earth sciences

METEOROLOGY

Pulp mills and precipitation

A study in Washington State provides evidence that particulates spewed into the atmosphere from pulp and paper mills have caused significant increases in rainfall.

Power plants of pulp and paper mills in Washington burn about 4,000 tons of wood waste a day. In addition the mills themselves emit about 20 tons of sodium sulfate a day. Measurements taken from aircraft in 1969 confirm that the mills are prolific sources of nuclei around which water particles can condense; each of the mills emits from 10^{15} to 10^{19} cloud condensation nuclei per second. Large sawmills and smelters produce similar amounts, report Drs. Peter V. Hobbs and L. F. Radke of the University of Washington and S. E. Shumway of the state's Department of Water Resources in the January JOURNAL OF THE ATMOSPHERIC SCIENCES.

In general the mean annual precipitation for the state has been higher in the period since 1946 than during the preceding quarter century. The pulp and paper industry has grown significantly since the end of World War II.

Precipitation has increased more than 30 percent in some cases in regions adjacent to or downwind of some of the larger pulp and paper mills. The stream that has experienced the largest increase in runoff since 1946 lies generally downwind of large mills at Everett, Port Townsend and Port Angeles.

GEOCHEMISTRY

Little water in solid mantle

The composition of volcanic gases and the concept that the earth's atmosphere and oceans evolved by outgassing suggest that significant amounts of water are contained in the interior of the earth.

But Drs. Robin E. T. Hill and A. L. Boettcher of Pennsylvania State University report in the Feb. 13 SCIENCE that their studies show water must be present only in trace amounts in the solid part of the earth's mantle.

Their finding is based on an experiment using a high-pressure chamber to simulate conditions within the earth. Water under pressure greatly lowers the melting temperatures of rock-forming silicates. Their work shows that the presence of as much as one percent water, by weight, would cause melting of the upper mantle basaltic material. It is likely the water is present in much smaller amounts.

TECTONICS

California coast mountains

The concept of plate tectonics is being put to use with great frequency lately to explain major earth features (SN: 2/14, p. 192). In the Feb. 10 JOURNAL OF GEOPHYSICAL RESEARCH a University of California at Los Angeles geologist, Dr. W. G. Ernst, proposes a speculative four-stage tectonic model to explain the origin of the mountains of the California Coast Ranges.

The evidence, he says, points to a profound and widespread interaction between converging blocks of continental and Pacific Ocean lithosphere.

First there was rapid relative northeastward or eastward spreading of the Pacific floor, he believes, coupled with westward or southwestward encroachment by the continental lithospheric plate. Then about 100 million years ago there was a buoyant uplift of the interior portion of a sediment-filled trough during a period of less intense spreading. Convergence of the two plates then accelerated again. Beginning about 20 million years ago there was another uplift of the Franciscan rocks related to a northwestward sea-floor spreading.

GEOPHYSICS

Bumps on the earth's core

In the 40 years since seismological studies revealed that the earth has a liquid core, little has been learned about the interface between the core and the overlying solid mantle. Electrical currents generated in the core by slow movements of its metallic fluid produce the earth's magnetic field.

Undulations or bumps on the interface have been postulated. Bumps a few kilometers high and several thousand kilometers in length would theoretically interact with fluid motions of the core. The interactions caused by the bumps could thus produce significant distortions in the geomagnetic field as it is observed on the earth's surface. The bumps would also distort the gravitational field.

Similarities in the variations of the earth's gravitational and magnetic fields would be an indication of the existence of such bumps. A statistical search for such similarity was conducted by two British scientists, Drs. R. Hide of the Meteorological Office and S. R. C. Malin of the Institute of Geological Sciences. In the Feb. 14 NATURE they report that they found a high degree of correlation between the two fields.

The correlation requires a displacement of the magnetic pattern 160 degrees to the east. This longitudinal separation, they say, may be the result of a drift of the magnetic field in the last 500 years. Magnetic data indicate a westward drift of the field of about 0.23 degrees a year since about 1400.

GEOLOGY

High pace of beach erosion

An estimated million cubic yards of sand is eroded and permanently lost from Southern California beaches every year, reports Dr. Bernard W. Pipkin, a geologist at the University of Southern California.

Probably the only way of saving the dwindling beaches will be to replenish them artificially with sand dredged from the seabottom, he says, but this could cost the public as much as $1.00 a cubic yard.

The beach erosion problem is at a critical stage in several places from Point Conception to the Mexican border, he says. The high erosion is due to both natural and man-made causes—primarily wave action, low rainfall in the last two decades, plus flood control structures on land and other structures and barriers on the shoreline.

It is estimated that 50 percent of the sand that would have been transported to the beaches in the last 10 years is trapped behind dams.