

Hydrography of the Mouth of the English Channel, 1929-1932.

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With 7 Figures in the Text.

SINCE 1921 hydrographic data have been collected by the S.S. *Salpa* and several merchant vessels, the records being published in the *Rapport Atlantique* and the *Bulletin Hydrographique* each year. A description of the conditions in the mouth of the Channel—the varying temperature, salinity, and movements of the water masses—during the years 1925-1928 was published in this Journal, Vol. XVI., pp. 791-820, and included a review of the objects of these investigations and the methods used in working up the collected data. This present publication forms a continuation of this. The same methods of dealing with the data have been used.

TEMPERATURE DISTRIBUTION.

Diagrams showing the distribution of temperature with depth at the International Station E1 for the years 1930, 1931, and 1932 are shown below, that for the year 1929 having been included on page 801, Vol. XVI. These three years are not remarkable, except that the water in the autumn of 1931 was warmer than any of the previous years except 1921. This cannot be attributed to an inflow of warmer Atlantic water such as occurred in 1921, because at this time the mouth of the Channel was of unusually low salinity.

SALINITY DISTRIBUTION.

Charts showing the distribution of salinity at the beginning of each month have been prepared from isopleth diagrams of the data as in previous years. A selection of these is reproduced in Figures 3-7, and illustrates changes which have occurred during the four years under review. It has been clear throughout that such charts only give a rough picture owing to the limited intensity of sampling, and, furthermore, that the isohalines are not smooth contours, but that numerous offshoots, lacunæ and isolated patches exist. The data shown in Figure 2 confirm this deduction.

However, in spite of this and the fact that a personal equation comes in when drawing the salinity diagrams, each one gives a consistent generalised picture. A number of such diagrams were drawn for fortnightly intervals, without reference to the diagram for the preceding and subsequent fortnight. Arranged in order these pictures gave a reasonable

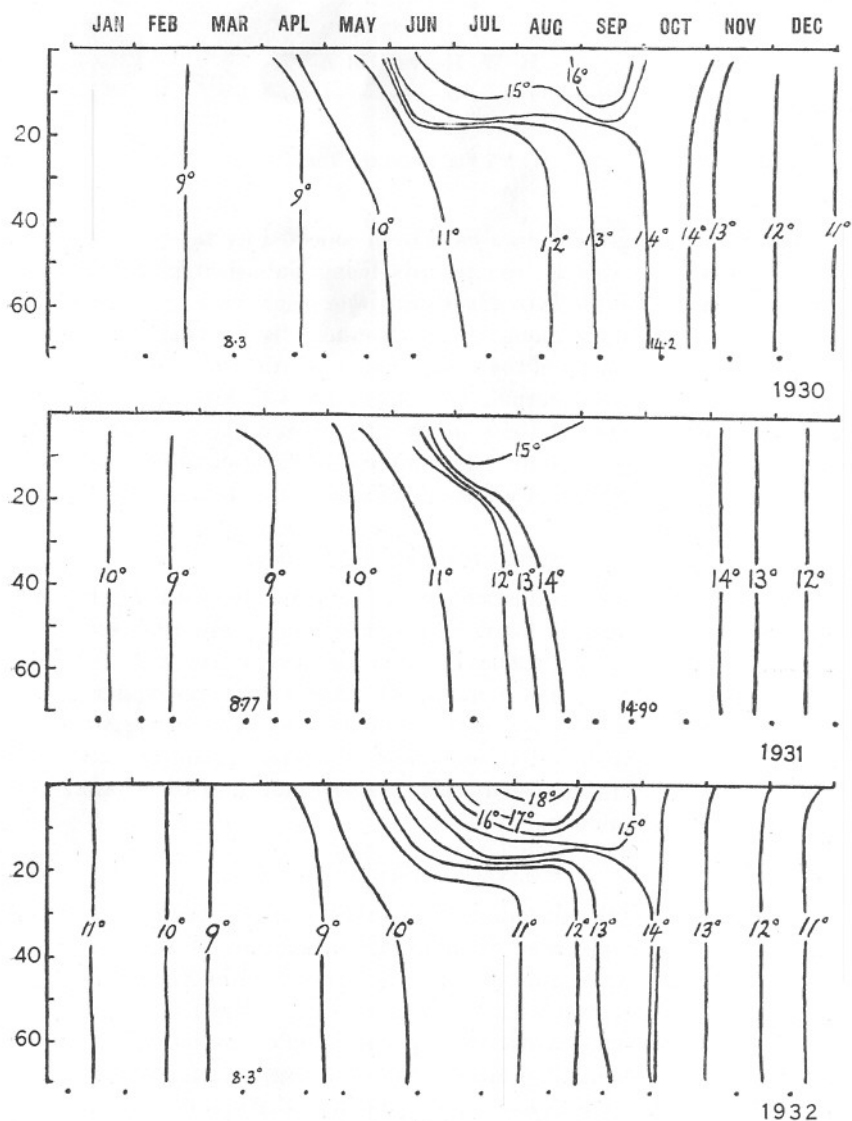


FIG. 1.—Isopleth diagrams showing distribution of temperature with depth (in metres) at Station E, from January, 1930, to December, 1932.

sketch of the general distribution, for if it had been otherwise diagrams for consecutive fortnights would not have been consistent.

The general circulation of the water masses in the area may be outlined. There is usually a slow drift of water through the Channel and out into the North Sea, undergoing gradual dilution as it passes eastward from the Atlantic. This east-going drift is sometimes held up and even reversed by northerly and easterly winds (Carruthers). At times Atlantic water in large quantity enters the mouth of the Channel in the form of a tongue,

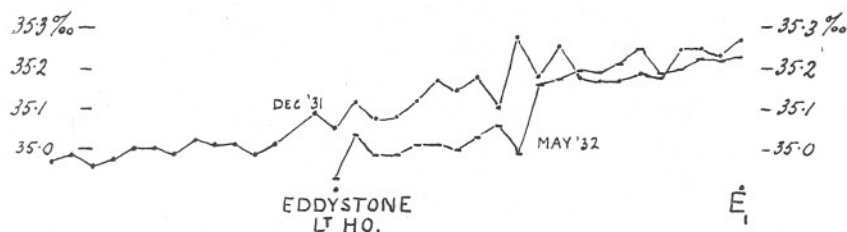


FIG. 2.—Diagram showing salinity of surface samples taken at half-mile intervals on the line Plymouth-Eddystone-International Station E₁, on December 31, 1931, and May 10, 1932.

the water which it displaces moving out north-westward past Lands End. Sometimes the tongue penetrates far up Channel in the east-going drift, either as a ribbon or as patches. More often the high salinity water forming the tongue moves out north-westward past Land's End, its place being taken for the most part by water of lesser salinity from the Atlantic and the west coast of France, and only a small moiety of it passes up Channel. On occasions the mouth of the Channel has filled up with quite low salinity water passing in round Ushant from the west coast of France (April-May, 1928, and again apparently in July, 1931), the water which it displaced having of necessity moved out north-westward for the most part.

Throughout the period under review current measurements have been made at the Varne Lightship and the movement of water into or out of the North Sea calculated for each month. I am indebted to Dr. J. N. Carruthers for these data.

The change in salinity distribution indicates during some months a passage of relatively high salinity water up Channel and during others a hold-up or even reversal. It could not be expected that they would every month reflect the nature of movement through the Straits of Dover, although this frequently occurred. The notable exceptions were that in July, 1931, there was a flow through into the North Sea, whereas the salinity distribution suggests a hold-up or reversal; again it was deduced from the salinity distribution that a flow into the North Sea was resumed during the latter part of October, 1931, whereas this did not happen until the beginning of November.

The changes and deductions may be epitomised as follows, where, for the sake of brevity, water above 35.3‰ salinity is termed Atlantic water.

1929.

During January and February Atlantic water in the Channel moved out north-westward past the Lizard and also up Channel.

March. Little or no change.

April. Atlantic water moving out north-westward past the Lizard. East-going drift through Dover Straits held up by easterly winds.

May. Atlantic water entering mouth of Channel past Ushant.

June, July, August, September, October, November. Gradual penetration of Atlantic water into mouth of Channel.

December. Notable east-going drift up Channel.

1930.

January. Movement up Channel. A patch of high salinity water $35.3\text{--}35.4\text{‰}$ occurred north of the Channel Islands during this month.

May. Appearance of high salinity water on the line Land's End-Ushant in the middle of the month and of remarkably high salinity water, $35.5\text{--}35.7\text{‰}$, at the end of the month.

Water of 35.8‰ occurred at Seven Stones light vessel at end of month.

A stratum of water with salinity $35.6\text{--}35.7\text{‰}$ was found by H.M.S. *Beaufort* at $50^{\circ} 08' \text{ N. } 6^{\circ} 15' \text{ W.}$ at a depth of 50 metres, with water of lesser salinity above and below. A stratum with salinity $35.5\text{--}35.59\text{‰}$ found by S.S. *Muirchu* on May 15 at $50^{\circ} 55' \text{ N. } 9^{\circ} 56' \text{ W.}$ with water of lesser salinity above and below.

June. Gradual penetration of the very high salinity water into mouth of Channel, a patch having salinity 35.75‰ being encountered early in July on the line Plymouth-Guernsey.

July. Retreat of the very high salinity water, probably north-westward past the Scillies.

August. Penetration of Atlantic water into mouth of Channel; rather marked movement of water through Dover Straits.

September and October. Continuation of the movements experienced in August but less marked; passage of Atlantic water out north-westward past Lizard.

1931.

November, December, 1930, January, February. Atlantic water seems to have been replaced largely by low salinity water moving in past Ushant from the French coast. Patches of Atlantic water meanwhile passing up Channel.

- March. Water of relatively high salinity, $35.4-35.58\text{‰}$, appeared on the line Land's End-Ushant at the beginning of the month and again towards the end of the month.
- April, May, June. Patches of high salinity water passing eastward up Channel. Reappearance of high salinity water on the line Land's End-Ushant at beginning of June.
- July, August. Mouth of Channel filled with water of unusually low salinity.
- September, October. Passage up Channel and through the Straits of Dover held up or reversed by easterly winds.
- November. Water from Atlantic entered mouth of Channel. Passage westward through Straits of Dover resumed.
- December. Atlantic water entered mouth of Channel.

1932.

- January. Water of 35.4‰ salinity and greater observed off the mouth of the Channel. Marked passage into North Sea through the Straits of Dover.
- February. Water of $34.4-35.5\text{‰}$ observed off mouth of Channel. A patch having salinity exceeding 35.5 moved up Channel as far as 3° W. Passage of water into North Sea held up or reversed.
- March. Atlantic water moves out from mouth of Channel.
- April. High salinity water reappears north of Ushant, 35.5‰ , and Atlantic water penetrates into Channel. Passage into North Sea took place.
- May, June. Patches only of high salinity water observed within the Channel. During June passage into North Sea held up.
- July. Water of lower salinity filling mouth of Channel, high salinity water off the mouth. Water of $35.5-35.6\text{‰}$ observed south-west of Ireland. Passage into North Sea took place.
- August, September, October. Water of relatively low salinity fills mouth of Channel; high salinity water observed across the mouth. A notable passage of water into the North Sea took place in October.
- November. Atlantic water penetrates mouth of Channel and high salinity water observed across the mouth.
- December. Water of high salinity, $35.5-35.6\text{‰}$, observed at entrance during early part of month. A passage of water into the North Sea took place.

The notable conditions during this period were the relatively low salinities and high temperatures during the latter part of 1931, and the frequent occurrence of unusually high salinity water off the mouth of the Channel at intervals during 1931 and 1932.

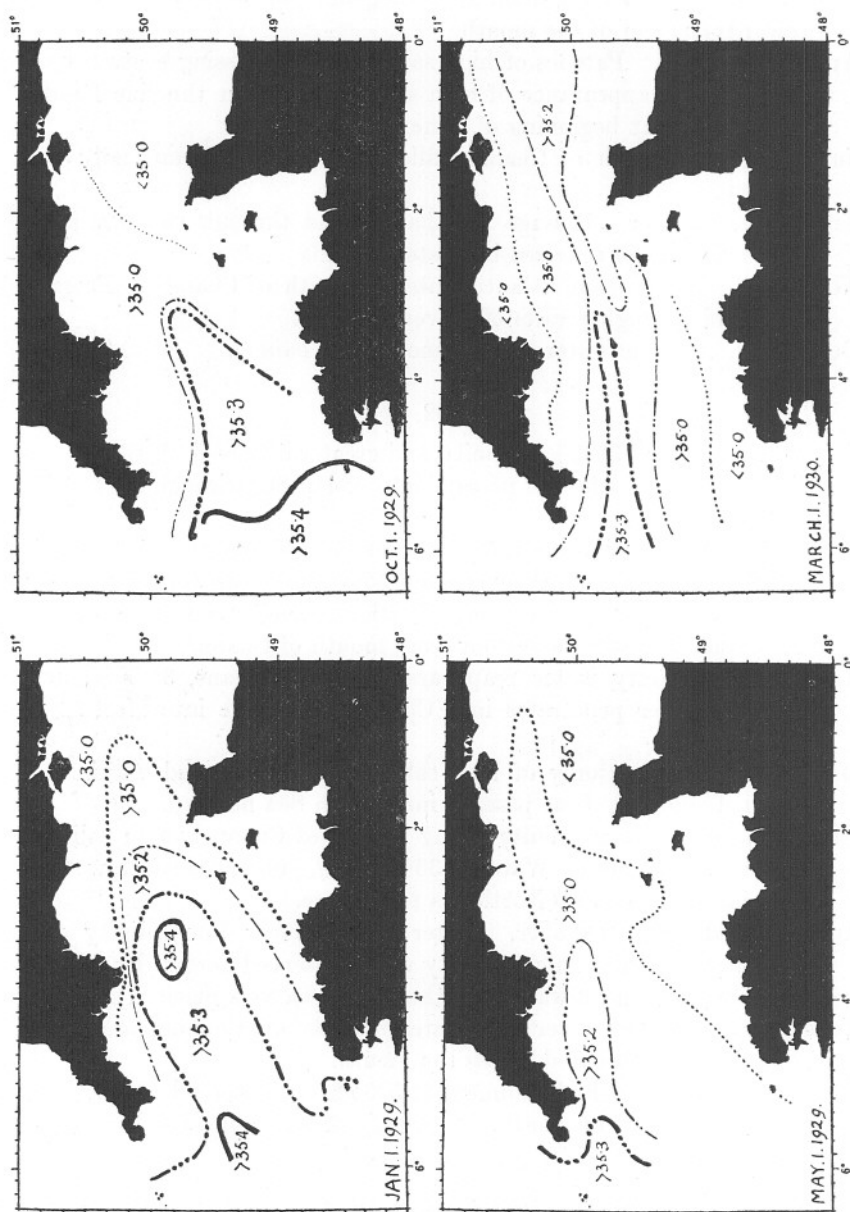


FIG. 3.

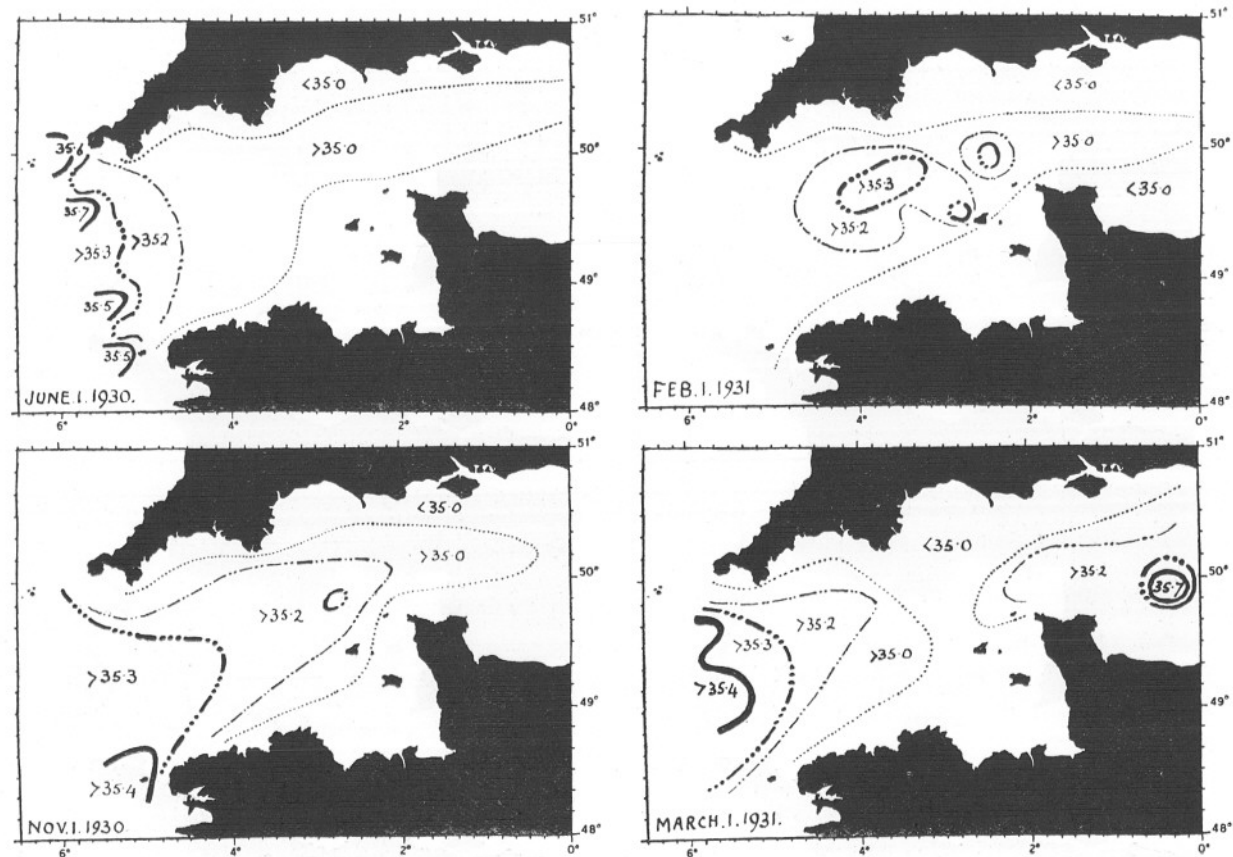


FIG. 4.

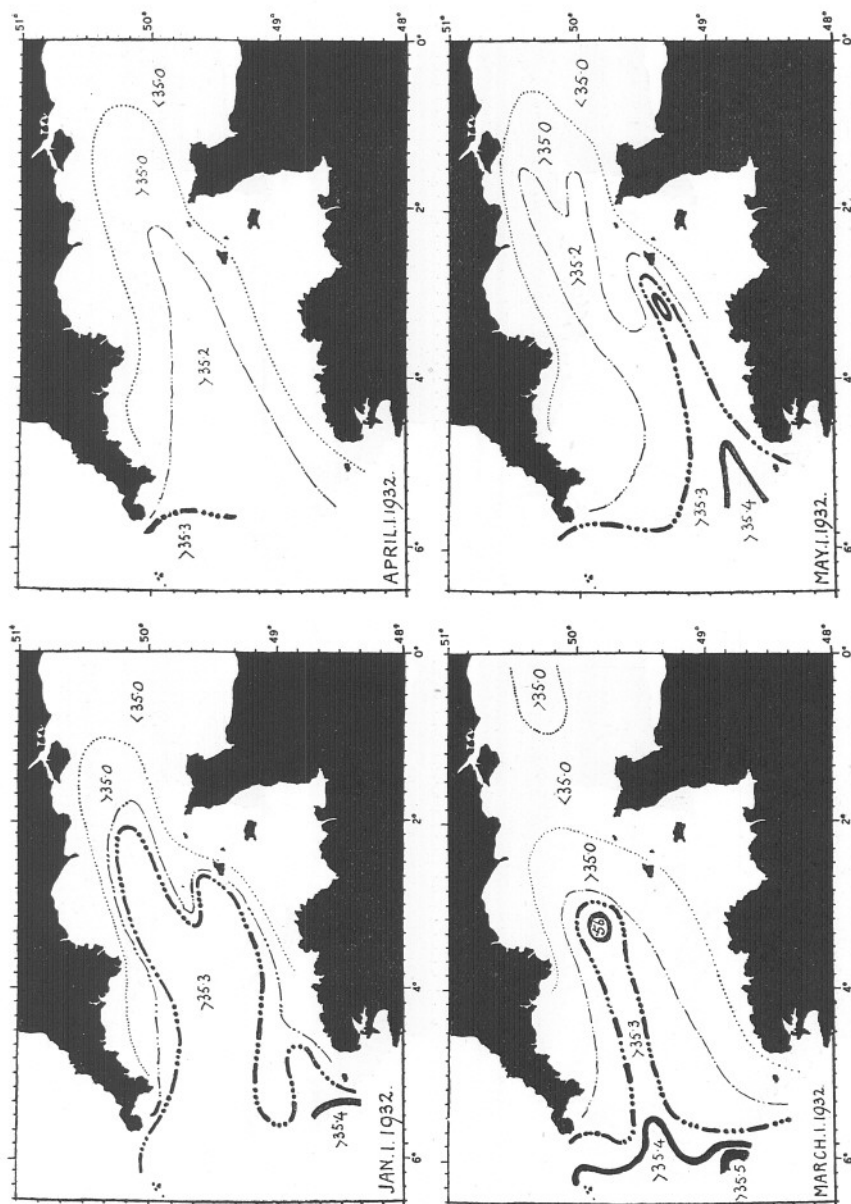


FIG. 6.

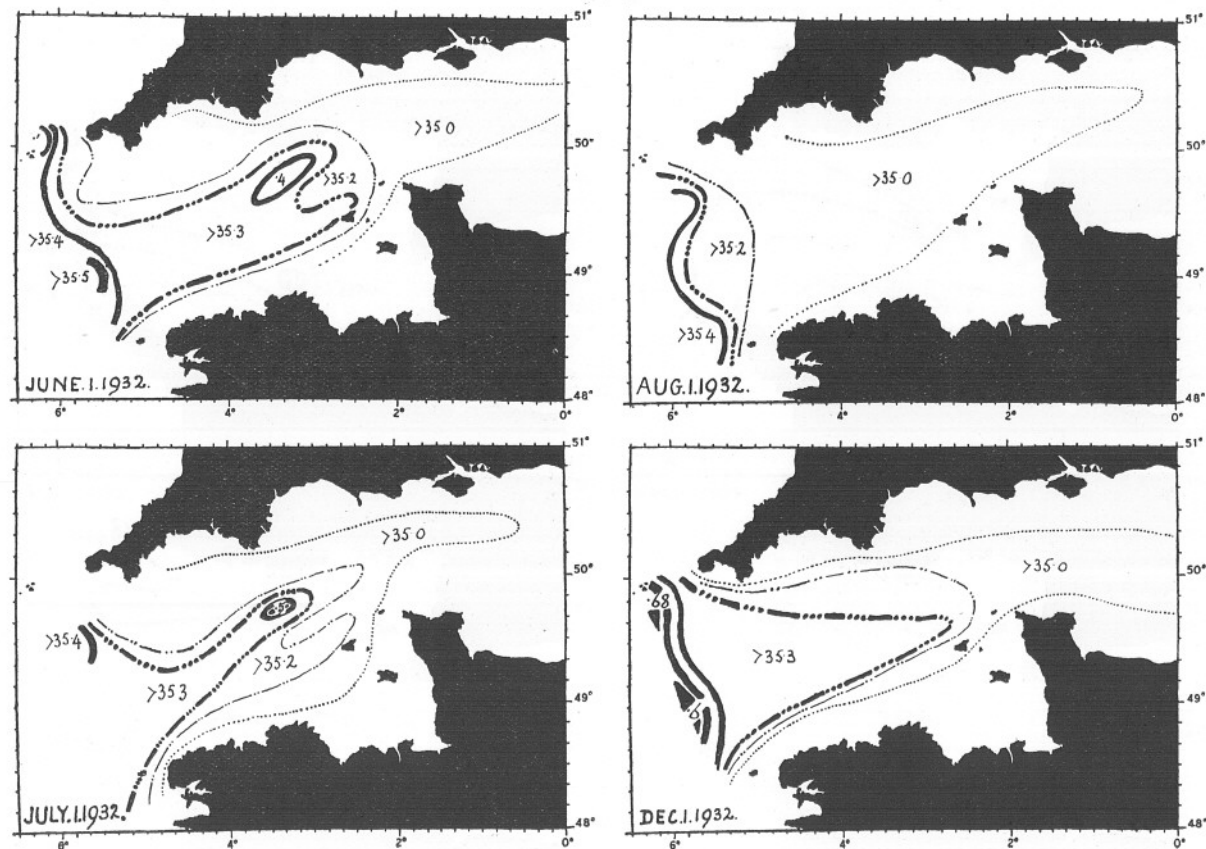


FIG. 7.