

## IV. WATER AS A MECHANICAL AGENT.

(1) **General sources of activity.** — (a) Water does mechanical work in each of its three states, the liquid, solid, and gaseous state (or that of vapor). Only the first and second states are here considered, the third coming more conveniently under the head of Heat. In the liquid state it constitutes rivers, lakes, oceans; in the solid, snow, ice-crusts, glaciers, and icebergs. Unlike the aerial ocean, it has a defined upper surface; and the basement on which it rests has usually no disturbing influence.

(b) In rivers, water derives its energy from gravitation; *it works as it falls*, and arrives at its zero of action on reaching the lowest level to which it can fall. It reaches only temporary or approximate zeros in lakes, except when the lakes are like the ocean in having no outlet. Winds make relatively feeble currents and waves in large rivers.

(c) In the ocean, water has three prominent working agencies: (1) the tidal wave; (2) the wind-waves and currents, both the regular winds, like the trades, and the winds of storms, each producing waves and also currents of greater or less depth and velocity; (3) the resupply currents caused by the sun's heat, which in evaporation removes surface waters, and, in the expansion of water, diminishes its density. Gravity acts toward a restoration of the equilibrium that has been disturbed, whether the disturbance be due to the tidal wave, wind-waves, currents, or heat, and in response also to changes in atmospheric pressure.

(d) Lakes of large size, like the ocean, have wind-made currents and waves, and movements due to evaporation, and sometimes appreciable tidal waves and currents. Those of small size are often only still-water incidents in the courses of rivers.

Winds over large rivers may slightly quicken, or retard, the flow. Over great lakes, they may make decided onward movements, which pile the waters, tide-like, on leeward shores, — as sometimes about Duluth at the western end of Lake Superior, — occasioning an under current of escape. But over the ocean they are in all parts a prominent source of currents, and in the tropics, as has been stated, the "trade winds" originate, according to some physicists, the Atlantic and Pacific tropical oceanic currents.

(e) *Owing to the earth's eastward rotation*, increasing in rate of surface velocity from the pole to the equator as the cosine of the latitude, flowing waters in the northern hemisphere, whether of rivers or the ocean, and whatever their source, are thrown toward the right side as they advance, and in the southern hemisphere toward the left side. The result is seen in the lagging of the Labrador current against the west side of the north Atlantic; in a like effect on the correlate current in the north Pacific; and in the eastward course of the Gulf Stream north of the parallel of 35°. It has also been observed along rivers in many parts of the world where the deposits intersected are earthy, and the pitch of the stream is too small for erosion at bottom. They are marked along the great rivers of Siberia and European