

## THE CENTRAL EUROPEAN ALPINE LAKES

In no other zone have the lakes been so closely studied as here; this is mainly due to Forel's fundamental investigations, but in addition to these we may also note the following works: *Austrian Alpine Lakes* (Richter, 1891, p. 189; 1897), *Halstättersee* (Lorenz v. Liburnau, 1898, p. 1), *The Lakes of Reschen Scheideck* (Müllner, 1900, p. 1), *The High Lakes of the East Alps* (Böhm, 1886), *The Lakes of the German Alps* (Geistbeck, 1884-5, p. 203, with list of literature), *Starnbergersee* (Ule, 1901, p. 1), *Lakes of Jura* (Delebecque, 1898a, and in many small papers), *The Swiss Alpine Lakes* (Zschokke, 1900; Bourcart, 1906; Bachmann, 1907, p. 1), *Zürich* (Pfenninger, 1902, p. 1), *Vierwaldstättersee* (Amberg, 1904, p. 1), *Montiggler Lakes* (Huber, 1905), *Lac d'Annecy* (Marc le Roux, 1907, p. 220), *Schoenenbodensee* (Tanner-Fullemann, 1907, p. 15), *Bodensee* (Bauer and Vogel, 1894, p. 5; Klunzinger, 1906, p. 97, etc.).

In these, and in a very great number of smaller, partly planktological papers, we find exceptional material to judge of the general physical conditions in these lakes. Only the following more general characteristics need be mentioned here.

The height above the level of the sea differs greatly; the great majority are over 400-500 m. above sea-level, thus at least three times as much as the majority of the Baltic lakes. A great many are in the regions of perpetual snow. The country surrounding the lakes is frequently covered by glaciers, but mostly consists of mountain slopes, forest ground, and to a less degree of arable land. The rivers hollow out their beds mainly in solid rock, not in loose, easily movable kinds of soil.

The lower-lying alpine lakes are often remarkable for their considerable size and their elongated, often irregular shape and considerable depths of 100 m. or more. The high alpine lakes are relatively small, with slight depths, often under 40 m., and mostly much shallower. It is principally the greatest depth which is slight; the mean depth (the relation between the volume and area of the lake) is on the other hand often great in high lakes (Bourcart, 1906, p. 104). The littoral zone is generally narrow; the shores are frequently formed of high, steep mountains, rising abruptly from the lake, with great depths near land; it is mainly in front of the river mouths that we find more evenly sloping shores (deltas). The primary lake-bottom is probably everywhere covered by soft bottom deposits, less rich in organic material than in the foregoing zone, but chemically varying according to the nature of the surrounding country—very calcareous in the lakes of the Jura mountains, poor in lime especially where the lake is fed from melting snow.