VII.—CAUSES OF THE ALLEGED ANNUAL VARIA-TIONS IN THE NUMBER OF MACKEREL:OB-SERVED.

It is well known that the spawn of the Herring is deposited at the bottom, and owing to the glutinous secretion binding the eggs one or the other, it adheres firmly to everything which may happen to touch it, and masses of eggs are found to be tightly glued together. But it has been conclusively established by Professor Sars that the mackerel spawn, like that of the cod, floats, and the spawn is developed at the surface of the sea, being drifted to and fro by currents and winds, and wholly unlike the spawn of the Herring, Sculpin, Smelt, Caplin, etc., is at the mercy of the ever varying currents of the ocean.

The taking of Mackerel on banks and shoals, dropping their spawn, must be accepted that the fish are ready to spawn at the place where they are then caught. The transparent floating spawn being very difficult to recognize and indeed rarely to be seen, except looked for and caught in tow-nets at the surface of the water.

But Mackerel fry are found near the land, in detached sea areas all the way from the shores of Massachusetts to the shores of North-east Newfoundland.

While the Cod spawn on the North American coast during every month of the year wherever the temperature of the water is sufficiently low and ice does not interfere, and the Herring spawn in like manner during Spring and Fall, when the *bottom* waters have acquired a certain temperature, the Mackerel spawns, as a general rule, in the Spring of the year, and large schools appear to be established only where the Arctic current exercises its influence either as a distinct surface current, or where it is brought to the surface by banks or shoals, and thus secures the requisite coldness in the waters for the floating spawn.

The floating spawn may be drifted by winds or tides many miles from the place where it is shed, and the birth place of the fish will be that portion of the sea area where the young fry first issue from the egg, but not the spawning ground of the mother In ordinary seasons the swing of the tides, apart from local fish. currents, brings back twice every day the drifting surface matter, whatever it may be, near to the place from which it set out; but winds may greatly alter the course and distance to which floating ova would be drifted. Hence, except in the case of secluded bays like the Bay of Chaleurs, Pleasant Bay or Massachusetts Bay, the geographical position of Mackerel fry is in a great measure dependent upon the winds which may have prevailed. A storm near the end of May or early in June on the coasts of the United States, may drive floating spawn far out to sea, even into the heated waters of the Gulf Stream, and it has yet to be shown that Mackerel spawn could survive the sudden and extreme change of temperature this would involve; or a continuance of southerly winds may drive the spawn on to the shore and destroy it. This occurs frequently with the spawn of those fish which are deposited near the shore, as in the case of the Caplin and Horring. The small size of the Mackerel spawn would cause it to be unobserved, and it would be more distributed than the spawn of the Herring and the Caplin. The United States Signal Service charts show the course of storms and winds during the spawning season, which would produce these results.

The relation of cod spawn to rain has been referred to elsewhere (Part 1, page xii.). Reasoning from analogy, which in so many instances must be for the present our only guide, the effect