

Stream, when out of sight of land or unable to anchor a boat, observations of the heavenly bodies are the only resource, and when the weather is clear, so that these observations can be obtained at short intervals, and especially when stars have been taken at sunrise and sunset, with a well-defined horizon, so that both latitude and longitude are determined at the same instant *twice* during the day, a very accurate estimate can be formed, by astronomical observations alone, of the rapidity of the stream. If star observations cannot be obtained, the operation is by no means so simple; and is sometimes impossible, as then the latitude cannot be determined at the same instant as the longitude,<sup>1</sup> double altitudes of the sun not being available owing to the want of knowledge of the alteration in the position of the ship between the times of observation; the latitude, therefore, can only be got at noon by meridian altitude of the sun.

Unfortunately, nearly all the great ocean streams, the phenomena of which it is most desirable to investigate, have in their neighbourhood cloudy, thick weather, with short, sharp gales, rendering their exploration at all times difficult. The officers were so far fortunate in the weather in the *Challenger*, whilst taking temperatures, soundings, &c., in the Gulf Stream from 6 A.M. to 5 P.M. on the 1st May, as to be able to obtain frequent observations of the sun, although the sky was too cloudy to permit the determination of the position by star observations at sunrise or sunset. It was therefore only possible to obtain one latitude at noon by meridian altitude of the sun. The positions of the ship at various times during the day were determined in the following manner:—A set of observations for longitude was taken at 6.40 A.M., when the bearing of the sun was E. 6° N., or nearly on the prime vertical, and another at 4.27 P.M., when its bearing was W. 1° S., or almost exactly on the prime vertical. Any error, therefore, of the latitude used in working these observations would have but a slight effect on the longitude. Now, the resulting longitude at 6.40 A.M. was 72° 4' W., and at 4.27 P.M. 71° 31' 30" W., it is, therefore, evident that between those hours the drift in longitude experienced by the ship was 32½ minutes. But in keeping the sounding line perpendicular it was found necessary to steam W.S.W. (S. 60° W. true) at the rate of 3 miles per hour, from which it is evident that the direction in which the stream was running was N. 60° E. Having then the direction in which the current was going, and the alteration of longitude due to it in a given time, it was possible to calculate the speed at which it was running, which amounted to 3¼ miles per hour, or very nearly the same rate at which it was necessary to steam in a W.S.W. direction whilst sounding.

If this conclusion as to the direction and rate of the current be correct, it is evident that by applying the amount due to a given interval of time, the longitude of the ship at that time, as determined by this method, should agree with the longitude obtained by actual observation. By taking a proportion of the whole alteration in the longitude between 6.40 A.M. and 4.30 P.M., it was found that the longitude at noon was 71° 45' 54" W.,

<sup>1</sup> Unless the moon is visible, or Venus or Jupiter passes the meridian during the day.