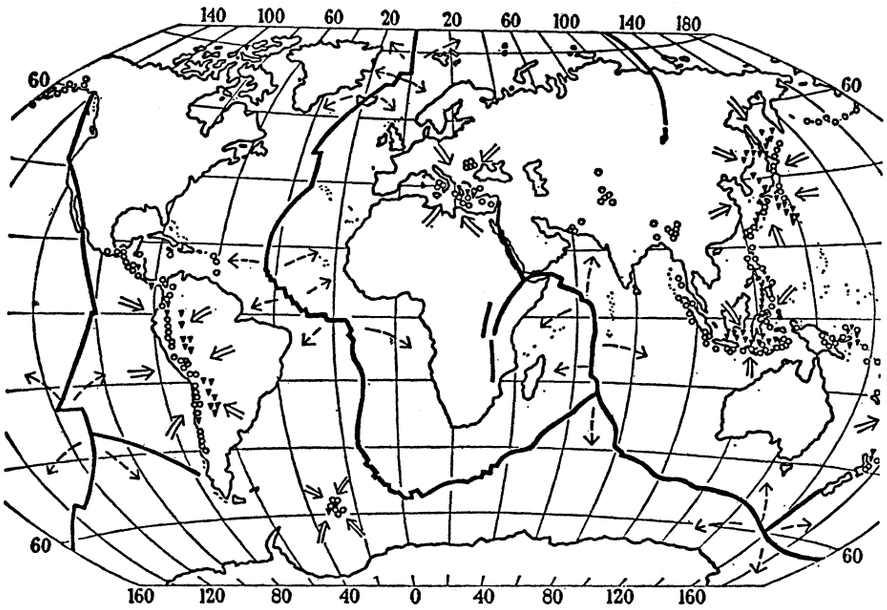
# Drifting Theories Shake Up Geology

## *New evidence promises understanding of earth's structure.*




Mantle circulation creates regions of upwelling and subsidence (dark lines).

Continental drift, a theory often considered amusing but rarely important, seems about to become the focus of a revolution in geology.

At the least, it has already split the geological community into those who find the evidence for it "formidable" and those who think it is not yet formidable enough to constitute a proof.

A summary of the arguments for continental drift was presented at last week's meeting of the American Geophysical Union in Washington, D.C., by Prof. J. Tuzo Wilson, a University of Toronto geophysicist.

Not only are the continents drifting, he feels, but the entire crust of the earth is constantly moving about on the surface of huge, slowly revolving cells of relatively plastic rock in the underlying mantle.

This material wells up, for example, under the mid-Atlantic Ridge and flows both east and west. In deep ocean trenches such as those off Japan and just west of the American continents, a corresponding subsidence absorbs the excess materials added to the earth's crust.

Furthermore, Dr. Wilson believes, the oceans have been opening and closing repeatedly, bringing the continents together and then forcing them apart.

Europe and North America first touched about 450 million years ago, he believes, then separated about 120 million years ago and have been moving apart at about six centimeters a year ever since.

Evidence for this is abundant, he says, in traditional fossil and rock forms and in a coincidence of magnetic data.

Analysis of this evidence indicates that eastern New England was once part of Europe, part of present-day Africa has been torn from the Appalachian Mountains and central Florida was once part of Africa.

Fossils and rocks found in each of those locations bear out that hypothesis, Dr. Wilson says, but the new confidence in continental drift is mainly based on correlation of measurements of three magnetic features of the earth's crust. Changes in these measurements have been found to all share exactly the same ratio, suggesting that they have a common explanation, Dr. Wilson argues.

The first measurement was of reversals of the earth's magnetic field as recorded in lava flows. A time scale— and ratio of reversal periods— can be extended all the way back to precambrian times.

Plotting of earth's magnetic field over the sea floor has shown it is arranged in strips running parallel to the ridges. The ratio of their widths is the same as the ratio of reversal periods.

Finally, cores of sea bottom material have also been found to have differently magnetized layers whose depth ratios correspond to the other two.

Taken together, he asserts, this data inescapably indicates that the ocean floor has been generated under the mid-ocean ridges, been magnetically imprinted as it formed and is being carried away from the ridges at a uniform velocity.

Thus, the continents are not rafts floating in the ocean floor as once theorized, but are being carried along with the floor which is generated from material in the earth's mantle in some places and absorbed in others.

Acceptance of the theory will mean some drastic modifications in geology. Textbooks on historical geology generally dismiss continental drift as merely an interesting theory. And many geologists are new to both the instrumentation that has brought in the evidence for drift and the broad-scale way of thinking that has produced the present theory.

Explanations of the origins of fossil fauna and flora will have to be reviewed. Theories of mountain building, faulting and accumulation of sediments will all need close scrutiny.

A previously unsuspected type of crustal fault may exist. If material is welling up from within the ocean ridges, Dr. Wilson suggests, faults perpendicular to the ridges may be only evidence of the upwelling and not indications of major movements of the crust.

A boundary-layer theory of convection within earth's mantle that seems to substantiate the theory of upwelling and horizontal movement at the surface has been developed by Donald L. Turcotte of Cornell University and E. Ronald Oxburgh of the University of Oxford, England.

They have shown that internal heating of the earth would result in the motions, temperatures and heat flux actually observed in earth's crust.

Laboratory simulation of such convection cells, described in the JOURNAL OF HEAT AND MASS TRANSFER last year, also substantiates both the boundary layer theory and its application to mantle convection.