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AQUATIC SCIENCES RESEARCH DIVISION
DEPARTMENT OF AGRICULTURE FOR N. IRELAND

CRUISE REPORT: LF/

BIOLOGICAL OCEANOGRAPHY OF THE WESTERN IRISH SEA 22-25 JULY 1991

PERSONNEL

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OBJECTIVES

1. To investigate the oceanography of the western Irish Sea.

2. To determine the spatial distribution of dissolved inorganic nutrients (ammonia, nitrate, nitrite, phosphate and silicate) and chlorophyll related phytoplankton biomass in the western Irish Sea.

3. To undertake preliminary primary productivity experiments using a standard 14C incubation technique.

CRUISE NARRATIVE

Lough Foyle left Belfast Harbour at 1608 hrs on Monday the 22 July and proceeded to station A located at 54:50N and 05:25W (see Figure 1). After initial problems with the CTD the station was successfully completed by 1920 hrs. On leaving stn. A, the Traaks Autoanalyser was set running for mapping near surface concentrations of dissolved inorganic nutrients. During the deployment of the fluorometer at stns 6 and 14 the output from the fluorometer proved difficult to stabilize and after several unsuccessful attempts to rectify the fault the use of the fluorometer was abandoned after stn 20. Zooplankton hauls and measurements of secchi depth and sub-surface irradiance were made at selected stations (see Table

1). The stations were worked in the order shown in Figure 1.

At Stn 58 a 5 l water sample was collected from the ships clean sea-water supply and used in a productivity experiment. After the completion of stn 64 at 1830 hrs on the 24 July, the ship returned to Belfast, and docked at 0900 hrs on the 25 July.

METHODS

Stations were positioned to compliment stations worked on previous biological oceanographic cruises and to provide spatial coverage of the different hydrographic regions in the western Irish Sea. The vertical distribution of temperature and salinity was measured at each station using a Hydro- Bios CTD profiling system. Water samples for the measurement of dissolved inorganic nutrients and estimation of phytoplankton biomass (chlorophyll) were collected from depths of 1, 5, 8, 16, 25 and 50 m (or 10 m above the sea-bed if the depth was less than 50 m) at each station. At those stations where the depth of water exceeded 50 m additional water samples were collected from depths down to approximately 10 m above the sea-bed. A sub-sample (30 ml) of the 5 m water sample was preserved with acidic Lugol's Iodine for phytoplankton species identification and enumeration. Zooplankton samples were collected using a Bongo net fitted with a pair of 300 um mesh nets. Samples were fixed in formalin for later analysis.

The attenuation of downwelling photosynthetically active irradiance was measured using a Biospherical Instruments Inc. QSP profiling system fitted with a depth sensor (courtesy of NERC, Dunstaffnage Marine Laboratory). The underwater frame of the profiling system was modified to support two, 2 phi light collectors, mounted to measure downwelling and upwelling irradiance. The output from the light and depth sensors together with surface irradiance was logged onto a computer.

At station 58 water from the ships clean sea-water supply was used to estimate the primary production of phytoplankton. Water samples (60 ml) were inoculated with 2 u ci of 14C and placed in a chamber providing a light gradient. Following a three hour incubation each sample was fixed with formalin and filtered. The phytoplankton and filter from each sample was stored frozen in glass vials until further analysis.

PRELIMINARY RESULTS AND DISCUSSION

Hydrography

The vertical distribution of temperature in the upper 50 m of the water column along a north-south section through the

center of the survey area is shown in Figure 2. Maximum near-surface water temperatures (14 - 14.4 C) were recorded in the area to the immediate south west of the Isle of Man. Near surface water temperatures in the North Channel and at the bottom of the survey area did not exceed 12.5 C and 13.0 C respectively.

The distribution of temperature indicates the presence of an area of stratified water to the south west of the Isle of Man. The surface water in this region had a temperature of 14 to 14.4 C which was 1.8 C warmer than the temperature of near surface water in the same region in June 1991. The warm near-surface water was separated from deeper and colder (10 - 11 C) water by a thermocline between 25 and 35 m. The thermocline was most marked at stations 38 and 45 at which there was a temperature change of approximately 2.6 C over a depth of 11 m. Frontal boundaries (regions between mixed and stratified water) separated the stratified water from water in the North Channel and to the south of the survey area. In these two regions the water column was essentially isothermal (surface to bottom differences in temperature being less than 1.0 C) indicating that the water was vertically mixed.

Interestingly, during the period 27 June to 24 July the temperature of near surface water at stn. 6 in the North Channel had increased by 1.4 C compared to a 1.8 C increase in temperature of near-surface water at stn. 38. In contrast, the increase in temperature of the deep (50 m) water at stn. 6, during the same period was 2.3 C compared to an increase of 1.4 C at 50 m at stn. 38. A similar, but less well marked difference in the warming of surface and deep water was apparent at stn. 57. One explanation for these changes in temperature is that there is less transfer of heat down the water column in the stratified area where there is less turbulent mixing.

Phytoplankton biomass

The maximum concentration of chlorophyll (18.5 mg cu. m) measured during the survey was at a depth of 5 m at stn 58. The vertical distribution of chlorophyll related phytoplankton biomass along the north-south section is shown in Figure 3. Maximum concentrations of chlorophyll along the section were measured at stns 13 and 62. which corresponded with the positions of the boundaries between the stratified and mixed water. In the near surface waters of the stratified region there was a patch of low (< 1.0 mg/cu. m) biomass. The maximum concentration measured in water samples collected from the survey area was 18.5 mg/ cu. m,

An interesting feature of the distribution of phytoplankton in the upper 5 m of the water column (Figure 4) is that the highest concentrations of chlorophyll were generally measured in water samples collected from the most westerly stations of

the survey area. At present the reason for this spatial pattern is unclear.

ACKNOWLEDGMENTS

I would like to thank the Captain, Officers and crew of the Lough Foyle for their assistance during the cruise. I would also like to thank the scientific staff for their commitment to ensuring that the scientific aims of the cruise were successfully completed.

FIGURE LEGENDS

Figure 1. A map of the Irish Sea showing the cruise track and the position stations worked.

Figure 2. A north-south section through the central region of the survey area showing the vertical distribution of temperature (C) in the water column.

Figure 3. The vertical distribution of chlorophyll related phytoplankton biomass (mg/ cu. m) along the north-south section.

Figure 4. A map of the Irish Sea showing the spatial distribution of chlorophyll related phytoplankton biomass (mg/ cu. m) in near surface waters of the survey area.

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(1st August 1991)

TABLE 1. A summary of the additional work carried out at specific stations.

Sampling/ Measurement	Station
Zooplankton haul	A, 26, 58, 64
Irradiance profile	26, 58
Secchi depth	26, 37, 38, 39, 55, 56, 57, 58, 61, 62, 63, 64
Water sample for salinity calibration	50, 51, 52, 55

FIGURE 1

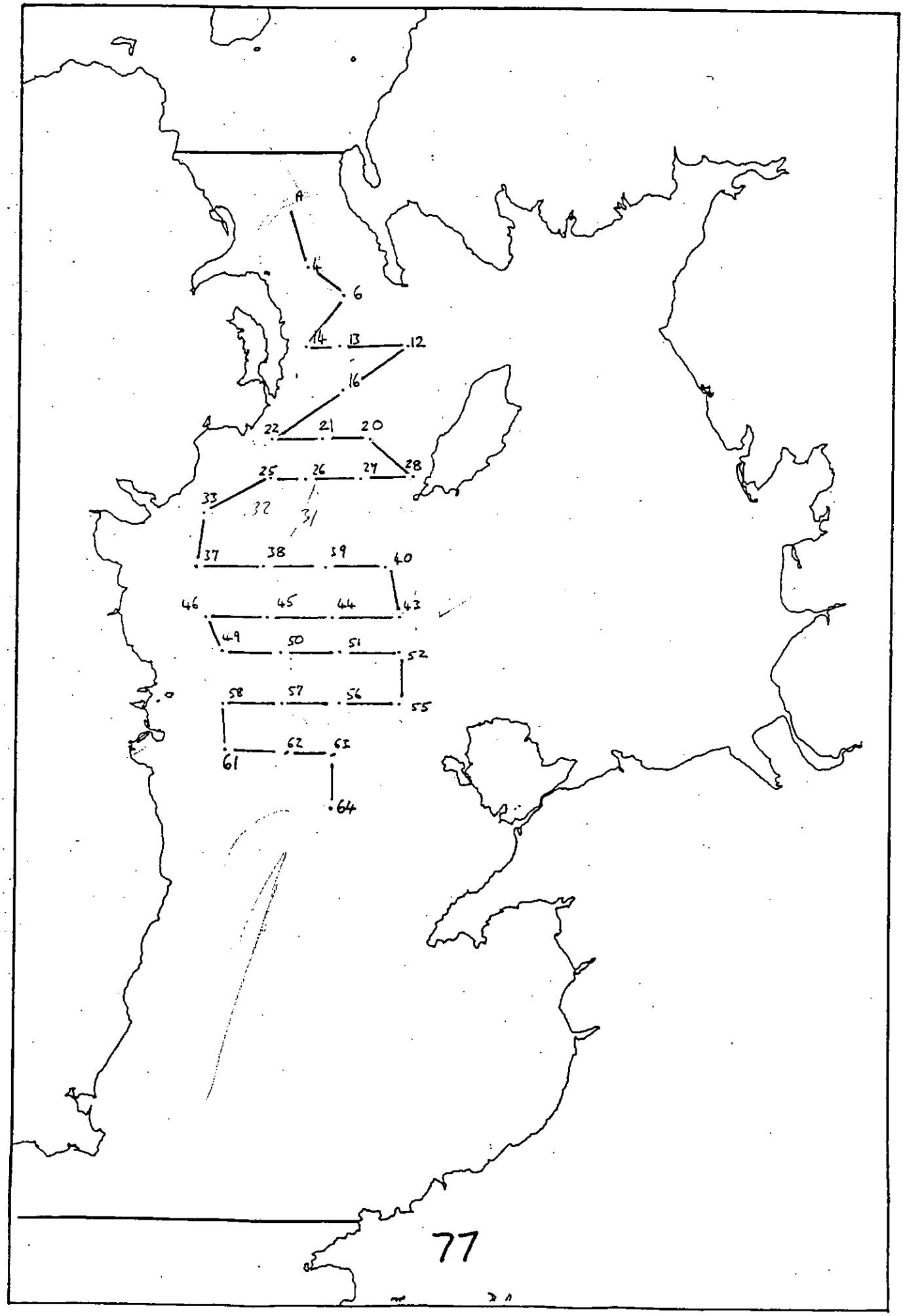
A
4
6
14
13
12
16
22
21
20
25
26
27
28
33
32
31
37
38
39
40
46
45
44
43
49
50
51
52
58
57
56
55
61
62
63
64

FIGURE 3

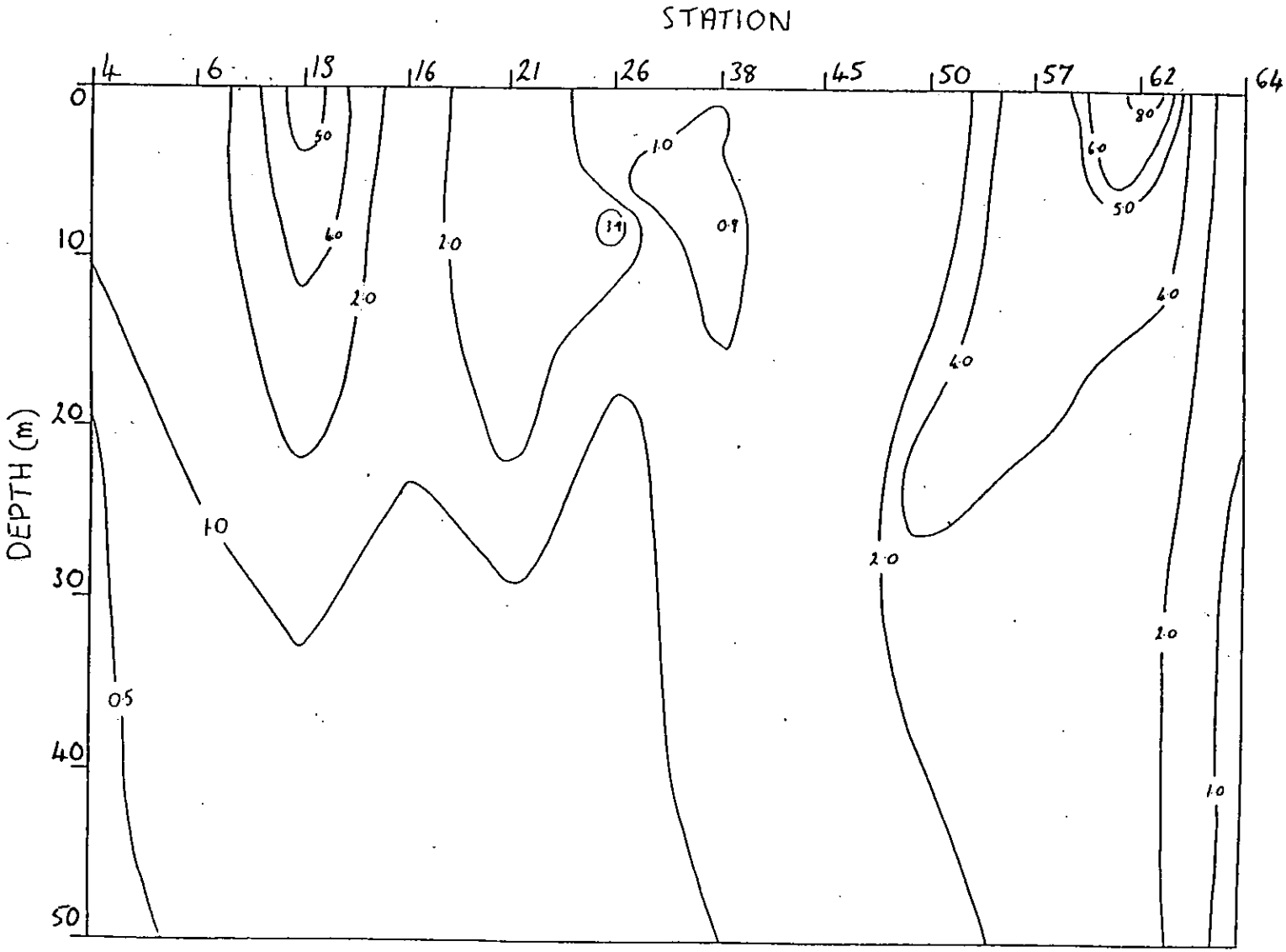
STATION
4
6
18
16
21
26
38
45
50
57
62
64
DEPTH (m)
0
10
20
30
40
50
.50
.40
2.0
2.0
1.9
1.0
0.9
1.0
0.5
2.0
4.0
4.0
6.0
5.0
8.0
2.0
1.0

FIGURE 2

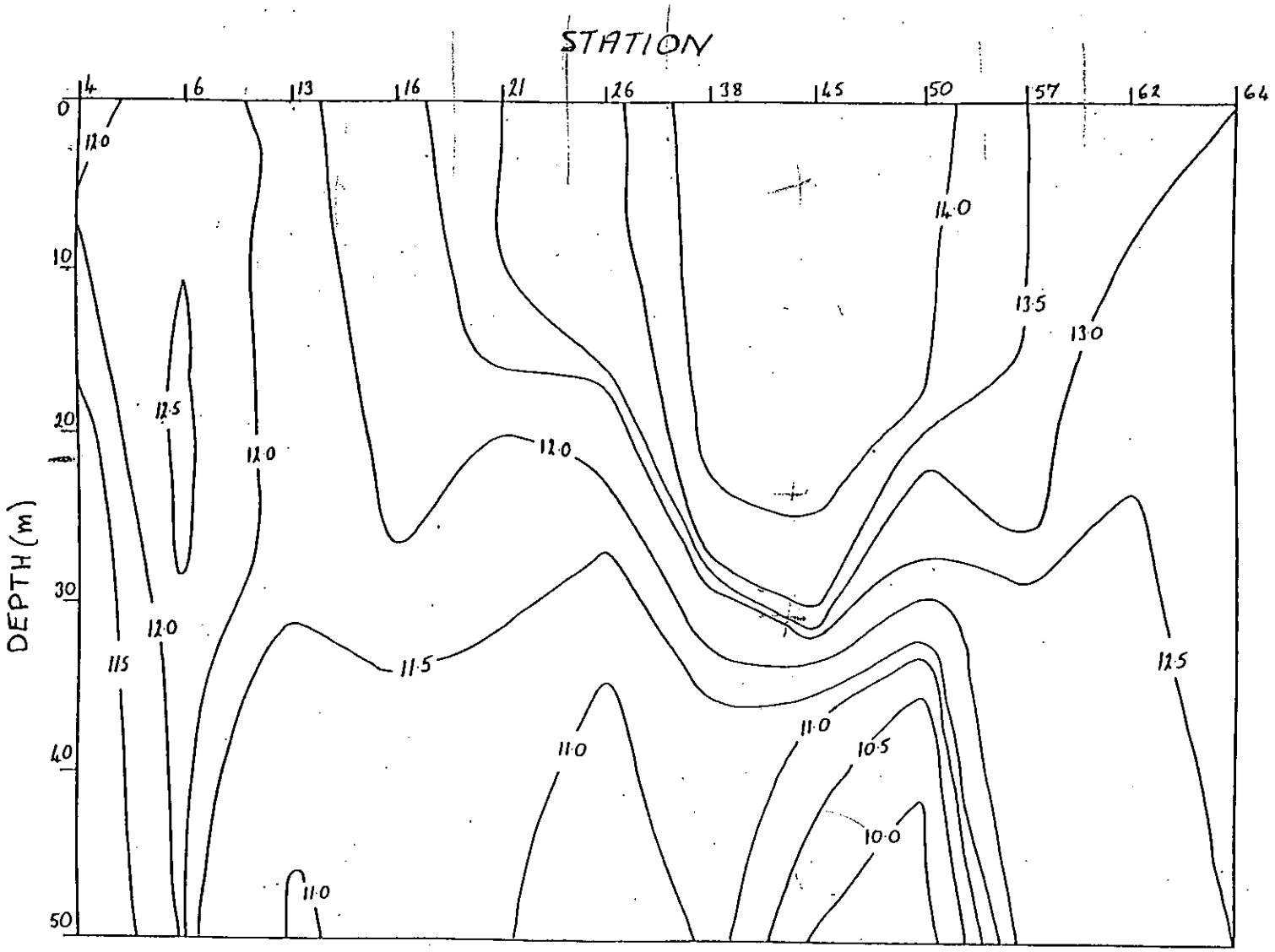
STATION
4
6
13
16
21
26
38
45
50
57
62
64
0
10
20
30
40
50
DEPTH (m)
12·0
12·5
12·0
11·5
12·0
11·5
12·0
11·5
11·0
11·0
11·0
10·5
10·0
14·0
13·5
13·0
12·5

FIGURE 4