

fish or scopolidæ, while at 60 metres there were several copepoda, and no scopolidæ. . In the same place, during the night, we obtained at the surface a rich collection of copepoda, numerous scopolidæ, and thirteen black fishes (*Astronesthes niger*). These instances furnish conclusive proof of vertical migrations of considerable extent.

Ostwald, after studying the variations in the viscosity of the water from time to time, has made an attempt to explain the vertical migrations as due entirely to physical laws. During the twenty-four hours certain changes occur in the temperature of the ocean surface, and the viscosity of the water is, as we have seen, largely dependent on temperature. According to Buchan, the mean diurnal fluctuation of the surface temperature, as shown by the "Challenger" observations, was in mid North Atlantic 0.8° Fahr., in mid South Atlantic also 0.8° F., in mid North Pacific 1.0° F., and in mid South Pacific 0.9° F.; near the equator both in the Atlantic and Pacific the diurnal range is only 0.7° F. The mean daily range deduced from the whole of the "Challenger" observations during the three years and a half is 0.8° F.¹

According to Krümmel² the daily range of temperature occurring in the surface waters of the open ocean amounts to about 0.5° C.; in the North Atlantic 0.59° C. Although several investigators, like Aimé and Hensen, tackled the problem we have very little knowledge regarding the daily changes at different depths. From Krümmel I give the following differences found by Aimé between evening and morning at different depths in the Mediterranean:—

Depth. Metres.	Temperature.		Difference.
	Evening.	Morning.	
0	15.1 ° C.	14.6 ° C.	0.5
2	15.1 ° C.	14.6 ° C.	0.5
4	15.0 ° C.	14.5 ° C.	0.5
6	14.8 ° C.	14.5 ° C.	0.3
10	14.6 ° C.	14.4 ° C.	0.2
14	14.4 ° C.	14.3 ° C.	0.1
18	14.3 ° C.	14.3 ° C.	0.0
22	14.3 ° C.	14.2 ° C.	0.1

¹ Phys. Chem. Chall. Exp., Part v. p. 6, 1889.

² Otto Krümmel, *Handbuch der Ozeanographie*, Bd. 1, Leipzig, 1907.