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Surface Temperatures in the Southern North Sea, January-March 1963

by

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The winter of 1962-63 has been assessed by Manley (1963) on the basis of the mean temperature during the three months December to February as being the most severe in the English midlands since the year 1740. In the light of this it is interesting to examine the available surface temperature data taken in the southern North Sea.

During the early months of 1963 the Lowestoft research vessel CLIONE carried out some intensive egg and larval surveys in the Southern Bight of the North Sea using the MAFF High-Speed Tow Net and the surface temperatures recorded by the ship's thermograph have provided a good picture of temperature changes in the central part of the area during winter. In conjunction with data from light-vessels and the standard ICES sampling routes a series of charts has been drawn of the surface temperature distribution.

Data The thermograph used by the R.V. CLIONE has its bulb at a depth of approximately 4.5 metres below the surface. The instrument was calibrated by comparison with Nansen-Pettersson water bottle observations during two cruises of the series. On the chart of temperature distribution the ship's station positions (usually tow-net or trawling stations) have been shown and in most cases thermograph records of temperature along the track to and from the ship's working areas have been available. A Nansen-Pettersson water bottle was used for the observations made in the Wash-Humber area in early February by R.V. TELLINA. Temperatures taken by the Galloper and Varne light-vessels and commercial vessels on ICES routes 18, 61a and 68 were taken through the ships' condenser intakes at less than 5 metres depth. Temperatures were taken by canvas bucket on ICES route 32 before 14 January and through the condenser intake after this date. Observations at the Smiths Knoll light-vessel were made with a Lumby surface sampler. No attempt has been made to correct the position of the observations for variation during tidal periods.

Distribution of Temperature Figures 1-9 show the distribution of temperature during periods of from four to six days chosen to include the R.V. CLIONE cruises and as much reasonably synoptic routine sampling data as possible. A key to the data used for each figure is given in the Appendix. The most immediately noticeable feature of the charts is the isolation of the warmer water in the centre of the Southern Bight from water of comparable temperature to north and south, suggesting that the predominating easterly winds had severely reduced the flow through the straits of Dover and from the north along the eastern coast of England. Comparison of the position of the 3° isotherm on Figures 2-5 shows a shrinking of this warm patch (No 4° water was encountered after 29 January in the Southern Bight) and a small northward displacement of its centre from about $51^{\circ}50'$N. in late January to about $52^{\circ}15'$N. in mid February. By 2-6 March (Figure 8) the warmest water to be found in this patch was at about 2.8°C. The final chart in the series, (Figure 9) shows warmer water advecting into the area from the south, the rivers and the coastal areas and breaking up the previous pattern. A small area above 3°C has re-formed in 53°N. latitude.

The largest area of cold water was found off the Dutch coast and Frisian Islands, where it extended much farther to seaward than water of the same temperature on the English coast. Sea ice formed along the Dutch coast and extended 8 miles offshore when CLIONE entered IJmiuden on 1 March. In Figures 3 and 4 where information is available from the Humber and Wash area the contrast between the two coasts in the position of the corresponding 0° isotherms is evident.

In the northern part of the area under consideration the data are too sparse to give more than an approximate idea of the course of the isotherms, but the shoal water of the central Dogger Bank seems to have encouraged the cooling of the incoming Atlantic water as it did in the winter of 1929 as noted by Lumby and Atkinson (1929). The station on ICES route 61a situated in approximately $55^{\circ}14'$N., $02^{\circ}03'$E. was colder than either of the two adjacent stations to the north-west and south-east on twelve successive passages along the route between 29 December 1962 and 7 April 1963.

Discussion The winter was notable for the steady easterly airflow from the Continent and Figure 10 shows the north-south and east-west wind components at Gorleston, averaged daily from four observations at the main synoptic hours as given in the Daily Weather Reports of the British Meteorological Office. An easterly component of the wind was absent for only 18 of the 73 days between 22 December and 4 March, and south-westerlies, significant from the point of view of flow into the Southern Bight through the Straits of Dover, blew on only three days between 11 December and 5 March. It would be unwise to infer too many detailed agreements between the water temperature fluctuations over the whole area and the winds at one station, but in Figure 11, which shows the variation of surface temperature at five points from the north-west Dogger Bank to the Varne light-vessel, the accelerated fall of temperature at the onset of the easterly winds during the last ten days of December was most marked at the Varne and Smiths Knoll light-vessels and was distinguishable at the position on the north-west Dogger Bank. Temperatures at the Galloper light-vessel fell during all December, possibly due to the cooling of the outflowing Thames water under the unusually clear skies experienced at the beginning of the month. (The mean cloudiness at Gorleston for the first 10 days of December from four observations per day was 2.3 oktas).

Figure 11 has several additional features of interest. The observations plotted are from the three light-vessels in the area, a station on ICES route 61a situated on the north-west of the Dogger Bank and a point in the middle of the Southern Bight where the R.V. CLIONE surveys have allowed the temperature to be read or estimated, the uppermost graph of the series being the most northerly and the bottom one the most southerly. Immediately noticeable are the differing dates of the minimum at the stations. At the Varne light-vessel, situated in the narrowest part of the Straits of Dover the minimum temperature occurred on 5 February and was followed by a sharp rise of temperature as winds became south-easterly and as warmer water advected up the English Channel. Figure 4 shows that temperatures rose by over a degree on ICES route 68. This temperature rise was not apparent at the other stations, although the fall of temperature was checked at the Galloper light-vessel at this time. The subsequent small rises at this station and at the Smiths Knoll may well be due to renewed easterly and north-easterly winds having brought the somewhat warmer water in the centre of the Southern Bight towards the English coast rather than to Channel water. However, the temperature at the Varne did not again fall as low, unlike that at the Smiths Knoll which reached its minimum on 21 February. At the Galloper and on the north-west Dogger Bank the temperature was at its lowest in early March and that in the centre of the Southern Bight was still falling up to the R.V. CLIONE's last visit to that vicinity in mid-March. The character of each of the curves is dissimilar and may be important with regard to the biological consequences of the abnormal winter: At the Varne and Galloper stations cooling and warming of the water was rapid and discontinuous, whilst at the Smiths Knoll and on the north-west of the Dogger Bank the rates of fall and rise, although still rapid, were steadier and levelled off for a longer period at the minimum temperatures reached. It is interesting to compare the lengths of time during which temperature was below, let us say, 3.5°C. At the Varne and Galloper, where minima were 1.5° and 1.3° respectively, temperatures were below 3.5° for 45 and 38 days, whereas at the Smiths Knoll (minimum 1.5°) and on the north-west Dogger (minimum 2.5°) 79 and 81 days respectively appear to have been below this temperature.

Unfortunately the data from the centre of the Southern Bight are too incomplete for comparisons with the other stations, but they have been included on account of the interesting late approach to the minimum. It is tempting to explain it by reference to the large quantities of cold run-off water which must have emerged from the Maas and Thames after the thaw which occurred during the second half of February, but calculation shows that the maximum daily outflow which is likely to have occurred would represent only about 0.1% of the volume of water in the band of water below 2° which appears on Figure 9.

Comparison with Normal Temperatures Figure 14 shows the temperatures at the three light-vessels in the area compared with previous means and the maximum and minimum values attained during the period of those means. For the Smiths Knoll light-vessel the means and extremes were obtained from data for January 1947 to April 1962, the minimum being the curve plotted for 1947 subsequent to 29 January. For the other two light-vessels data from December 1949 to April 1962 were employed for computing the means and extremes.

These curves show that temperatures at the beginning of December were close to the mean at the Galloper and about a degree below normal at the other two positions. At the Galloper rapid cooling took place during the month, but temperature did not become lower than the minimum experienced in the previous thirteen Decembers until the last week of the month. At the Smiths Knoll and Varne temperatures began to fall quickly at about this time and on the first day of January the Smiths Knoll was 2.2°, the Galloper 3.3° and the Varne 3.8° below the mean.

In Figures 12 and 13 an attempt has been made to construct charts showing the anomaly of temperature during two of the periods covered by the synoptic charts (Figures 3 and 9) from the mean distribution of temperature as deduced from the ICES atlas of mean monthly charts (1962). For Figure 12 this has meant that values of temperature read off from the January and February mean temperature charts at intervals of 10' latitude and 15' latitude have been interpolated to provide a satisfactory comparison with values read off at similar intervals from the synoptic chart for the period 2-7 February. For Figure 13 (12-16 March) a comparison of figures at these intervals with those obtained from the March mean temperature chart has been possible. Figure 12 shows the greatest offshore anomalies in early February to have been in the Straits of Dover, where temperatures were 5° to 6° below normal. Water in the centre of the Eastern Channel was about 2.5° below normal on ICES route 68 and Holme (in press) shows that temperatures in mid-Channel between Plymouth and the Channel Islands were about 2° below the 1903-27 means. Water 5° below normal was found between the Wash and Humber on the English coast and extended up to 50 miles off the Dutch coast at the Texel. This very cold water was not present all the way down the coast, but adjoined a tongue of water with somewhat smaller anomaly, situated to the north-west of the Maas estuary. The central Southern Bight was little less than 4° below normal. Conditions were nearest to normal to the north-west of the Dogger Bank, where the anomaly was -1°C. Eggvin (1963) shows that in mid-February temperatures were normal around the Shetland Isles and about 0.5° above normal in the Faroes-Shetland Channel. The cooling effect of the Dogger Bank on the incoming Atlantic water has been noted earlier, but Figure 12 suggests that the influence of the latter was detectable at this period in a slight decrease of anomaly in a tongue extending down over the Norfolk Banks and ending to the eastward of Lowestoft.

Figure 13 shows the anomalies in mid-March when warming had recommenced over most of the area and corresponds with the area and corresponds with the synoptic chart shown in Figure 9. Water in the Straits of Dover was about 2° below normal and data collected just before this period on ICES route 68 also had a anomaly of about -2°. The greatest anomalies were to be found off the Dutch coast south of the Texel and in the centre of the Southern Bight. As we have previously seen, on the north-west Dogger Bank temperatures remained low until early April and this is reflected in the fact that the anomaly in this area was greater than some five weeks previously. In general though conditions were less extreme and reference to Figure 14, shows that temperatures at the Varne and Galloper were higher at both stations at this time than the minima which had occurred during the previous thirteen winters.

Comparison with the Winters of 1929 and 1947 Data and descriptions are available of hydrographic conditions in the southern North Sea in two other severe winters of this century, 1928-29 and 1946-47, and make an interesting comparison with 1962-63.

In 1929 the Continental coast and the eastern half of the northern North Sea were the most affected areas. In Figure 14 the temperatures at the Smiths Knoll light-vessel in December 1928 to April 1929 are plotted in addition to those for 1947 and 1963. From the end of January 1929 is the warmest year of the three under consideration having 49 days when temperatures were below 3.5°C. The minimum was reached on 1 March, this being 2.5° below the 1947-1962 mean. Lumby and Atkinson (1929) give a temperature anomaly chart for the end of February which shows anomalies of between -2° and -3° on the English coast from the Thames to the Norfolk Banks and of about -0.75° from the Humber northwards. In the southern part of the North Sea anomalies greater than -4° were restricted to a belt ten to thirty miles from the Dutch coast. By comparison with the anomalies prevailing at the time when temperatures were minimal in 1963 (Figure 12) the variations from the normal in 1929 in the southern North Sea were far less marked, though it must be borne in mind that fewer data were available in the Southern Bight area at that time.

In 1947 the lowest temperature at the Smiths Knoll light-vessel occurred on 12 and 16 March, and was 1.3°C, 0.2° below the minimum recorded at this station in 1963. 69 days had temperatures of less than 3.5°, as compared with 79 days in 1963. Despite the late minimum at the Smith Knoll, surface temperature distributions given by Vaux (1953) show that the coldest water extended farthest in mid-February, when water of temperature -1.5° was found some seventy miles north-west of the Texel. Anomalies from the ICES normal charts were therefore from -7° to -3° in the northern approaches to the Southern Bight at this time, although less (-1.5° to -2°) off Flamborough Head. Towards the middle of March when temperatures were lowest at the Smiths Knoll a survey in the region between Lowestoft, the Hook of Holland and Flamborough encountered temperatures about 4° below normal in the Southern Bight and 4° to 5° below normal in the area immediately adjacent to the north-west. As we have seen, in 1963 anomalies were similarly at their greatest during February and were from -4° to -5°C in the Southern Bight. Despite the later minimum at Smiths Knoll in 1947 the focus of the cold water and the minimum temperatures encountered were north-west of the Texel in February in that year but they were in early March in the Southern Bight in 1963.

To sum up, surface temperatures during the winters of both 1947 and 1963 were lower in the southern North Sea than during that of 1929, which may have gained undue prominence in England as one of the two colder winters during the first thirty years of this centruy. Lamb (1963) lists 1917 and 1929 as the only two winters between those of 1895 and 1940 with mean air temperatures below 3°C in central England, but neither have months with mean air temperatures equal to or less than 0°C as do the subsequent winters of 1940, 1947, 1956 and 1963. In 1947 the area to the immediate north of the Southern Bight became much colder than in 1929 or 1963, but in the offshore waters of the Southern Bight itself surface temperatures in March 1963 appear to have been the lowest recorded to date. Evidence suggests that in the Southern Bight and on the north-west Dogger Bank temperatures remained low for a longer period than in 1929 and 1947.

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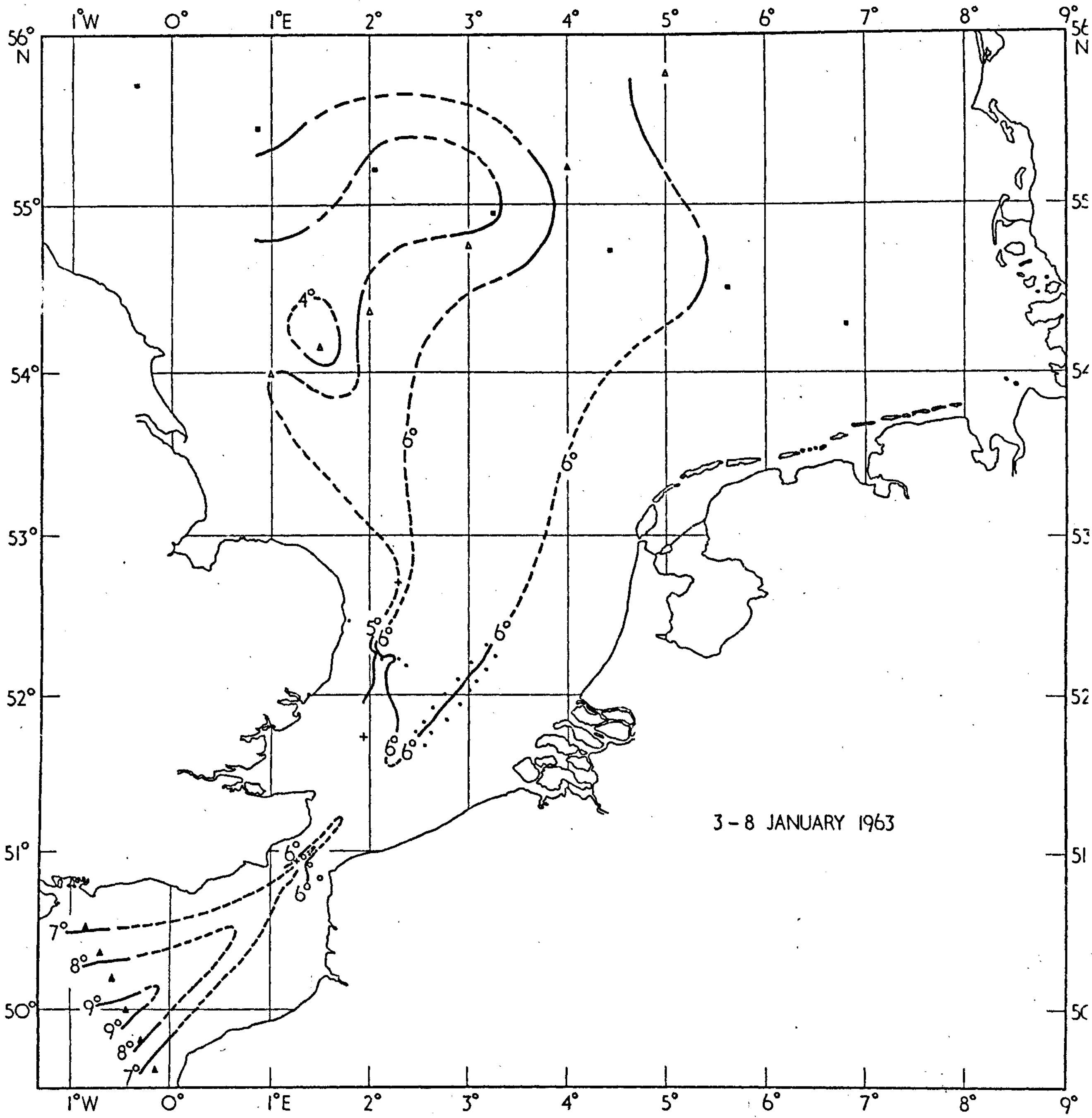

Figure 1 Surface temperature distribution °C in the southern North Sea, 3-8 January 1963

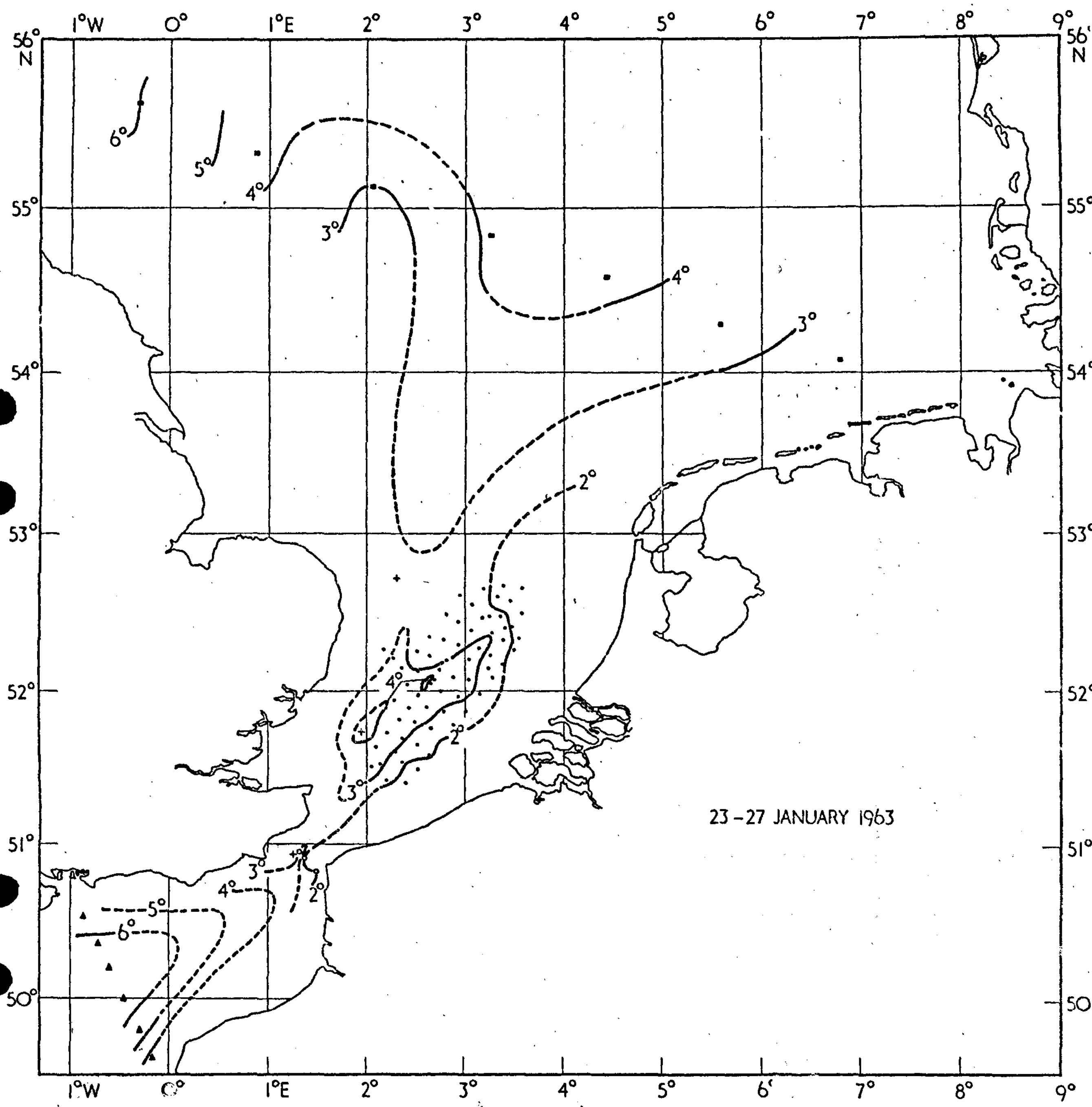

Figure 2 Surface temperature distribution °C in the southern North Sea, 23-27 January 1963

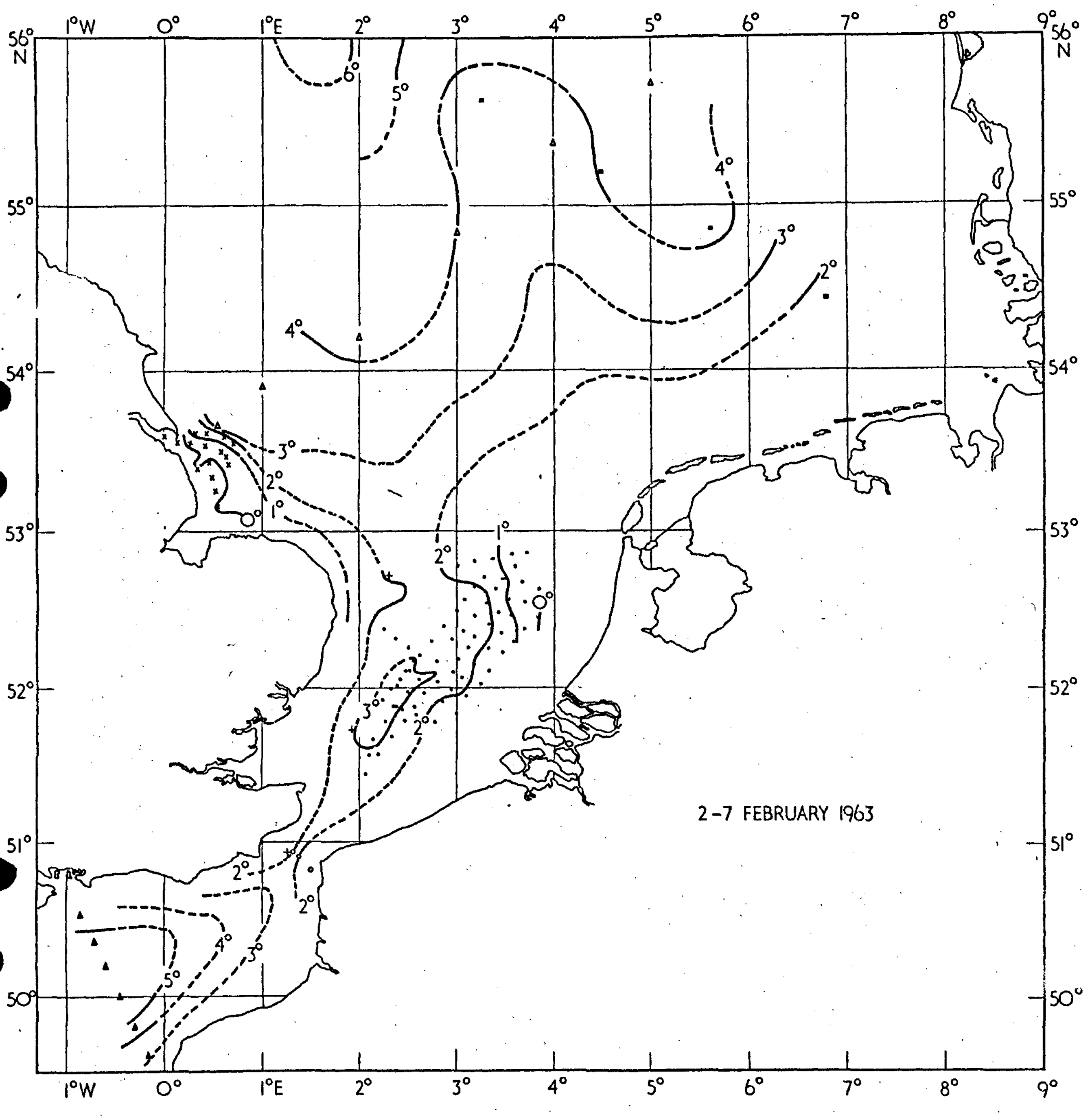

Figure 3 Surface temperature distribution °C in the southern North Sea, 2-7 February 1963

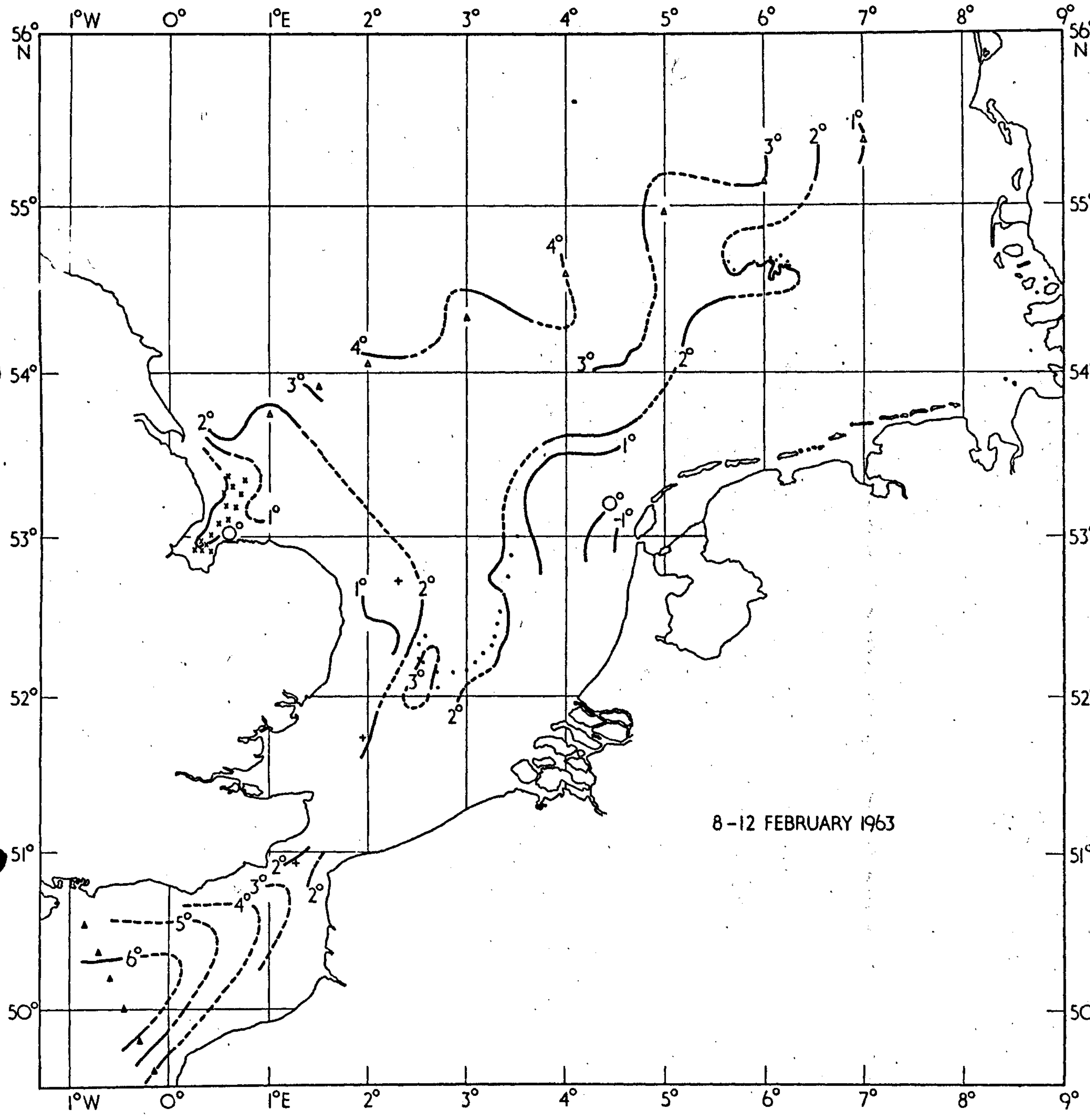

Figure 4 Surface temperature distribution °C in the southern North Sea, 8–12 February 1963

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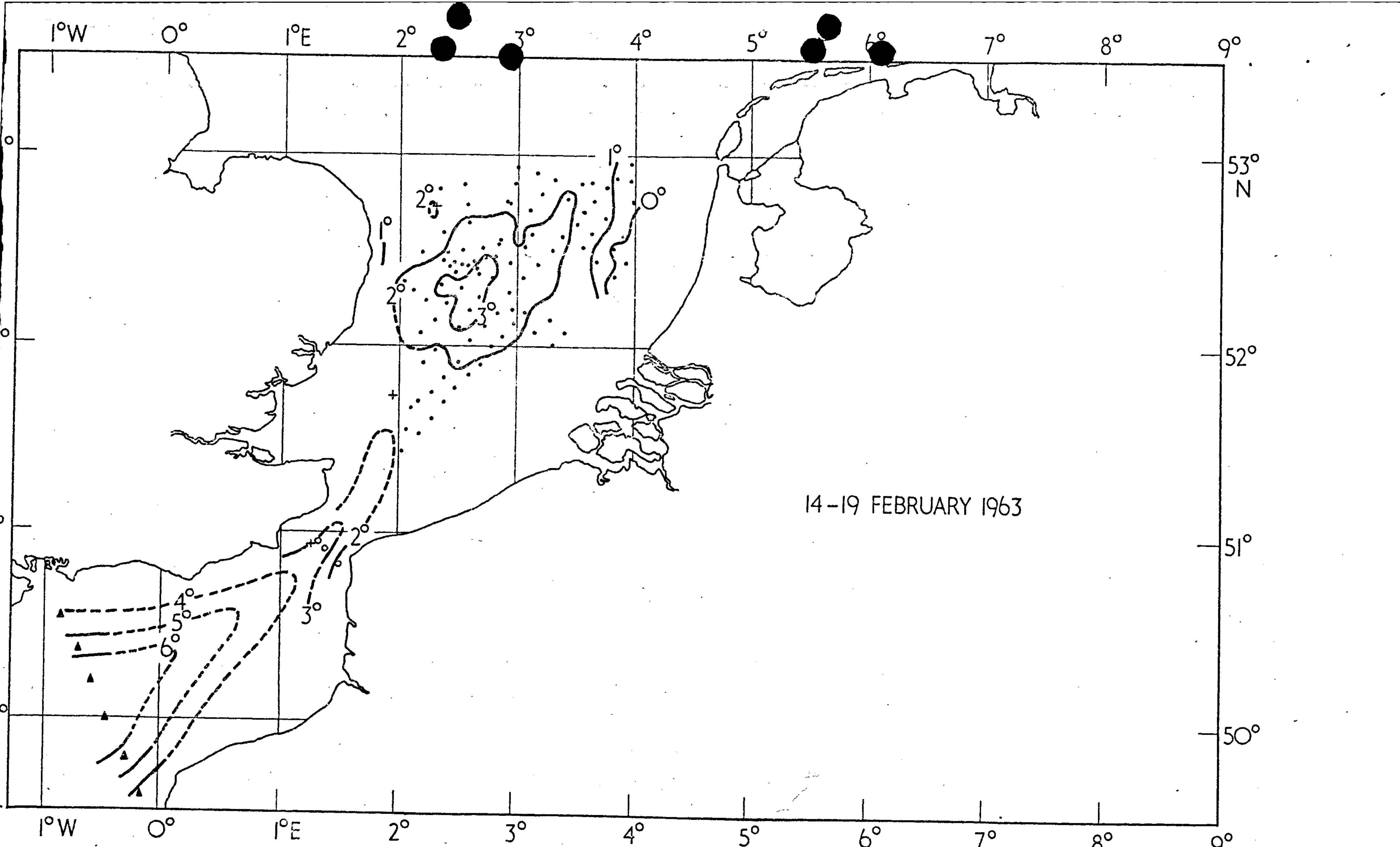

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Figure 5 Surface temperature distribution °C in the southern North Sea, 14–19 February 1963

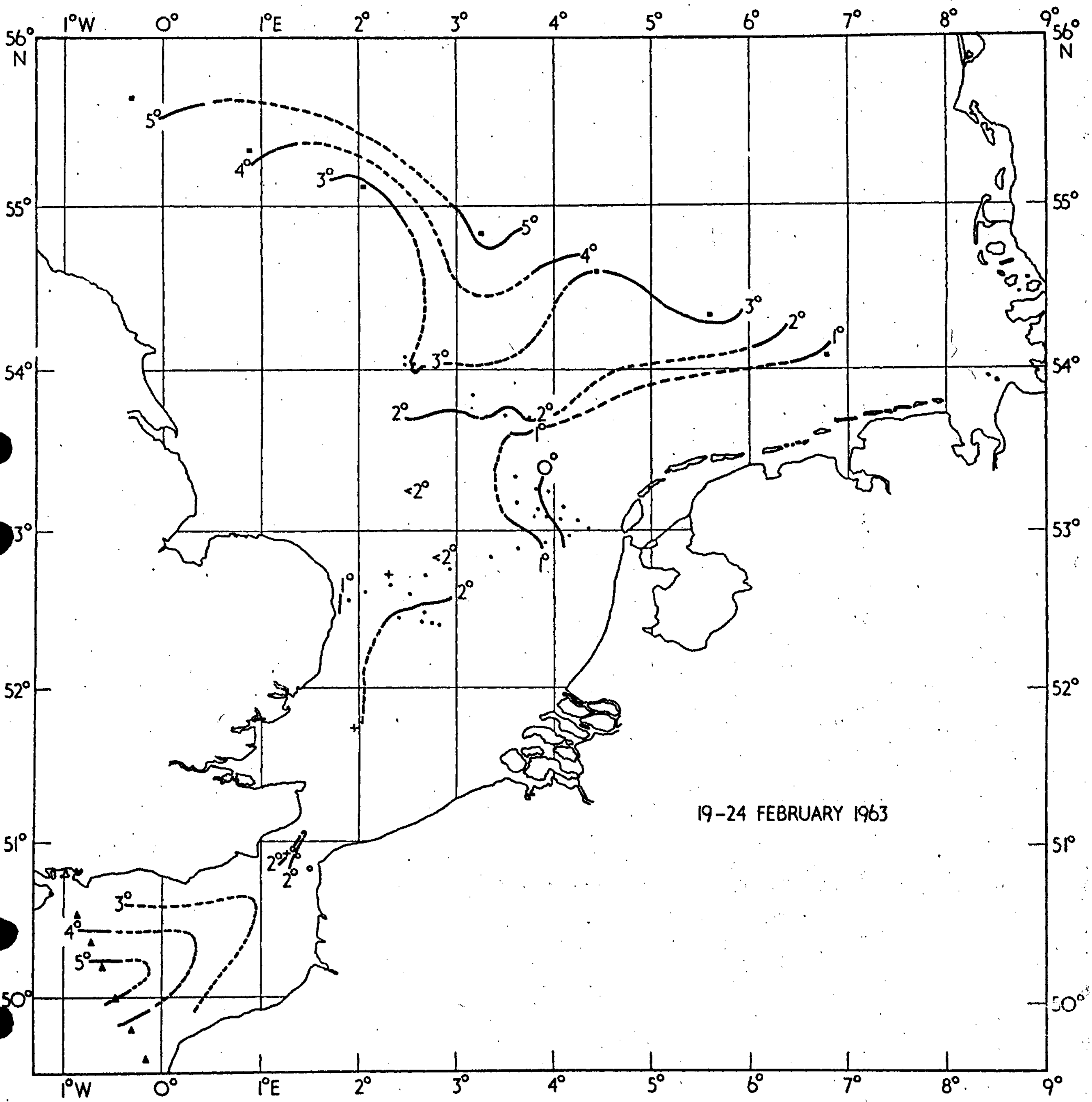

Fig. 6

Figure 6 Surface temperature distribution °C in the southern North Sea, 19-24 February 1963

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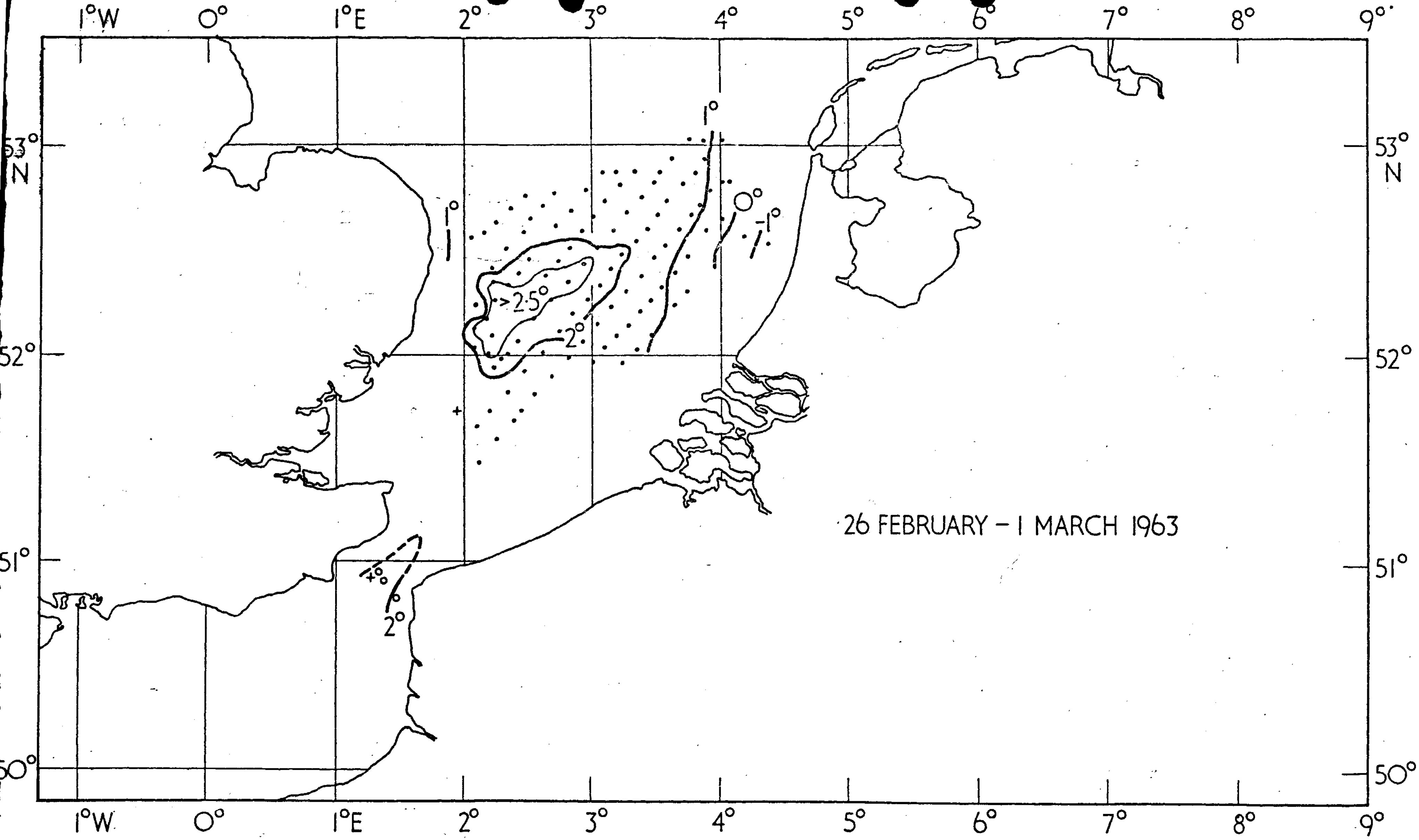

Figure 7 Surface temperature distribution °C in the southern North Sea, 26 February-1 March 1963

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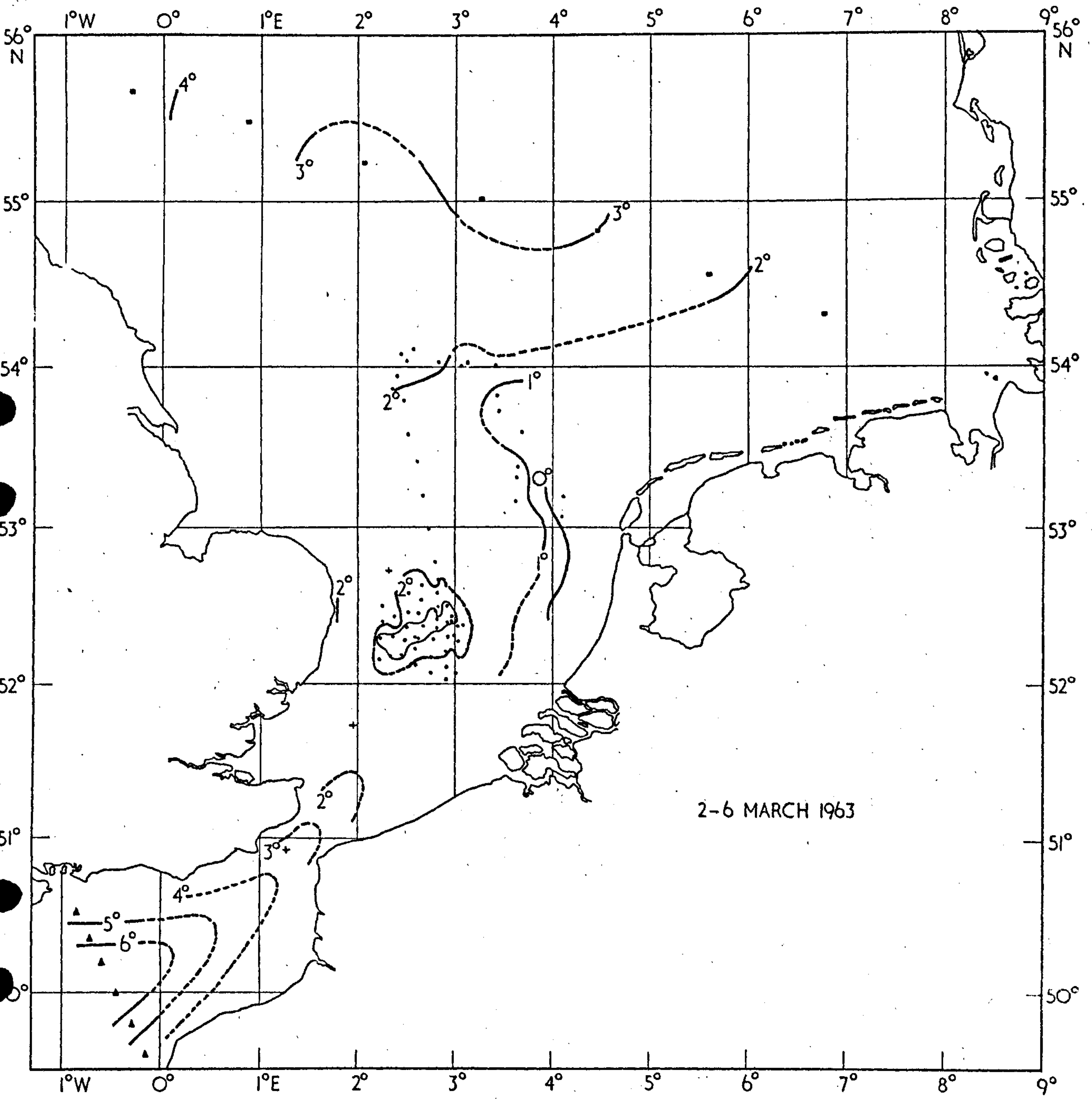

Figure 8 Surface temperature distribution °C in the southern North Sea, 2-6 March 1963

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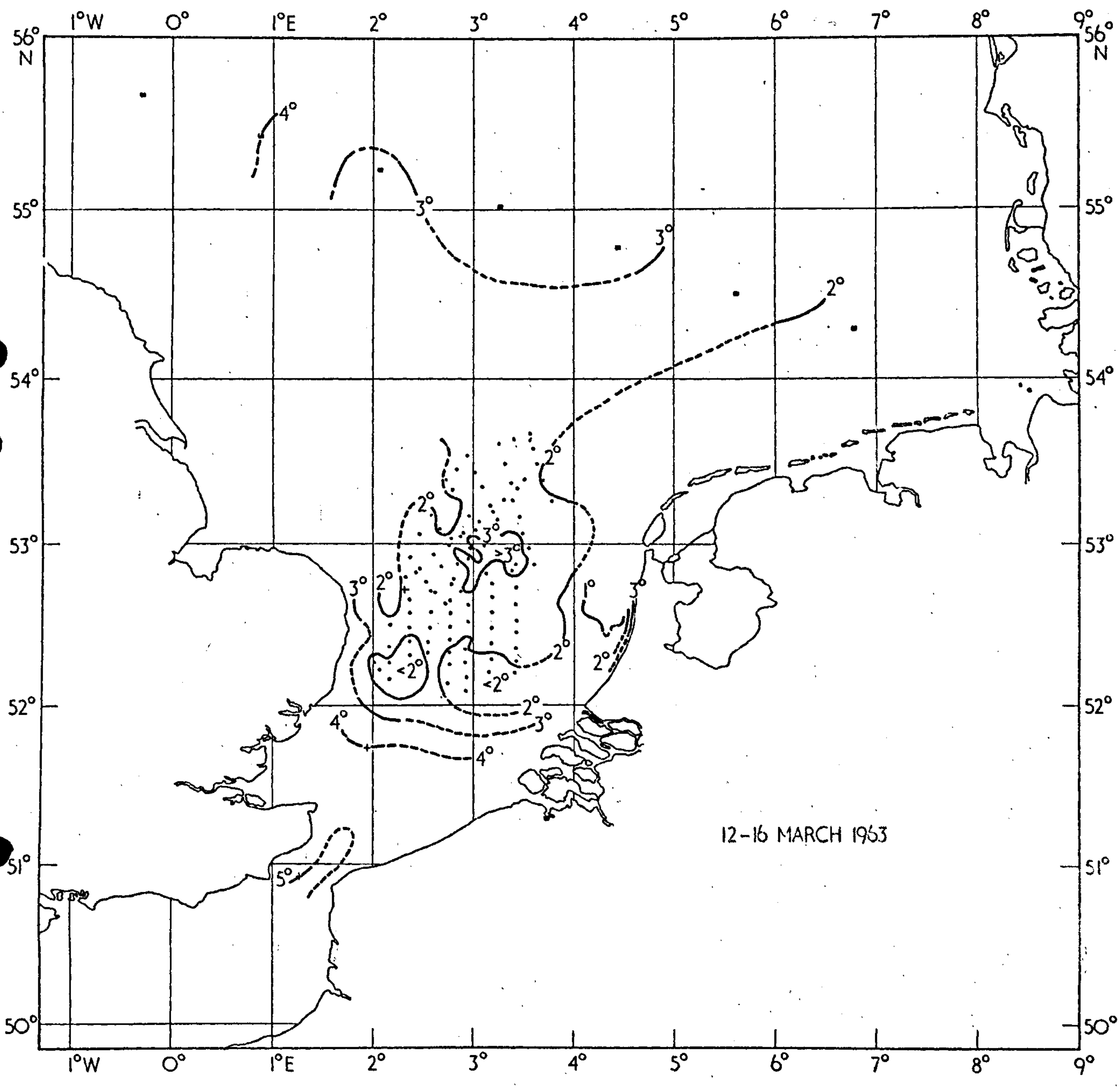

Figure 9 Surface temperature distribution °C in the southern North Sea, 12-16 March 1963

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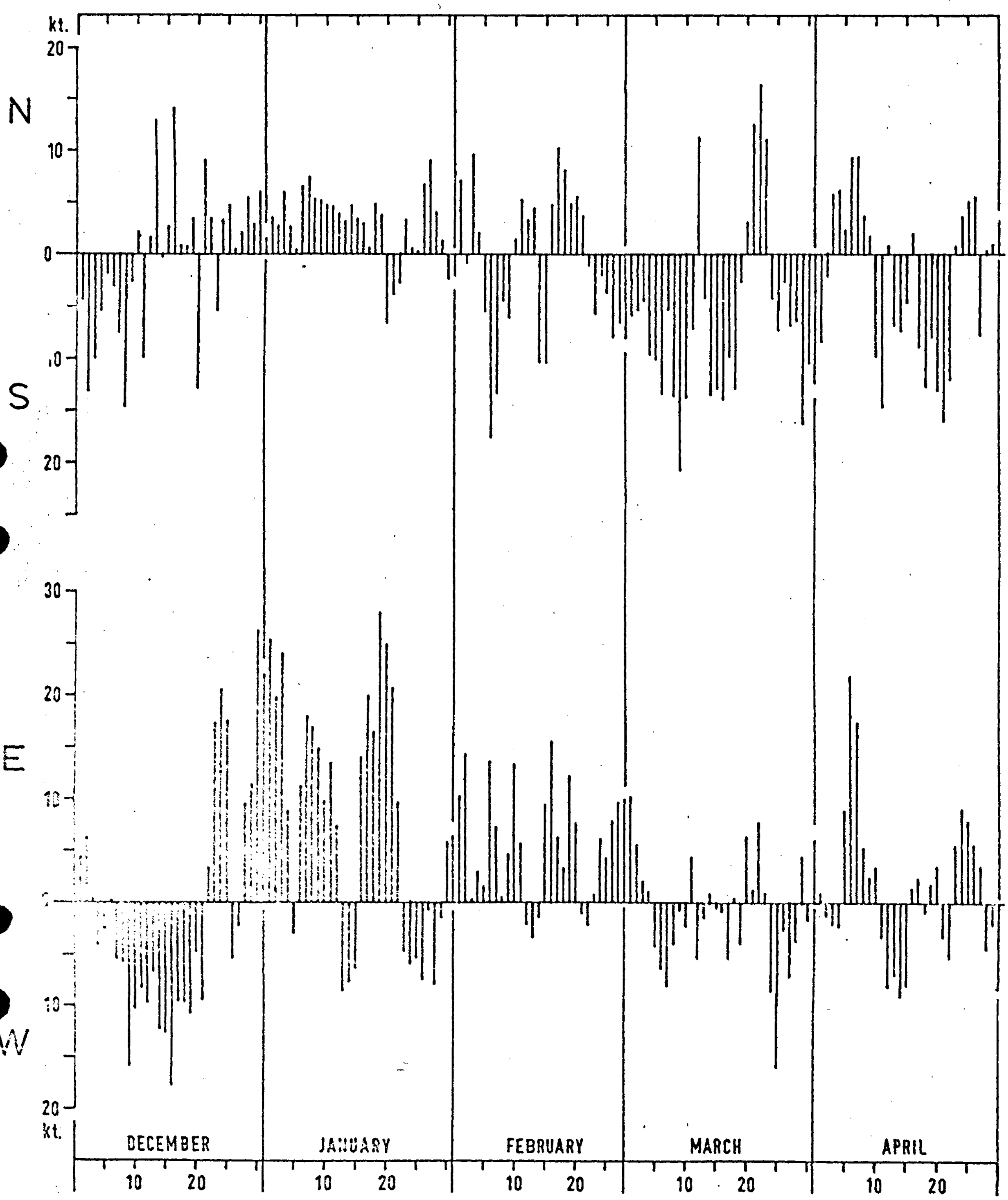

Figure 10 Daily Mean Wind Components at Gorleston, December 1962-April 1963.

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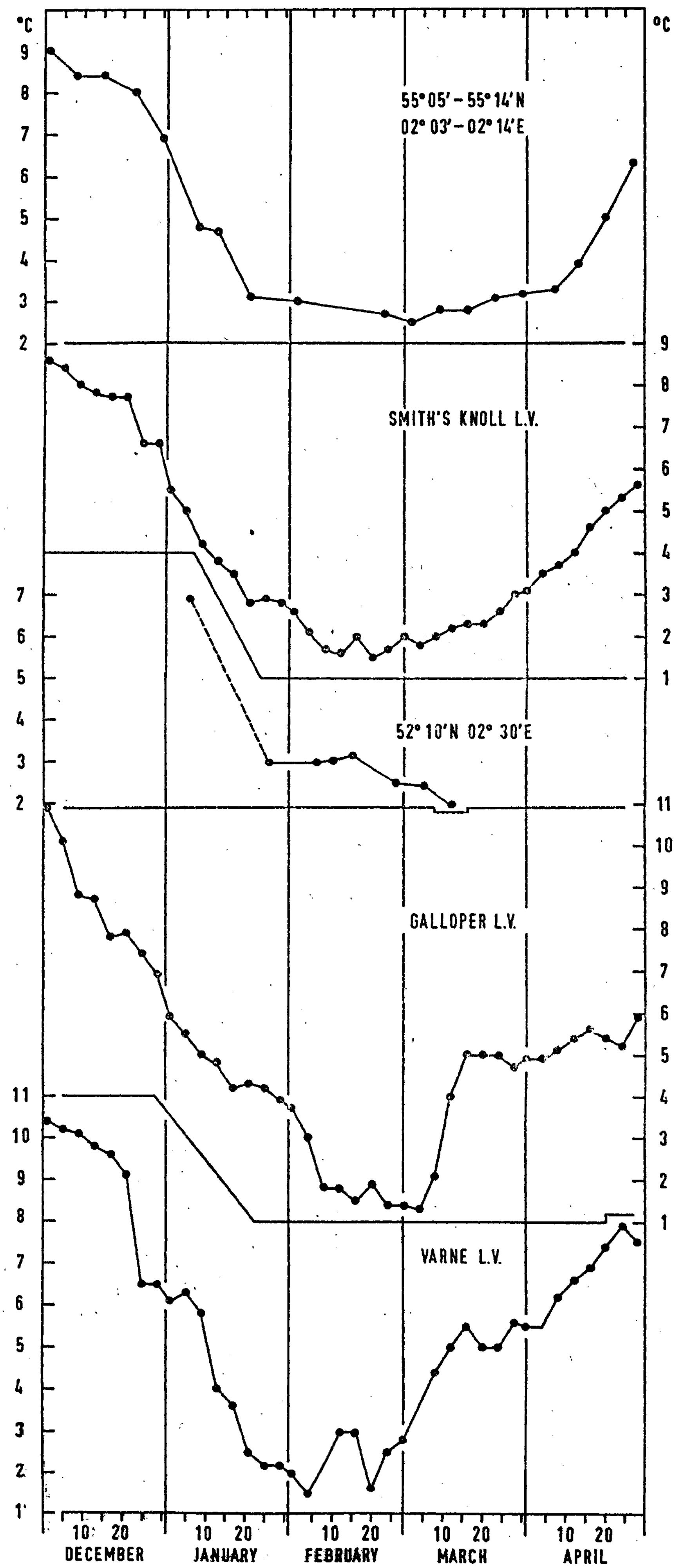

Figure 11 Variation of Surface Temperature at five positions in the southern

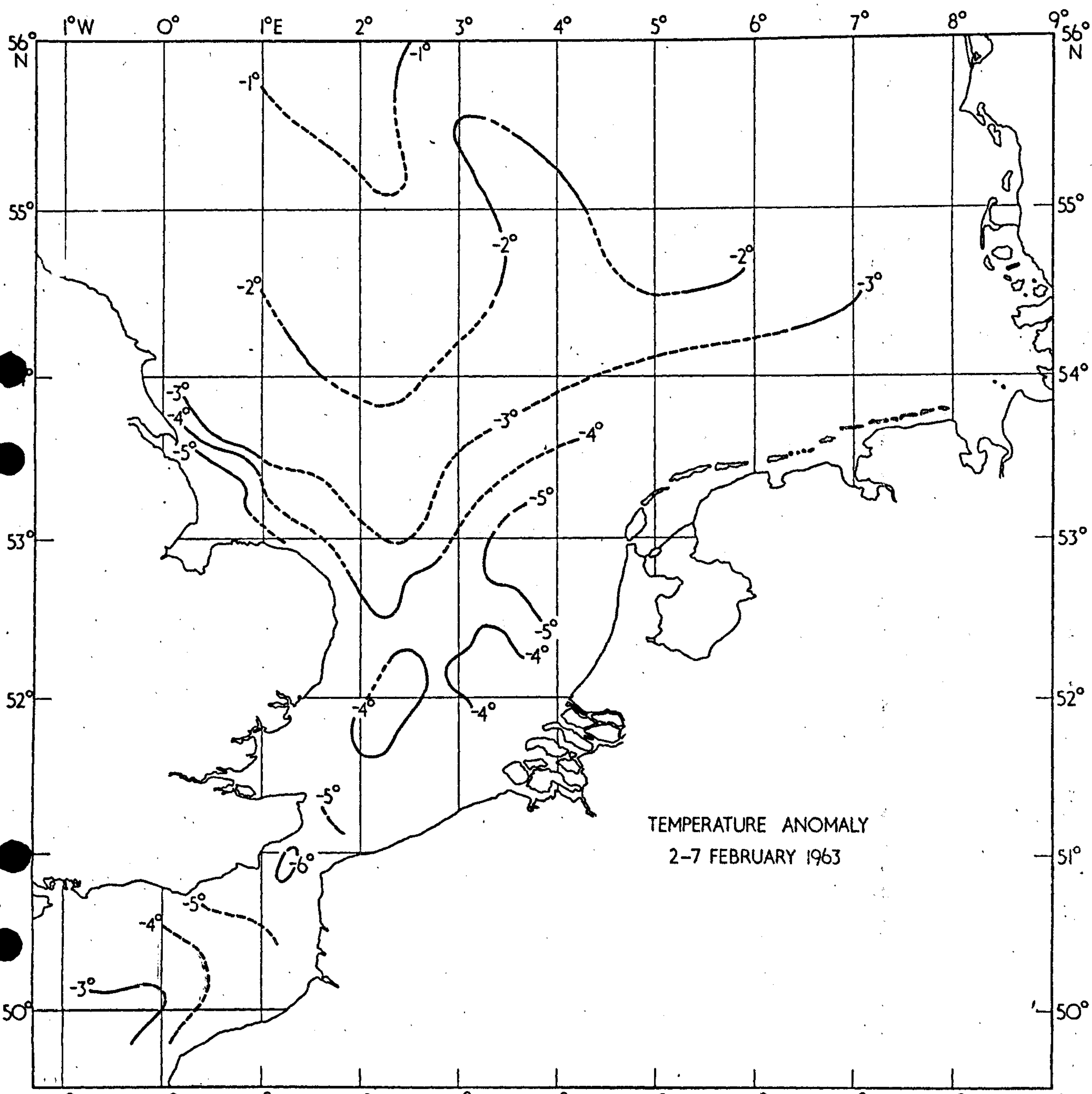

Figure 12 Surface Temperature Anomaly, °C, in the southern North Sea, 2-7 February 1963.

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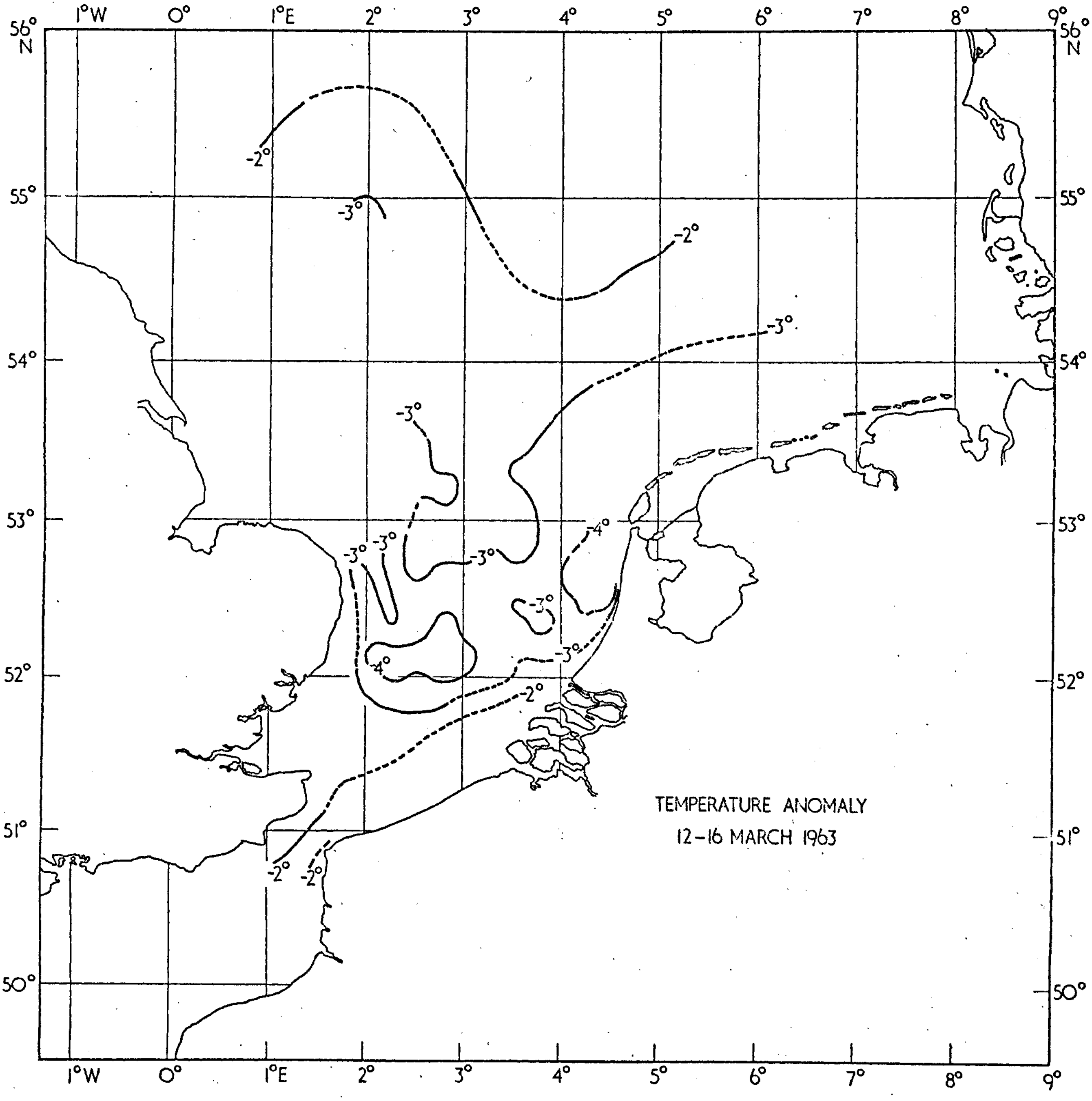

Figure 13 Surface Temperature Anomaly, °C, in the southern North Sea, 12–16 March 1963.

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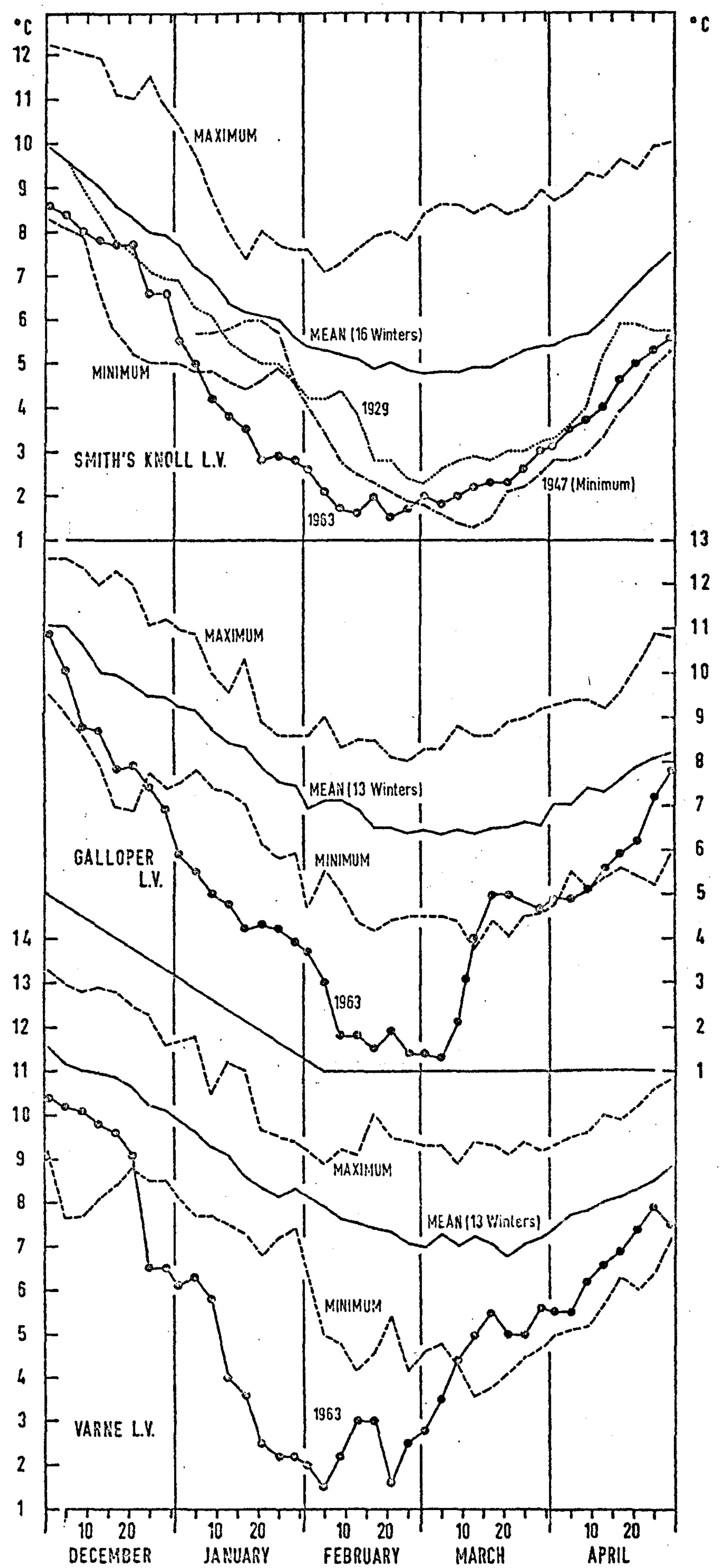

Figure 14 Comparison of Light-Vessel Temperatures, December 1962–April 1963, with Means and Extremes for previous 16 winters (Smiths Knoll L.V.) or previous 13 winters (Galloper L.V. and Varne L.V.) (See text)

Appendix

Data used in compiling the Synoptic Charts

Figure 1, 3-8 January

R.V. CLIONE	4-7 Jan.
SMITHS KNOLL, GALLOPER and VARNE Light Vessels	5 Jan.
M.V. AARO (ICES Route 32)	5-6 Jan.
M.V. PENTLAND (ICES Route 61a)	8 Jan.
S.S. DEAL (ICES Route 18)	3 Jan.
S.S. FALAISE (ICES Route 68)	5-6 Jan.

Figure 2, 23-27 January

R.V. CLIONE	24-26 Jan.
SMITHS KNOLL, GALLOPER and VARNE Light Vessels	25 Jan.
M.V. PENTLAND (ICES Route 61a)	26-27 Jan.
S.S. DEAL (ICES Route 18)	23 Jan.

Figure 3, 2-7 February

R.V. CLIONE	4-7 Feb.
R.V. TELLINA	4-5 Feb.
SMITHS KNOLL, GALLOPER and VARNE Light Vessels	5 Feb.
M.V. AARO (ICES Route 32)	2-3 Feb.
M.V. PENTLAND (ICES Route 61a)	3-4 Feb.
S.S. DEAL (ICES Route 18)	6 Feb.
S.S. NORMANNIA (ICES Route 68)	2-3 Feb.

Figure 4, 8-12 February

R.V. CLIONE	8-11 Feb.
R.V. TELLINA	8-10 Feb.
SMITHS KNOLL, GALLOPER and VARNE Light Vessels	9 Feb.
M.V. AARO (ICES Route 32)	11-12 Feb.
S.S. NORMANNIA (ICES Route 68)	9-10 Feb.

Figure 5, 14-19 February

R.V. CLIONE	15-19 Feb.
SMITHS KNOLL, GALLOPER and VARNE Light Vessels	17 Feb.
S.S. DEAL (ICES Route 18)	14 Feb.
S.S. NORMANNIA (ICES Route 68)	16-17 Feb.

Figure 6, 19-24 February

R.V. CLIONE	19-22 Feb.
SMITHS KNOLL, GALLOPER and VARNE Light Vessels	21 Feb.
M.V. PENTLAND (ICES Route 612)	22-23 Feb.
S.S. DEAL (ICES Route 18)	20 Feb.
S.S. NORMANNIA (ICES Route 68)	23-24 Feb.

Figure 7, 26 February–1 March

R.V. CLIONE	26 Feb.–1 Mar.
SMITHS KNOLL, GALLOPER and VARNE Light Vessels	1 Mar.
S.S. DEAL (ICES Route 18)	28 Feb.

Figure 8, 2–6 March

R.V. CLIONE	2–6 Mar.
SMITHS KNOLL, GALLOPER and VARNE Light Vessels	5 Mar.
M.V. PENTLAND (ICES Route 61a)	2–3 Mar.
S.S. NORMANNIA (ICES Route 68)	2–3 Mar.

Figure 9, 12–16 March

R.V. CLIONE	12–16 Mar.
SMITHS KNOLL, GALLOPER and VARNE Light Vessels	13 Mar.
M.V. PENTLAND (ICES Route 61a)	16 Mar.