characterized some of the principal currents as oceanic rivers, which he describes as being from 50 to 250 miles in breadth, and having a rapidity exceeding that of the largest navigable rivers of the continents, and so deep as to be sometimes obstructed, and occasionally turned aside, by banks, the tops of which do not rise within forty, fifty, or even one hundred fathoms of the surface of the sea.*

Greatest Velocity of Currents.—The ordinary velocity of the principal currents of the ocean is from one to three miles per hour; but when the boundary lands converge, large bodies of water are driven gradually into a narrow space, and then wanting lateral room, are compelled to raise their level. Whenever this occurs, their velocity is much increased. The current which runs through the Race of Alderney, between the island of that name and the main land, has a velocity of about eight English miles an hour. Captain Hewett found that in the Pentland Firth, the stream, in ordinary spring tides, runs ten miles and a half an hour, and about thirteen miles during violent storms. The greatest velocity of the tidal current through the "Shoots," or New Passage, in the Bristol Channel, is fourteen English miles an hour; and Captain King observed, in his survey of the Straits of Magellan, that the tide ran at the same rate through the "First Narrows," and about eight geographical miles an hour in other parts of those straits.

Causes of Currents.—That movements of no inconsiderable magnitude should be impressed on an expansive ocean, by winds blowing for many months in one direction, may easily be conceived, when we observe the effects produced in our own seas by the temporary action of the same cause. It is well known that a strong south-west or north-west wind invariably raises the tides to an unusual height along the west coast of England and in the Channel; and that a north-west wind of any continuance causes the Baltic to rise two feet and upwards above its ordinary level. Smeaton ascertained by experiment, that in a canal four miles in length, the water was kept up four inches higher at one end than at the other merely by the action of the wind along the canal; and Rennell informs us that a large piece of water, ten miles broad, and generally only three feet deep, has, by a strong wind, had its waters driven to one side, and sustained so as to become six feet deep, while the windward side was laid dry.†

As water, therefore, he observes, when pent up so that it cannot escape, acquires a higher level, so, in a place *where it can escape*, the same operation produces a current; and this current will extend to a greater or less distance, according to the force by which it is produced. By the side of the principal oceanic currents, such as the Lagullas, and the Gulf Stream, parallel "counter currents" run steadily in an opposite direction.

Currents flowing alternately in opposite directions are occasioned

* Rennell on Currents, p. 58.

† Rennell on the Channel Current.