

greater than the fall below it; and although the difference has been hitherto supposed insufficient to cause an appreciable error, it is, nevertheless, worthy of observation, that the error, such as it may be, would tend to reduce the small difference, now inferred, from the observations of Mr. Lloyd, to exist between the levels of the two oceans.

There is still another way in which heat and cold must occasion great movements in the ocean, a cause to which, perhaps, currents are principally due. Whenever the temperature of the surface of the sea is lowered, condensation takes place, and the superficial water, having its specific gravity increased, falls to the bottom, upon which lighter water rises immediately and occupies its place. When this circulation of ascending and descending currents has gone on for a certain time in high latitudes, the inferior parts of the sea are made to consist of colder or heavier fluid than the corresponding depths of the ocean between the tropics. If there be a free communication, if no chain of submarine mountains divide the polar from the equatorial basins, a horizontal movement will arise by the flowing of colder water from the poles to the equator, and there will then be a reflux of warmer superficial water from the equator to the poles. A well known experiment has been adduced to elucidate this mode of action in explanation of the "trade winds."* If a long trough, divided in the middle by a sluice or partition, have one end filled with water and the other with quicksilver, both fluids will remain quiet so long as they are divided; but when the sluice is drawn up, the heavier fluid will rush along the bottom of the trough, while the lighter, being displaced, will rise, and, flowing in an opposite direction, spread itself at the top. In like manner the expansion and contraction of seawater by heat and cold, have a tendency to set under-currents in motion from the poles to the equator, and to cause counter-currents at the surface, which are impelled in a direction contrary to that of the prevailing trade winds. The geographical and other circumstances being very complicated, we cannot expect to trace separately the movements due to each cause, but must be prepared for many anomalies, especially as the configuration of the bed of the ocean must often modify and interfere with the course of the inferior currents, as much as the position and form of continents and islands alter the direction of those on the surface. Thus on sounding at great depths in the Mediterranean, Captains Berard and D'Urville have found that the cold does not increase in a high ratio as in the tropical regions of the ocean, the thermometer remaining fixed at about 55° F. between the depths of 1000 and 6000 feet. This might have been anticipated, as Captain Smyth in his survey had shown that the deepest part of the Straits of Gibraltar is only 1320 feet, so that a submarine barrier exists there which must prevent the influx of any under-current of the ocean cooled by polar ice.

Each of the four causes above mentioned, the wind, the tides, evapo-

* See Capt. B. Hall's clear explanation of the Theory of the Trade Winds, *vol. i.*, and his Letter in the Appendix to *Daniell's Meteorology*.
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