LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Undercurrents in the Strait of Bab-el-Mandeb.

AN interesting observation has recently been made by one of H.M. surveying vessels, and I forward the Preface to the account of the details published by the Hydrographic Department, which contains the principal facts, and also the Analysis of the observations, both of which may be of interest to some of your readers.

W. J. L. WHARTON.

Hydrographic Department, Admiralty, Whitehall,
London, S.W., September 27.

UNDERCURRENTS IN THE STRAIT OF BAB-EL-MANDEB.

IT has long been known that in the Bosporus and Dardanelles when the surface water sets strongly from the Black Sea to the Mediterranean, the lower strata of the water for a certain height from the bottom sets strongly in the opposite direction.

While in this instance it is probable that the many large rivers which discharge their waters into the Black Sea have a share in producing the surface current, the observations by which the undercurrent was revealed appeared to plainly indicate that the surface drift, caused by the generally prevailing N.E. wind heaping the water up in the south-western part of the Black Sea, was the main factor.

The somewhat similar conditions which occur in the strait of Bab-el-Mandeb offered another opportunity of observation on this interesting form of oceanic circulation, and for many years such observations have been a desideratum.

In this strait for nearly half the year a more or less strong easterly wind prevails, driving much water before it into the Red Sea, and, great as is the evaporation from the surface of that sea, which must be made up wholly by an inflow of water through the strait of Bab-el-Mandeb, it appeared on the whole probable that during this season the phenomenon of the Dardanelles would be repeated.

The observation is, however, difficult. The water is deep, over 100 fathoms; the sea generally heavy; there is a tidal current to complicate matters; and it seemed doubtful whether the somewhat crude apparatus which served to unravel the movement of the lower strata in the shallower and smoother Dardanelles would give good results in this locality.

Nevertheless, Captain W. Usborne Moore was directed to attempt it in H.M.S. *Penguin* in 1890, but the results, while showing that the under strata were not running with the surface, were two ambiguous to afford much definite information.

The possession, however, of a deep-sea current meter, originally devised by Lieutenant Pilsbury, U.S.N., and considerably altered after a series of experiments by Captain Usborne Moore in the English and Færoe Channels, seemed to offer a chance of more success.

Lieutenant and Commander Gedge, commanding H.M. surveying ship *Stork*, was therefore directed to endeavour to get further observations in Bab-el-Mandeb by means of this instrument, and has admirably and most successfully carried them out.

On January 19, 1898, the *Stork* was anchored in 118 fathoms about seven miles S.W. by W. from Perim Island, and remained constantly observing, during daylight, for four days, when the parting of the cable brought the series to a close. Had not the wind been unusually light, varying from force 3 to 6, it is probable that the observations could not have been continued so long.

The observations are appended (in publication quoted), but the broad result may be briefly stated.

There was a permanent current on the surface setting into the Red Sea of about 1½ knots per hour.

There was at 105 fathoms depth a permanent current setting outwards of probably the same velocity.

The tidal stream was about 1¼ knots at its maximum, and flowed for about twelve hours each way, as might be expected from the fact that in this locality there is practically only one tide in the day.

Analysis of Tidal Streams observed in the Large Strait of Bab-el-Mandeb by H.M.S. Stork *in January* 1898.

Time of tide at Perim.	At surface.		At 5 fms.		At 25 fms.		At 50 fms.		At 75 fms.		At 105 fms.	
	Direction.	Rate.	Direction.	Rate.	Direction.	Rate.	Direction.	Rate.	Direction.	Rate.	Direction.	Rate.
High water ...	N.W. ½ W.	2¼	N.W. by W.	3¼	N.W.	3	Slack	—	—	—	—	—
1h. after ...	N.W. ½ W.	2¾	N. ½ W.	3⅓	—	—	S. by E.	¼	Variable	—	—	—
2 ,, ...	N.W.	2¾	N.W.	4	N.W.	2	N.W. by W.	⅛	—	—	—	—
3 ,, ...	N.W. ½ W.	2⅓	N.W. by N.	3	—	—	N.W. by N.	¼	N.N.W. ½ W.	½	—	—
4 ,, ...	N.W.	2	N.W. by N.	2½	N.N.W. ½ W.	2	N.W.	1⅛	N. ½ E.	1	S. by W.	¾
5 ,, ...	N.W.	1⅜	N. by W.	2	—	—	N.N.E,	½	N. by E. ½ E.	⅜	S. by W.	1¾
6 ,, ...	N.W. ½ W.	1¼	N.W. ½ N.	¾	N.W. ¾ W.	1	E. by S.	½	S.S.E.	⅔	South	1⅓
7 ,, ...	N.W. ½ W.	⅜	N.W.	⅓	N.N.W.	½	West	1	—	—	S. E. ½ S.	1½
8 ,, ...	W.N.W.	½	S.W. ½ W.	½	—	—	South	1½	S.E. by E.	1⅓	S.S.E. ½ E.	3
9 ,, ...	W.N.W.	¼	W.N.W.	½	Slack.	—	S.S.E.	1	S.E.	1	S.S.E. ½ E.	2½
10 ,, ...	N.N.W.	¼	N.W.	¼	E. by N.	½	—	—	S.S.E. ½ E.	1½	E.S.E.	1¾
11 ,, ...	North	¼	N.N.W.	½	S.E.	½	S.E.	1	E. by S.	2¼	—	—
12 ,, ...	N.W.	¾	N. by E.	½	—	—	—	—	—	—	—	—
13 ,, ...	N.W. by N.	1¾	—	—	N.W. by N.	⅜	—	—	E.S.E.	2	S.E. by E.	1⅜

This tidal stream prevails to the bottom, with variations of strength.

Somewhere about 75 fathoms is the dividing line between the two permanent currents, but it would require a longer series of observations to determine this point with any precision.

Fourier's Series.

IN all expositions of Fourier's series which have come to my notice, it is expressly stated that the series can represent a discontinuous function.

The idea that a real discontinuity can replace a sum of continuous curves is so utterly at variance with the physicists' notions of quantity, that it seems to me to be worth while giving a very elementary statement of the problem in such simple form that the mathematicians can at once point to the inconsistency if any there be.

Consider the series

$$y = 2\,[\sin x - \tfrac{1}{2}\sin 2x + \tfrac{1}{3}\sin 3x - \ldots]$$

In the language of the text-books (Byerly's "Fourier's Series and Spherical Harmonics") this series "coincides with $y = x$ from $x = -\pi$ to $x = \pi$ . . . Moreover the series in addition to the continuous portions of the locus . . . gives the isolated points $(-\pi, 0)$ $(\pi, 0)$ $(3\pi, 0)$, &c."