summers in California, Oregon, and Washington, as it brings air from the colder portion of the ocean in over the land, which, as soon as it is reached, increases the temperature of the air, and thereby its capacity for retaining water vapor in an invisible state. The dryness of the land adjacent to the South Pacific HIGH is even greater than in the Northern Hemisphere, for the southern HIGH is less subject to changes from summer to winter than the northern one.

The tropical regions of the Pacific are under the influence of the trades, which show seasonal variations, and the monsoons.

This general system of air circulation is frequently invaded by storms, both tropical and extratropical, of which the Pacific has its full quota. But little is known, however, of the storms of either kind which occur in the Southern Hemisphere. The storms of the Northern Hemisphere are strongly influenced by the semi-permanent "centers of action," e. g., the Aleutian LOW and the North Pacific HIGH.

There is a great need for additional information as to the centers of action of the Pacific and the changes taking place in them; this information could be obtained by the establishment of more first-class meteorological stations on the islands and coasts of the Pacific; by maintaining cruisers equipped for meteorological observations, including aerological observations, at permanent stations or within limited areas; and by enlisting every Pacific ship for the purpose of taking observations, including those of the temperature and salinity of the water. Progress along all of these lines has already commenced.—*E. W. W.*

THE DISTRIBUTION OF TEMPERATURES AND SALINITIES, AND THE CIRCULATION, IN THE NORTH PACIFIC OCEAN.[1]

By GEORGE F. MCEWEN.

[Abstract.]

Observation shows that, by reason of well-known causes, no part of the ocean is motionless. Observations of temperature and salinity are of great value in determining the details of the oceanic circulation, for the presence of water differing significantly in any property from that corresponding to local conditions indicates a flow of water from regions where different conditions prevail. The vertical and horizontal flow of water is the factor most concerned in modifying the simple temperature distribution to be expected from the variation of solar radiation with respect to latitude and from the distribution of land and water. The thermal equator is at latitude 10° N.; most of the surface of the Atlantic from latitudes 20° to 60° N. is from 1° to 4° above the normal temperature at corresponding latitudes, and the North Pacific averages 2° colder than the North Atlantic; greater temperature anomalies are found in many small areas. The distribution of salinity is even more irregular, depending upon more factors. In both the northern oceans the maximum surface salinity is found in the Horse latitudes, but it is notably higher in the Atlantic. In some regions, e. g., the Bahamas, the salinity decreases continually from the surface to the bottom, while in others, e. g., the North Pacific off southern California, it decreases only in the upper 40 meters, and increases from there to the bottom.

A great desideratum is a systematic study of the North Pacific comparable with [or even more extensive than] that which has been made of the North Atlantic. Observations now available, though inadequate, supply the following general information:

Owing to the well-known difference in the heating effects of insolation upon land and upon water, the water of the North Pacific, from the Equator to 45°, tends to be colder than land, especially in summer, and that north of 45°, especially in winter, tends to be warmer than land; these tendencies in part give rise, respectively, to the HIGH about 1,500 miles west of San Francisco, and to the Aleutian LOW. The resulting winds cause the North Pacific oceanic circulation to be, in its main outlines, a clockwise eddy lying between the Equator and latitude 45°. Great modifications as to details and to seasonal variations exist.

The California current is shown to be an upwelling of cold bottom water, which the author holds to be continuous with a slow northward drift of cold bottom water from the Antarctic. (For an account of how this influences the California climate, see McEwen, MONTHLY WEATHER REVIEW, 1914, **42**, 14–23.).—*E. W. W.*

[1] Presented at the Pasadena meeting of the A. A. A. S., June, 1919. Published in full by University of California Press, 1920.

A PHYSICAL THEORY OF OCEAN OR RESERVOIR TEMPERATURE DISTRIBUTIONS REGARDED AS EFFECTS OF SOLAR RADIATION, EVAPORATION, AND THE RESULTING CONVECTION.[1]

By GEO. F. MCEWEN.

[Author's abstract.]

Assume radiant energy to be absorbed in accordance with the well-known exponential function of the thickness of the medium traversed, and that a similar relation having a larger exponent holds for the removal of heat by evaporation, since the direct effect of the latter is confined to a comparatively thin surface layer, in spite of the mechanical disturbance usually present near the surface. It then follows that evaporation removes heat at a greater rate near the surface than can be directly supplied by radiation. This surface layer thus becomes colder than that underneath, and consequently tends to change places with it. This interchange may not be complete. That is, a fraction r of the cold upper layer may remain to mix with the fraction $(1-r)$ of the rising warmer layer. Similarly, the cold water replacing this warm layer tends to change places with the one underneath, and so on downward. Thus a convective circulation is generated consisting of the descent of relatively cold water elements, and the ascent of relatively warm ones in which the difference in temperature decreases as the depth increases

Two differential equations, one giving the rate of change of the temperature of the descending cold water, the other giving the temperature rate for the ascending warm water can be derived from these assumptions. Regarding the measured temperature as the mean of that of the intermixed warm and cold elements, a combination of the two differential equations into a single one can be obtained whose solution, subject to suitable boundary conditions gives the relation in such form as to admit of observational tests. The satisfactory qualitative agreement of one such solution with generally accepted facts led to preliminary estimates of the physical constants. The results thus found appear to justify an extended investigation of the theory.

[1] Presented before American Physical Society, St. Louis, December 30, 1919.