

also in the direction, of the great ocean currents, not only by reason of the tides and as the effect of the wind, but also because the currents are subject to a sort of pulsation, the nature and origin of which are as yet unknown. There is an interplay of many different forces, producing an extremely variegated picture; the sea in motion is a far more complex thing than has hitherto been supposed. Physical oceanography is confronted with a host of new problems, the solution of which will be a matter of the highest interest. It was to attack a few of these general problems that the physical and chemical investigations of the "Michael Sars" Atlantic Expedition were undertaken.

We shall now consider the investigations made during the "Michael Sars" Atlantic Expedition into the physical conditions in the Straits of Gibraltar. At the current-measurement station (Station 18) on the 29th and 30th April we obtained a series of observations from different depths throughout one complete tide-period. Some of the results are represented in the accompanying three figures. Fig. 194 shows the direction and velocity of the movement at different depths on the 30th April: (1) at 10 metres (about 5 fathoms), (2) at 46 metres (25 fathoms), (3) at 91 metres (50 fathoms), (4) at 183 metres (100 fathoms), and (5) at 274 metres (150 fathoms). The arrows are drawn in the true directions; the velocities are seen by the scale. The current 10 metres below the surface (1) had a westerly set on the 30th April between 2 and 4 A.M., afterwards—until 4 P.M. at least—running without interruption eastwards (between south-east and north-east), that is into the Mediterranean. The velocities were at times very considerable, being greatest about 9 A.M., when we measured velocities up to 118 cm. per second, corresponding to 2.3 knots per hour; velocities of about 1 metre per second, or 2 knots per hour, were found during the whole time from 7 to 11 A.M. Later in the day the current slowed down; at noon it was only 40 cm. per second (0.8 knot per hour), increasing a little later; at 4.30 P.M. it was 70 cm. per second (1.4 knot per hour); then the observations were broken off, but it was ascertained that the velocity was decidedly on the increase. The current thus ran into the Mediterranean with no very fixed set, the uncertainty of direction being partly due to the formation of vortices on the sides of the strait. Early in the morning the current set from the Mediterranean into the Atlantic, as mentioned above; the velocity at 2 A.M. was 47 cm. per second (0.9 knot per hour), but it was then

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