COMMONWEALTH OF AUSTRALIA

Commonwealth Scientific and Industrial Research Organization

Division of Fisheries and Oceanography

REPORT 30

F.R.V. "DERWENT HUNTER"

Scientific Report of Cruise 10/58
June 6 - 16, 1958

Scientific Report of Cruise 11/58
June 19 - 26, 1958

Scientific Report of Cruise 13/58
July 28 - August 3, 1958

Scientific Report of Cruise 14/58
August 5 - 9, 1958

Scientific Report of Cruise 15/58
Parts I and II August 16 - 26,
28 - September 2, 1958

Scientific Report of Cruise 16/58
October 2 - 10, 1958

Scientific Report of Cruise 17/58
Parts I and II
October 15 - 25, 26 - 31, 1958

Scientific Report of Cruise 18/58
November 4 - 7, 1958

Scientific Report of Cruise 20/58 - Parts I and II
December 1 - 10, 11 - 17, 1958

Marine Biological Laboratory
Cronulla, Sydney
1960

F.R.V. "DERWENT HUNTER"

F.R.V. "Derwent Hunter" is the Division's 72 ft research vessel operating from Sydney. She is an auxiliary schooner powered with a 68 h.p. Gardner diesel. She has two Kelvin Hughes echosounders, a Type 24B and a Type 24E. The deck winch is hydraulically operated.

CREW

Master	- Captain R.M. Davies (June 6 - September 2, 1958)
	- Captain P.S. Bowes (October 2 - December 17, 1958)
Mate	- R.W. Spaulding
Engineer	- H. Davenport (June 6 - 26, 1958)
	- G. Nesvadba (June 28 - September 2, 1958)
	- H. O'Donovan (October 2 - December 17, 1958)
Deckhands	- G. Ross
	- W. Elsmore
Cook	- A. Jackson
Oceanographical Assistant	- J. Staniforth

At the beginning of the period under review the vessel was in Melbourne. Cruise 10/58 was designed to collect samples for hydrology, phytoplankton, pigments, and to measure the rate of CO_2 uptake at certain stations between Melbourne and Sydney. Owing to bad weather off the New South Wales coast the programme was considerably curtailed.

The study of the structure and dynamics of the East Australian Current was continued. The report of Cruise DH11/58 gives the detail of the eleventh and DH16/58 the twelfth of this series. In July 1958, it was decided to extend the scope of this study so that certain cruises -

When citing this report abbreviate as follows:
C.S.I.R.O. Aust. Div. Fish. Oceanogr. Rep. No. 30

DH15/58, DH17/58, and DH20/58 - covered a greater area than the first cruises of this series. Each of these was divided into four sections: (1) Sydney to Lord Howe Island, (2) Lord Howe Island to Coff's Harbour, (3) Coff's Harbour to an easterly position (157°15'E. 35°40'S.), (4) from this position to Sydney. The scientific work done on each cruise was also extended so that it included the collection of samples for hydrology, pigments, and phytoplankton; the use of the G.E.K., the measurement of light penetration, and the collection and incubation of samples for the measurement of the rate of CO_2 uptake.

Cruises 13/58 and 14/58 were short cruises off Sydney to measure CO_2 uptake.

Cruises 12/58 and 19/58 were short cruises to test zooplankton collecting gear and methods, their results are not discussed here.

The oceanographical data used in the preparation of the reports of these cruises have been published in C.S.I.R.O. Aust. (1960).- Oceanographical investigations from F.R.V. "Derwent Hunter," 1958. C.S.I.R.O. Aust. Oceanogr. Sta. List 41.

F.R.V. "DERWENT HUNTER"

SCIENTIFIC REPORT OF CRUISE DH10/58

June 6 - 16, 1958

SCIENTIFIC PERSONNEL

N. Dyson (in charge)

ITINERARY

The vessel was in Melbourne at the commencement of this cruise. It was planned to measure the rate of CO_2 uptake, submarine light penetration, and pigment content in conjunction with hydrological observations in the waters at the eastern approaches of Bass Strait. This was to have been followed by sampling at the line of productivity stations to the east of Port Hacking. Adverse weather prevented the second part of the programme. Figure 1 shows the track chart and station positions.

RESULTS

(a) PRODUCTIVITY - N. DYSON

1. CO_2 Uptake

At each station the rate of uptake of samples from 0, 25, 50, and 100 m was measured both by half-day in situ, and four-hourly bath incubations. These in situ incubations were carried out for half-day periods, from sunrise to noon. The results obtained were doubled to obtain the daily rate of production in mg C/day/m^3. These results, which are shown in Figures 2-5, were the highest yet obtained in the productivity investigations in the Tasman Sea.

2. Light penetration

Submarine light was measured at the first three stations and the results calculated to give the depth of penetration of 1 per cent. of surface light. The results were 98, 90, and 90 m respectively.

(b) HYDROLOGY - A.D. CROOKS

Hydrology samples were collected at only four stations to 1000 m for chlorinity, dissolved oxygen, and total phosphorus. Mean total phosphorus values (0.44 - 0.52 µg at.P/l), oxygen saturation percentages (90-94%), and near homogeneity of temperature and chlorinity within the upper 100 m of water at Stations DH10/93-96/58 indicated that deeper waters had been mixed into surface layers.

(c) PIGMENTS - G.F. HUMPHREY

Samples for pigment determination were collected at Stations DH10/93-96/58. The results in C.S.I.R.O. Aust. (1960) are graphed in Figure 6.

LEGENDS FOR FIGURES 1-6 - Cruise DH10/58

Fig. 1. Track chart showing positions of stations.

Fig. 2. Rate of CO_2 uptake at Station DH10/93/58.

Fig. 3. Rate of CO_2 uptake at Station DH10/94/58.

Fig. 4. Rate of CO_2 uptake at Station DH10/95/58.

Fig. 5. Rate of CO_2 uptake at Station DH10/96/58.

Fig. 6. Depth profiles of pigment concentrations.

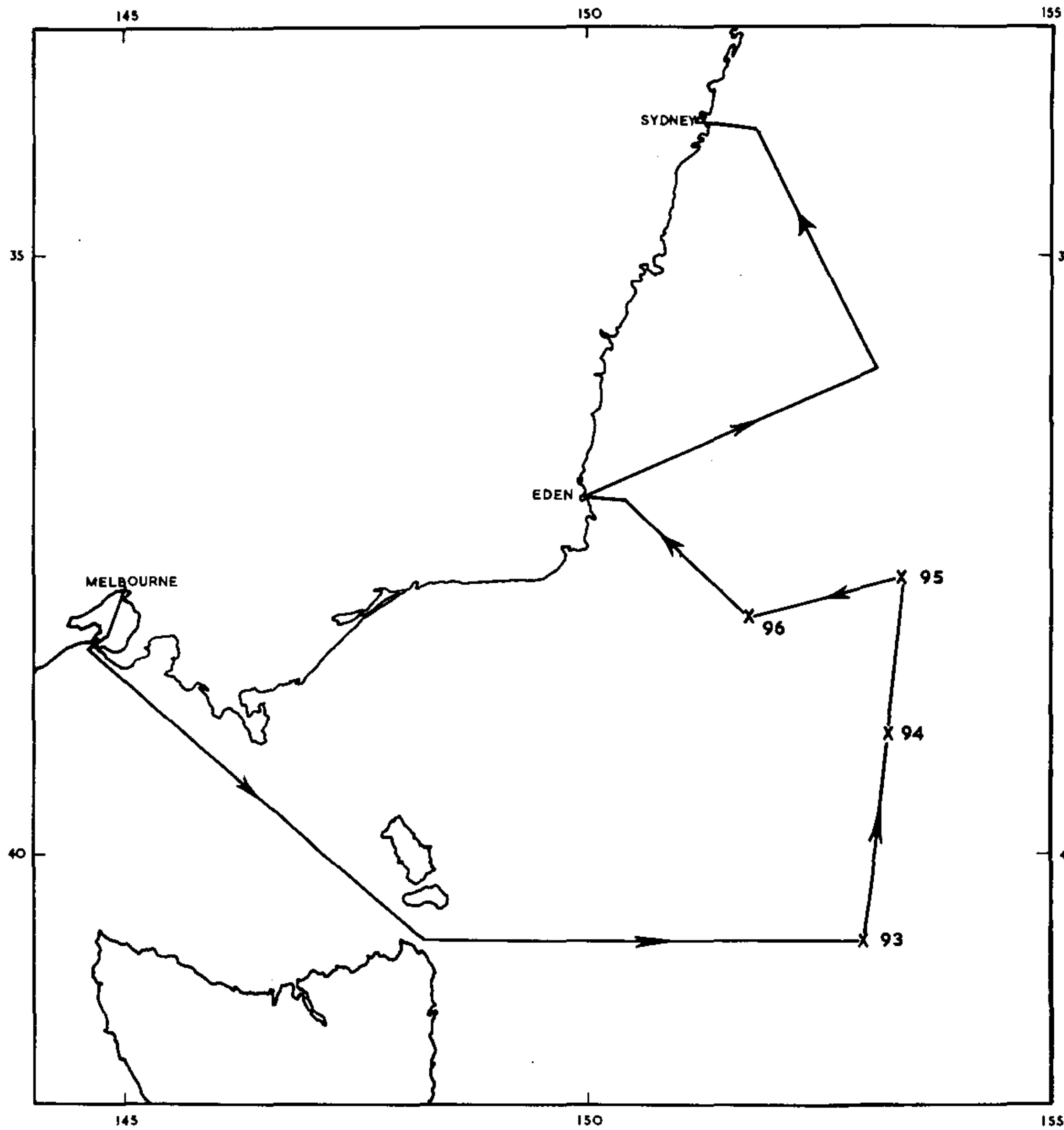


Fig. 1

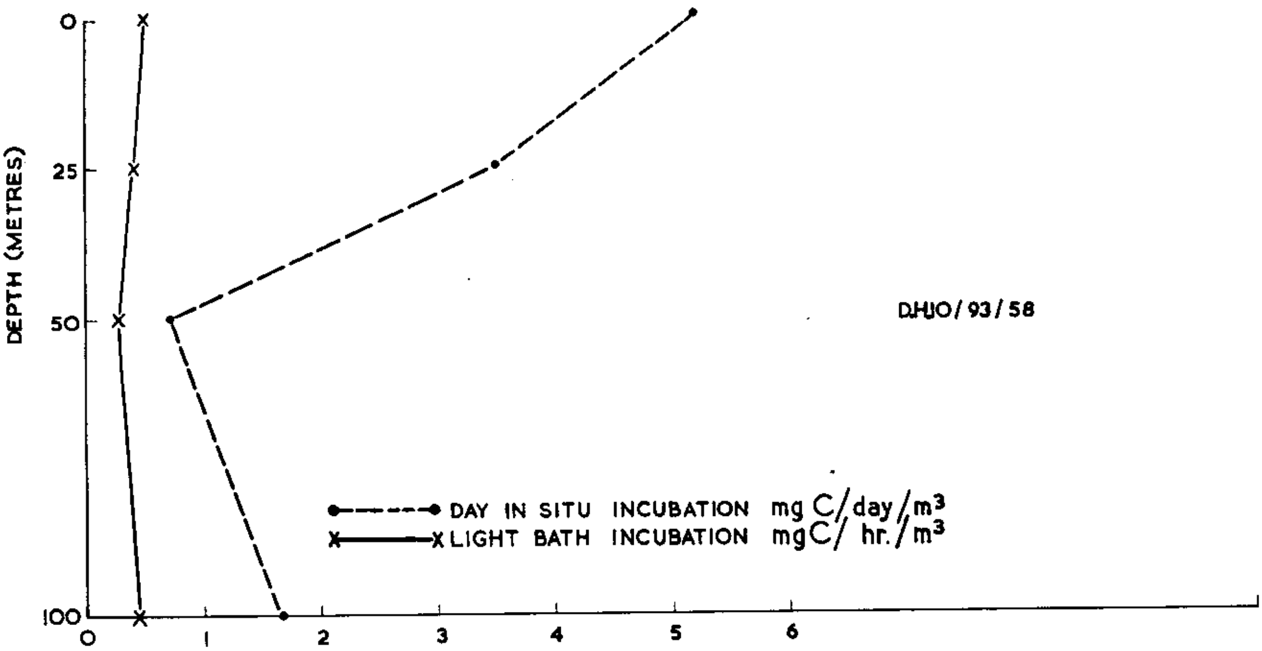


Fig. 2

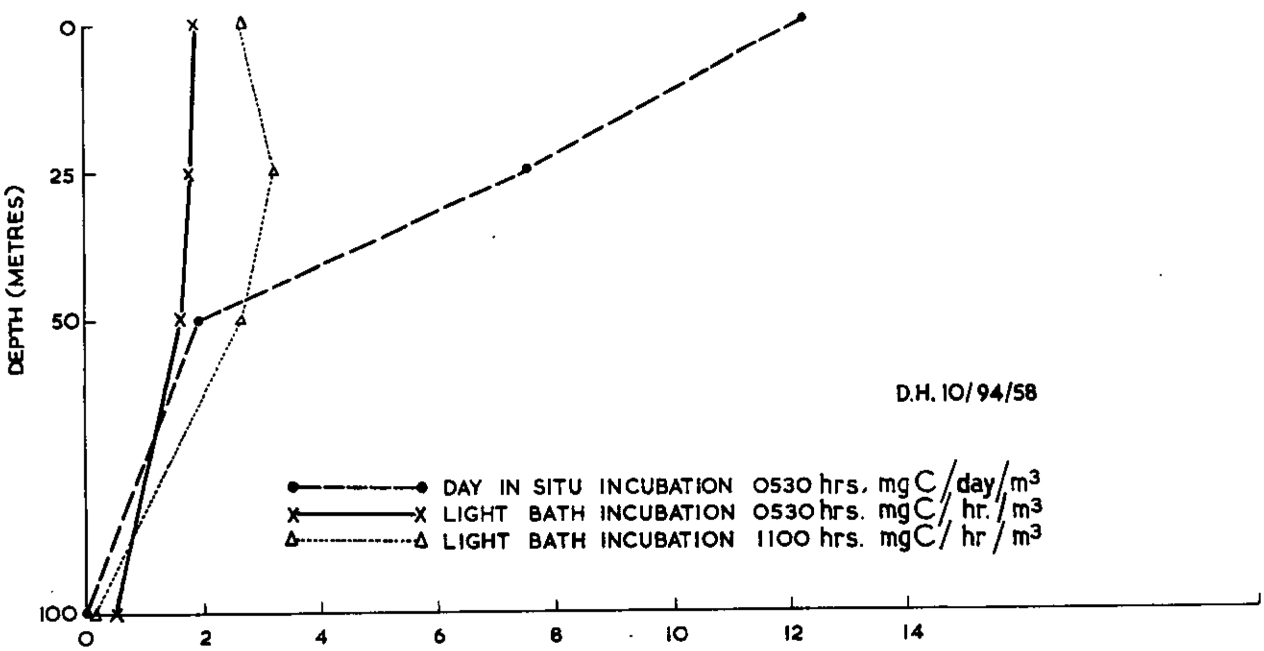


Fig. 3

mg C/m³

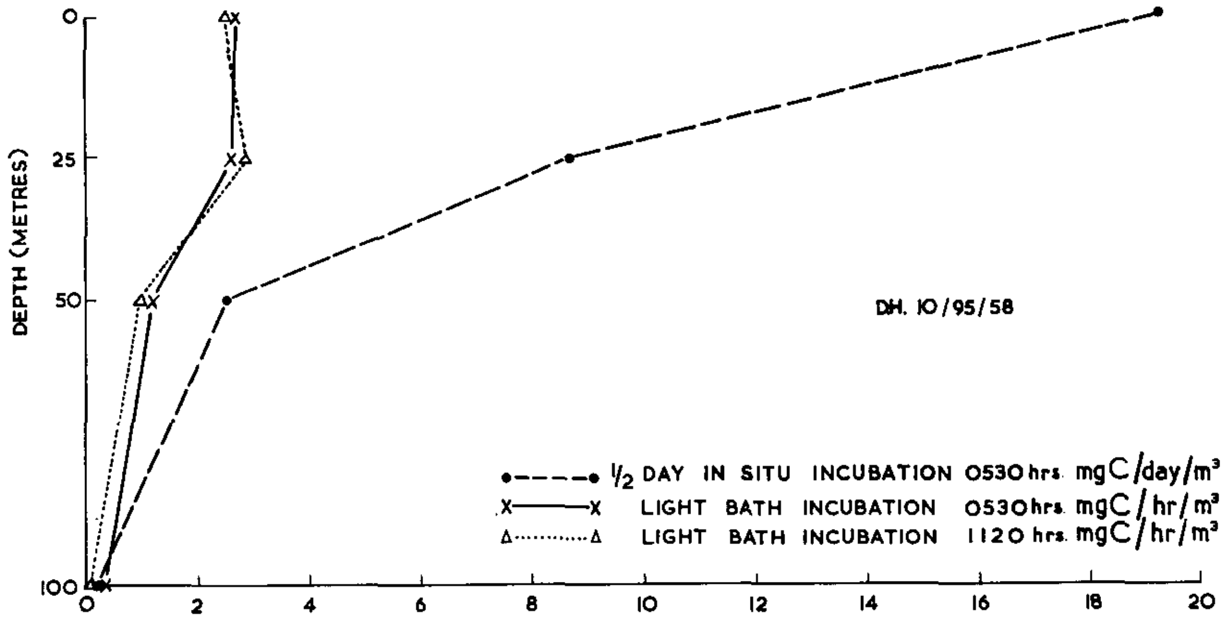
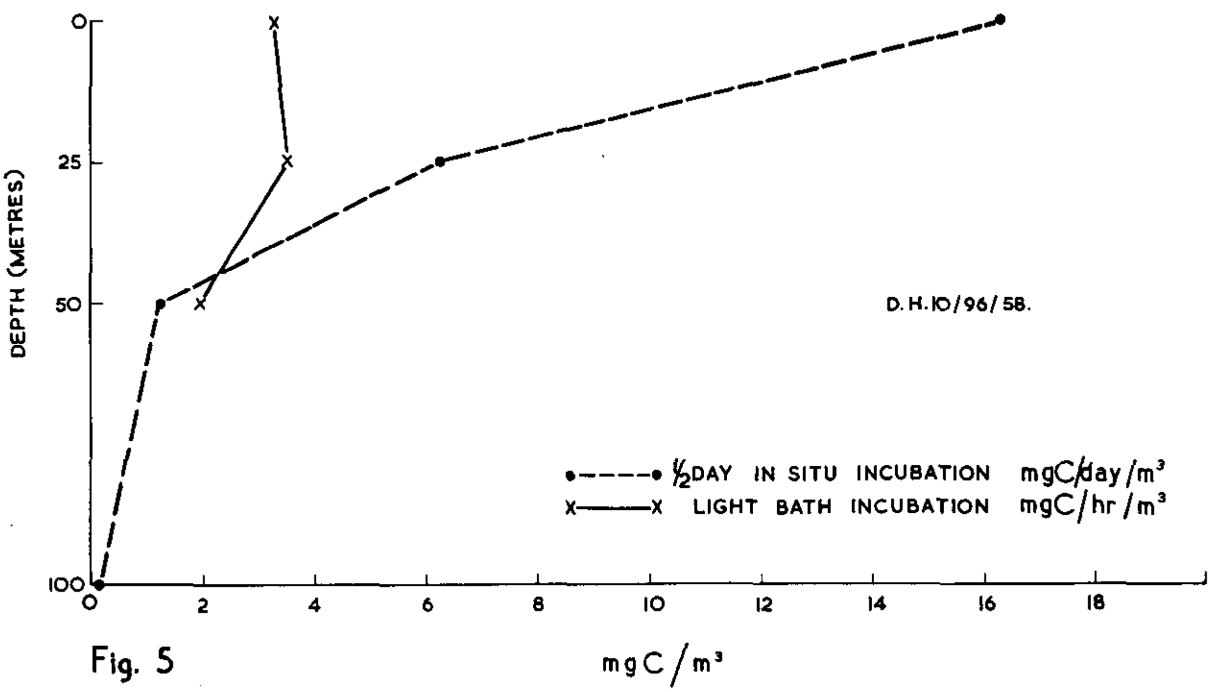

DEPTH (METRES)
0
25
50
100
0
2
4
6
8
10
12
14
16
18
20
DH. 10/95/58
½ DAY IN SITU INCUBATION 0530 hrs. mgC/day/m³
LIGHT BATH INCUBATION 0530 hrs. mgC/hr/m³
LIGHT BATH INCUBATION 1120 hrs. mgC/hr/m³

Fig. 4


DEPTH (METRES)
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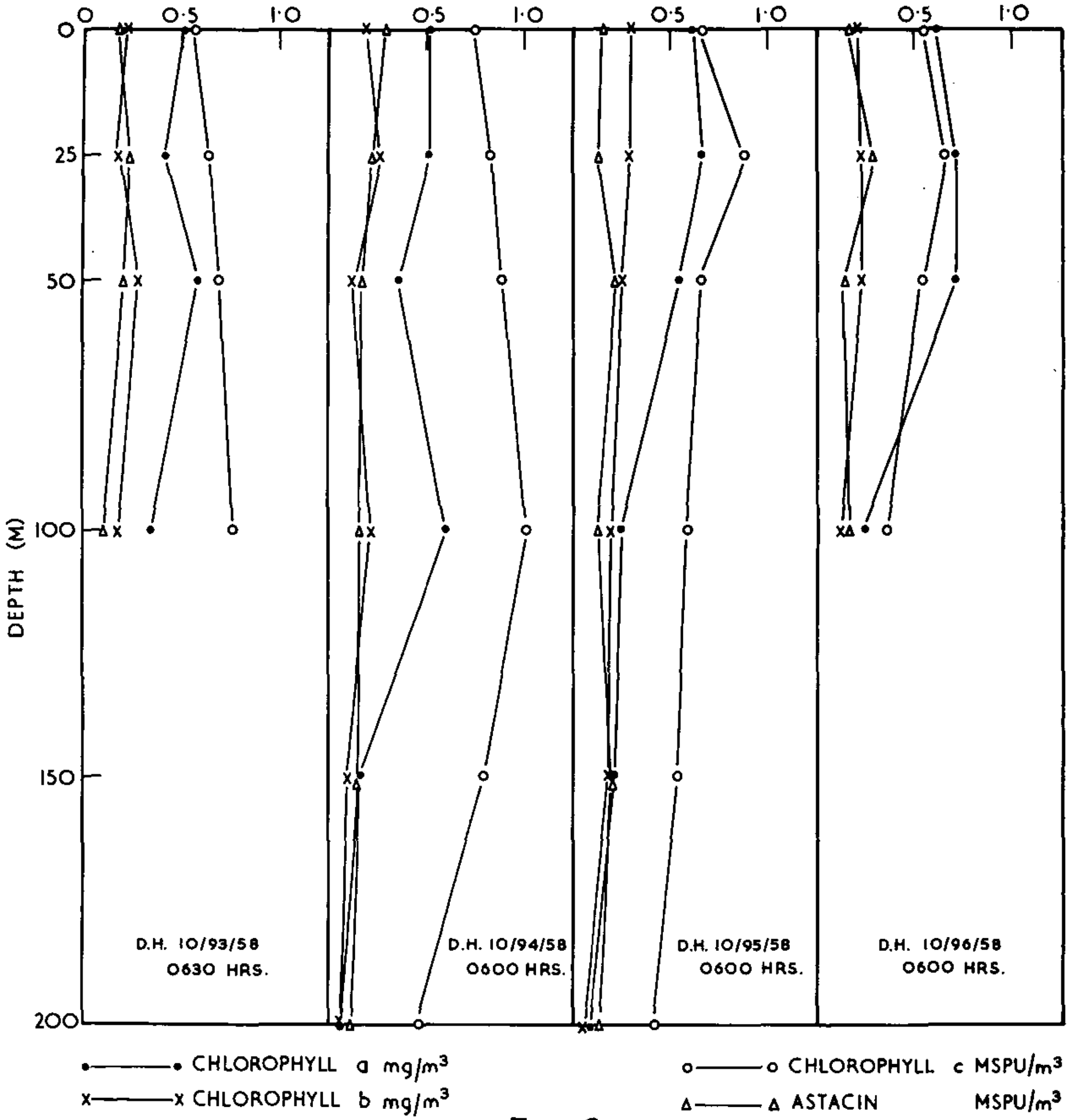
25
50
100
0
2
4
6
8
10
12
14
16
18
D. H. 10/96/58.
½ DAY IN SITU INCUBATION mgC/day/m³
LIGHT BATH INCUBATION mgC/hr/m³
mgC/m³

Fig. 5



0
0·5
1·0
DEPTH (M)
0
25
50
100
150
200
D.H. 10/93/58
0630 HRS.
D.H. 10/94/58
0600 HRS.
D.H. 10/95/58
0600 HRS.
D.H. 10/96/58
0600 HRS.
CHLOROPHYLL a mg/m³
CHLOROPHYLL b mg/m³
CHLOROPHYLL c MSPU/m³
ASTACIN MSPU/m³

Fig. 6

F.R.V. "DERWENT HUNTER"

SCIENTIFIC REPORT OF CRUISE DH11/58

June 19 - 26, 1958

SCIENTIFIC PERSONNEL

J. Staniforth (in charge)
N. Dyson

ITINERARY

This is the eleventh of the series of cruises to study the structure and circulation of the East Australian Current off Sydney. Figure 1 shows the positions of the stations and the work done at each station.

SCIENTIFIC REPORTS

Hydrological sampling at depths 0, 25, 50, 75, 100, 150, 200, 300, 500, 750, 1000, and 1500 m was carried out for chlorinity, dissolved oxygen, and total phosphorus. Paired protected and unprotected thermometers were used to calculate thermometric depths below 100 m. Figure 1 shows the stations at which G.E.K. tows, B.T. lowerings, and phytoplankton samples were collected. CO_2 uptake studies, which previously had been done on separate short cruises immediately following that to study the East Australian Current, were done at the same time on this occasion. Samples were also collected for the estimation of plankton pigments.

(a) HYDROLOGY - A.D. CROOKS

1. Temperature

(a) 110°T Section Line (Fig. 2)

Maximum surface temperature (21.03°C) was recorded at Station DH11/98/58 and minimum temperature (17.18°C) at Station DH11/100/58. Between Stations DH11/98 and 99/58 there occurred a region of homogeneous water, with average depth of 120 m, with temperatures ranging from 20.97°C - 21.03°C. On either side of this region surface temperatures decreased rapidly. Warmest water was found at all depths at Station DH11/99/58 and the coldest at Station DH11/100/58.

(b) 290°T Section Line (Fig. 3)

Maximum surface temperature (21.13°C) was recorded at Station DH11/108/58 and minimum temperature (17.62°C) at Station DH11/104/58. Between Stations DH11/106 and 108/58 the homogeneous surface water with average depth of 150 m had temperatures ranging from 20.00°C to 20.80°C. Below the surface maximum temperature was recorded at Station DH11/107/58 and minimum at Station DH11/105/58.

2. Density (σ_t)

(a) 110°T Section Line (Fig. 4)

Maximum surface density (25.98 σ_t) occurred at Station DH11/100/58 and minimum (25.00 σ_t) at Station DH11/98/58. Between Stations DH11/98 and 99/58 there was a homogeneous layer of water corresponding to the high temperature region noted above. Surrounding this homogeneous layer was a very weak pycnocline. At all depths maximum density waters occurred at Station DH11/100/58 and minimum at Station DH11/99/58.

(b) 290°T Section Line (Fig. 5)

Maximum surface density (25.82 σ_t) occurred at Station DH11/104/58 and minimum (24.92 σ_t) at Station DH11/108/58. The layer of homogeneous surface water was apparent in the density section. A pycnocline was observed at about 100 m at Station DH11/108/58. The vertical gradient was 0.002 σ_t/m.

3. Chlorinity

(a) 110°T Section Line (Fig. 6)

Maximum surface chlorinity (19.73 ‰) occurred at Stations DH11/98 and 99/58 and minimum (19.67 ‰) at Station DH11/100/58. The homogeneous layer was evident to a greater depth (160 m) in chlorinity (with a range of 19.70 - 19.73 ‰) and it extended westward to Station DH11/91/58. Below the surface the chlorinity minimum (19.10 ‰) occurred between 875 m at Station DH11/100/59 and 1075 m at Station DH11/98/58. On this section there was a close relation between chlorinity and density, but there were small anomalies below 600 m at Station DH11/98/58.

(b) 290°T Section Line (Fig. 7)

Maximum surface chlorinity (19.73 ‰) was observed at Stations DH11/106 and 107/58 and a minimum (19.69 ‰) at Stations DH11/104 and 108/58. A surface layer of almost homogeneous chlorinity extended to 200 m at Station DH11/107/58. The dotted line in Figure 7 indicates that a chlorinity maximum above 100 m occurred at all stations except Station DH11/104/58. The depth of the intermediate chlorinity maximum was not reached on this section. There was a close relation between the chlorinity and density distributions.

4. Percentage Oxygen Saturation

(a) 110°T Section Line (Fig. 8)

Maximum surface percentage oxygen saturation (94%) was found at Station DH11/99/58 and minimum (90%) at Stations DH11/97 and 100/58. Within the homogeneous layer, the percentage oxygen saturation was greater than 95%. Below 200 m the highest oxygen saturation values were found at Station DH11/98/58 and the lowest at Station DH11/100/58.

The dotted lines in Figure 8 indicate two oxygen minima. The first, less than 85% with an average depth of about 30 m, occurred in the cooler water to the east of Station DH11/99/58. The second between 70 and 75% occurred throughout the section and was 300 m in depth at Station DH11/99/58 and 100 m at Station DH11/100/58.

The oxygen and density distribution were similar except above 200 m between Stations DH11/99 and 100/58.

(b) 290°T Section Line (Fig. 9)

Maximum surface oxygen (97%) was observed at Station DH11/104/58 and minimum (80%) at Station DH11/107/58. High oxygen values were recorded to 300 m in the region of the homogeneous stratum, but two small areas of minimum oxygen were recorded, one at the surface at Station DH11/107/58 and the other at 40 m at Station DH11/106/58. The distribution of oxygen paralleled that of density with only small anomalies at Stations DH11/104, 106, 109/58.

5. Total Phosphorus

(a) 110°T Section Line (Fig. 10)

Maximum surface total phosphorus (0.44 µg at./l) was recorded at Stations DH11/100 and 102/58 and minimum (0.3 µg at./l) at Station DH11/98/58. At other depths the maximum was at Station DH11/100/58 and the minimum at DH11/98/58. The density total phosphorus relation was close throughout the section below 400 m.

(b) 290°T Section Line (Fig. 11)

Maximum surface total phosphorus (0.48 µg at./l) was recorded at Station DH11/104/58 and minimum (0.33 µg at./l) at Stations DH11/107 and 108/58. Low total phosphorus values were associated with the homogeneous layer. Below the surface, maximum total phosphorus was observed at Station DH11/109/58 and minimum at Station DH11/107/58. The distribution of total phosphorus corresponded closely with that of density.

6. Horizontal Distribution of Properties

(a) Temperature (Fig. 12)

The temperature distribution was similar at all depths. There was a warm tongue of water with its axis in a north-south direction and an almost parallel tongue of cooler water to the east.

(b) Density (Fig. 13)

The density distribution at all depths showed clearly the two tongues of water observed in the temperature data.

(c) Chlorinity (Fig. 14)

The chlorinity distribution paralleled the distribution of density. The warm tongue was of water of high chlorinity and the cooler tongue was of low chlorinity.

(d) Percentage Oxygen Saturation (Fig. 15)

The high temperature tongue of water had a relatively high oxygen value at all depths and the cool temperature tongue had somewhat lower oxygen values, but at no point on the cruise were saturated values observed.

TABLE 1

DIATOMS IN PHYTOPLANKTON COLLECTIONS

CRUISE DH11/58

	97	98	99	100	102	104	107	108	109
Stephanopyxis palmeriana	+								
S. turris						+			
Schroederella delicatula	+					+			
Melosira crenulata								+	
Planktoniella sol	+	+	+++		+		+	+	+
Rhizosolenia alata	+	+		+	+	+	+	+	+
v. gracillima		+	+				+		
R. styliformis		+	+	+	+				+
R. clevei		+						+	+
R. imbricata			+						+
v. shrubsolei			+						+
R. bergonii			+						+
R. stolterforthii			+						+
R. styliformis v. latissima					+		+		
R. castracanei					+				
R. calcar-avis									+
Detonula confervacea				+	+				
Biddulphia sp. nov.				+					
Streptotheca thamesis	+			+					
Chaetoceros coarctatum	+	+		+	+			+	+
Ch. atlanticum									
v. neapolitanum				+					+
Ch. secundum	+								+
Ch. lorenzianum		+	+			+			+
Ch. vanheurckii		+					+		
Ch. teres						+	+	+	+
Ch. danicum								+	
Ch. eibenii									
Ch. affine									+
Ch. peruvianum									+
Hemiaulus membranaceus	+								
Guinardia flaccida		+	+	+	+		+	+	+
Coscinodiscus granii		+							
C. concinnus			+		+				
C. rex					+(frag)				
Thalassiosira subtilis				+				+	
T. aestivalis									+
T. decipiens							+		
Thalassiothrix nitzschioides									
T. longissima				+				+	
Cerataulina pelagica					+			+	
Nitzschia seriata						+			
Climacodium frauenfeldianum								+	+
Bacteriastrum hyalinum									+

TABLE 2

DINOFLAGELLATES IN PHYTOPLANKTON COLLECTIONS

CRUISE DH11/58

	97	98	99	100	102	104	107	108	109
Ceratium horridum					+				+
C. fusus			+	+	+	+		+	+
C. pentagonum								+	+
C. massiliense		+	+				+	+	+
C. tripos			+	+	+	+	+	+	+
C. trichoceros			+	+	+		+	+	+
C. gallicum			+			+		+	+
C. macroceros									+
C. carriense			+				+	+	+
C. teres					+		+		+
C. compressum									+
C. symmetricum			+			+		+	
C. contrarium	+		+					+	
C. pentagonum	+		+		+			+	
C. ranipes	+		+					+	
C. gibberum								+	
C. concilians			+					+	
C. hexacanthum			+		+			+	
C. setaceum			+					+	
C. arietinum			+					+	
C. lunula			+	+				+	
C. belone			+		+			+	
C. declinatum		+	+					+	
C. extensum		+	+		+	+		+	
C. buceros		+	+					+	
C. falcatiforme			+					+	
C. karstenii		+	+		+	+		+	
C. gravidum			+				+		
C. falcatum	+						+		
C. porrectum			+					+	

DINOFLAGELLATES IN PHYTOPLANKTON COLLECTIONS (Contd.)

CRUISE DH11/58

	97	98	99	100	102	104	107	108	109
C. candelabrum			+						
C. vultur v. sumatranum			+						
C. cephalotum			+						
C. contortum			+						
C. longissimum			+						
C. furca	+				+	+	+		
C. platycorne			+						
Pyrocystis pseudonoctiluca	+	+	+	+	+			+	+
P. biconica					+		+		
P. hamulus									
v. semicircularis			+					+	
Pyrocystis lunula			+		+				
Peridinium grande	+		+					+	
P. okamurai	+								
P. brevipes	+								
P. oceanicum		+	+					+	+
P. murrayi			+					+	+
P. pallidum							+		
P. brochii								+	
P. solidicorne									+
Ceratocorys horridum		+	+					+	
Ornithocercus thurni			+						
Ornithocercus quadratus									+
Dinophysis tripos			+					+	+
D. miles								+	
Amphisolenia bidentata			+						
Diplopsalis lenticula					+				
Podolampas palmipes							+		

(e) Total Phosphorus (Fig. 16)

The tongue of warm water had the lower total phosphorus and that of cold water the higher total phosphorus at all depths. The total phosphorus distribution paralleled that of density except in the eastern limits at 100 m.

(b) PHYSICS - B.V. HAMON

Dynamics

Figure 17 shows the dynamic heights of the surface relative to 1000 decibars, and also relative to 400 decibars. The direction of movement of the surface water, relative to either reference level, is indicated by the arrows. There is evidence of appreciable flow to the north-east about 200 miles off Sydney.

(c) PHYTOPLANKTON - E.J.F. WOOD

Collections from Stations DH11/99 and 108/58 contained an unusual number of Ceratium species indicative of East Australian Current community, and there was an extension of some of these to Stations DH11/98 and 109/58. It would appear that there was a strong southward set of surface water about 153°E. The presence of the Indonesia - New Guinea species Dinophysis miles is remarkable. This species has not hitherto been recorded south of Cairns. Podolampas palmipes occurred at Station DH11/107/58. This species characterized a water mass just south and west of Noumea during the"Quickmatch"cruise in April 1958.

All stations showed warm water species, such as Chaetoceros coarctatum, Guinardia flaccida, Planktoniella sol, and Pyrocystis which indicates the extent of tropical influence off Sydney at this time.

(d) CO_2 UPTAKE - N. DYSON

As on previous cruises the rate of uptake was measured both by in situ and light bath incubation of samples from 0, 25, 50, and 100 m.. Further samples for light bath incubation were collected during the all-day stations when time permitted. The results of the two methods of incubation are shown in Figures 18, 19, and 20.

(e) LIGHT PENETRATION - N. DYSON

Light penetration measurements were made on several occasions during each of the three all day stations to obtain information on the variability of the depth of penetration of surface light. The results are shown in Table 1.

TABLE 1

STATION	TIME	DEPTH OF PENETRATION OF 1% OF SURFACE LIGHT
DH11/97/58	1030 1245	97 76
DH11/98/58	1040 1230 1425	102 102 80
DH11/99/58	1100 1230 1410	99 85 75

(f) PIGMENTS - G.F. HUMPHREY

Samples were collected at depths from 0-200 m at Stations DH11/97-99/58. The results are in C.S.I.R.O. Aust. (1960) and are graphed in Figure 21.

LEGENDS FOR FIGURES 1 - 21 - Cruise DH11/58

Fig. 1. Track chart showing positions of stations.

Fig. 2. Sectional distribution of temperature (°C) along 110°T line to 1500 m.

Fig. 3. Sectional distribution of temperature (°C) along 290°T line to 1500 m.

Fig. 4. Sectional distribution of σ_t along 110°T line to 1500 m.

Fig. 5. Sectional distribution of σ_t along 290°T line to 1500 m.

Fig. 6. Sectional distribution of chlorinity (‰) along 110°T line to 1500 m.

Fig. 7. Sectional distribution of chlorinity (‰) along 290°T line to 1500 m.

Fig. 8. Sectional distribution of oxygen saturation (%) along 110°T line to 1500 m.

Fig. 9. Sectional distribution of oxygen saturation (%) along 290°T line to 1500 m.

Fig.10. Sectional distribution of total phosphorus (μg at./l) along 110°T line to 1500 m.

Fig.11. Sectional distribution of total phosphorus (μg at./l) along 290°T line to 1500 m.

Fig.12. Horizontal distribution of temperature, A, at 0 m; B, at 100 m; C, at 300 m at hydrology stations.

Fig.13. Horizontal distribution of density, A, at 0 m; B, at 100 m; C, at 300 m at hydrology stations.

Fig.14. Horizontal distribution of chlorinity, A, at 0 m; B, at 100 m; C, at 300 m at hydrology stations.

Fig.15. Horizontal distribution of percentage oxygen saturation, A, at 0 m; B, at 100 m; C, at 300 m at hydrology stations.

Fig.16. Horizontal distribution of total phosphorus, A, at 0 m; B, at 100 m; C, at 300 m at hydrology stations.

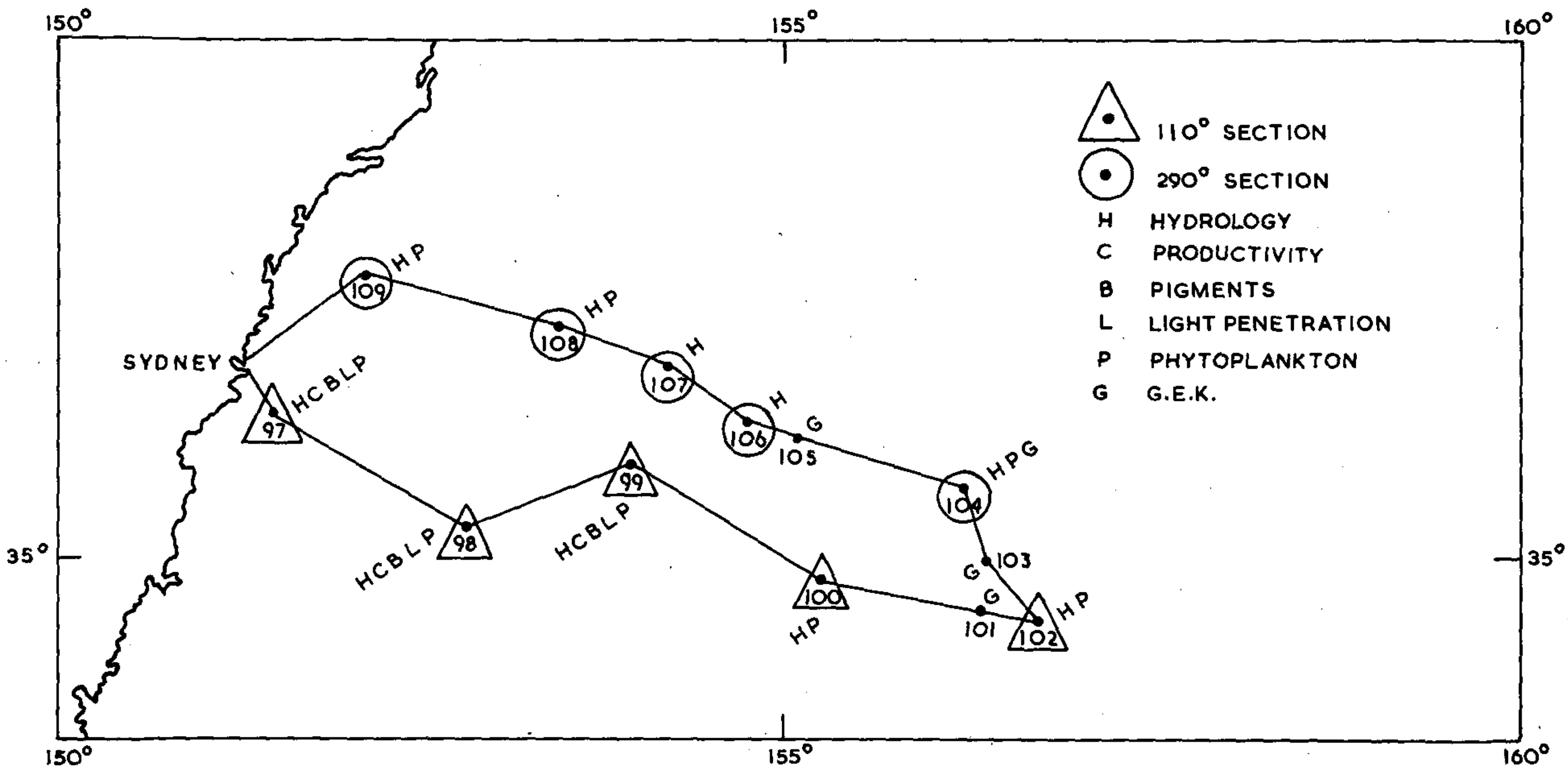
Fig.17. Dynamic topography of surface, A, relative to 1000 decibars; B, relative to 400 decibars.

Fig.18. Rates of CO_2 uptake at Station DH11/97/58.

Fig.19. Rates of CO_2 uptake at Station DH11/98/58.

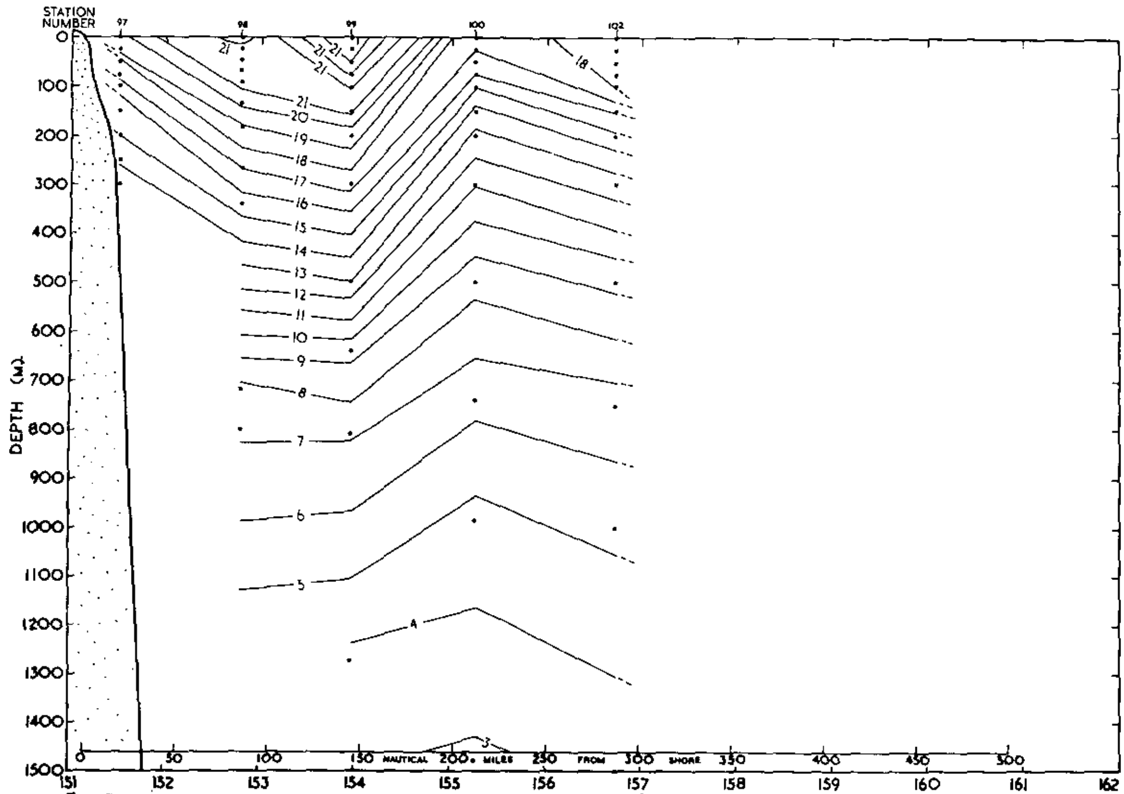
Fig.20. Rates of CO_2 uptake at Station DH11/99/58.

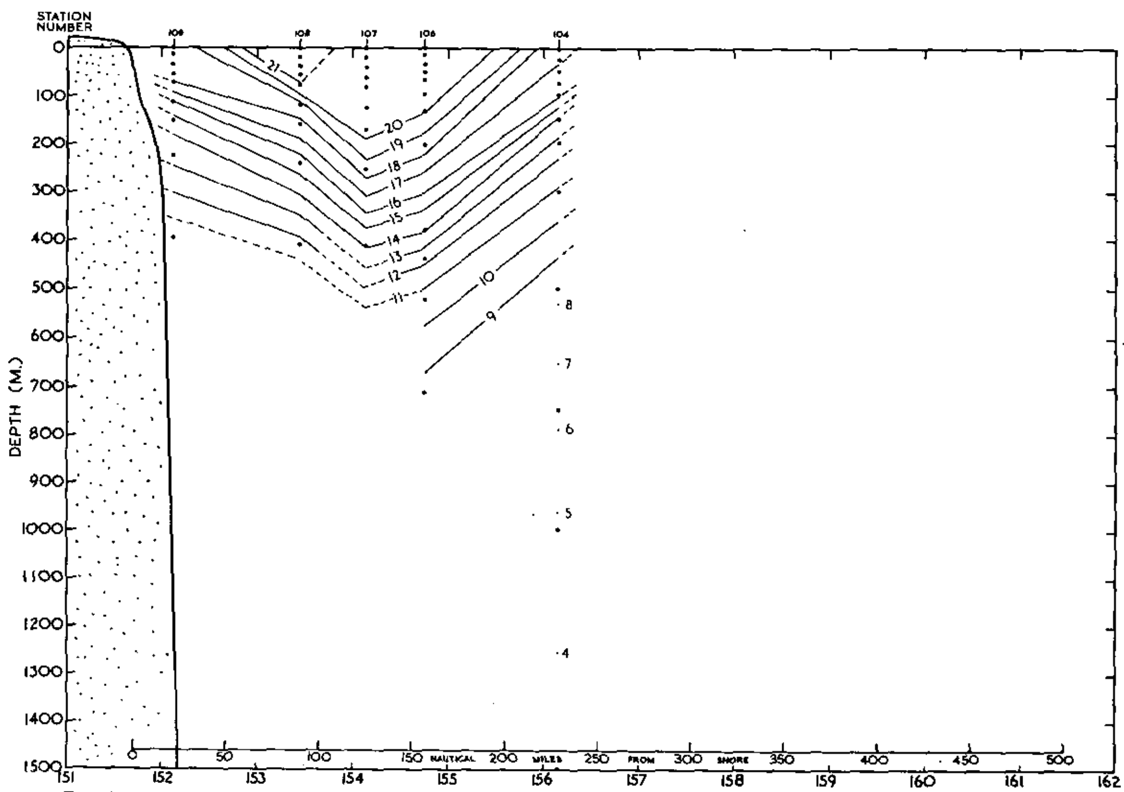
Fig.21. Depth profiles of pigment concentrations.



150°
155°
160°
35°
110° SECTION
290° SECTION
H HYDROLOGY
C PRODUCTIVITY
B PIGMENTS
L LIGHT PENETRATION
P PHYTOPLANKTON
G G.E.K.
SYDNEY
HP
109
108
H
107
106
G
105
HPG
104
103
101
HCBLP
97
98
99
100
102

Fig. 1


STATION NUMBER
97
98
99
100
102
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE °E.
Fig. 2


STATION NUMBER
109
108
107
106
104
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)
Fig. 3

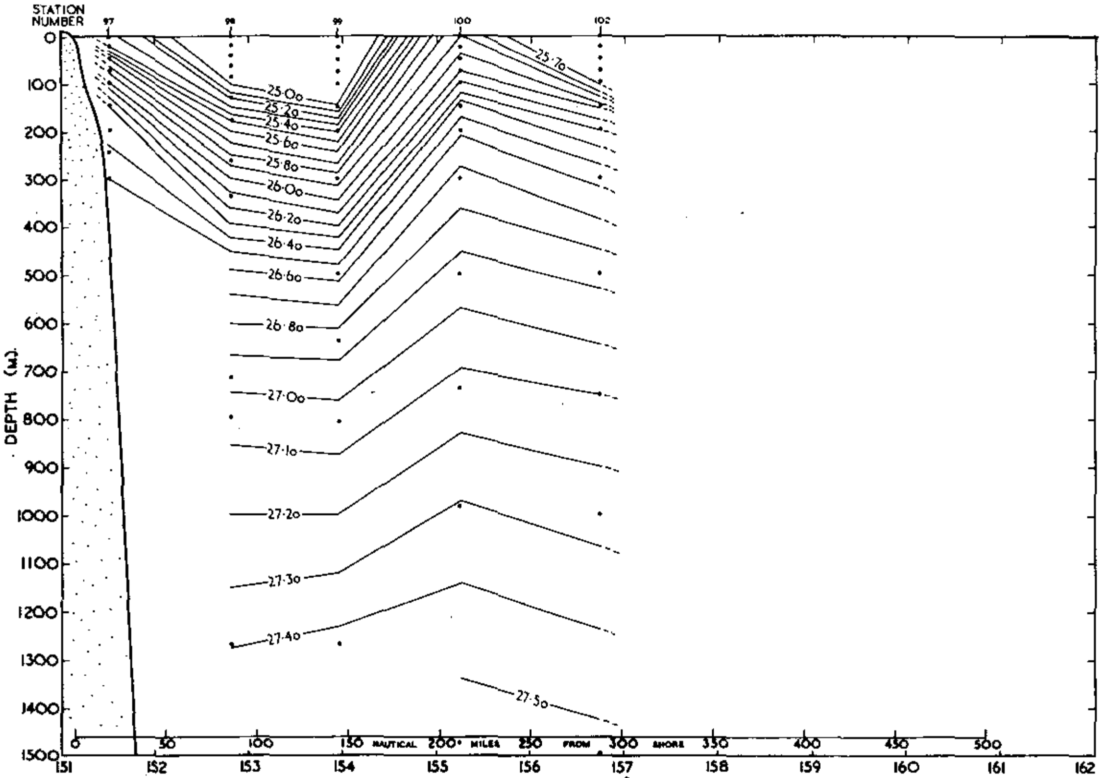

STATION NUMBER
97
98
99
100
102
DEPTH (M.)
25·00
25·20
25·40
25·60
25·80
26·00
26·20
26·40
26·60
26·80
27·00
27·10
27·20
27·30
27·40
27·50
25·70
NAUTICAL MILES FROM SHORE
LONGITUDE °E.

Fig. 4

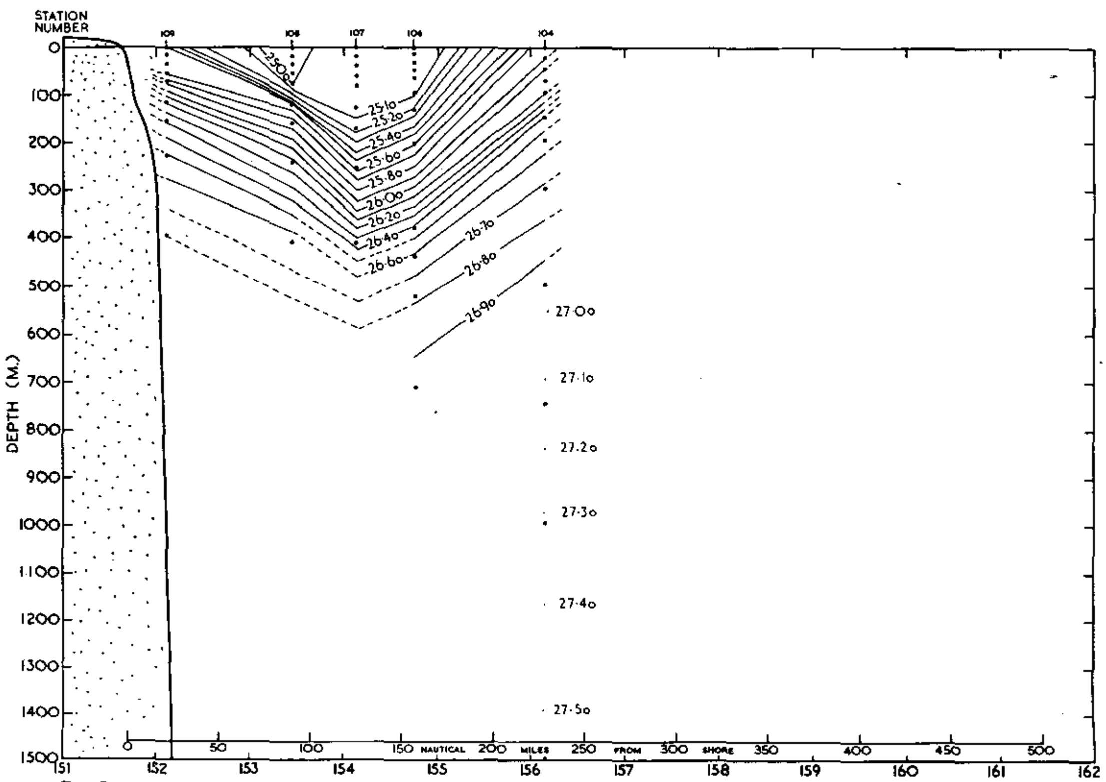

STATION NUMBER
109
108
107
106
104
DEPTH (M.)
25·00
25·10
25·20
25·40
25·60
25·80
26·00
26·20
26·40
26·60
26·70
26·80
26·90
27·00
27·10
27·20
27·30
27·40
27·50
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)

Fig. 5

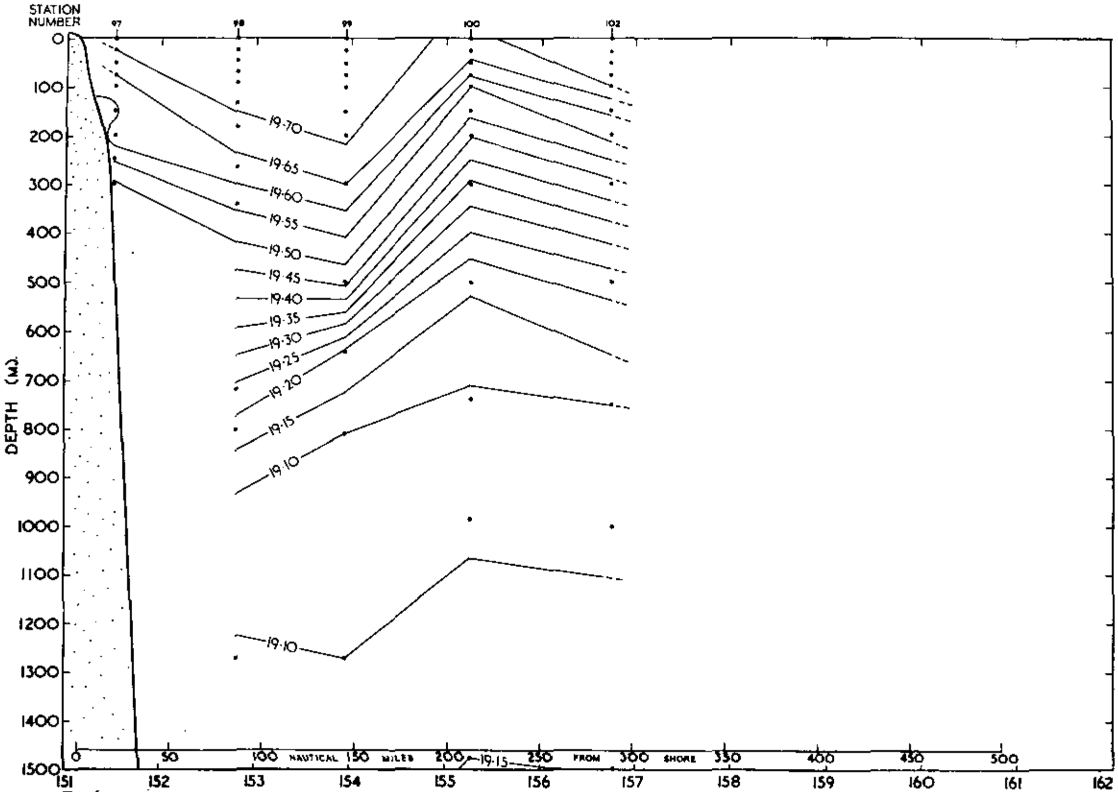

STATION NUMBER
97
98
99
100
102
DEPTH (M.)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
19·70
19·65
19·60
19·55
19·50
19·45
19·40
19·35
19·30
19·25
19·20
19·15
19·10
19·10
19·15
0 50 100 NAUTICAL 150 MILES 200 250 FROM 300 SHORE 350 400 450 500
151 152 153 154 155 156 157 158 159 160 161 162
LONGITUDE °E.

Fig. 6

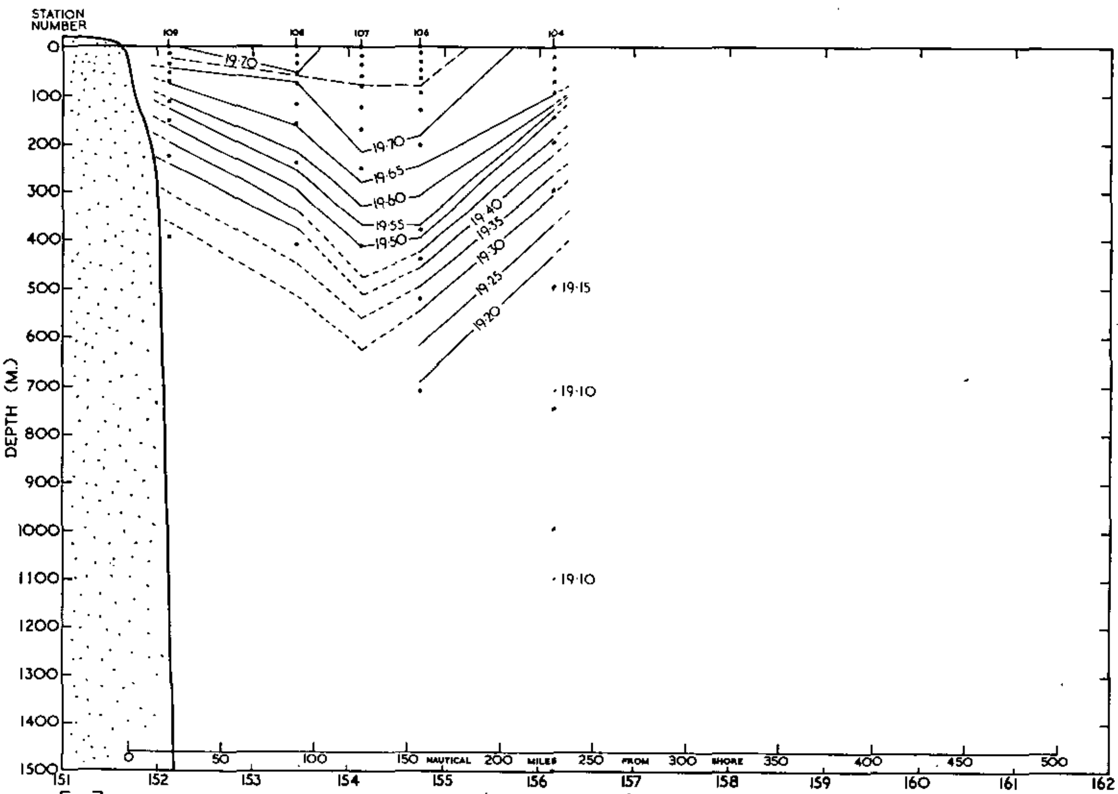
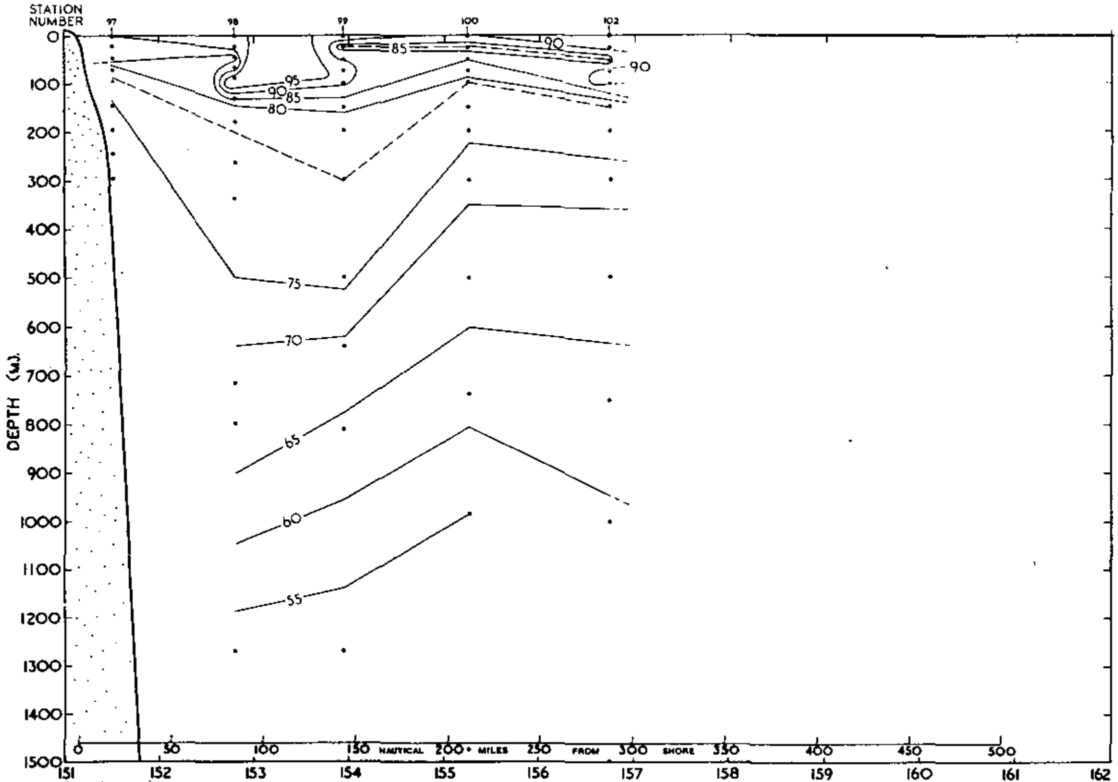
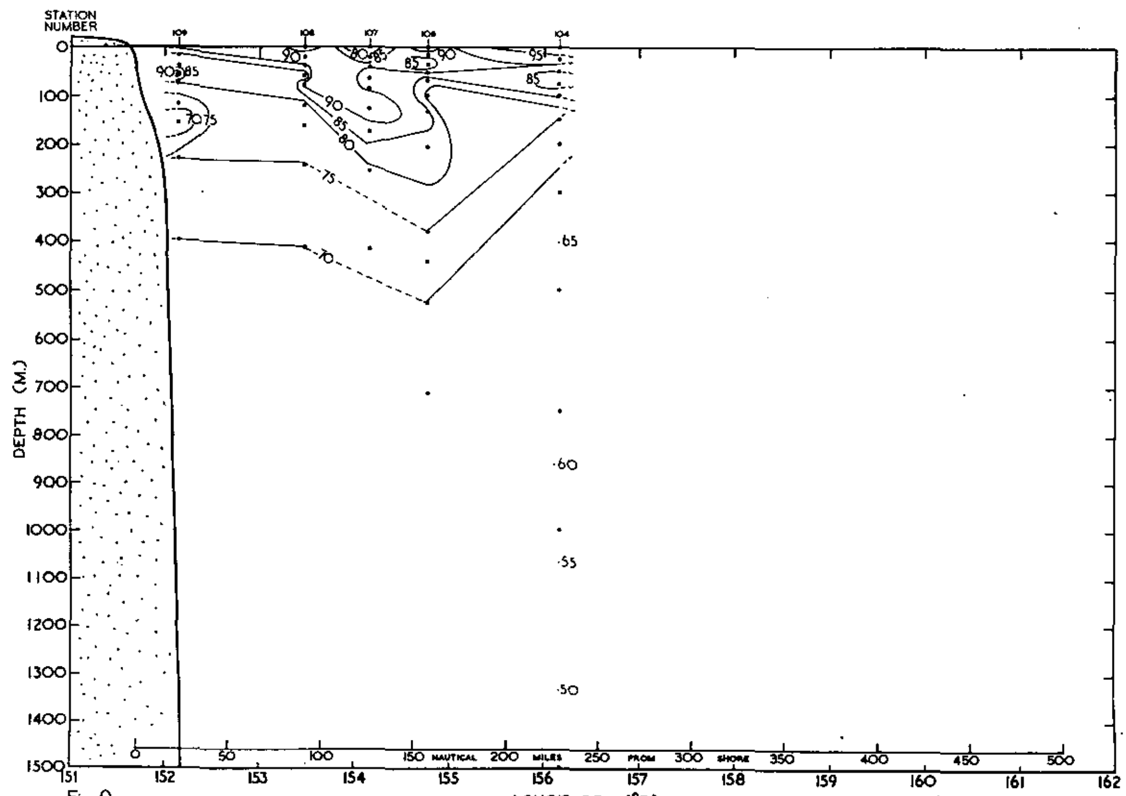

STATION NUMBER
109
108
107
106
104
DEPTH (M.)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
19·70
19·70
19·65
19·60
19·55
19·50
19·40
19·35
19·30
19·25
19·20
19·15
19·10
19·10
0 50 100 150 NAUTICAL 200 MILES 250 FROM 300 SHORE 350 400 450 500
151 152 153 154 155 156 157 158 159 160 161 162
LONGITUDE (°E.)

Fig. 7



STATION NUMBER
97
98
99
100
102
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE °E.

Fig. 8



STATION NUMBER
109
108
107
106
104
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)

Fig. 9

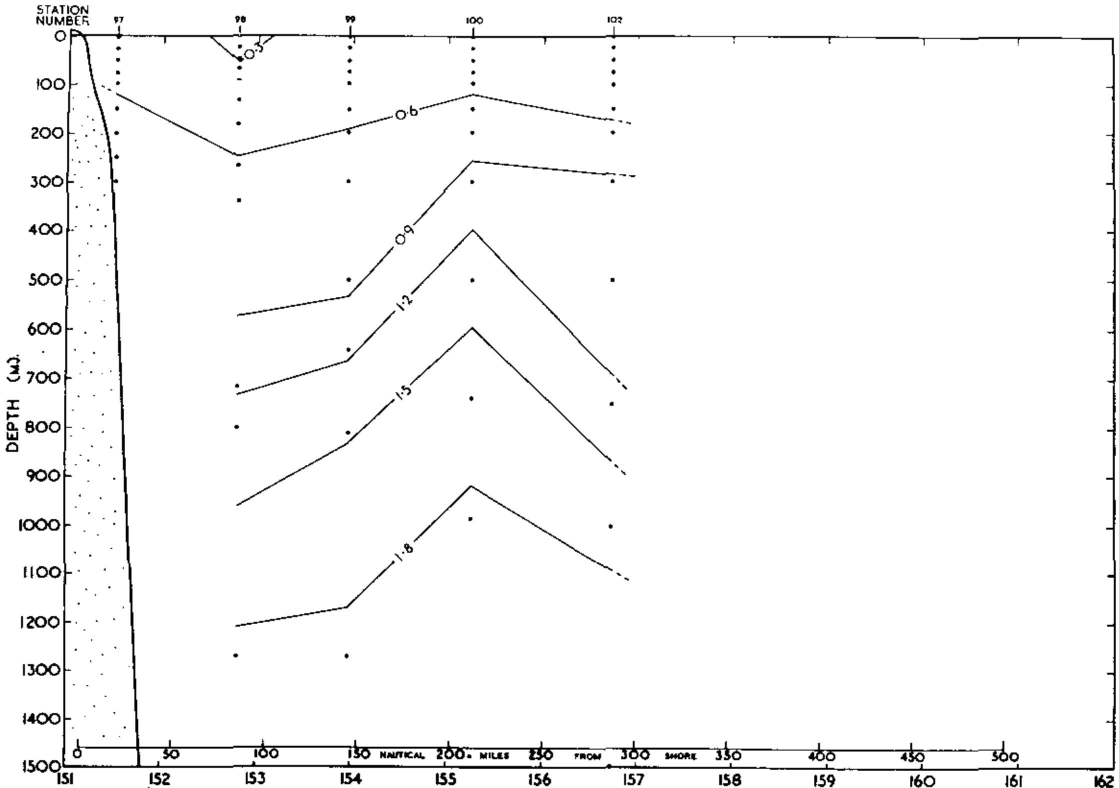

STATION NUMBER
97
98
99
100
102
0·3
0·6
0·9
1·2
1·5
1·8
DEPTH (M.)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
0 50 100 150 NAUTICAL 200 MILES 250 FROM 300 SHORE 350 400 450 500
151 152 153 154 155 156 157 158 159 160 161 162
LONGITUDE °E.

Fig. 10

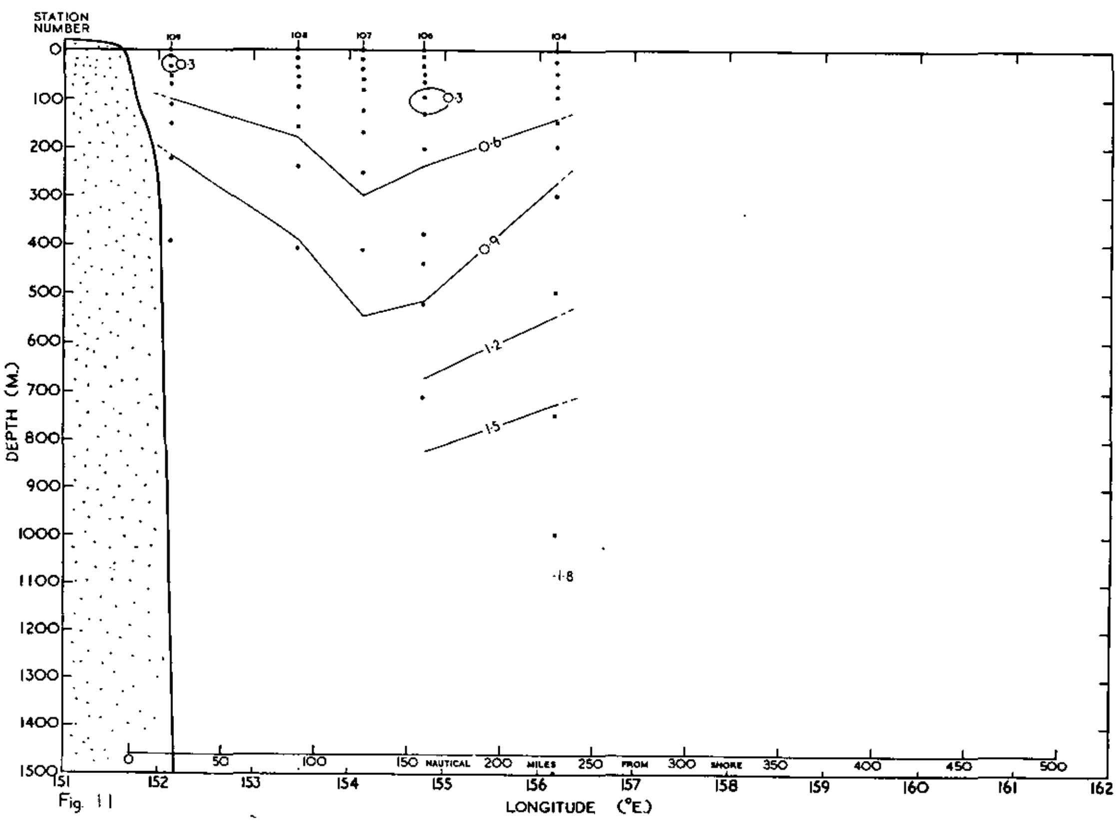

STATION NUMBER
109
108
107
106
104
0·3
0·3
0·6
0·9
1·2
1·5
1·8
DEPTH (M.)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
0 50 100 150 NAUTICAL 200 MILES 250 FROM 300 SHORE 350 400 450 500
151 152 153 154 155 156 157 158 159 160 161 162
LONGITUDE (°E.)

Fig. 11

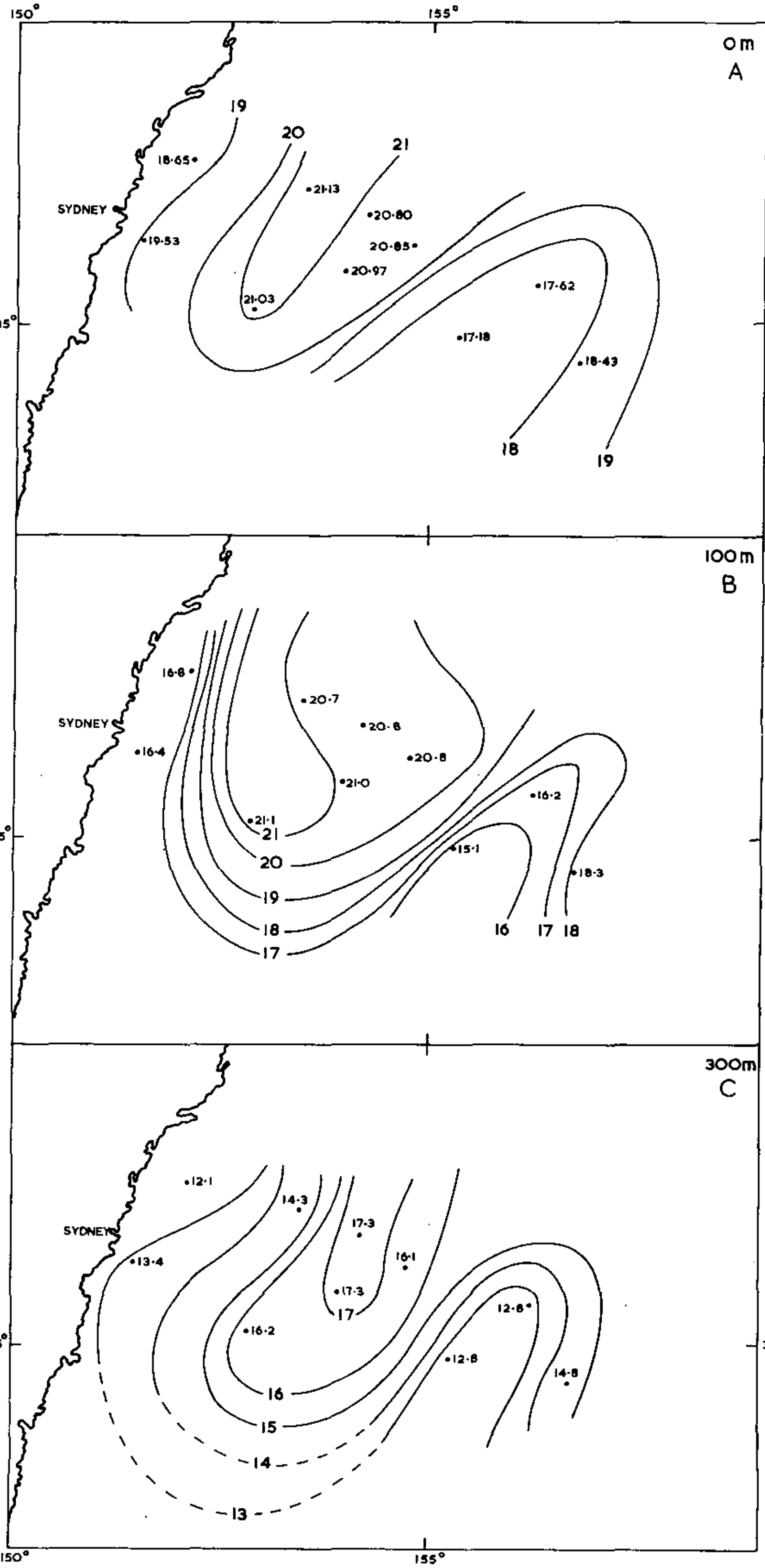

150°
155°
0m
A
19
20
21
18·65
21·13
SYDNEY
20·80
19·53
20·85
20·97
17·62
21·03
35°
17·18
18·43
18
19
100m
B
16·8
20·7
SYDNEY
20·8
16·4
20·8
21·0
16·2
21·1
21
35°
20
15·1
18·3
19
18
16
17
18
17
300m
C
12·1
14·3
17·3
SYDNEY
13·4
16·1
17·3
17
12·8
16·2
35°
12·8
14·8
16
15
14
13
150°
155°

Fig. 12

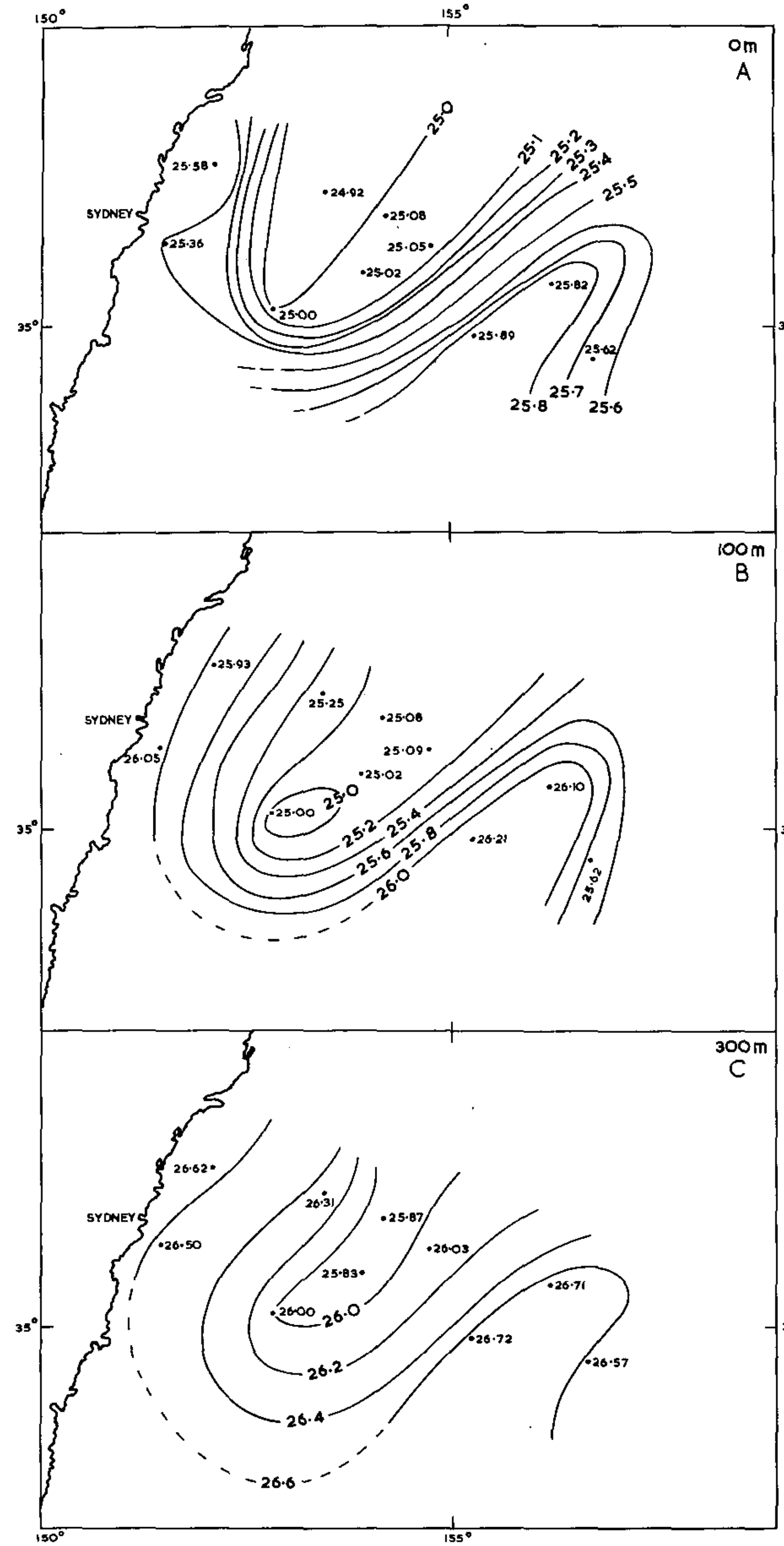

150°
155°
0m
A
SYDNEY
25·58
25·36
24·92
25·08
25·05
25·02
25·00
25·82
25·89
25·62
25·0
25·1
25·2
25·3
25·4
25·5
25·6
25·7
25·8
35°
100m
B
SYDNEY
25·93
26·05
25·25
25·08
25·09
25·02
25·00
26·10
26·21
25·62
25·0
25·2
25·4
25·6
25·8
26·0
300m
C
SYDNEY
26·62
26·50
26·31
25·87
26·03
25·83
26·00
26·71
26·72
26·57
26·0
26·2
26·4
26·6

Fig. 13

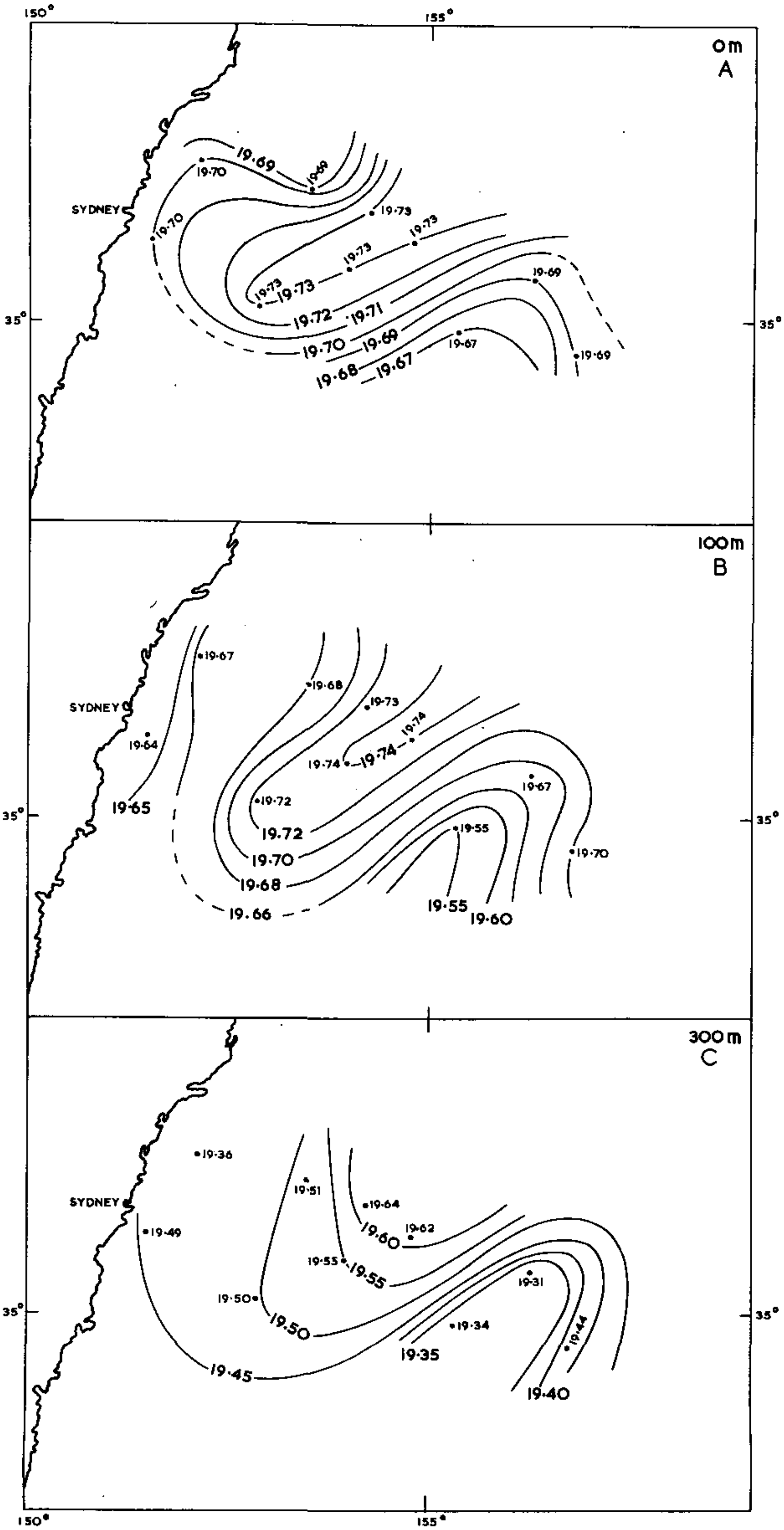

150°
155°
35°
0m
A
SYDNEY
19·69
19·70
19·73
19·72
19·71
19·68
19·67
100m
B
19·65
19·66
19·74
19·55
19·60
300m
C
19·36
19·51
19·64
19·62
19·49
19·60
19·55
19·31
19·50
19·34
19·44
19·45
19·35
19·40

Fig. 14

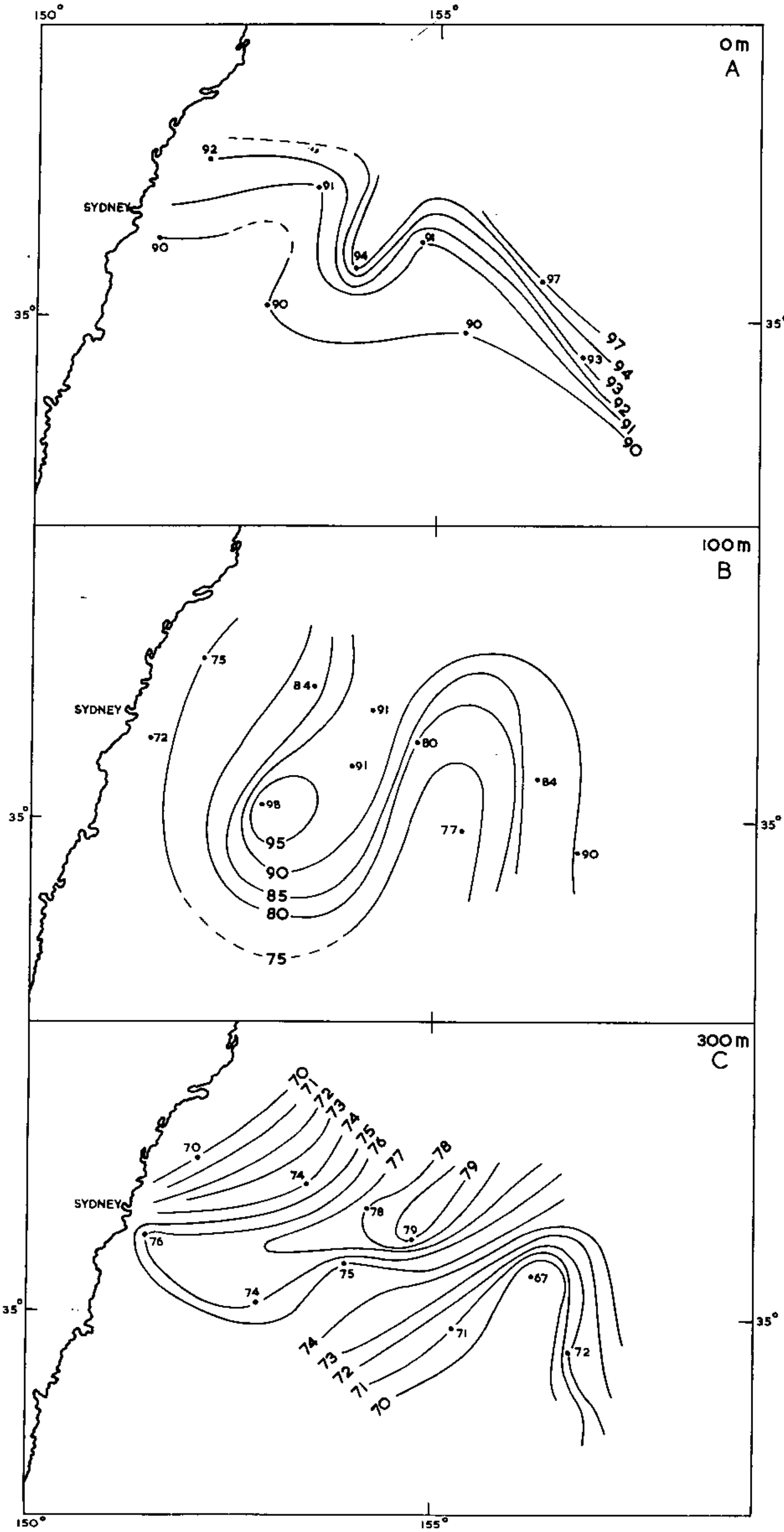
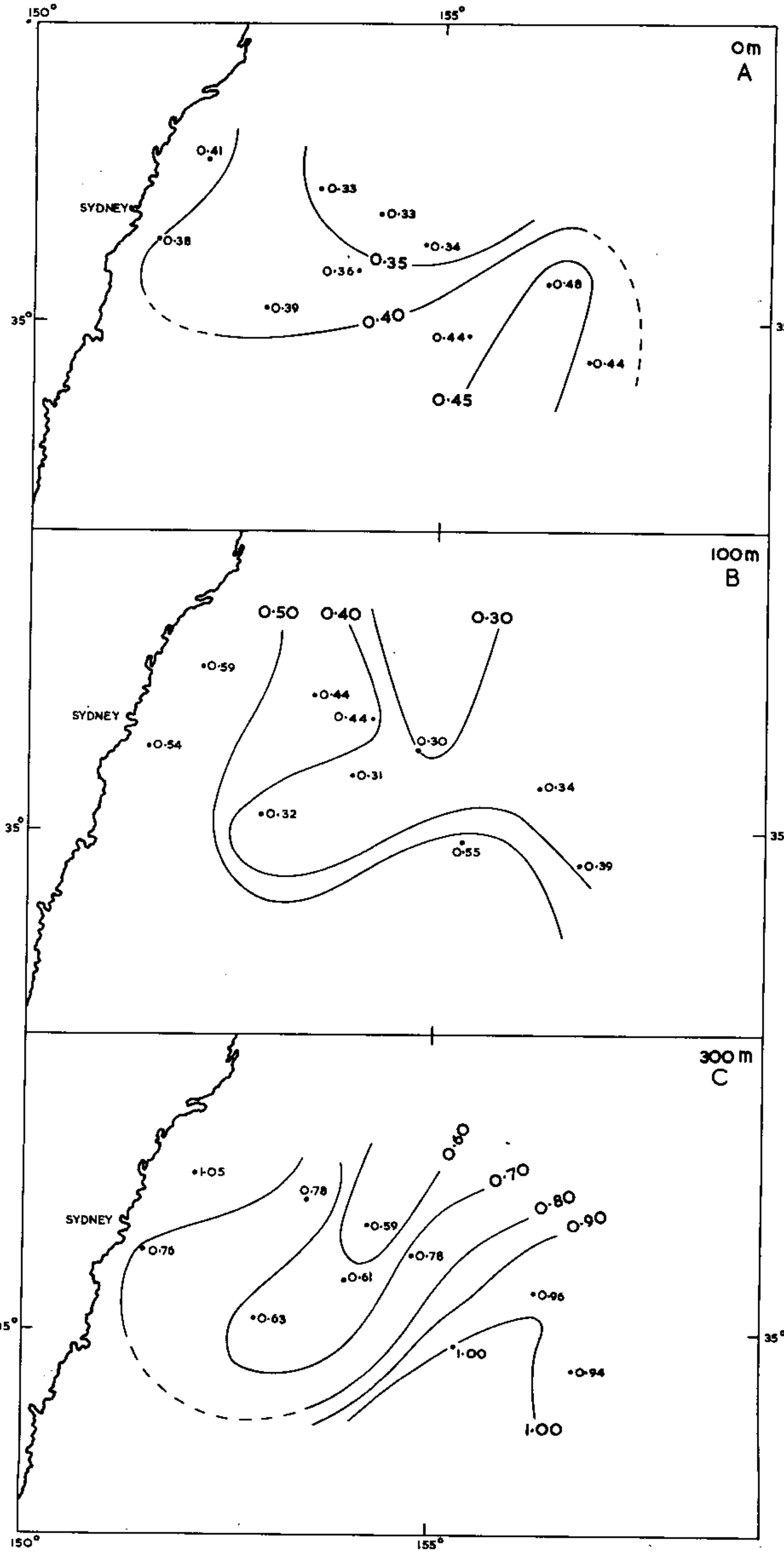
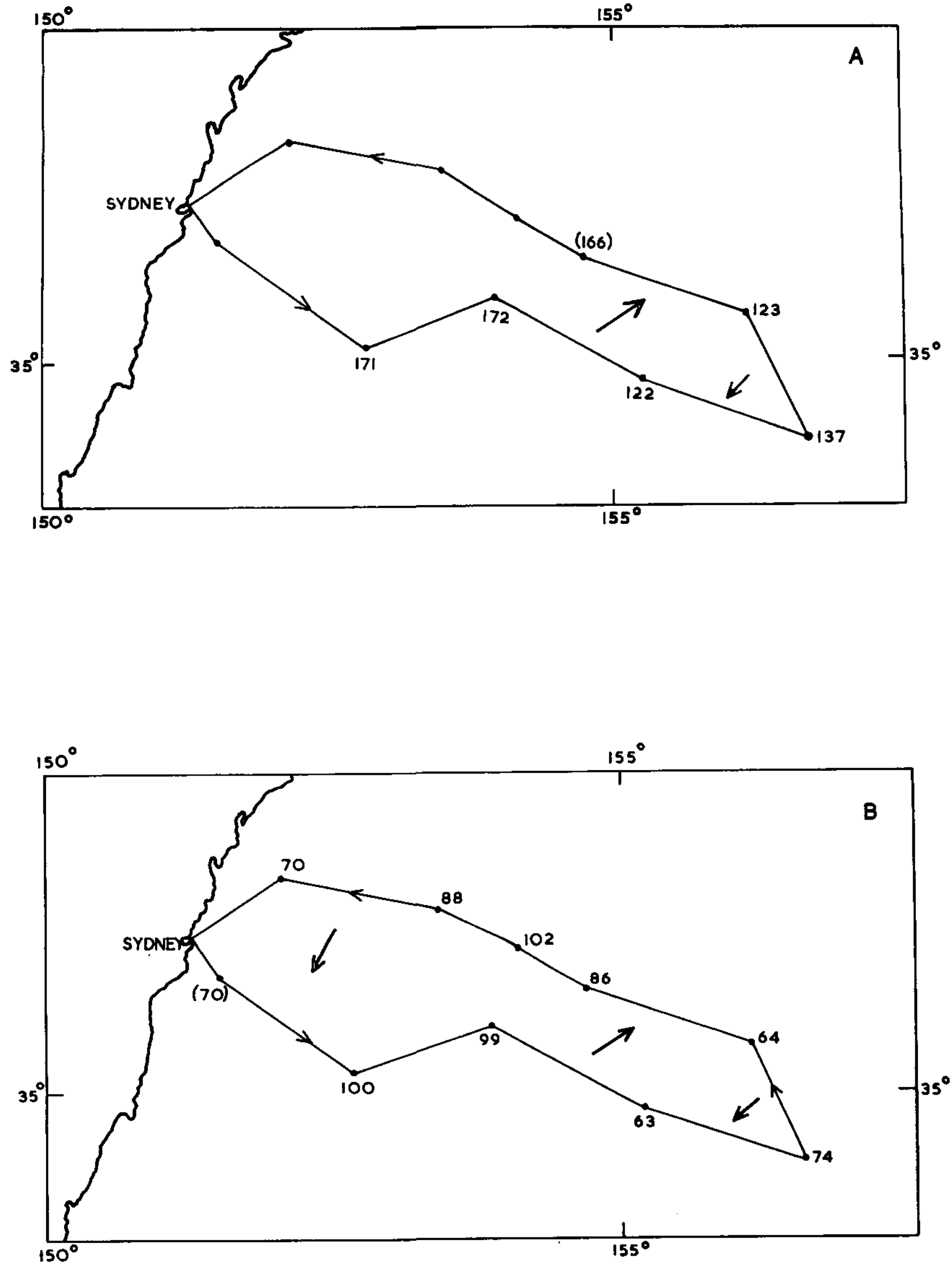

150°
155°
0m
A
SYDNEY
92
91
90
94
97
93
35°
90
97
94
93
92
91
90
100m
B
SYDNEY
75
84
91
72
80
91
98
84
77
90
35°
95
90
85
80
75
300m
C
SYDNEY
70
71
72
73
74
75
76
77
78
79
70
74
78
79
76
75
67
74
71
72
35°
74
73
72
71
70
150°
155°

Fig. 15



150°
155°
0m
A
SYDNEY
0·41
0·33
0·33
0·34
0·38
0·35
0·36
0·48
0·39
0·40
0·44
0·44
0·45
35°
100m
B
0·50
0·40
0·30
0·59
0·44
0·44
SYDNEY
0·54
0·30
0·31
0·34
0·32
0·55
0·39
300m
C
0·60
0·70
1·05
0·80
0·78
0·90
SYDNEY
0·59
0·76
0·78
0·61
0·96
0·63
1·00
0·94
1·00

Fig. 16



150°
155°
A
SYDNEY
(166)
123
172
171
35°
35°
122
137
150°
155°
150°
155°
B
70
88
SYDNEY
102
86
(70)
64
99
100
35°
35°
63
74
150°
155°

Fig. 17

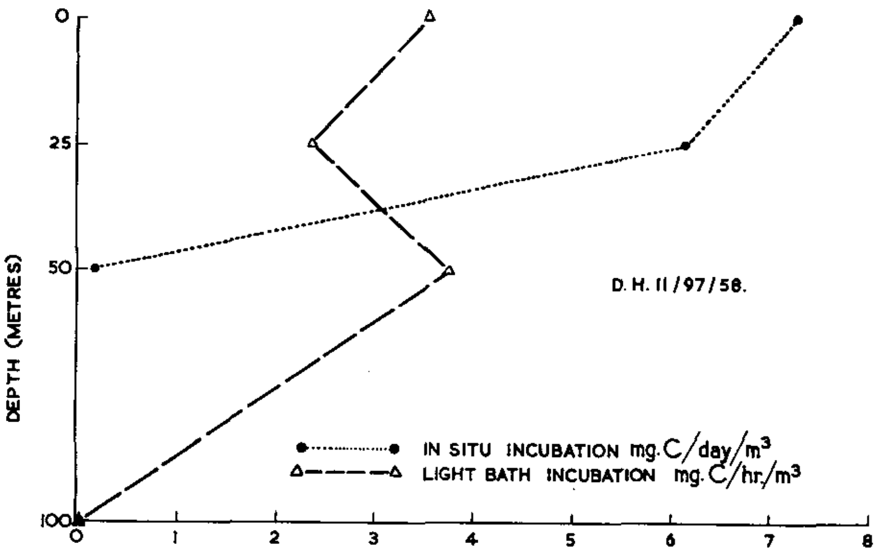


Fig. 18

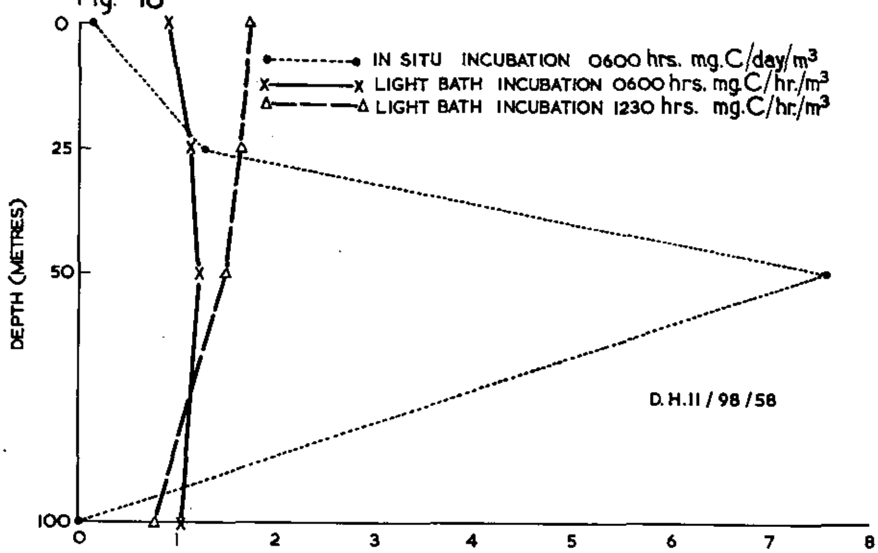


Fig. 19

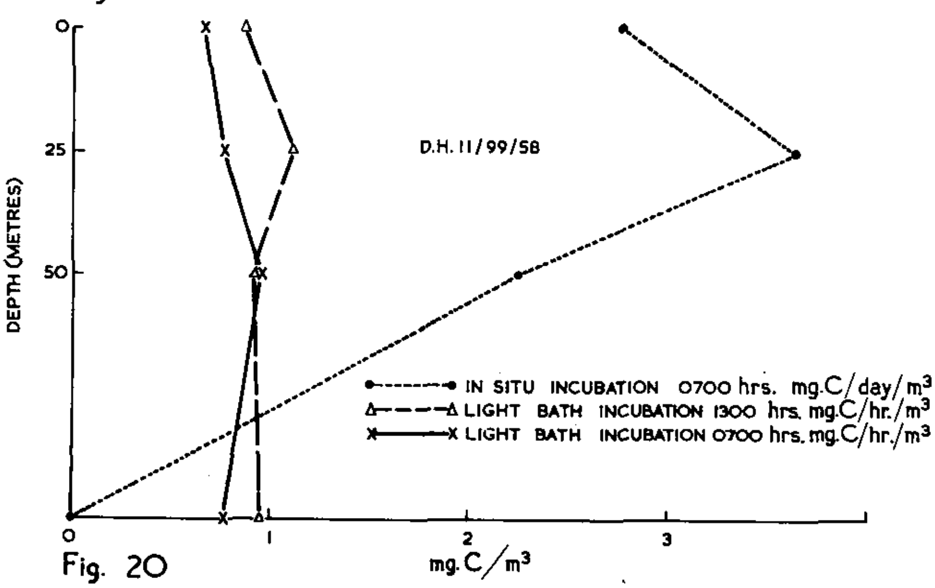
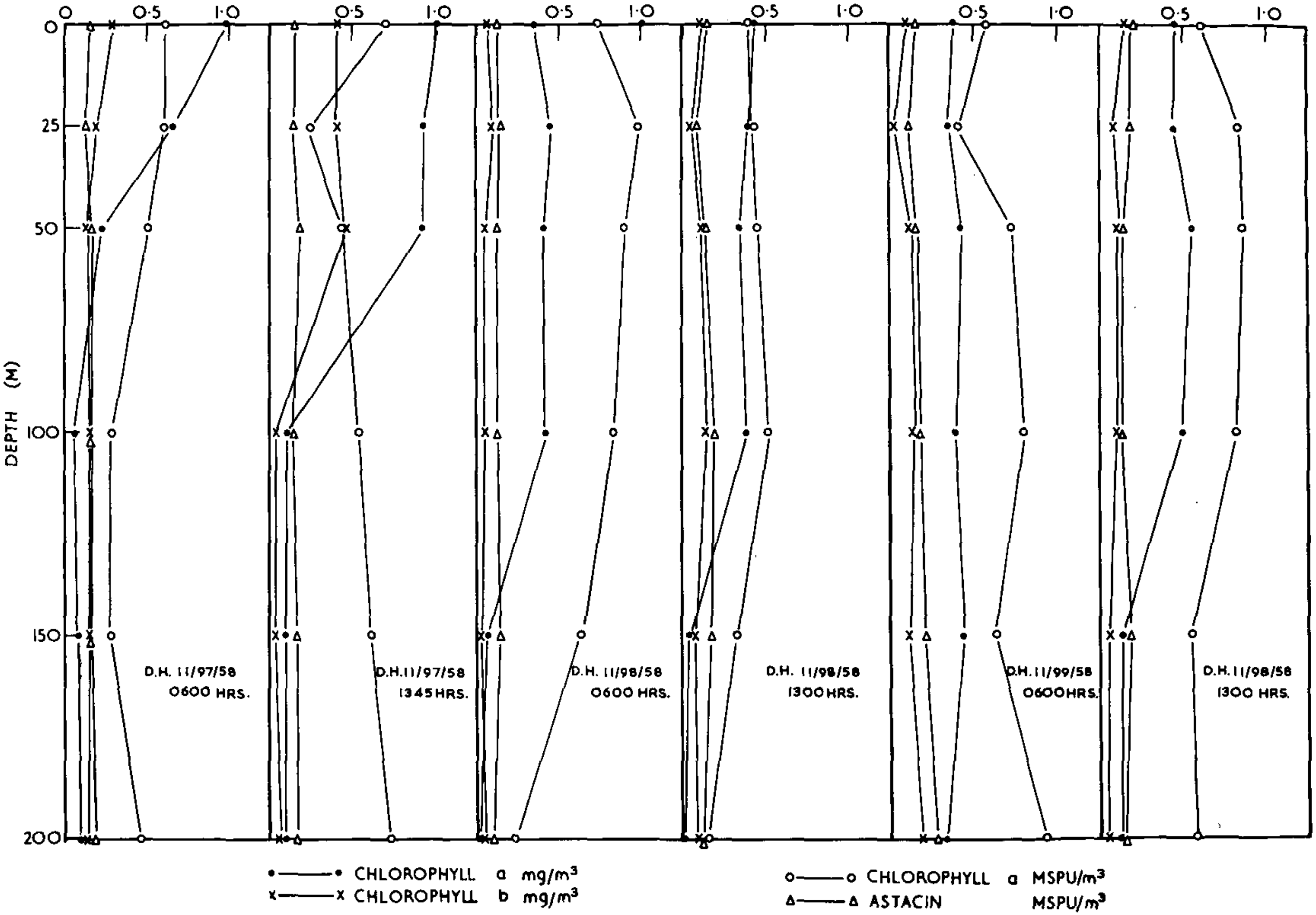


Fig. 20



0
0·5
1·0
DEPTH (M)
0
25
50
100
150
200
D.H. 11/97/58
0600 HRS.
D.H. 11/97/58
1345 HRS.
D.H. 11/98/58
0600 HRS.
D.H. 11/98/58
1300 HRS.
D.H. 11/99/58
0600 HRS.
D.H. 11/98/58
1300 HRS.
•——• CHLOROPHYLL a mg/m³
x——x CHLOROPHYLL b mg/m³
o——o CHLOROPHYLL a MSPU/m³
Δ——Δ ASTACIN MSPU/m³

Fig. 21

F.R.V. "DERWENT HUNTER"

SCIENTIFIC REPORT OF CRUISE DH13/58

July 28 - August 3, 1958

SCIENTIFIC PERSONNEL.

N. Dyson (in charge)

ITINERARY

This cruise was the twelfth of the series designed to study the chemical, physical, and biological structure of the East Australian Current off Sydney. Owing to failure of the winch and the auxiliary engine, the cruise was abandoned after six stations had been completed. Figure 1 shows the positions of the stations worked.

SCIENTIFIC REPORTS

Samples for chlorinity, dissolved oxygen, and total phosphorus were taken at the same depths as on Cruise DH11/58. As so few stations were worked no report has been prepared on the hydrology data.

(a) PRODUCTIVITY - N. DYSON

1. CO_2 Uptake

Sampling to measure the rate of uptake by the two methods of incubation was carried out at two stations and the results are shown in Figures 2 and 3. To measure the variation in the rate of uptake samples were collected from 0, 25, and 50 m on six occasions during the day and incubated in the light bath for four hours. The results, given in Figure 4, show that the highest rates of uptake occurred in the samples collected at 0740 and 1550 hours.

2. Light Penetration

Submarine light was measured on three occasions at Station DH13/116/58 and the results expressed as the depth of penetration of 1 per cent. of surface light were 82, 92, and 78 m for the times 0900, 1100, and 1415 hours respectively.

(c) PIGMENTS - G.F. HUMPHREY

Samples for plankton pigment determination were collected at 0-100 m at Station DH13/113/58 and at Station DH13/116/58. The results are in C.S.I.R.O. Aust. (1960) and are graphed in Figure 5.

LEGENDS FOR FIGURES 1-5 - Cruise DH13/58

Fig. 1. Track chart showing positions of stations.

Fig. 2. Rates of CO_2 uptake at Station DH13/113/58.

Fig. 3. Rates of CO_2 uptake at Station DH13/116/58.

Fig. 4. Variation of rate of CO_2 uptake by bath incubation at Station DH13/116/58.

Fig. 5. Depth profiles of pigment concentrations.

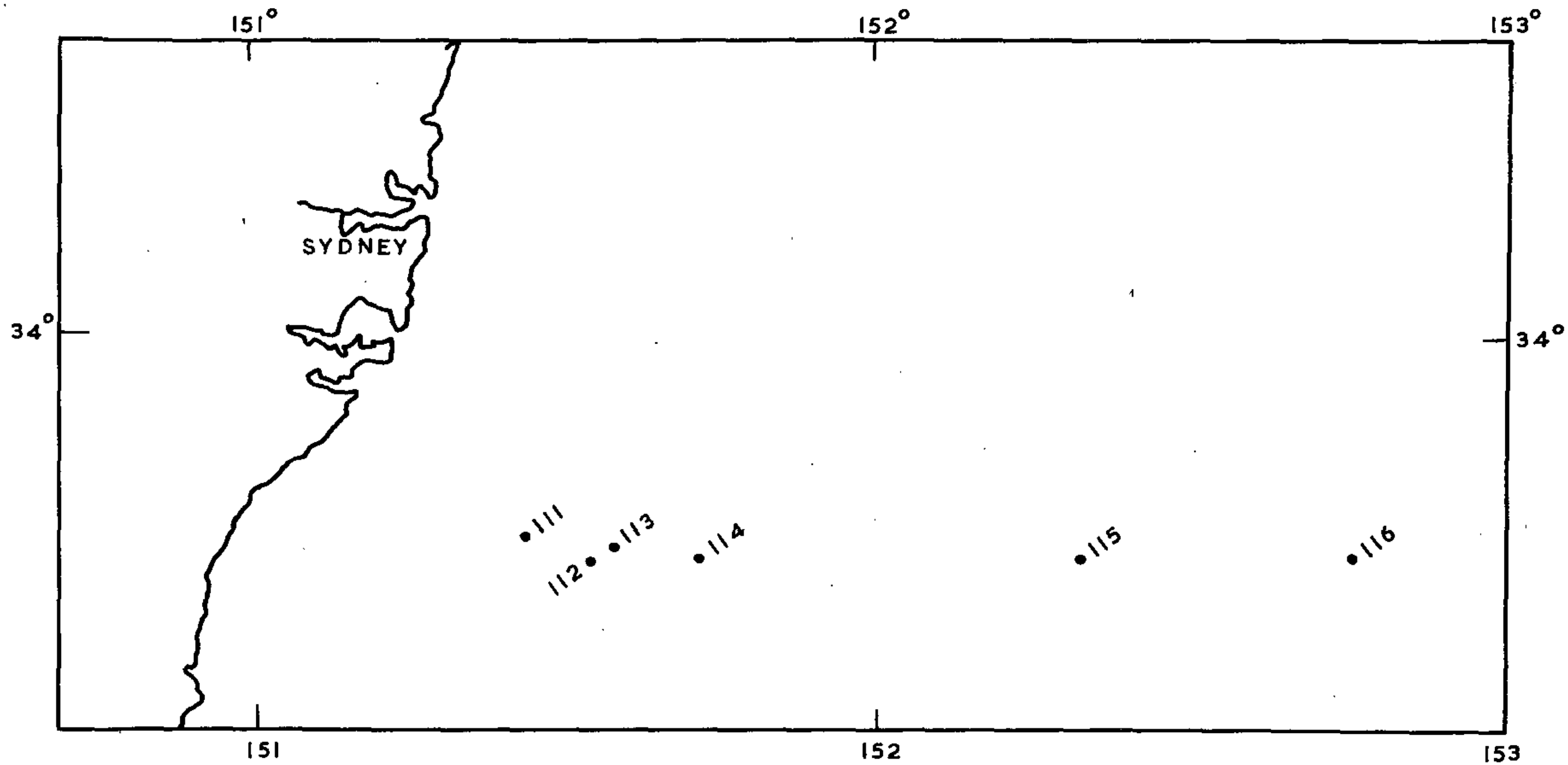


Fig. 1

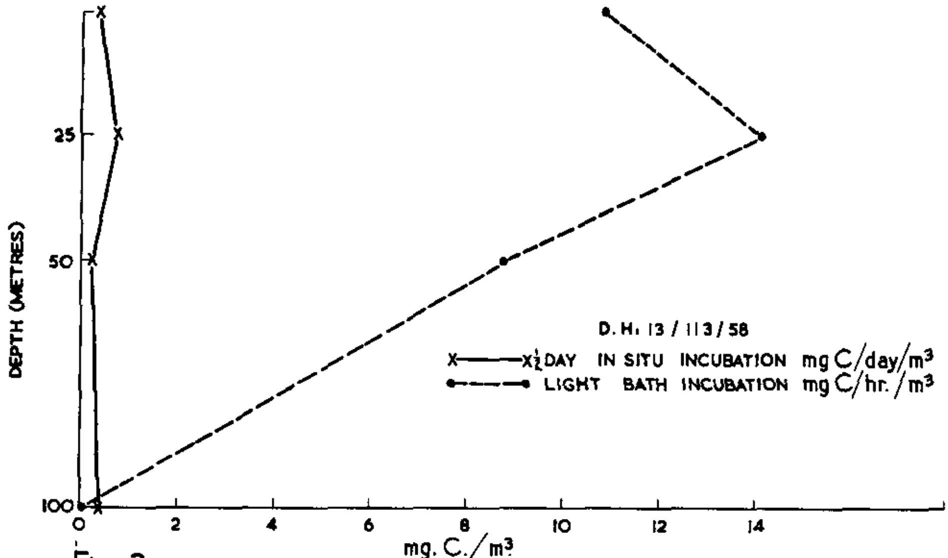


Fig. 2

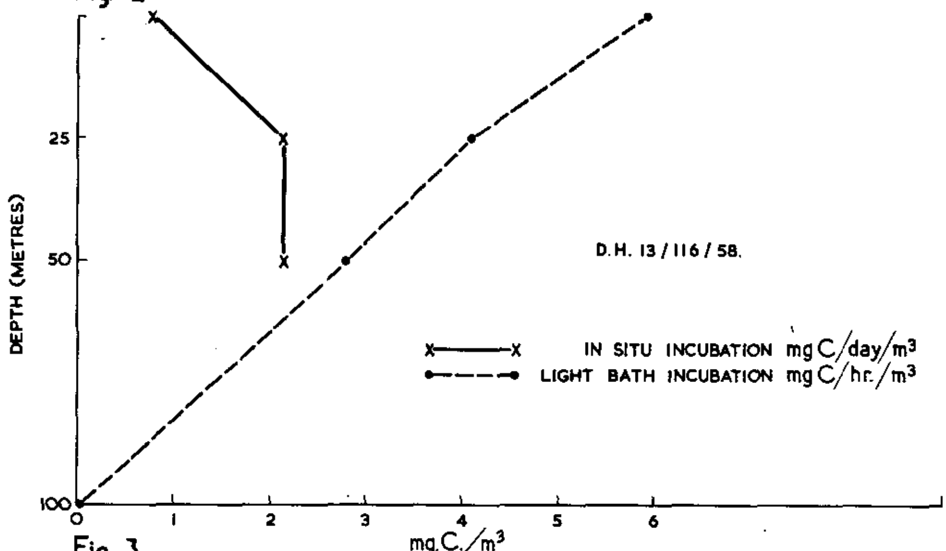


Fig. 3

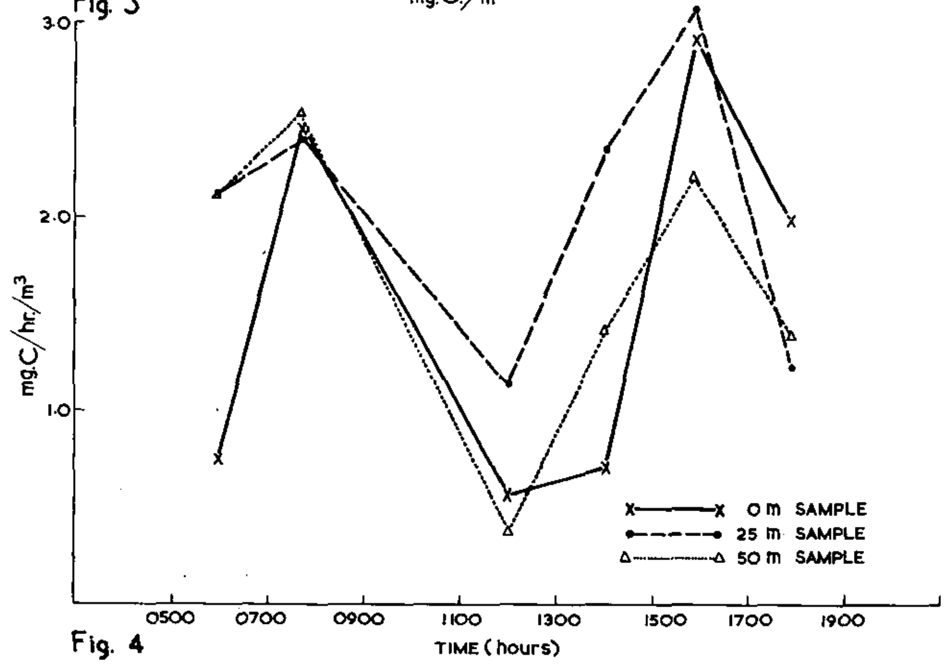
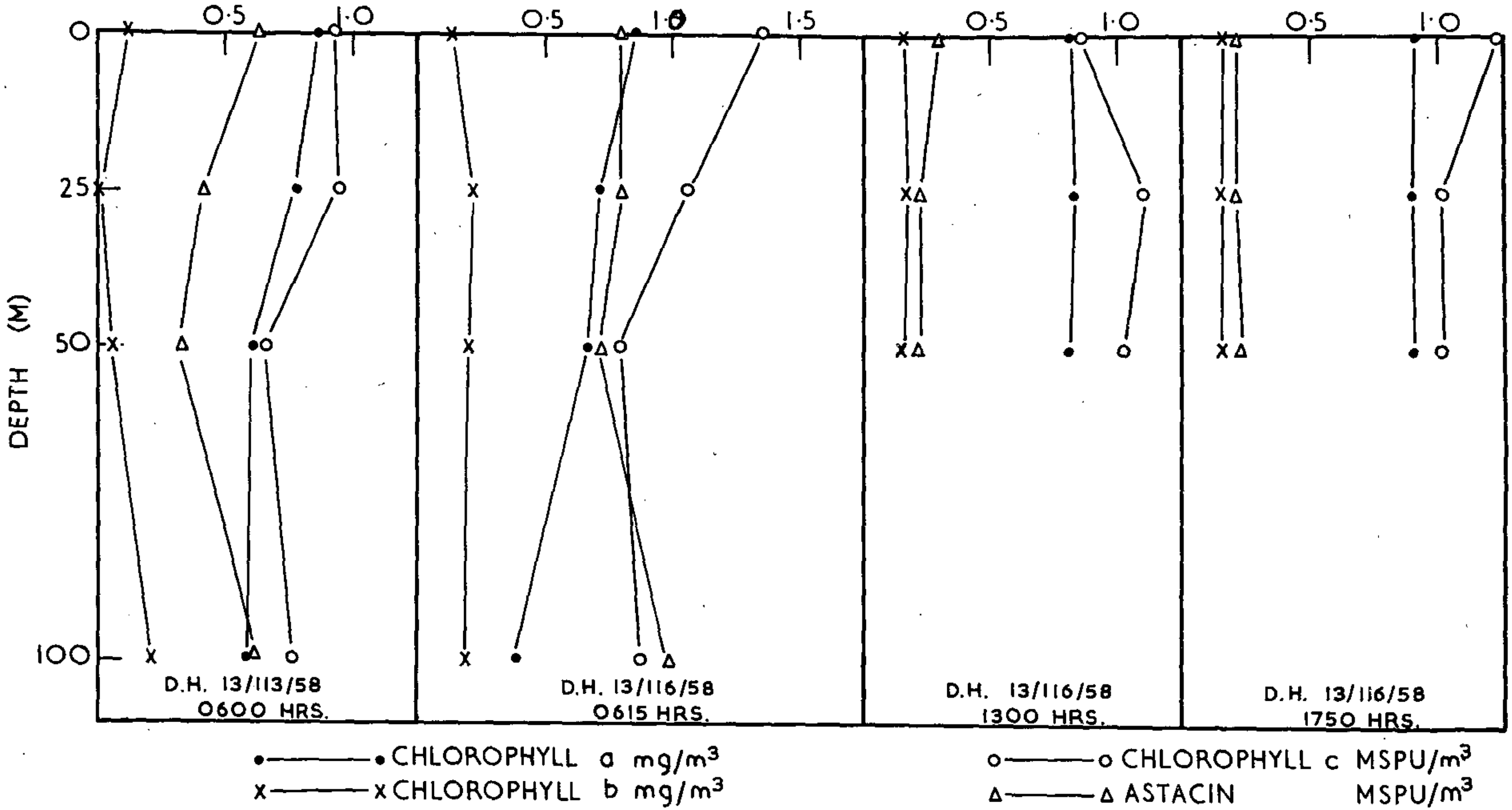


Fig. 4



0
0·5
1·0
1·5
25
50
100
DEPTH (M)
D.H. 13/113/58
0600 HRS.
D.H. 13/116/58
0615 HRS.
D.H. 13/116/58
1300 HRS.
D.H. 13/116/58
1750 HRS.
•——• CHLOROPHYLL a mg/m3
x——x CHLOROPHYLL b mg/m3
o——o CHLOROPHYLL c MSPU/m3
Δ——Δ ASTACIN MSPU/m3

Fig. 5

F.R.V. "DERWENT HUNTER"

SCIENTIFIC REPORT OF CRUISE DH14/58

August 5 - 9, 1958

SCIENTIFIC PERSONNEL

N. Dyson (in charge)

ITINERARY

This cruise was planned to study the variation in the rate of CO_2 uptake over a 48 hour period with the ship drifting at the same station. It was also planned to test the accuracy of temperature readings, to examine the variability of zooplankton hauls and to examine the variations in phytoplankton populations. Owing to adverse weather little work could be done, and difficulties with sampling gear caused the cancellation of work on zooplankton and phytoplankton. Figure 1 shows the position of the station.

SCIENTIFIC REPORTS

(a) HYDROLOGY - A.D. CROOKS

Six hydrology casts were done to 1500 m. Samples for temperature and chlorinity were taken at 0, 250, 500, 700, 900, 1100, 1300, 1500 m. B.T. lowerings were done at 1500 on August 6, 0815 and 1940 on August 7.

Temperature (Fig. 2)

The minimum surface temperature recorded on the two days was 17.9°C at 0750 on August 6. The maximum 19.30°C occurred in the afternoon of August 7. Surface temperatures increased from the beginning of the first day to the end of the second. Below about 300 m however, minimum temperatures were found at the middle and end of the second day.

Chlorinity varied only .02 ‰ during the two days at any depth. Figure 3 shows the temperature chlorinity relation at all stations.

It was not possible to use the data collected to check the accuracy of temperature readings because of the large differences in wire angles (45°-10°).

(b) CO_2 UPTAKE - N. DYSON

The variation in the rate of uptake was measured by collecting samples from 0, 25, and 50 m as often as possible and incubating them in the light bath for four hours. The results are shown in Figure 4. On two successive days, a diurnal variation was found, but the magnitudes and times of maximum production were different.

(c) LIGHT PENETRATION - N. DYSON

The depth of penetration of 1 per cent. of surface light was determined on two occasions on August 6. The results were 73 and 88 m for 0945 and 1300 hours respectively.

(d) PIGMENTS - G.F. HUMPHREY

Samples for the determination of plankton pigments were collected at Station DH14/117/58 at 0600 and 1210 hours and at 0800, 1230, and 1745 on August 7. The results are in C.S.I.R.O. Aust.(1960) and are graphed in Figure 5.

LEGENDS FOR FIGURES 1-5 - Cruise DH14/58

Fig. 1. Cruise DH14/58. Chart to show position of station worked.

Fig. 2. Variation of temperature with time from B.T. traces and hydrology stations.

Fig. 3. Temperature-chlorinity diagram.

Fig. 4. Variation in rate of CO_2 uptake at Station DH14/117/58 by light bath incubation on August 6, 1958 and on August 7, 1958.

Fig. 5. Depth profiles of pigment concentrations.

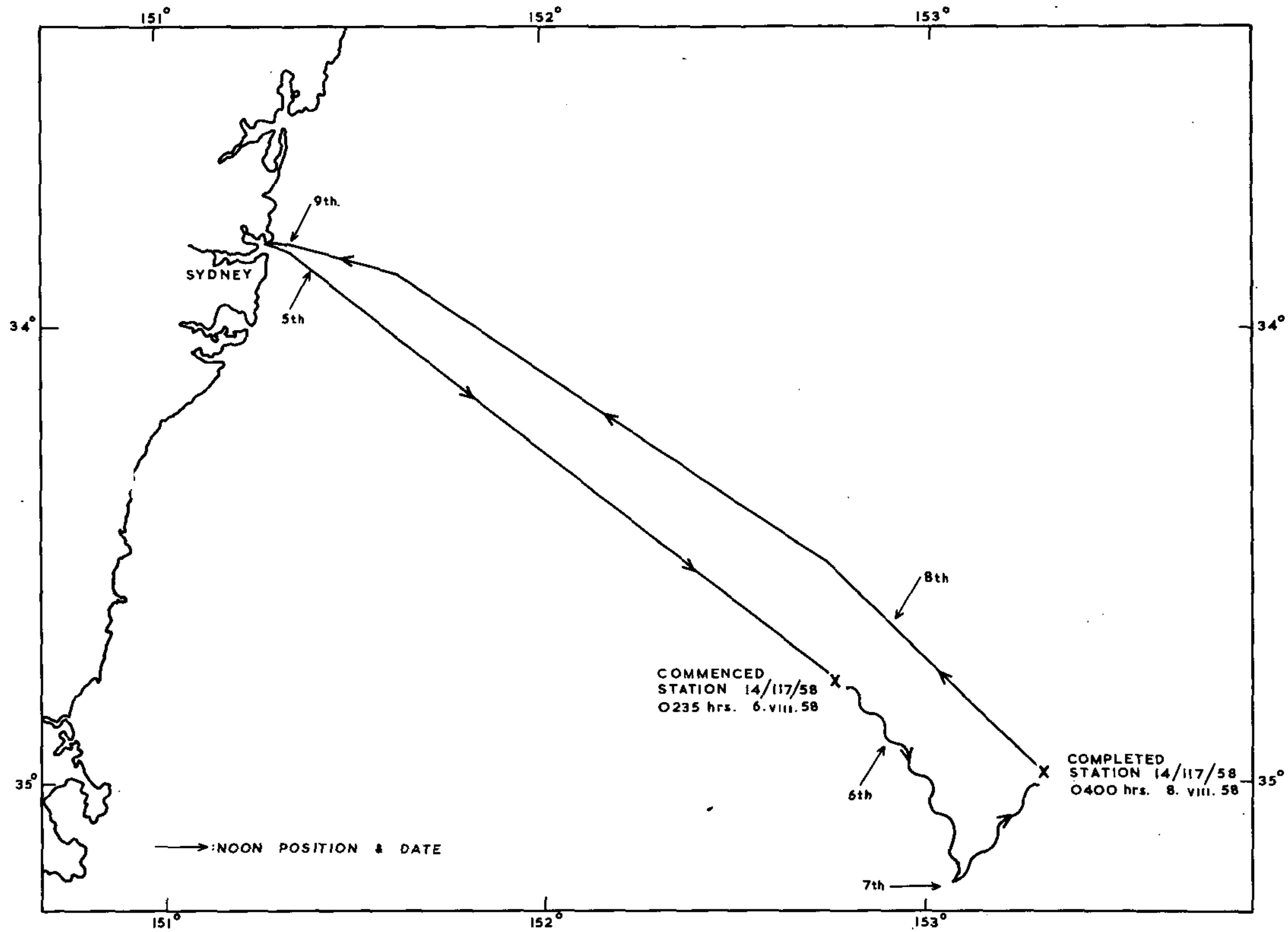
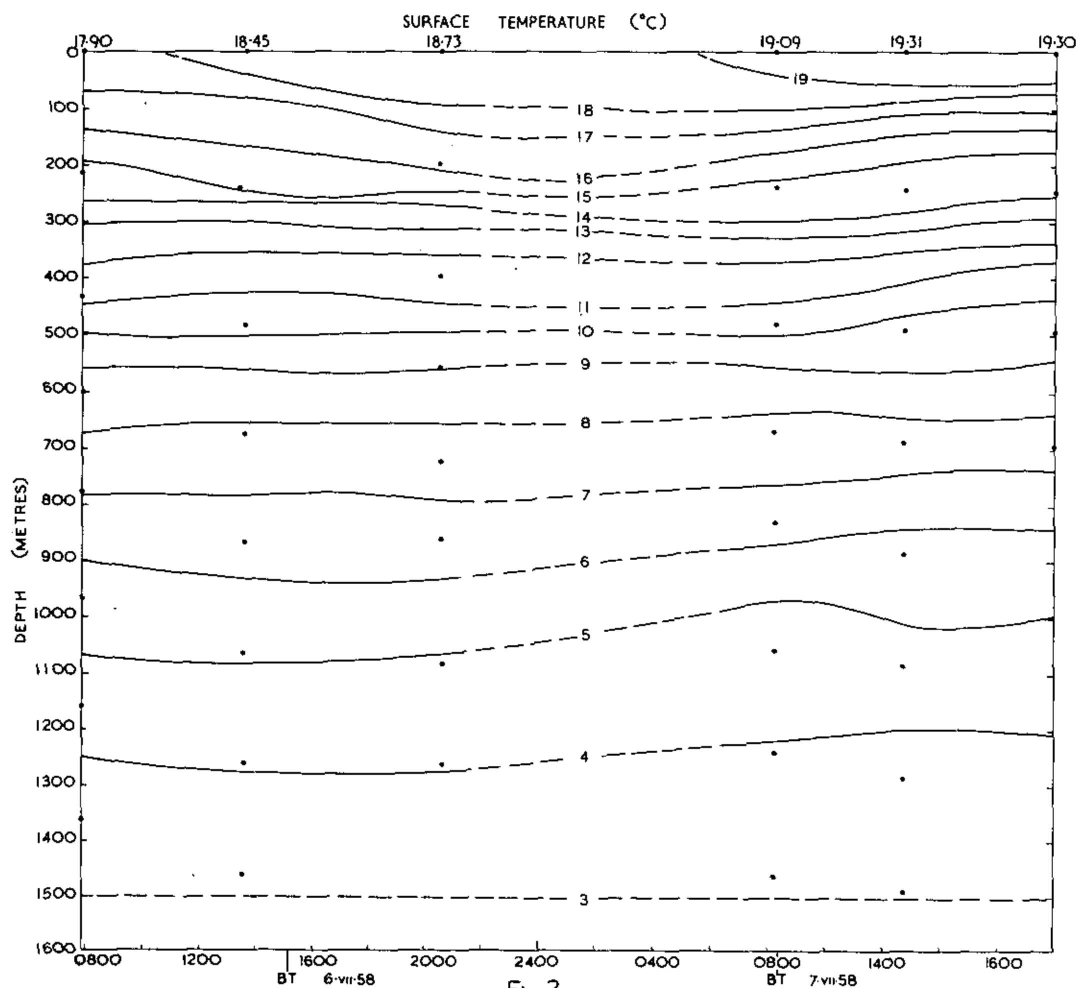
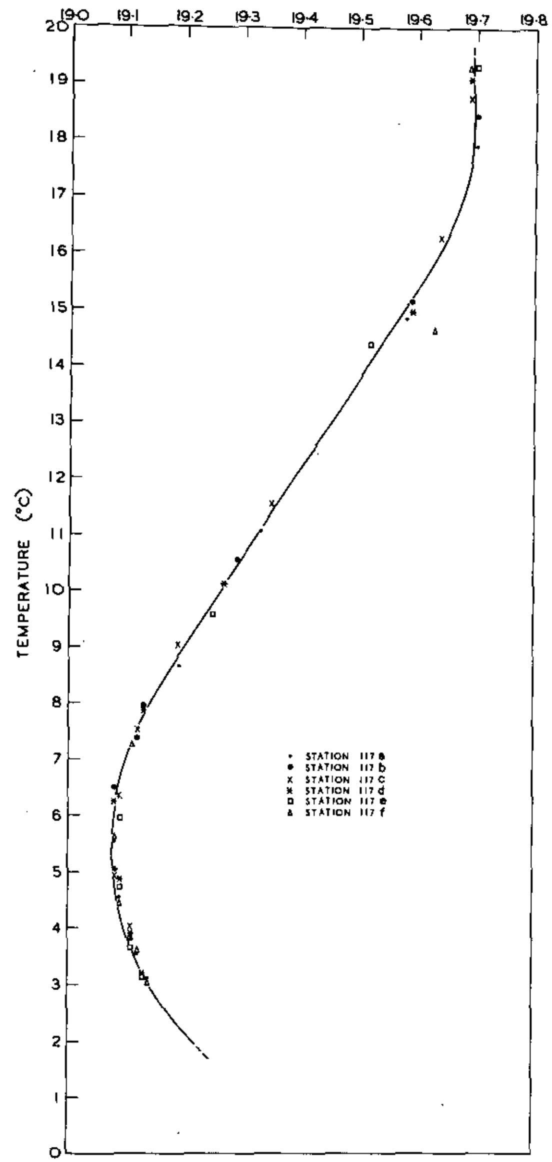

151°
152°
153°
34°
35°
SYDNEY
9th.
5th
8th
6th
7th
COMMENCED
STATION 14/117/58
0235 hrs. 6. VIII. 58
COMPLETED
STATION 14/117/58
0400 hrs. 8. VIII. 58
:NOON POSITION & DATE

Fig. 1


SURFACE TEMPERATURE (°C)
17·90
18·45
18·73
19·09
19·31
19·30
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
DEPTH (METRES)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
0800
1200
1600
2000
2400
0400
0800
1400
1600
BT 6·VII·58
BT 7·VII·58
Fig. 2


19·0
19·1
19·2
19·3
19·4
19·5
19·6
19·7
19·8
TEMPERATURE (°C)
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
STATION 117 a
STATION 117 b
STATION 117 c
STATION 117 d
STATION 117 e
STATION 117 f
Fig. 3

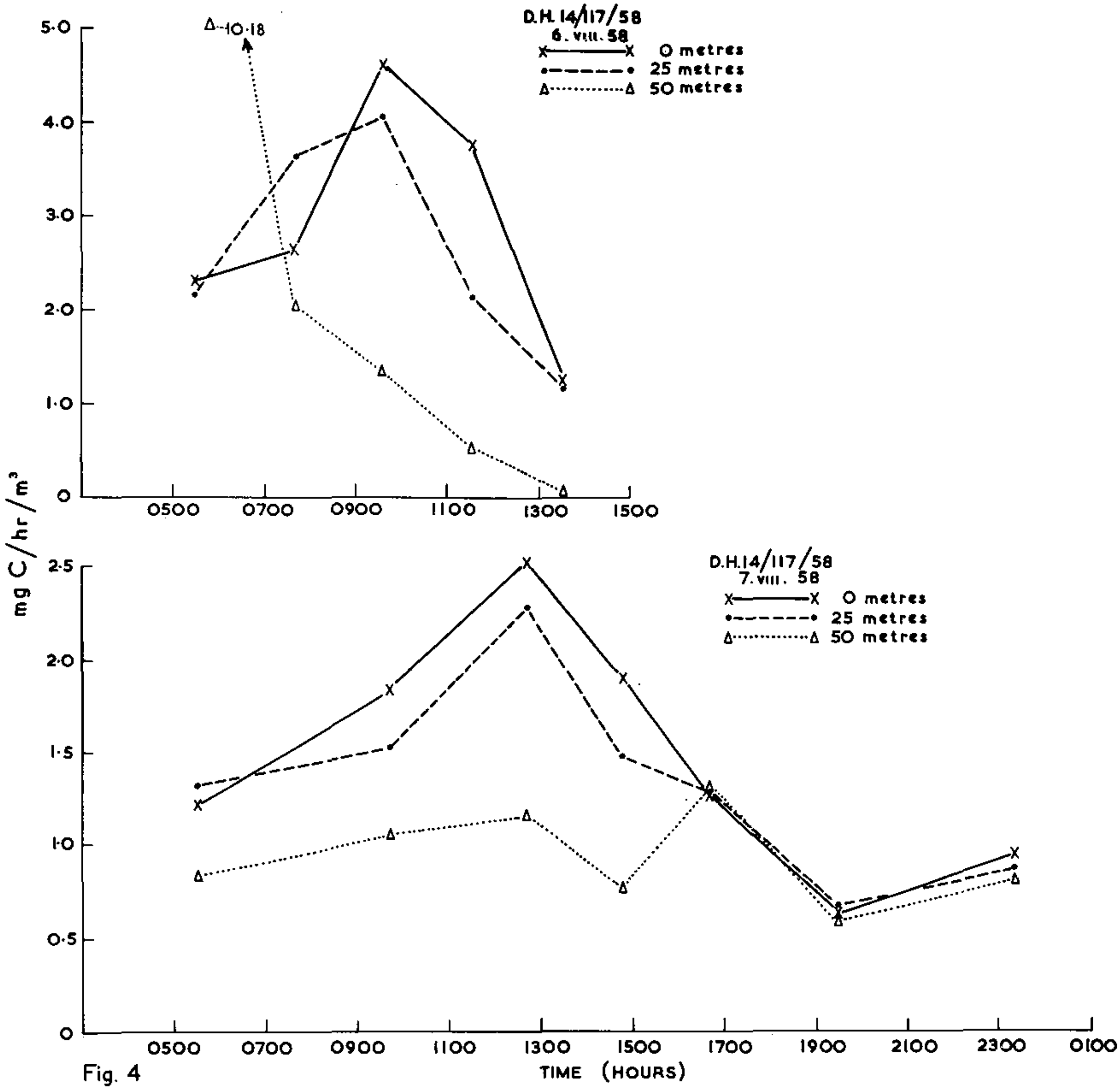

D.H. 14/117/58
6. viii. 58
X——X 0 metres
•– – – –• 25 metres
Δ·········Δ 50 metres
Δ–10·18
5·0
4·0
3·0
2·0
1·0
0
0500
0700
0900
1100
1300
1500
mg C/hr/m³
D.H.14/117/58
7. viii. 58
X——X 0 metres
•– – – –• 25 metres
Δ·········Δ 50 metres
2·5
2·0
1·5
1·0
0·5
0
0500
0700
0900
1100
1300
1500
1700
1900
2100
2300
0100
TIME (HOURS)

Fig. 4

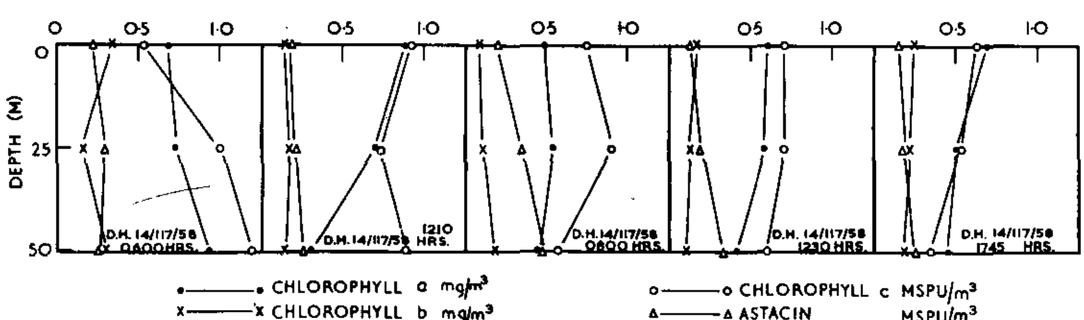

0
0·5
1·0
DEPTH (M)
0
25
50
D.H. 14/117/58 0400 HRS.
D.H. 14/117/58 1210 HRS.
D.H. 14/117/58 0800 HRS.
D.H. 14/117/58 1230 HRS.
D.H. 14/117/58 1745 HRS.
•——• CHLOROPHYLL a mg/m³
x——x CHLOROPHYLL b mg/m³
o——o CHLOROPHYLL c MSPU/m³
Δ——Δ ASTACIN MSPU/m³

Fig. 5

F.R.V. "DERWENT HUNTER"

SCIENTIFIC REPORT OF CRUISE DH15/58

First Part: August 18 - 26, 1958
Second Part: August 28 - September 2, 1958

SCIENTIFIC PERSONNEL

First Part: N. Dyson (in charge)

Second Part: J. Staniforth (in charge)

ITINERARY

This was the first of the extended cruises to study the structure and circulation of the East Australian Current. Four sections were planned, but bad weather prevented work on Sections 2 and 4. Figure 1 shows the track chart indicating the work done at each station.

SCIENTIFIC REPORTS

Samples for chlorinity, dissolved oxygen, total phosphorus were collected at depths of 0, 25, 50, 75, 100, 150, 200, 300, 500, 750, 1000, and 1500 m. Samples for pigments (Chl. a,b,c) and CO_2 uptake were collected at 0, 25, 50, 100 m. Light penetration measurements were carried out at five stations. Phytoplankton collections were made with a modified Hardy plankton indicator whose discs are made with monel metal gauze, 120 meshes to the inch. The indicators were towed for a period of 15 minutes at the surface at certain stations (Fig. 1).

(a) HYDROLOGY - A.D. CROOKS

Sampling was carried out in two casts to 1500 m. Unprotected thermometers were used at 100, 150, 200, 300, 500, 750, 1000, and 1500 m to determine the depths of sampling. At 0, 25, and 50 m paired protected thermometers were used. Sufficient stations were worked only on Sections I and III to give adequate data to examine sectional distribution of properties.

1. Temperature
   (a) Section 1 (Fig. 2)

The maximum surface temperature (20.5°C) was found between Stations DH15/119 and 120/58 and at DH15/121/58. The minimum (19°C) was found on the eastern end of the section at Station DH15/124/58. The greater part of the surface water to 120 m was occupied by a homogeneous stratum with temperatures between 20.63°C and 19°C. Between Stations DH15/119 and 120/58 this stratum deepened to 300 m. Below 500 m, maximum temperatures were found near Station DH15/120/58 and minimum at Station DH15/118/58. There was a weak thermocline (vertical gradient 0.06°C/m) near the surface at Station DH15/118/58.

   (b) Section 3 (Fig. 3)

The maximum surface temperature (20.89°C) was recorded at Station DH15/129/58 and the minimum (16.72°C) at Station DH15/132/58. There was a stratum 100 m in depth of high temperature water between Stations DH15/120 and 129/58. East of Station DH15/120/58 the surface temperature dropped to the minimum and then rose sharply at Station DH15/133/58 to 19.69°C. Below the surface, the maximum temperature was recorded between Stations DH15/120 and 131/58 and the minimum at Station DH15/132/58. There was a weak thermocline (vertical gradient 0.04°C/m) at Station DH15/133/58 between 100 m and 200 m.

2. Density (σ_t)
   (a) Section 1 (Fig. 4)

Minimum σ_t occurred in a narrow band at Station DH15/121/58 with a surface minimum of σ_t 25.07. There was also a band of homogeneous light water (σ_t 25.12 - σ_t 25.10) between Stations DH15/119 and 120/58, extending to a depth of 150 m. Surface maximum (σ_t 25.57) occurred at Station DH15/124/58. At Station DH15/118/58 there was a pycnocline (vertical gradient 0.026 σ_t/m) extending from 50 m to 130 m. A vertical column of relatively low density water extended to at least 1500 m between Stations DH15/119-120/58.

   (b) Section 3 (Fig. 5)

Maximum surface density (25.98 σ_t) was recorded at Station DH15/132/58 and a minimum (25.08 σ_t) at Station DH15/129/58. Rapid changes in surface density with a general increase to the east occurred between Stations

DH15/120 and 132/58 and DH15/132 and 133/58. Below the surface the maximum occurred at Station DH15/132/58 and the minimum at Stations DH15/120 and 131/58, except between 900 m and 1300 m where it occurred at Station DH15/129/58. There was a pycnocline (0.008 σ_t/m) between 80 m and 200 m at Station DH15/133/58.

3. Chlorinity

(a) Section 1 (Fig. 6)

Maximum surface chlorinity (19.73 ‰) occurred at Station DH15/120/58 and minimum (19.59 ‰) at Station DH15/118/58. This maximum occurred in a homogeneous layer of high chlorinity water (19.70 - 19.73 ‰) which extended from 153°30'E. to 159°00'E. and had an average depth of 150 m deepening to 240 m at Station DH15/120/58. This layer corresponds closely to the homogeneous layer observed in the temperature profile. Higher chlorinity waters extended to greater depths between Stations DH15/119 and 120/58 than elsewhere. The depth of the chlorinity minimum varied between 1000 m at Station DH15/118/58 and 1250 m at Station DH15/131/58. A weak halocline (vertical gradient 0.004 ‰) was apparent at Station DH15/118/58.

The chlorinity distribution was closely related to density distribution below 150 m (cf. Fig. 4).

(b) Section 3 (Fig. 7)

Maximum surface chlorinity (19.75 ‰) occurred at Station DH15/129/58 and the minimum (19.65 ‰) at Station DH15/132/58. Between 154°E. and 155°30'E. a homogeneous layer (with a maximum variation of 0.06 ‰) occurred to a depth of 150 m but deepened to 300 m at Station DH15/130/58. The chlorinity field paralleled the density field except in the upper 50 m at Station DH15/133/58 and between 900 m and 1300 m at Station DH15/129/58.

4. Percentage Oxygen Saturation

(a) Section 1 (Fig. 8)

Saturation and near saturation values were associated with the low density surface water at Station DH15/121/58 and between Stations DH15/119 and 120/58 (cf. Fig. 4). A large vertical gradient of oxygen varying from 95 per cent. at the upper limit of the pycnocline to 75 per cent. at the lower limit occurred at Station DH15/118/58. Between

Stations DH15/123 and 124/58 the 95 per cent. isoline deepened suddenly from 10 m to 120 m. Between Stations DH15/118 and 121/58 an oxygen minimum (55 per cent.) occurred in depths varying between 1100 m and 1500 m, beneath the chlorinity minimum (Fig. 6).

(b) Section 3 (Fig. 9)

Maximum surface value (102%) occurred at Station DH15/129/58 and minimum value (90%) at Station DH15/131/58. Surface saturation occurred only between Stations DH15/129 and 130/58. Below 300 m the maximum value was observed at Station DH15/131/58 and the minimum value at Station DH15/132/58.

5. Total Phosphorus

(a) Section 1 (Fig. 10)

Maximum surface value of total phosphorus (0.41 µg at./l) occurred at Station DH15/124/58 and the minimum surface value (0.30 µg at./l) at Station DH15/122/58. The surface water was homogeneous down to 200 m over the whole section except for a small area around Station DH15/124/58. A relatively high total phosphorus value (0.6 - 0.9 µg at./l) was associated with the pycnocline at Station DH15/118/58. The lowest total phosphorus values at all depths occurred at Station DH15/120/58. The phosphate distribution is similar to the density distribution at all depths except below 500 m at Station DH15/124/58.

(b) Section 3 (Fig. 11)

Maximum surface value of total phosphorus (0.44 µg at./l) was observed at Station DH15/129/58 and minimum (0.34 µg at./l) at Station DH15/120/58.

Good agreement was found between the total phosphorus and density distribution except between 900 m and 1300 m at Station DH15/129/58. This was closely related to the chlorinity, oxygen, and density anomalies.

6. Horizontal Distribution of Properties

(a) Temperature (Fig. 12)

Maximum surface temperature (20.90°C) occurred in the northern coastal region near Coff's Harbour, and minimum temperature (16.70°C) in the east, at Station DH15/132/58. A reading of 17°C was recorded in the vicinity of Lord Howe I.

These high and low temperatures persisted to a depth of 1000 m. At 100 m the maximum (20.70°C) was found at Station DH15/130/58 and the minimum (15.7°C) at Station DH15/132/58. At 500 m the maximum (14.9°C) occurred at Station DH15/130/58 and the minimum (8.8°C) at Station DH15/132/58. At 1000 m the maximum (7.2°C) was at Station DH15/131/58 and the minimum (4.7°C) was recorded at Station DH15/118/58.

The main feature of the surface temperature plot is the tongue of warm water observed at Station DH15/129/58 running south then east to Station DH15/123/58. At 1000 m the axis appeared to be north-south. To the east of Sydney, below 500 m, the coldest waters of the region were found.

(b) Density (σ_t) Fig. 13)

A column of high density water in the vicinity of Lord Howe I. extended downwards to 1000 m. Minimum densities at all depths were found in the central tongue of warm water. The density maximum appeared to be associated with an eddy approximately 40 miles in diameter at the surface but which had almost disappeared at 500 m.

(c) Chlorinity (Fig. 14)

With a few exceptions the highest chlorinities at the surface and at all depths occurred in the tongue of high temperature water (Fig. 12). Water of lower chlorinity occurred to the north, east and west of it. As with temperature, the axis of the tongue was slightly further to the east with increasing depth, but the general distribution of chlorinity was similar at all depths. The distribution of chlorinity paralleled that of density, except at 1000 m where in the vicinity of Lord Howe I. the relatively large differences in density had no counterparts in chlorinity values.

(d)

Saturation values occurred only at the surface and in the northern section (north of a line between Sydney and Lord Howe I.) except at Station DH15/130/58 where saturated water was found at 100 m. Minimum surface values were found in the south of the area. High values for oxygen saturation were found to be associated with the tongue of warm water down to 1000 m. The distribution at 100 m, 500 m, and 1000 m was similar, with high values occurring in the warmer water and low values in the cooler onshore waters and the waters to the east of the area. Below the surface the distribution of percentage oxygen saturation closely corresponded with that of density.

TABLE 1

DIATOMS IN COLLECTIONS OF PHYTOPLANKTON

CRUISE DH15/58

	118	119	120	121	122	123	124	125	126	127	129	130	131	132	133
Planktoniella sol	+	+	+	+	+	+	+		+	+	+	+	+		+
Coscinodiscus concinnus	+			+			+				+		+		
C. gigas		+	+	+							+				+
C. marginatus		+							+	+					
Schroederella delicatula				+							+			+	
Climacodium frauenfeldianum	+			+		+					+		+		+
Stephanopyxis turris														+	
S. palmeriana		+								+				+	+
Rhizosolenia alata											+	+	+		
f. gracillima	+	+		+	+		+							+	
R. imbricata	+						+				+				
R. styliformis			+	+		+	+			+					
R. bergonii		+		+	+	+	+			+					
R. stolterforthii			+	+					+	+	+				
R. castracanei				+							+				
R. calcar avis				+											
R. acuminata						+				+	+				
R. hebetata f. semispina				+											
R. clevei											+				
R. setigera															+
R. robusta											+				
R. fragilissima														+	
Leptocylindrus danicus									+		+				
Chaetoceros affine	+		+	+					+	+	+				
Ch. decipiens	+				+	+				+	+	+	+		
Ch. vanheurckii		+	+	+						+					
Ch. denticulatum				+							+			+	+
Ch. secundum				+						+				+	
Ch. atlanticum v. neapolitanum				+	+		+				+				
Ch. peruvianum					+		+			+					
Ch. messanense											+				
Ch. pendulum											+				

TABLE 1 (Contd)

DIATOMS IN COLLECTIONS OF PHYTOPLANKTON

CRUISE DH15/58

	118	119	120	121	122	123	124	125	126	127	129	130	131	132	133
Ch. danicum															
Ch. eibenii							+			+	+				
Ch. coarctatum															
Ch. sumatranum											+				
Ch. lauderi											+				
Ch. lorenzianum										+	+				
Ch. laciniosum											+				
Ch. sociale									+	+	+			+	
Bacteriastrum hyalinum											+				
Gossleriella tropica				+							+				
Nitzschia seriata						+									
Melosira crenulata				+	+					+					
Thalassiothrix nitzschioides				+			+				+				
T. longissima				+											
Hemidiscus cunieformis					+					+					
Thalassiosira subtilis						+	+								
Guinardia flaccida							+								
Hemiaulus membranaceus							+								
Streptotheca thamesis										+					
Hyalodiscus stelliger										+					
Eucampia cornuta											+				
Hemiaulus sinensis											+				
H. hauckii											+				
Skeletonema costatum											+				
Thalassiosira decipiens											+	+			
Thalassiothrix longissima														+	
T. nitzschioides											+		+	+	
Eucampia zoodiacus											+	+	+		
Pleurosigma balticum											+				
												+			

TABLE 2

DINOFLAGELLATES IN PHYTOPLANKTON COLLECTIONS

CRUISE DH15/58

	118	119	120	121	122	123	124	125	126	127	129	130	131	132	133
Ceratium concilians	+			+	+										
C. buceros	+	+	+		+		+			+	+	+	+	+	
C. trichoceros	+	+	+	+							+				
C. tripos	+	+		+	+						+	+			+
C. gallicum		+	+		+								+		
C. extensum		+	+									+			
C. contrarium		+										+	+		
C. symmetricum		+		+											
C. gravidum		+													
C. arietinum		+													
C. massiliense			+												
C. paradoxides			+												
C. teres			+		+										
C. belone			+		+					+					
C. setaceum				+											
C. hexacanthum					+							+			
C. kofoidi					+										
C. fusus					+		+	+					+	+	+
C. furca								+							
C. pentagonum										+					
C. incisum												+			
C. candelabrum				+											
Diplopsalis lenticula														+	
Ornithocercus quadratus															+
O. magnificus							+								
Amphisolenia bidentata					+							+			
Phalacroma doryphorum					+		+					+			

TABLE 2 (Contd)

DINOFLAGELLATES IN PHYTOPLANKTON COLLECTION

CRUISE DH15/58

	118	119	120	121	122	123	124	125	126	127	129	130	131	132	133
Pyrocystis hamulus						+				+					
v. semicircularis		+	+												
P. pseudonoctiluca	+				+										
P. lunula															
Podolampas bipes	+													+	
P. palmipes															
Dinophysis caudata	+	+			+										
D. tripos		+	+	+					+	+		+		+	+
D. fortii													+		
Peridinium oceanicum	+		+	+	+	+	+				+	+		+	+
P. solidicorne	+			+											
P. steinii	+														
P. divergens			+		+						+				
P. quarnerense				+											
P. murrayi				+											
P. pedunculatum									+	+					
P. granii										+	+				
P. brochii											+				
P. abei															
P. grande						+									
Goniaulax kofoidi		+													
Ceratocorys horrida			+		+										
Goniodima polyedricum				+											
Pyrophacus horologicum				+											
Ceratocorys armata						+									
Phalacroma ovum															+

(e) Total Phosphorus (Fig. 16)

At the surface the maximum total phosphorus values occurred in the high temperature water, but at deeper levels high total phosphorus values were associated with the lower temperature waters. The centre of the low temperature eddy at the surface however was water of high total phosphorus and probably therefore of deep origin. The distribution of total phosphorus at all depths paralleled that of density.

(b) PHYSICS - B.V. HAMON

Dynamics

Figure 17 shows the dynamic heights of the surface relative to 1000 decibars. The values cannot be contoured, but there is some evidence of an appreciable southward flow 60 to 100 miles off Newcastle and a flow to the north or north-east 120 miles further offshore. West of Lord Howe I. there appears to be a movement of water to the west.

(c) PHYTOPLANKTON - E.J.F. WOOD

On this cruise the phytoplankton characteristic of Coral Sea water occurred in two bands, one inshore and one further offshore. These were separated by an area in which species occurred which are typical of the East Australian Current. In the north eastern part of the region was an area poor in plankton, which may have been Central Tasman water. South of this area species occurred which have previously been taken south-east of Noumea. Tables 1 and 2 list the species of diatoms and dinoflagellates found in the phytoplankton collections.

(d) CO_2 UPTAKE - N. DYSON

The rate of CO_2 uptake, of samples from 0, 25, 50 and 100 m, was measured by light bath incubation at five stations on Section 1 and at four stations on Section 2 of this cruise. At Stations DH15/124 and 126/58 the rate of CO_2 uptake was also measured by all day *in situ* incubation.

Figure 19 shows the results obtained by the two methods of incubation at the all day stations.

The rate of CO_2 uptake per day per column of water under 1 metre square of each station is shown in Figure 20. This daily rate was calculated by the formula -

$$\text{Daily Rate} = \frac{10}{1000}\left(\frac{25}{2}(a+b) + \frac{25}{2}(b+c) + \frac{50}{2}(c+d)\right) \text{ gc/day/m}^2$$

where a, b, c, and d are the rate of CO_2 uptake in mg $C/hr/m^3$ at 0, 25, 50, and 100 m respectively. Multiplication by the factor 10 in the above formula assumes the daily rate to be 10 times that of the hourly one.

(e) LIGHT PENETRATION - N. DYSON

Light penetration measurements were made whenever possible at day time stations. The results, expressed as the depth of penetration of 1 per cent. of surface light are shown in Figure 20. At Station DH15/126/58 the depth of light penetration was measured at intervals during the day and the results showed no variation in the period 0830-1430 hours.

(f) PIGMENTS - G.F. HUMPHREY

Samples for the determination of plankton pigments were collected at 0, 25, 50, and 100 m at Stations DH15/119 to 127/58. The results are in C.S.I.R.O. Aust. (1960) and are graphed in Figure 21.

LEGENDS FOR FIGURES 1-21 - Cruise DH15/58

Fig. 1. Track chart showing positions of stations.

Fig. 2. Sectional distribution of temperature (°C) along Section 1 to 1500 m.

Fig. 3. Sectional distribution of temperature (°C) along Section 3 to 1500 m.

Fig. 4. Sectional distribution of density (σ_t) along Section 1 to 1500 m.

Fig. 5. Sectional distribution of density (σ_t) along Section 3 to 1500 m.

Fig. 6. Sectional distribution of chlorinity (‰) along Section 1 to 1500 m.

Fig. 7. Sectional distribution of chlorinity (‰) along Section 3 to 1500 m.

Fig. 8. Sectional distribution of oxygen saturation (%) along Section 1 to 1500 m.

Fig. 9. Sectional distribution of oxygen saturation (%) along Section 3 to 1500 m.

Fig.10. Sectional distribution of total phosphorus (µg at./l) along Section 1 to 1500 m.

Fig.11. Sectional distribution of total phosphorus (µg at./l) along Section 3 to 1500 m.

Fig.12. Horizontal distribution of temperature, A at 0 m, B at 100 m, C at 500 m, and D at 1000 m.

Fig.13. Horizontal distribution of density, A at 0 m, B at 100 m, C at 500 m, and D at 1000 m.

Fig.14. Horizontal distribution of chlorinity, A at 0 m, B at 100 m, C at 500 m, and D at 100 m.

Fig.15. Horizontal distribution of percentage oxygen saturation, A at 0 m, B at 100 m, C at 500 m, and D at 1000 m.

Fig.16. Horizontal distribution of total phosphorus, A at 0 m, B at 100 m, C at 500 m, and D at 1000 m.

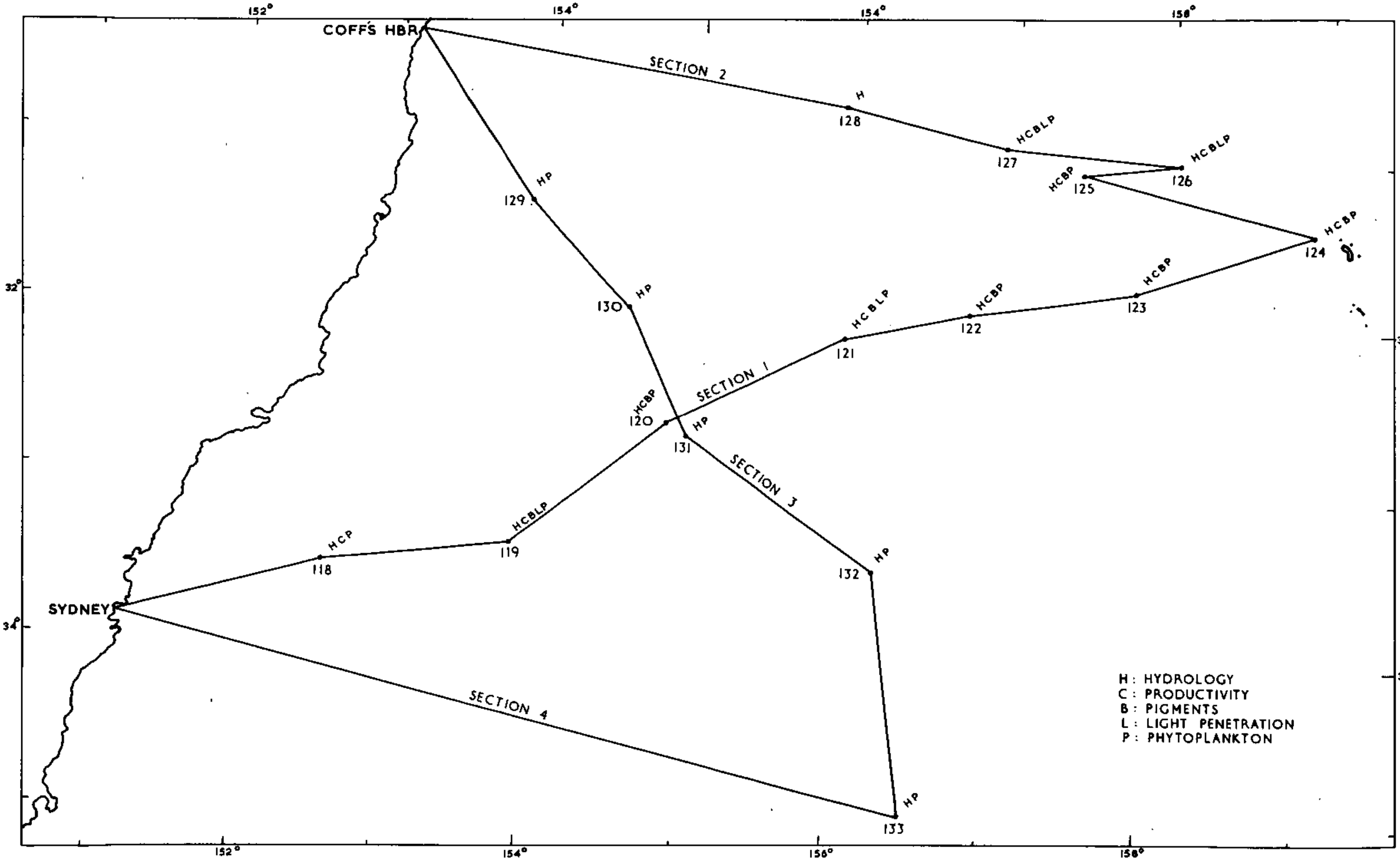
Fig.17. Dynamic heights (dyn. cm) relative to 1000 decibars.

Fig.18. Phytoplankton communities determined from collections at various stations.

Fig.19. Rate of CO_2 uptake at Stations DH15/124 and 126/58.

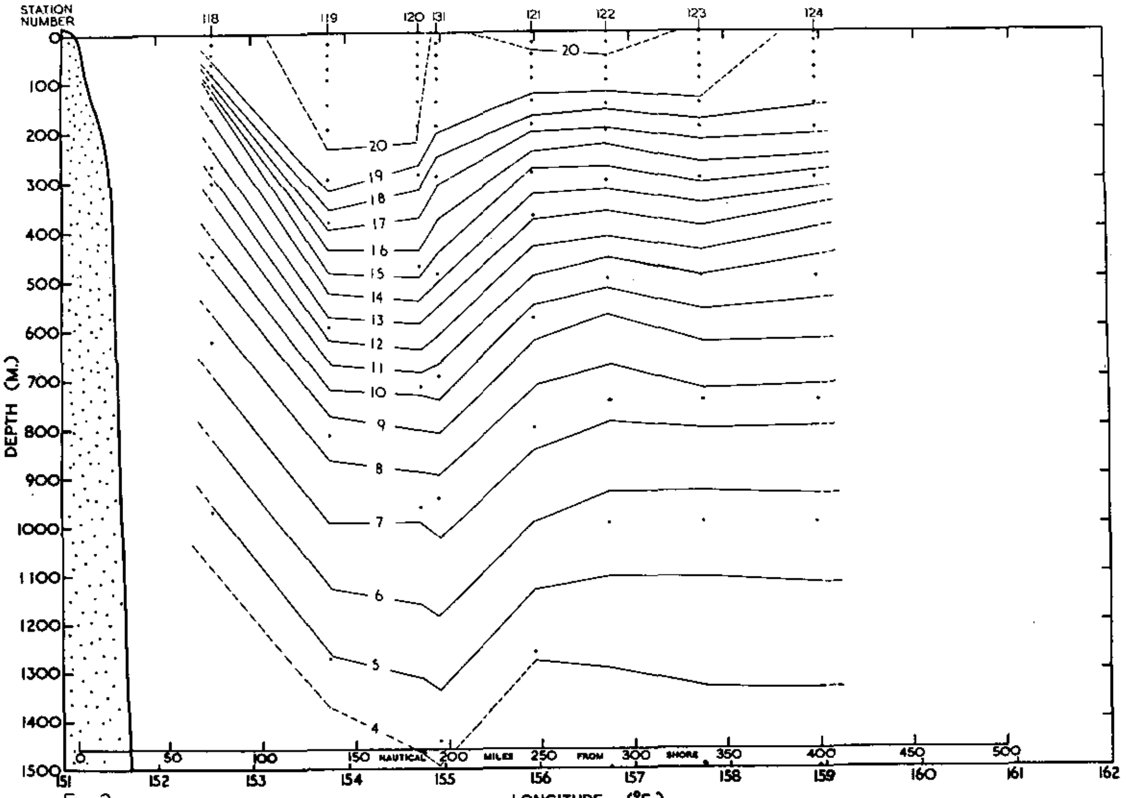
Fig.20. Distribution of rate of CO_2 uptake g $C/day/m^2$ and depth of penetration of 1% surface light at stations worked during cruise.

Fig.21. Depth profiles of pigment concentrations.



COFF'S HBR
SYDNEY
SECTION 1
SECTION 2
SECTION 3
SECTION 4
H: HYDROLOGY
C: PRODUCTIVITY
B: PIGMENTS
L: LIGHT PENETRATION
P: PHYTOPLANKTON

Fig. 1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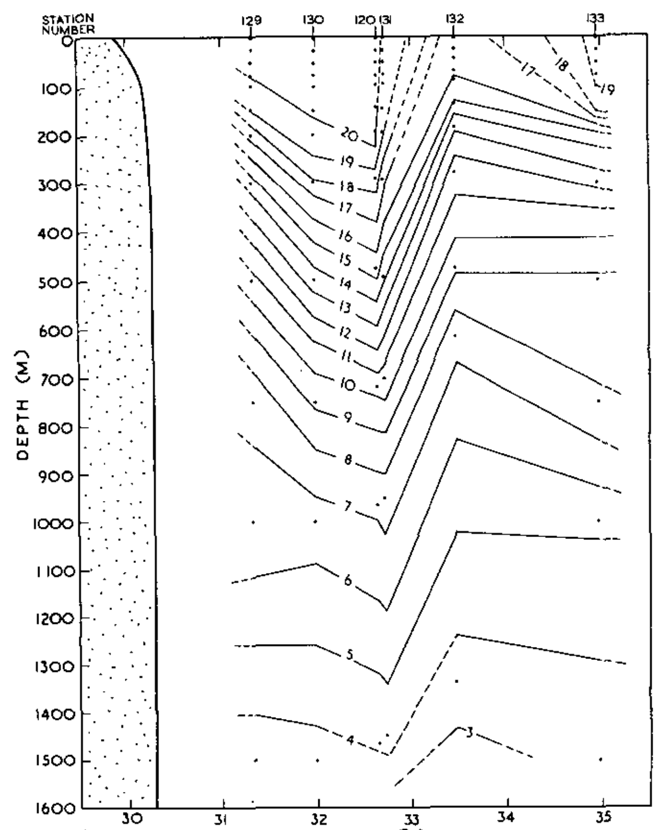
119
120
131
121
122
123
124
DEPTH (M.)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
0
50
100
150 NAUTICAL 200 MILES 250 FROM 300 SHORE 350
400
450
500
151
152
153
154
155
156
157
158
159
160
161
162
LONGITUDE (°E.)

Fig. 2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130
120
131
132
133
DEPTH (M)
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200
300
400
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600
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800
900
1000
1100
1200
1300
1400
1500
1600
20
19
18
17
16
15
14
13
12
11
10
9
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7
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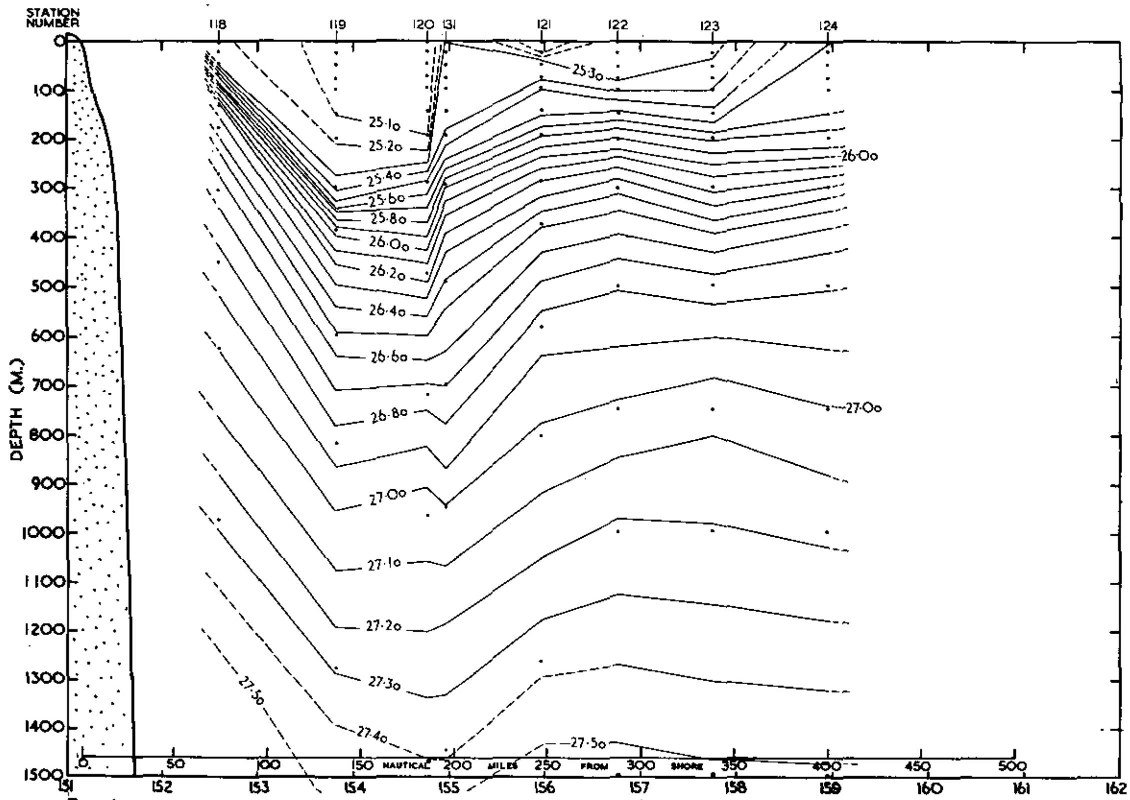
4
3
30
31
32
33
34
35
LATITUDE (°S.)

Fig. 3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120
131
121
122
123
124
DEPTH (M.)
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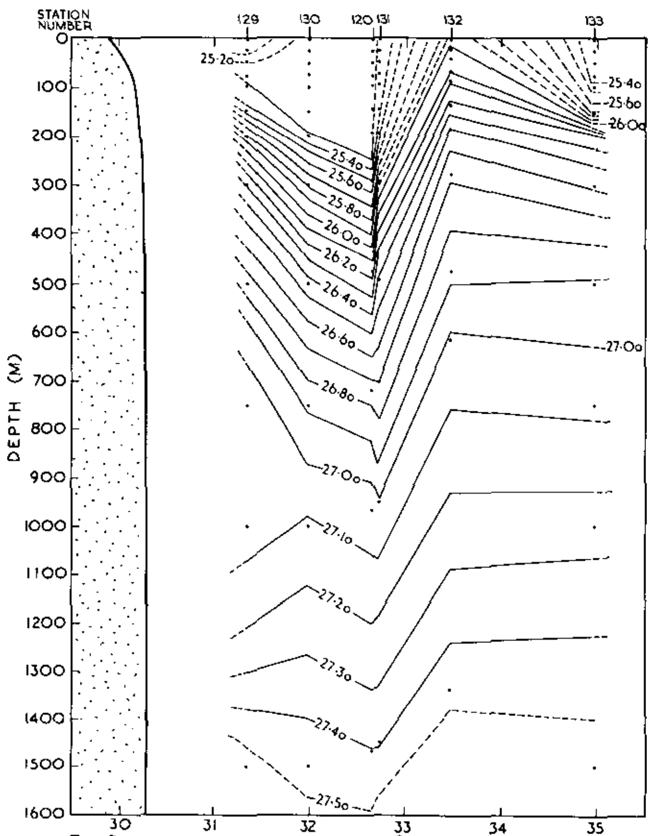
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
25·3o
25·1o
25·2o
25·4o
25·6o
25·8o
26·0o
26·2o
26·4o
26·6o
26·8o
27·0o
27·1o
27·2o
27·3o
27·4o
27·5o
26·0o
27·0o
0
50
100
150 NAUTICAL
200 MILES
250 FROM
300 SHORE
350
400
450
500
151
152
153
154
155
156
157
158
159
160
161
162
LONGITUDE (°E.)
Fig. 4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120
131
132
133
DEPTH (M)
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200
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25·6o
25·8o
26·0o
26·2o
26·4o
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27·3o
27·4o
27·5o
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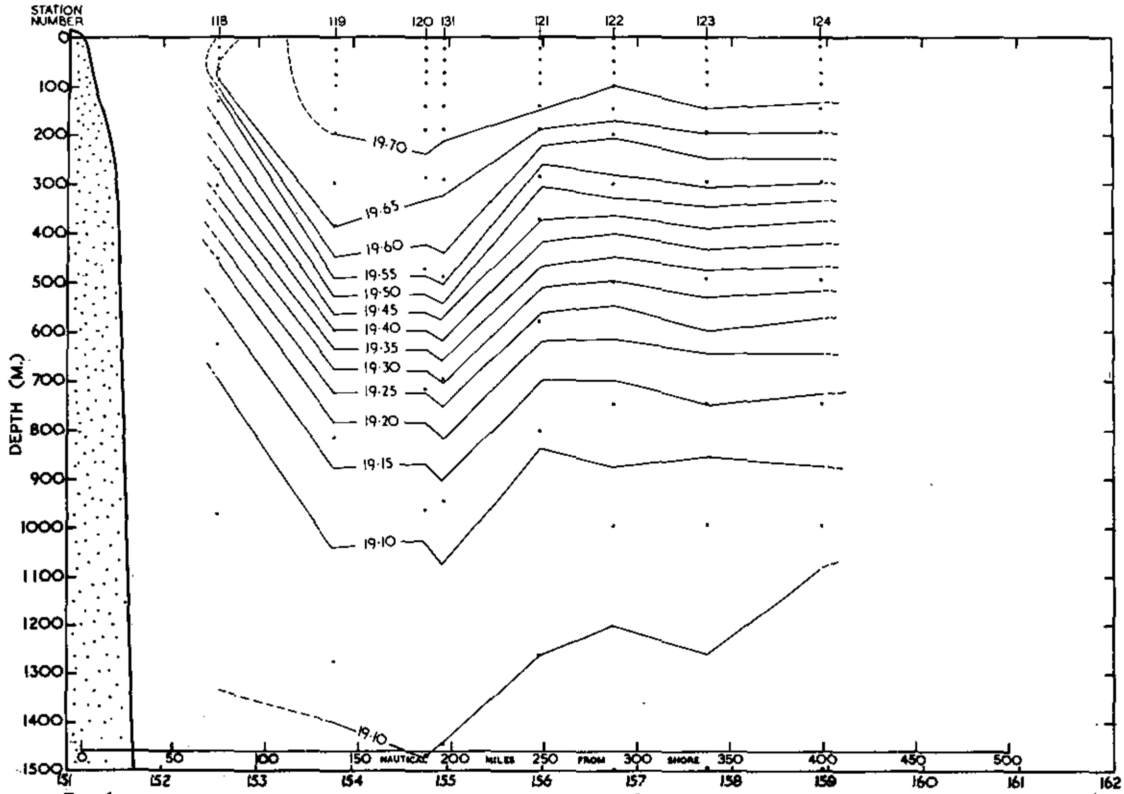
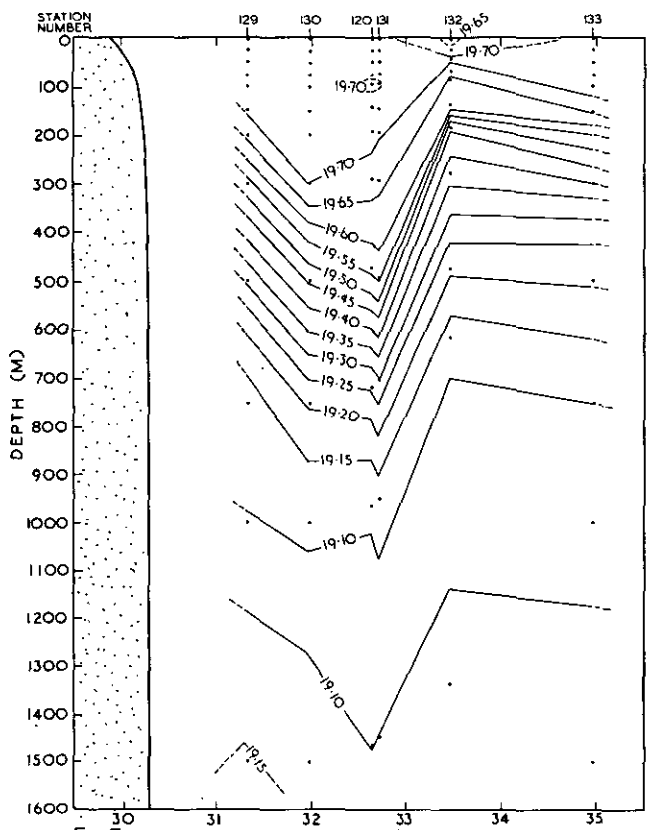
33
34
35
LATITUDE (°S)
Fig 5



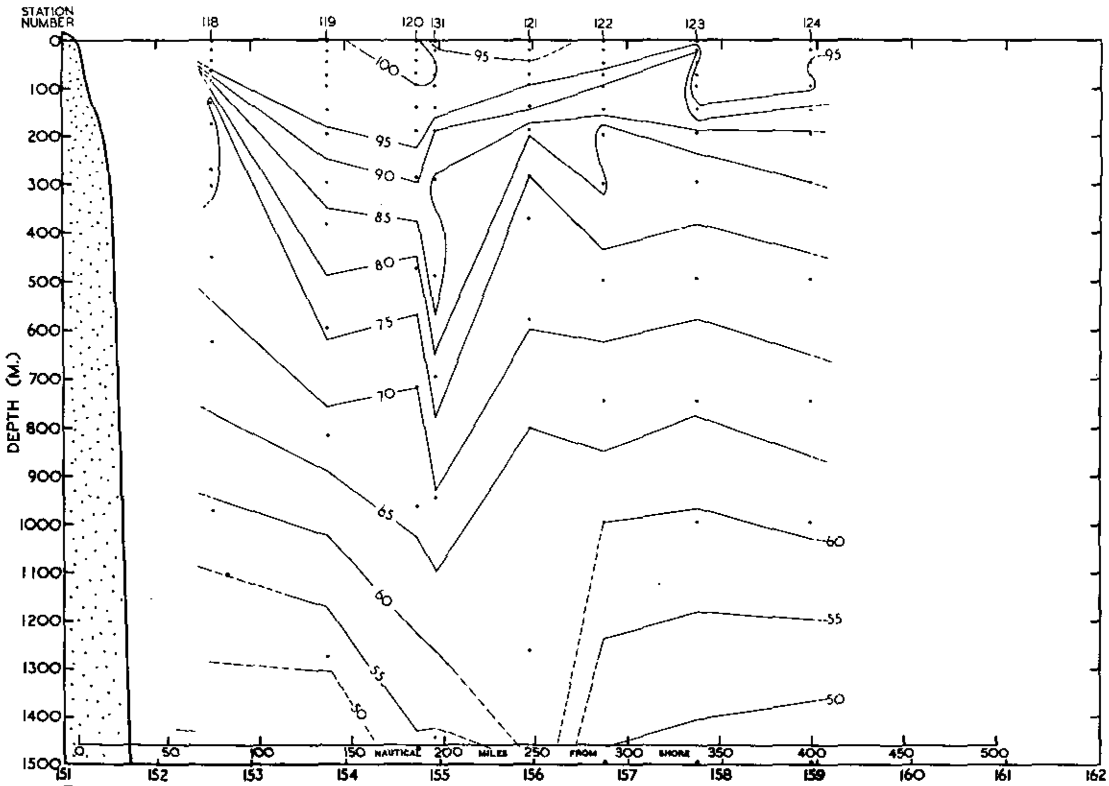
STATION NUMBER
118
119
120
131
121
122
123
124
19·70
19·65
19·60
19·55
19·50
19·45
19·40
19·35
19·30
19·25
19·20
19·15
19·10
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)

Fig. 6



STATION NUMBER
129
130
120
131
132
133
19·65
19·70
19·15
19·10
DEPTH (M)
LATITUDE (°S)

Fig. 7


STATION NUMBER
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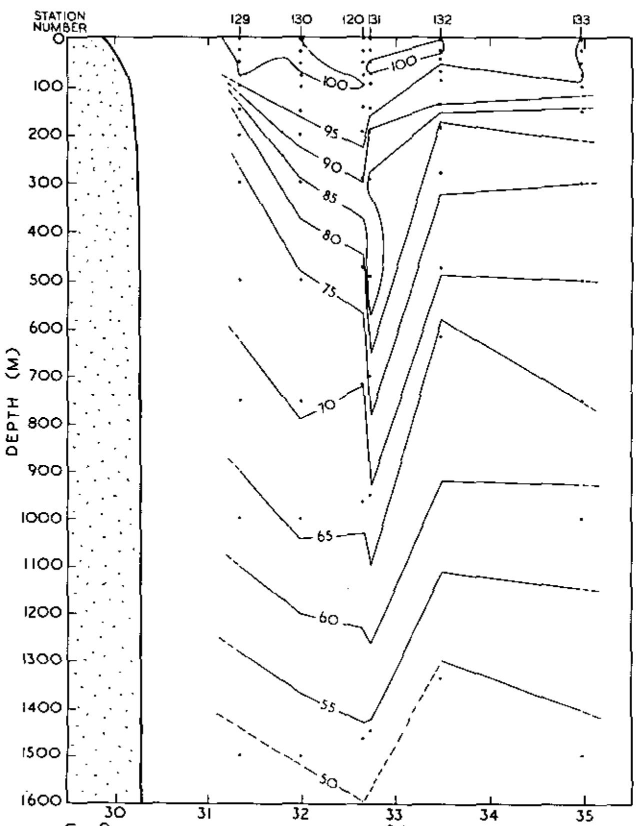
119
120
131
121
122
123
124
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)

Fig. 8


STATION NUMBER
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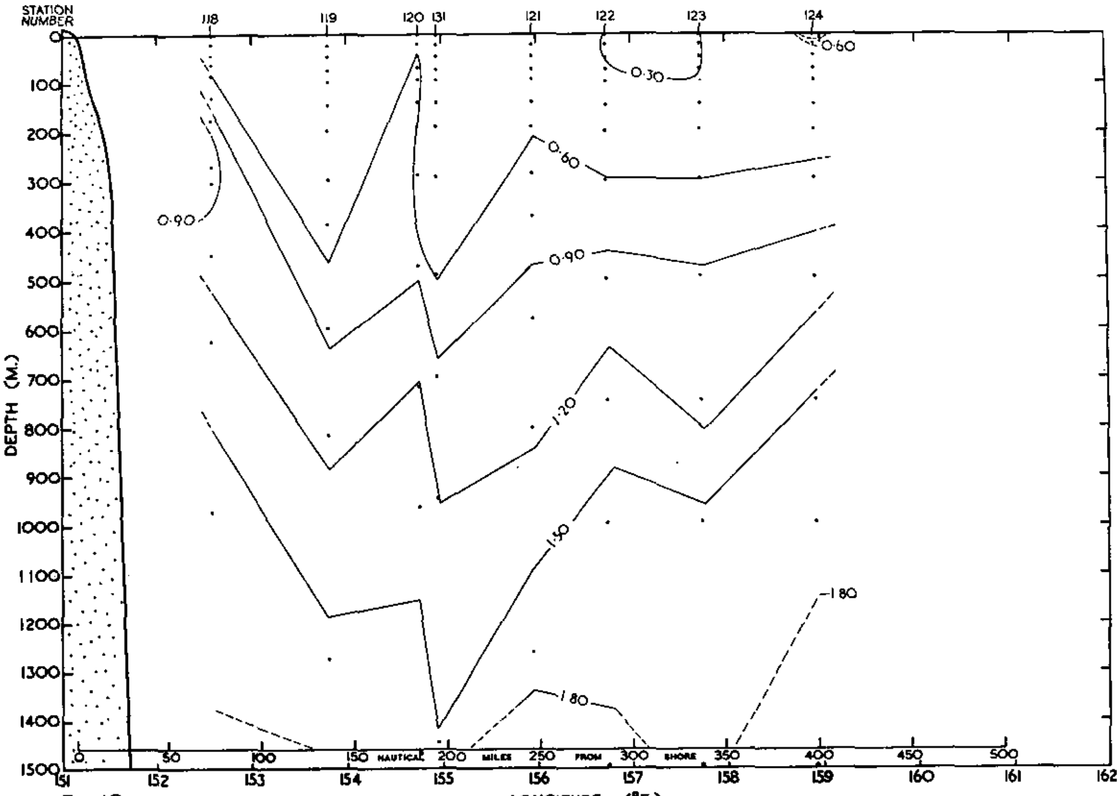
130
120
131
132
133
DEPTH (M)
LATITUDE (°S)

Fig. 9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120 131
121
122
123
124
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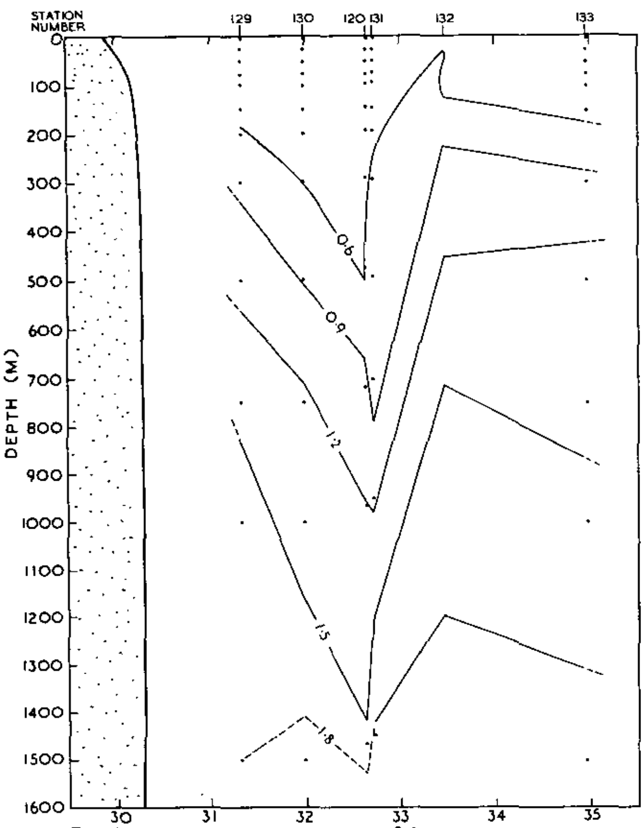
0.60
0.90
0.90
1.20
1.50
1.80
1.80
DEPTH (M.)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
0 50 100 150 NAUTICAL 200 MILES 250 FROM 300 SHORE 350 400 450 500
151 152 153 154 155 156 157 158 159 160 161 162
LONGITUDE (°E.)

Fig. 10


STATION NUMBER
129
130
120 131
132
133
0.6
0.9
1.2
1.5
1.8
DEPTH (M)
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100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
30 31 32 33 34 35
LATITUDE (°S)

Fig. 11

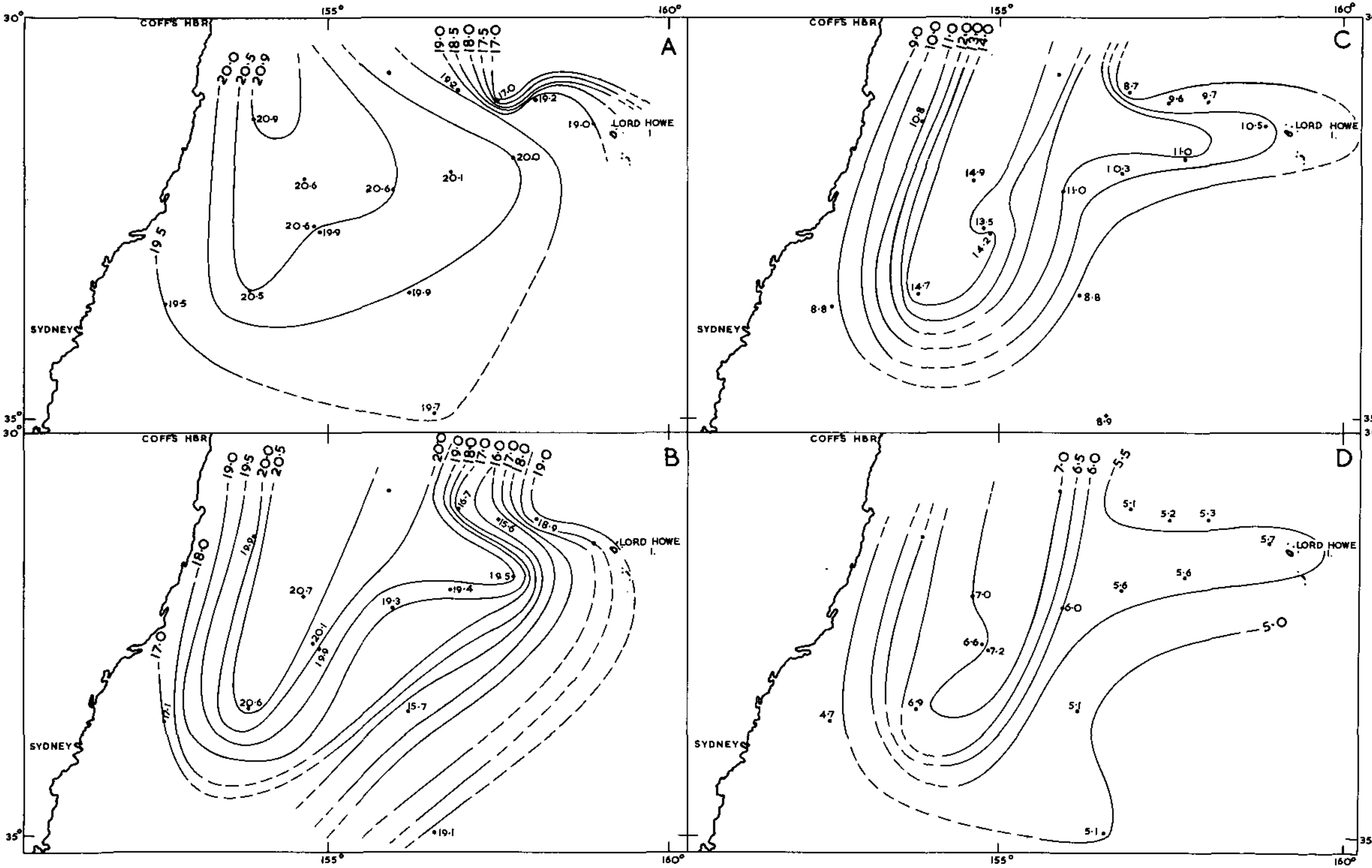
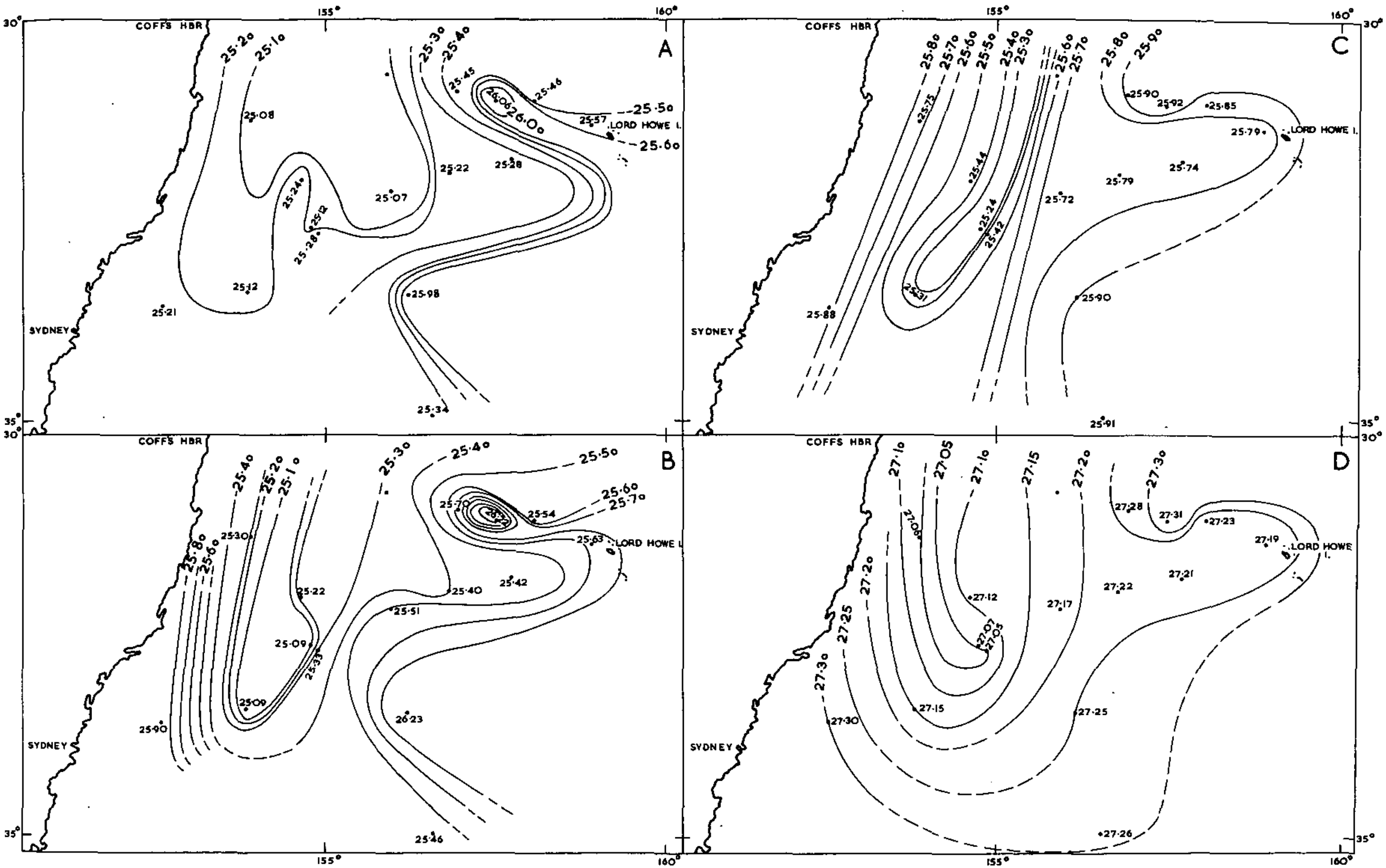


Fig. 12



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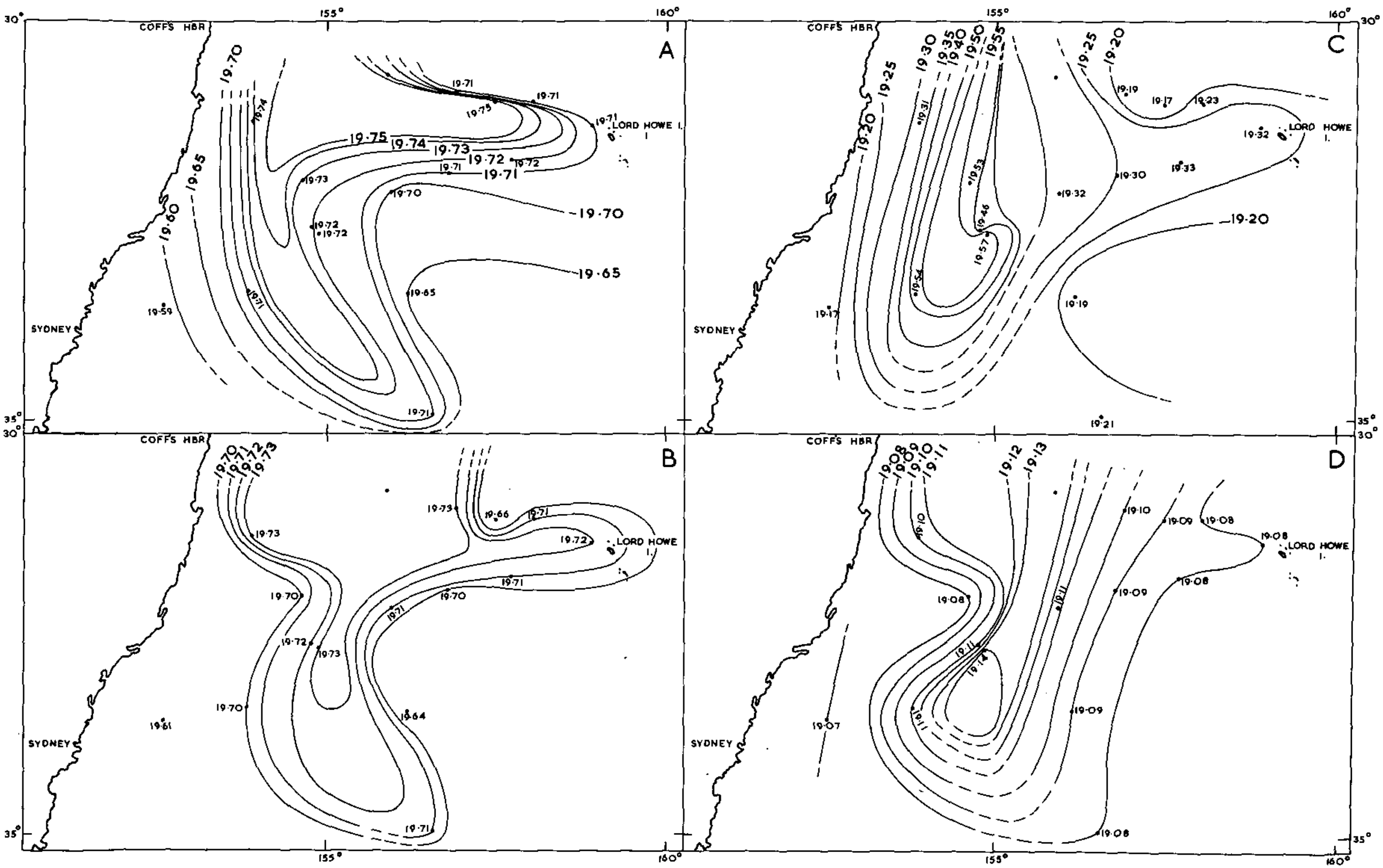


Fig. 14

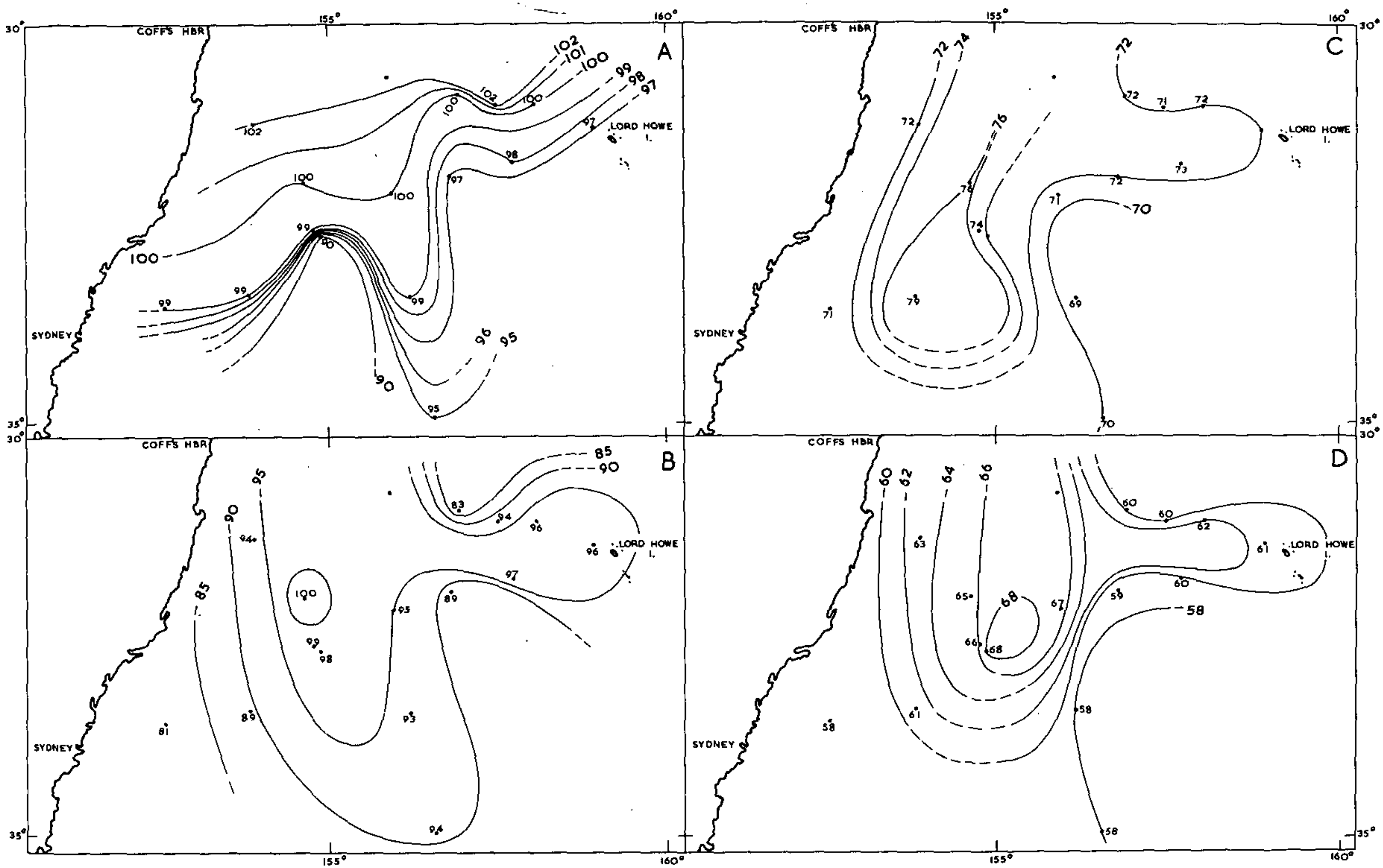
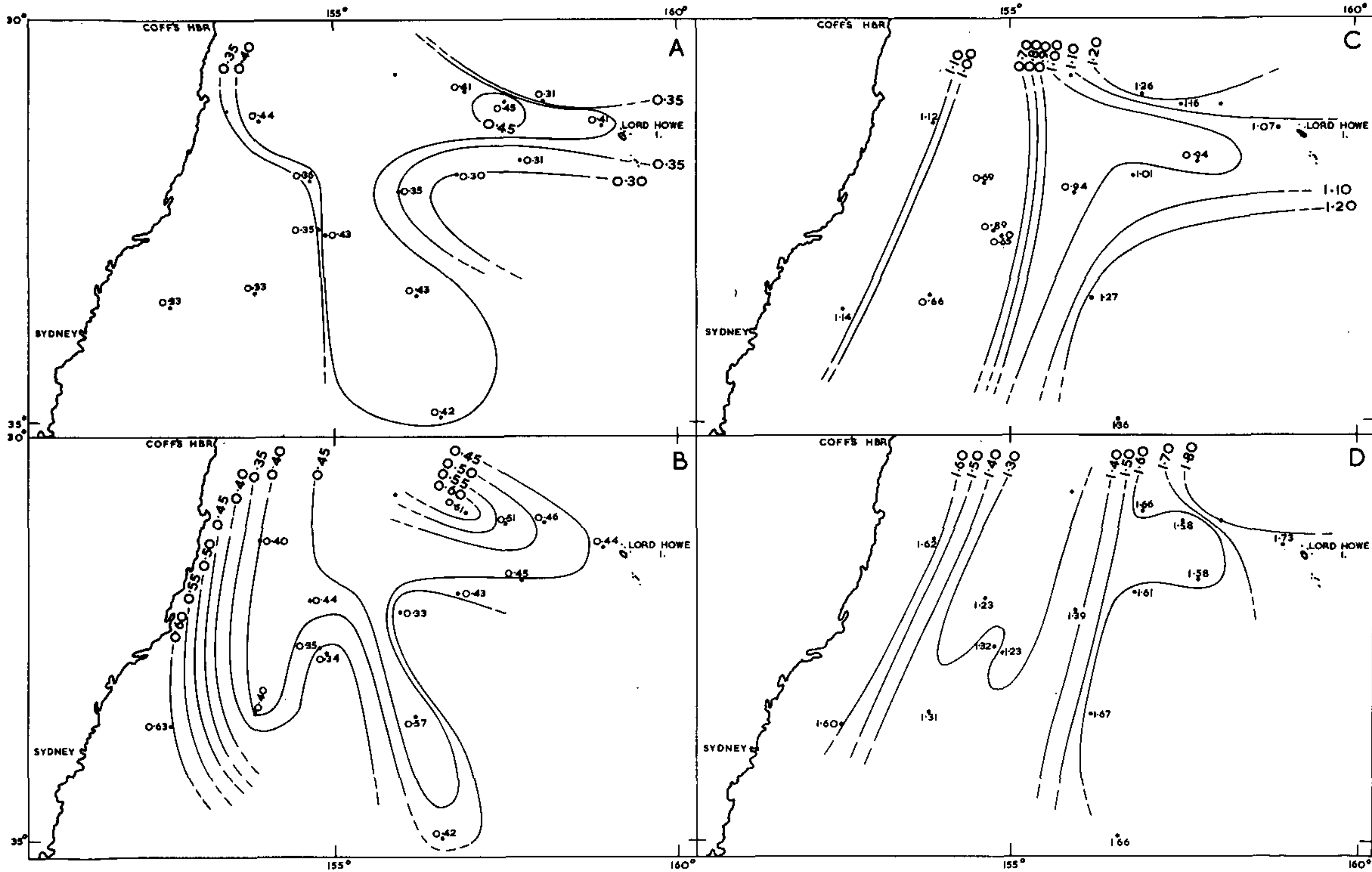
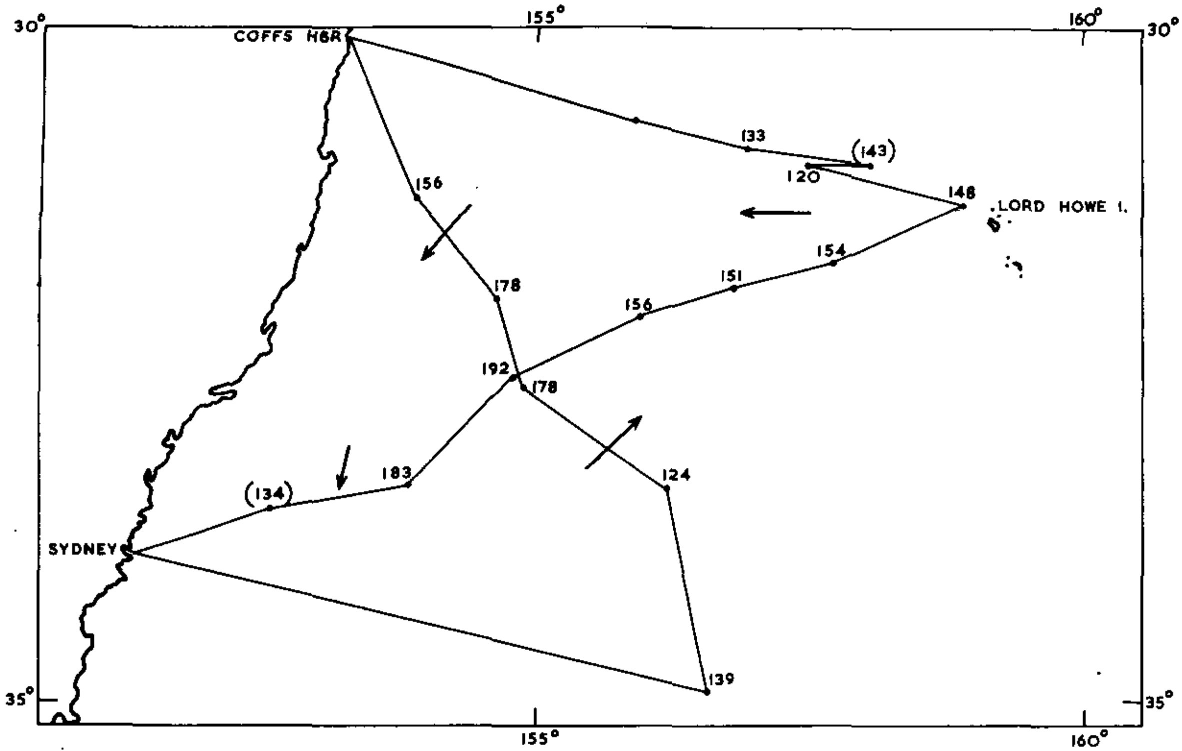


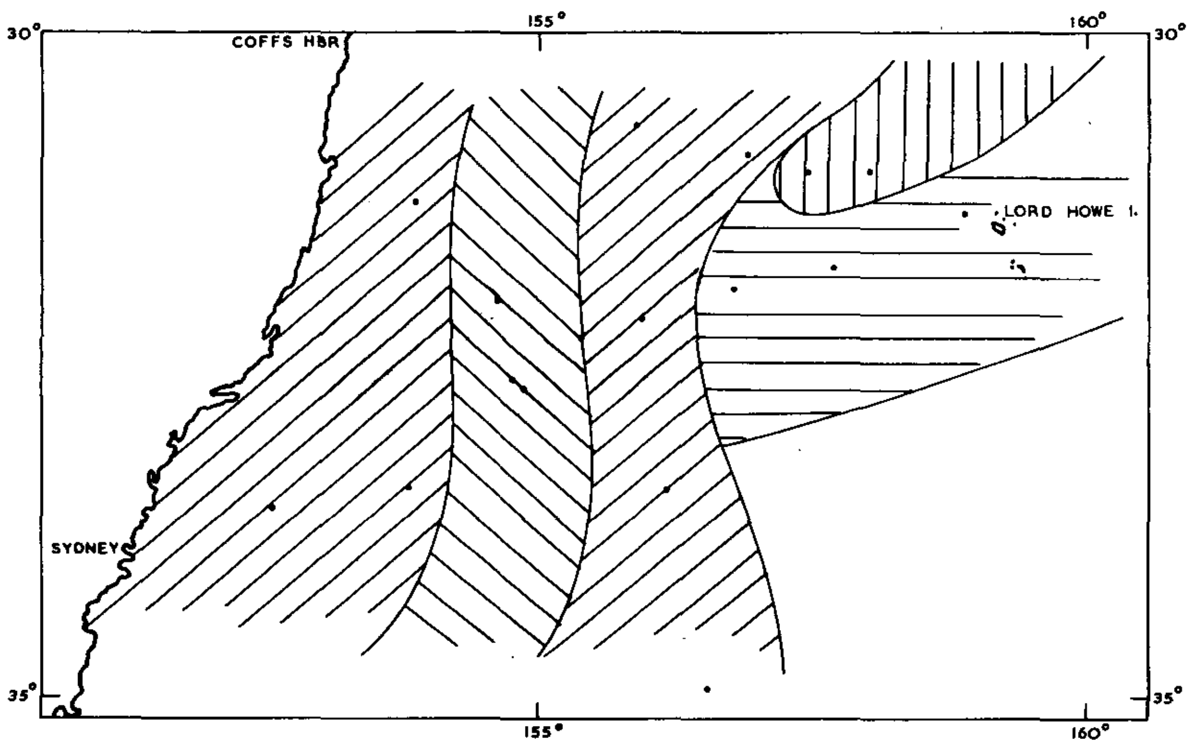
Fig. 15



30°
35°
155°
160°
COFFS HBR
SYDNEY
LORD HOWE I.
A
B
C
D
0·35
0·40
0·45
0·30
1·10
1·20
1·30
1·40
1·50
1·60
1·70
1·80

Fig. 16


30°
155°
160°
30°
COFFS HBR
133
(143)
120
148
LORD HOWE I.
156
154
151
178
156
192
178
183
(134)
124
SYDNEY
139
35°
35°
155°
160°
Fig. 17


30°
155°
160°
30°
COFFS HBR
LORD HOWE I.
SYDNEY
35°
35°
155°
160°
Fig. 18

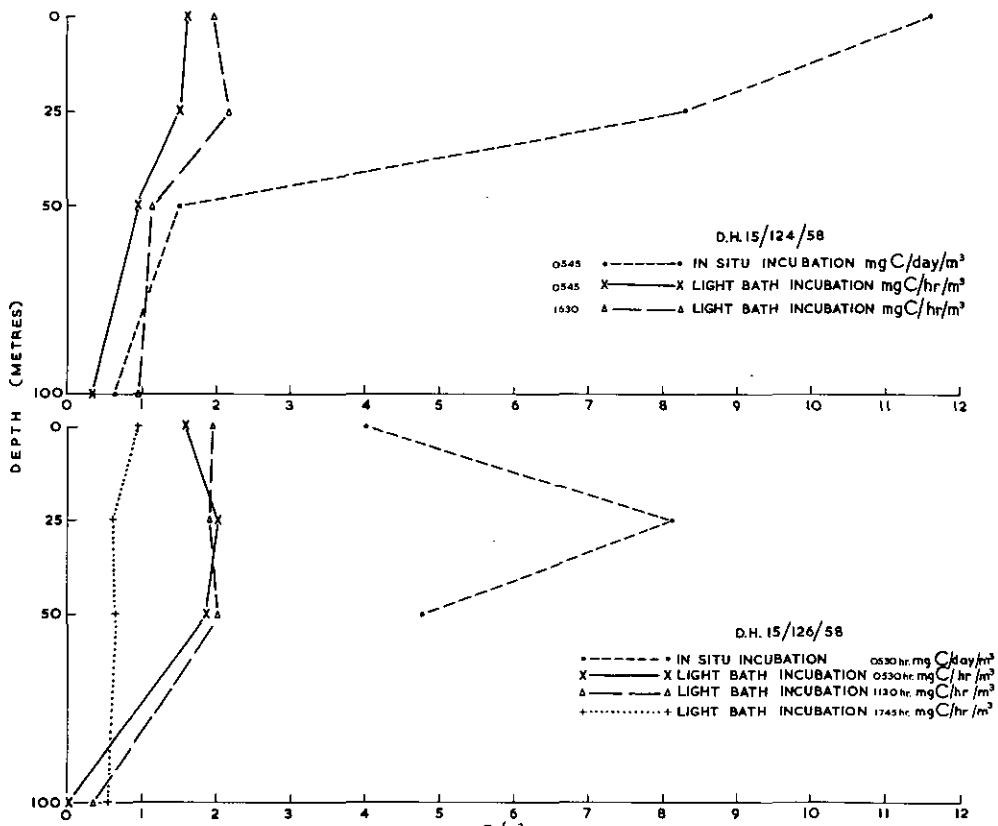

DEPTH (METRES)
D.H. 15/124/58
0545 IN SITU INCUBATION mg C/day/m³
0545 LIGHT BATH INCUBATION mgC/hr/m³
1630 LIGHT BATH INCUBATION mgC/hr/m³
D.H. 15/126/58
IN SITU INCUBATION 0530 hr. mg C/day/m³
LIGHT BATH INCUBATION 0530 hr. mgC/hr/m³
LIGHT BATH INCUBATION 1130 hr. mgC/hr/m³
LIGHT BATH INCUBATION 1745 hr. mgC/hr/m³
mg C/m³

Fig. 19

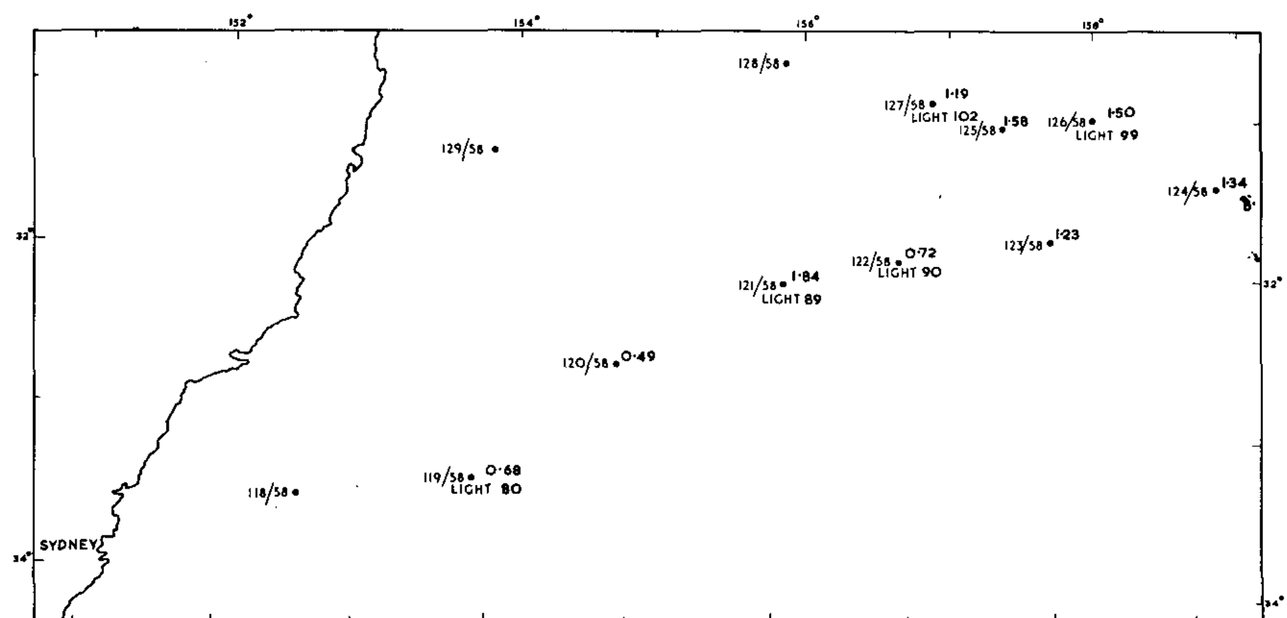
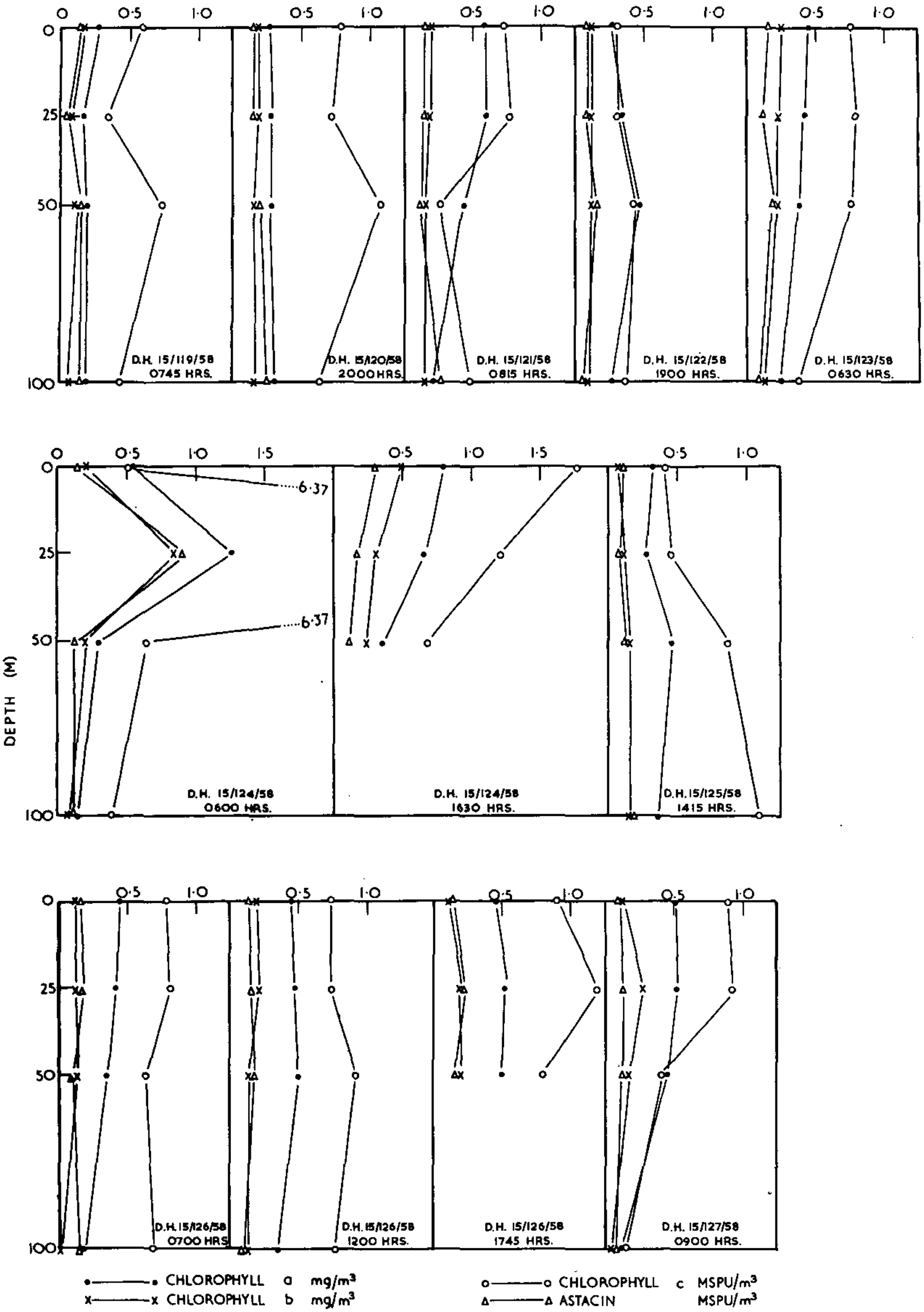

152°
154°
156°
158°
32°
34°
SYDNEY
128/58
127/58 1·19
LIGHT 102
125/58 1·58
126/58 1·50
LIGHT 99
129/58
124/58 1·34
123/58 1·23
122/58 0·72
LIGHT 90
121/58 1·84
LIGHT 89
120/58 0·49
119/58 0·68
LIGHT 80
118/58

Fig. 20



D.H. 15/119/58 0745 HRS.
D.H. 15/120/58 2000 HRS.
D.H. 15/121/58 0815 HRS.
D.H. 15/122/58 1900 HRS.
D.H. 15/123/58 0630 HRS.
D.H. 15/124/58 0600 HRS.
D.H. 15/124/58 1630 HRS.
D.H. 15/125/58 1415 HRS.
D.H. 15/126/58 0700 HRS.
D.H. 15/126/58 1200 HRS.
D.H. 15/126/58 1745 HRS.
D.H. 15/127/58 0900 HRS.
DEPTH (M)
6·37
CHLOROPHYLL a mg/m³
CHLOROPHYLL b mg/m³
CHLOROPHYLL c MSPU/m³
ASTACIN MSPU/m³

Fig. 21

F.R.V. "DERWENT HUNTER"

SCIENTIFIC REPORT OF CRUISE DH16/58

October 2 - 10, 1958

SCIENTIFIC PERSONNEL

N. Dyson (in charge)

ITINERARY

This is a continuation of the twelfth of the series of cruises to study the structure and circulation of the East Australian Current off Sydney. Figure 1 shows the track chart and the work done at each station.

SCIENTIFIC REPORTS

Samples were taken for hydrology, pigments, and CO_2 uptake. Phytoplankton samples were taken with the Hardy Indicator. G.E.K. tows and B.T. lowerings were done.

(a) HYDROLOGY - A.D. CROOKS

Hydrology samples for chlorinity, dissolved oxygen, and total phosphorus were collected at depths of 0, 25, 50, 75, 100, 150, 200, 300, 500, 750, 1000, and 1500 m at fifteen stations. Paired protected and unprotected thermometers were used below 100 m, and duplicate protected thermometers above 100 m.

1. Temperature

(a) 110°T Section Line (Fig. 2)

Maximum surface temperature (19.11°C) was recorded at Station DH16/138/58 and minimum (16.23°C) at Station DH16/142/58. Below the surface, maximum temperature was recorded at Station DH16/140/50 and a minimum down to 600 m at Station DH16/142/58 and below 600 m at Station DH16/138/58.

(b) 290°T Section Line (Fig. 3)

Maximum surface temperature (23.08°C) occurred at Station DH16/156/58 and minimum (17.65°C) at Station DH16/147/58. There was a decrease in temperatures at all depths from west to east along the section, except at Stations DH16/153 and 156/58 where subsurface temperatures were respectively higher and lower. Between Stations DH16/150 and 154/58 there was an area of almost homogeneous surface water within the upper 150-200 m.

2. Density (σ_t)

(a) 110°T Section Line (Fig. 4)

Maximum surface density (26.03 σ_t) occurred at Station DH16/142/58 and minimum (25.48 σ_t) at DH16/138/58. Below the surface, maximum density occurred at Station DH16/138/58 and minimum at Station DH16/140/58 to 800 m, and below 800 m at Station DH16/139/58. Onshore Stations DH16/134-136/58 had relatively high densities.

(b) 390°T Section Line (Fig. 5)

Maximum surface density (25.78 σ_t) occurred at Station DH16/147/58 and minimum (24.44 σ_t) at Station DH16/156/58. Densities increased from west to east at all depths, to the east of Station DH16/156/58. In the upper 150-200 m an area of homogeneous density was located between Stations DH16/150-154/58.

3. Chlorinity

(a) 110°T Section Line (Fig. 6)

Maximum surface chlorinity (19.72 ‰) was recorded at Stations DH16/137-8/58 and minimum (19.60 ‰) at Station DH16/142/58. Down to about 700 m, maximum chlorinity occurred at Stations DH16/136 and 140/58 and minimum at Station DH16/137/58. Onshore waters, particularly at 100 m, had a low chlorinity. The depth of the chlorinity minimum varied between 800 m at Station DH16/138/58 and 1050 m at Station DH16/145/58.

The distribution of chlorinity was closely related to that of density except west of Station DH16/137/58 where anomalies occurred at some depths.

(b) 290°T Section Line (Fig. 7)

Maximum surface chlorinity (19.75 ‰) was observed at Station DH16/155/58 and minimum (19.67 ‰) at Station DH16/147/58. Chlorinities were similar in the upper 200 m between Stations DH16/150-156/58. Between 200 m and 1000 m chlorinities decreased at all levels to the east of Station DH16/156/58. Below 1000 m there was a slight decrease in chlorinity in the same direction. The depth of the chlorinity minimum varied between 1020 m at Station DH16/150/58 and 1150 m at Station DH16/153/58.

4. Percentage Oxygen Saturation
   (a) 110°T Section Line (Fig. 8)

Maximum percentage oxygen saturation (107%) at the surface occurred at Station DH16/135/58 and minimum (100%) at DH16/140/58. Saturation was observed at the surface at every station. The maximum depth of this saturated layer was 110 m at Station DH16/142/58 and minimum 20 m at Station DH16/140/58. Down to 700 m maximum percentage oxygen saturation was observed at Stations DH16/135 and 145/58 and minimum at Station DH16/138/58. Below 700 m maximum oxygen occurred at Station DH16/140/58 and minimum at Station DH16/138/58.

The distribution of percentage oxygen saturation paralleled that of density, except near the coast (upper 300 m) and between Stations DH16/139 and 142/58 (down to 400 m).

(b) 290°T Section Line (Fig. 9)

Maximum percentage oxygen saturation (104%) at the surface occurred at Station DH16/155/58 and minimum (101%) at Station DH16/147/58. The average depth of the 100% isoline was 130 m between Stations DH16/150 and 155/58, 70 m between Stations DH16/147 and 150/58 and 40 m between Stations DH16/155 and 156/58. In the upper 700 m maximum percentage oxygen saturation values were observed at Station DH16/153/58. Below 700 m, values were nearly uniform.

5. Total Phosphorus
   (a) 110°T Section Line (Fig. 10)

Maximum total phosphorus values (0.5 µg at./l) at the surface occurred at Station DH16/138/58 and minimum (0.33 µg at./l) at Station DH16/134/58. In the upper 50 m onshore waters were low in total phosphorus. Below the surface, minimum total phosphorus occurred at Station DH16/140/58.

The total phosphorus and density distributions were closely related except west of Station DH16/139/58 below 400 m. There the larger anomalies occurred nearer the coast. The deepening of the total phosphorus isolines between Stations DH16/142 and 145/58 paralleled the oxygen distribution. This is true also of the upper 600 m layer.

(b) 290°T Section Line (Fig. 11)

Maximum surface total phosphorus values (0.59 µg at./l) occurred at Station DH16/150/58 and minimum (0.32 µg at./l) at Station DH16/156/58. Below the surface, maximum values occurred at Station DH16/156/58 and minimum at DH16/153/58.

Above 1000 m there was a close relationship between total phosphorus and density, but below 1000 m there were frequent anomalies.

6. Horizontal Distribution of Properties

(a) Temperature (Fig. 12)

The temperature distribution at the surface and at 100 m was dominated by a tongue of warm water, whose axis ran north-south, approximately 120 miles off the coast. Maximum temperature was found in this tongue. At 100 m, a secondary tongue appeared approximately 180 miles east of the primary tongue. The latter was not so well defined as the former and its water was cooler. At 500 m the primary tongue had disappeared and the secondary tongue dominated the distribution. A well developed temperature front was found at the extreme south of this tongue. At 1000 m the warm tongue became much wider but less defined. There was an area of homogeneous water to the east of the area.

(b) Density (σ_t) (Fig. 13)

The distribution of density was similar to that of temperature except that at 500 m the secondary tongue (Fig. 12) was not shown in the density field. Maximum densities were found at all depths below 500 m at Station DH16/139/58.

(c) Chlorinity (Fig. 14)

At the surface and at 100 m the warm tongue of water had high chlorinity values. The cooler waters to the south-east had lower chlorinity. At all depths the cooler onshore water had low chlorinity. Between 500 m and 1000 m the direction of the meridional gradient of chlorinity was reversed, so that low chlorinities were found to the south at 500 m but to the north at 1000 m.

The chlorinity and density fields were similar at the surface and at 100 m, but quite different at 500 m and 1000 m.

TABLE 1

DIATOMS IN PHYTOPLANKTON COLLECTIONS

CRUISE DH16/58

	134	135	136	137	138	139	140	142	145	146	150	154	155	156
Bacteriastrum delicatulum				+						+		+		
B. varians														+
B. hyalinum													+	
B. comusum														+
Chaetoceros teres	+			+	+				+	+				
Ch. laciniosum				+								+		
Ch. vanheurckii				+								+		+
Ch. debile				+								+		
Ch. lorenzianum				+						+	+	+		
Ch. secundum				+	+					+				
Ch. concavicorne							+		+		+	+		
Ch. decipiens											+	+		
Ch. eibenii											+	+		
Ch. neapolitanum								+				+		
Ch. peruvianum												+		+
Ch. atlanticum												+		
Cerataulina pelagica												+		
Climacodium frauenfeldianum													+	+
Coscinodiscus concinnus												+		+
Ditylum brightwellii					+									
Fragilaria oceanica				+										
Guinardia flaccida				+										+
Lauderia annulata				+	+							+		
Leptocylindricus danicus				+	+									
Melosira crenulata											+			
Nitzschia closterium		+												
N. seriata				+	+	+	+	+	+	+	+			+
Planktoniella sol							+					+	+	+
Rhizosolenia alata					+	+	+						+	
f. gracillima								+	+	+++	+	+++		+
f. indica														+
R. stolterforthii					+							+		+
R. delicatula					+									
R. imbricata	+													
R. calcar-avis							+			+				+
R. acuminata							+				+			
R. clevei														+
R. hebetata f. semispina														+
R. bergonii														+
Schroederella delicatula	+		+	+	+	+			+					
Stephanopyxis palmeriana	+		+	+										+
S. turris					+									
Streptotheca thamesis	+		+											
Striatella unipunctata												+		
Thalassiosira rotula	+			+	+							+		
T. decipiens					+							+		
Thalassiothrix longissima						+		+						+
Th. nitzschioides							+							

TABLE 2

DINOFLAGELLATES IN PHYTOPLANKTON COLLECTIONS

CRUISE DH16/58

	134	136	137	138	142	145	146	150	154	155	156
Diplopsalis lenticula	+										
Peridinium granii		+	+	+							
P. oceanicum								+	+	+	+
P. crassipes									+		
P. pentagonum									+		
P. oblongum									+		
P. abei									+		
P. globulus									+	+	
P. curtipes									+		
P. quarnerense									+		
P. pellucidum									+		
P. okamurai										+	+
P. brochii										+	+
Ceratium fusus					+		+		+	+	
C. furca							+			+	+
C. trichoceros									+		+
C. buceros					+						
C. extensum											+
C. massiliense									+		
C. carriense										+	
C. tripos									+	+	+
C. candelabrum									+	+	+
C. contrarium										+	+
C. karstenii										+	+
C. arietinum										+	
C. setaceum									+		
C. declinatum									+		
C. pulchellum										+	
C. concilians										+	
C. kofoidi											+
Dinophysis fortii						+					
Pyrophacus horologicum									+	+	+
Ceratocorys horrida									+		
Pyrocystis lunula									+	+	
Py. pseudonoctiluca										+	
Py. hamulus f. semicircularis											+

(d) Percentage Oxygen Saturation (Fig. 15)

Except at the surface the primary warm tongue of water had a relatively low percentage of oxygen saturation, but the secondary tongue, even at 500 m, contained waters of high percentage oxygen saturation. The oxygen and density fields were similar at the surface and at 100 m.

(e) Total Phosphorus (Fig. 16)

The primary tongue of warm water had minimum total phosphorus values at the surface and at 100 m. At 500 m and 1000 m the axis of the total phosphorus tongue shifted to the north in the eastern, but to the south in the western half of the region.

(b) PHYSICS - B.V. HAMON

Dynamics

Figure 17A shows the contours of dynamic heights (in dyn. cm) relative to the 600 decibar level and Figure 17B to the 1000 decibar level.

The dynamic height contours indicate a southward current between 20 and 80 miles offshore, N.E. from Sydney. East of Sydney, the current turns towards the east, and again turns towards the north-east about 250 miles offshore. No significance should be attached to the wave-like pattern of the contours in Figure 17B.

The volume transport between Stations DH16/137 and 155/58 (A and B, Fig. 17B) was found to be $19 \times 10^6 m^3/sec$, and the surface geostrophic current 32 cm/sec, both relative to 1000 decibars.

Figure 18 shows the surface vectors from G.E.K. readings.

(c) PHYTOPLANKTON - E.J.F. WOOD

On this cruise a most interesting feature was the almost complete absence of dinoflagellates from Stations DH16/136-146/58 (Fig. 19) while at Stations DH16/146-156/58 numerous species were present (Table 2). The collection from Station DH16/154/58 contained nine species of *Peridinium* all of which are characteristic Coral Sea species. This collection also contained a *Rhizosolenia alata* f. *gracillima* bloom and ten species of *Chaetoceros* (Table 1).

(d) CO_2 UPTAKE - N. DYSON

In order to measure the daily rate of uptake of CO_2 by *in situ* incubation Station DH16/135/58 was occupied for half-day and Stations DH16/138 and 139/58 for one day. The results obtained at the half-day station were multiplied by 2 to give the daily rate of production. At each of these three stations samples were also collected at intervals to determine the hourly rate of CO_2 uptake by the light bath incubation method. Figure 20 shows the results obtained by the two methods of measurement.

At the two all-day stations the late afternoon samples gave the lowest results which is consistent with the evidence previously obtained suggesting a diurnal cycle in photosynthesis of phytoplankton.

(e) LIGHT PENETRATION - N. DYSON

At the three productivity stations a total of seven light penetration measurements was made to depths of 80 m. The results were calculated to give the depth of penetration of 1 per cent. of surface light and are shown in Table 3. Large stray angles occurred during some of the measurements which may account for the variation from results obtained on previous cruises.

TABLE 3

STATION	TIME	DEPTH OF PENETRATION OF 1% OF SURFACE LIGHT
135	0800 1000 1200	80 81 89
138	0800 1345 1600	94 82 86
139	0805	189

(f) PIGMENTS - G.F. HUMPHREY

Samples for the determination of plankton pigments were collected at Stations DH16/135, 138, and 139/58 at 0, 25, 50, and 100 m. The results are in C.S.I.R.O. Aust. (1960) and are graphed in Figure 21.

LEGENDS FOR FIGURES 1-21 - Cruise DH16/58

Fig. 1. Track chart showing stations worked.

Fig. 2. Sectional distribution of temperature (°C) along 110°T line to 1500 m.

Fig. 3. Sectional distribution of temperature (°C) along 290°T line to 1500 m.

Fig. 4. Sectional distribution of density (σ_t) along 110°T line to 1500 m.

Fig. 5. Sectional distribution of density (σ_t) along 290°T line to 1500 m.

Fig. 6. Sectional distribution of chlorinity (‰) along 110°T line to 1500 m.

Fig. 7. Sectional distribution of chlorinity (‰) along 290°T line to 1500 m.

Fig. 8. Sectional distribution of oxygen saturation (%) along 110°T line to 1500 m.

Fig. 9. Sectional distribution of oxygen saturation (%) along 290°T line to 1500 m.

Fig.10. Sectional distribution of total phosphorus (µg at./l) along 110°T line to 1500 m.

Fig.11. Sectional distribution of total phosphorus (µg at./l) along 29C°T line to 1500 m.

Fig.12. Horizontal distribution of temperature, A at 0 m, B at 100 m, C at 500 m, and D at 1000 m.

Fig. 13. Horizontal distribution of density, A at 0 m, B at 100 m, C at 500 m, and D at 1000 m.

Fig. 14. Horizontal distribution of chlorinity, A at 0 m, B at 100 m, C at 500 m, and D at 1000 m.

Fig. 15. Horizontal distribution of percentage oxygen saturation, A at 0 m, B at 100 m, C at 500 m, and D at 1000 m.

Fig. 16. Horizontal distribution of total phosphorus, A at 0 m, B at 100 m, C at 500 m, and D at 1000 m.

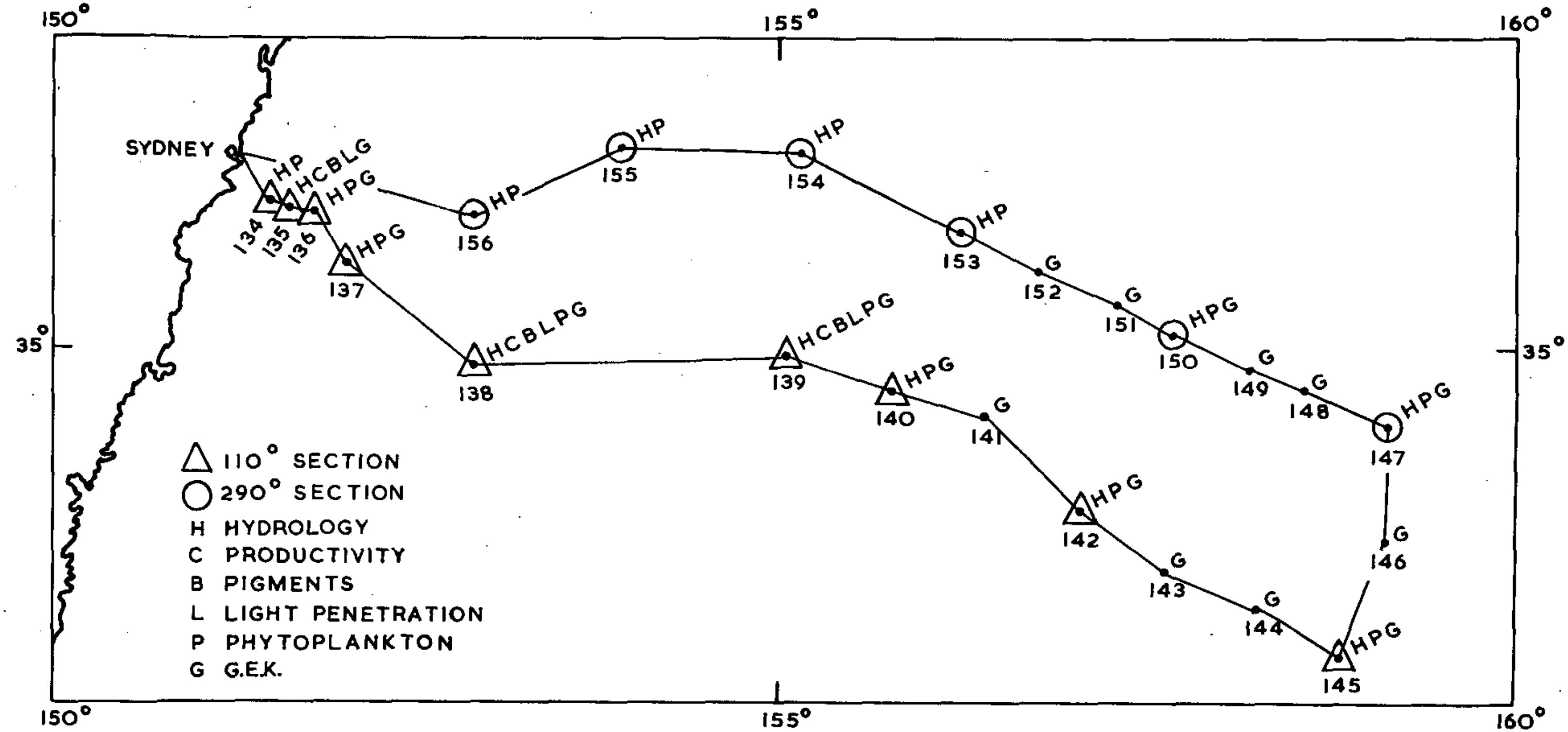
Fig. 17. Dynamic heights (dyn. cm) relative to A, 600 decibars; B to 1000 decibars.

Fig. 18. Surface vectors from G.E.K. readings.

Fig. 19. Phytoplarkton communities determined from collections at various stations.

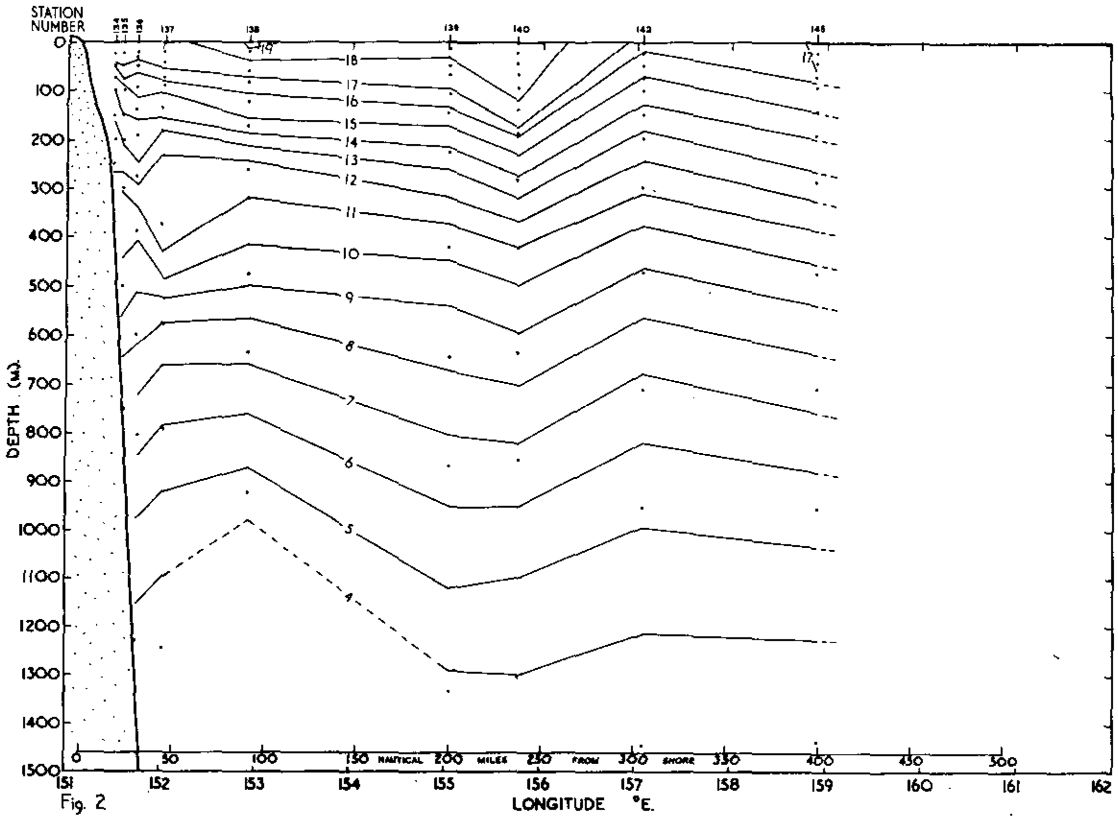
Fig. 20. Rate of CO_2 uptake at Stations DH16/135, 138, and 139/58.

Fig. 21. Depth profiles of pigment concentrations.



150°
155°
160°
35°
SYDNEY
HP
HCBLG
HPG
HCBLPG
HPG
HP
G
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
110° SECTION
290° SECTION
H HYDROLOGY
C PRODUCTIVITY
B PIGMENTS
L LIGHT PENETRATION
P PHYTOPLANKTON
G G.E.K.

Fig. 1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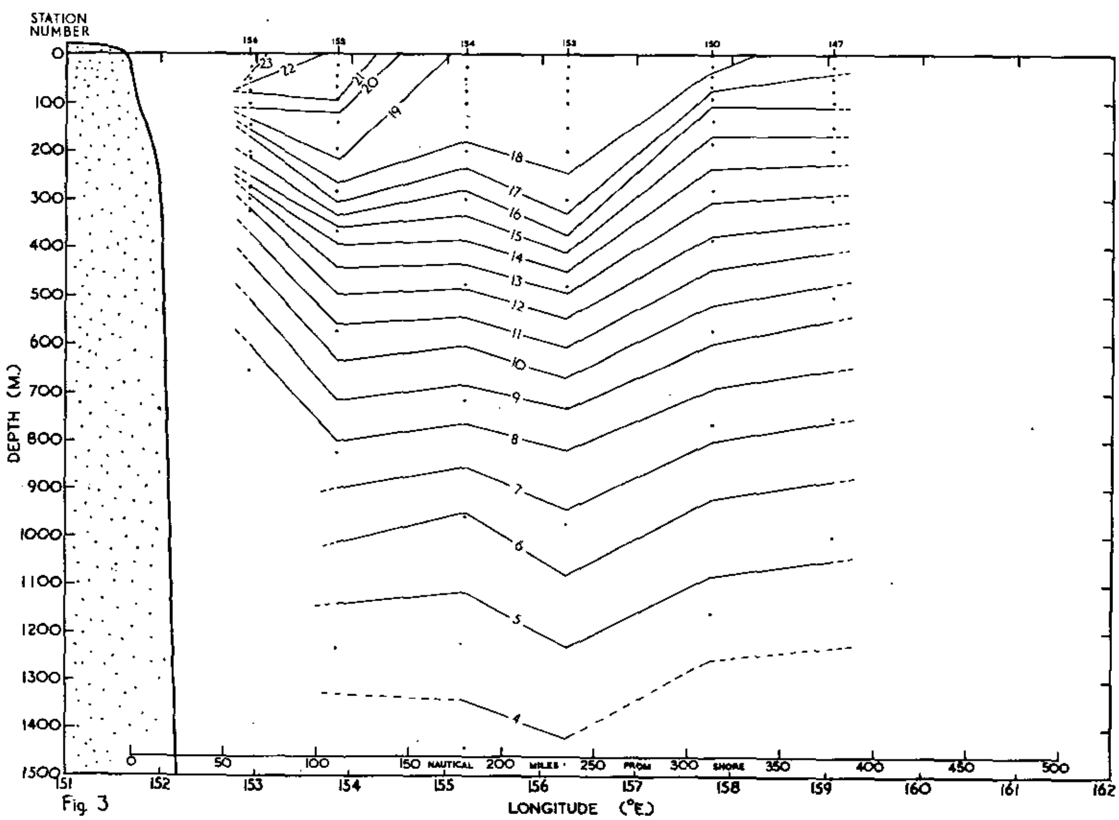
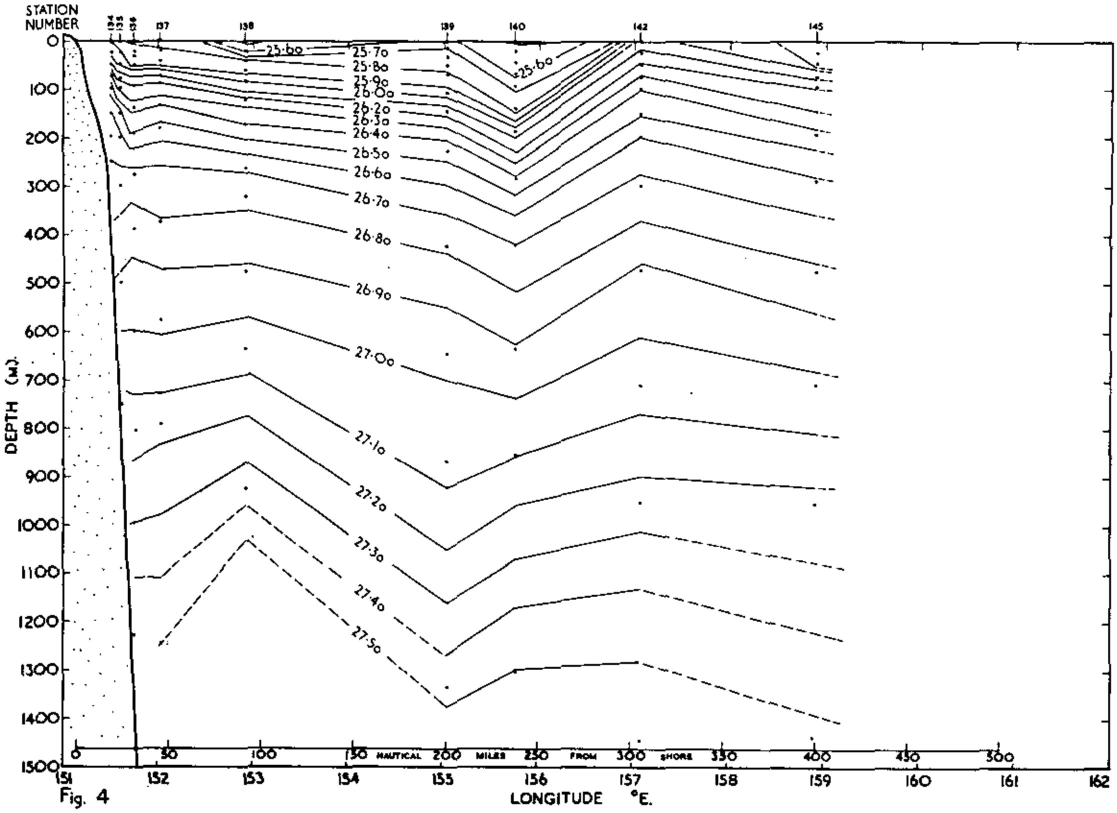
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE °E.
Fig. 2


STATION NUMBER
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)
Fig. 3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DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE °E.

Fig. 4

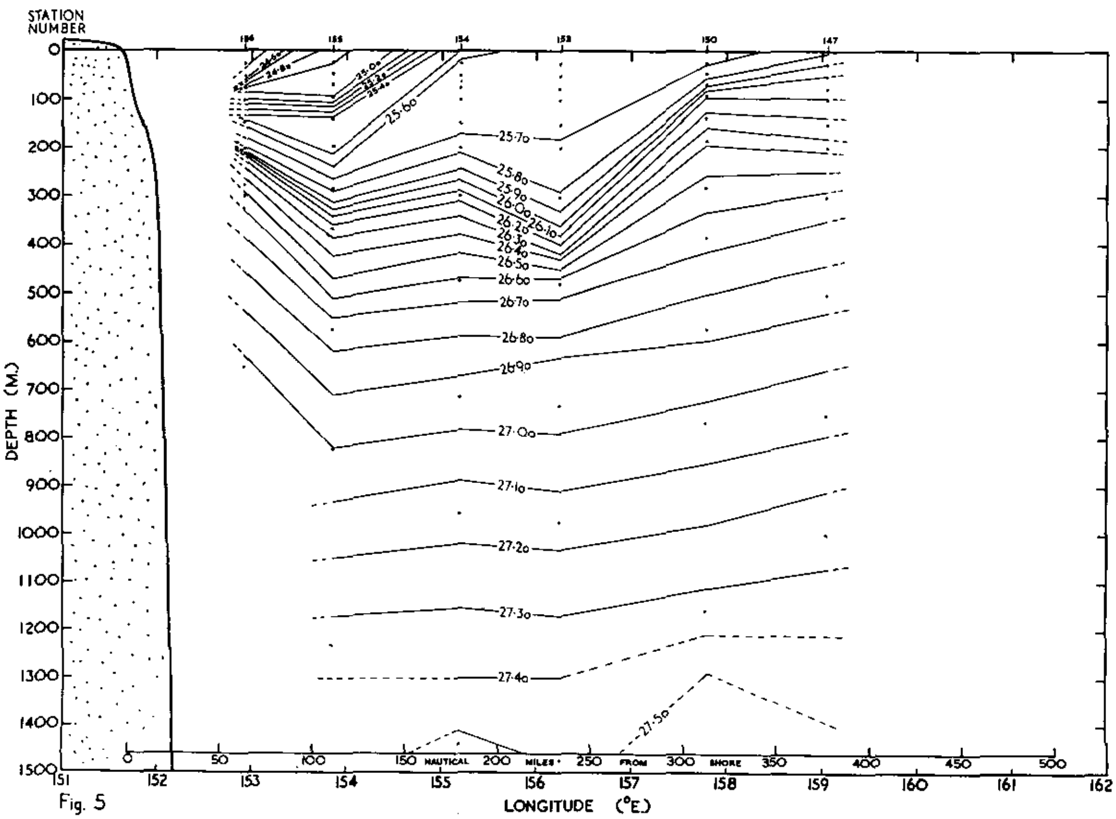

STATION NUMBER
156 155 154 152 150 147
25·60 25·7o 25·8o 25·9o 26·0o 26·1o 26·2o 26·3o 26·4o 26·5o 26·6o 26·7o 26·8o 26·9o 27·0o 27·1o 27·2o 27·3o 27·4o 27·5o
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)

Fig. 5

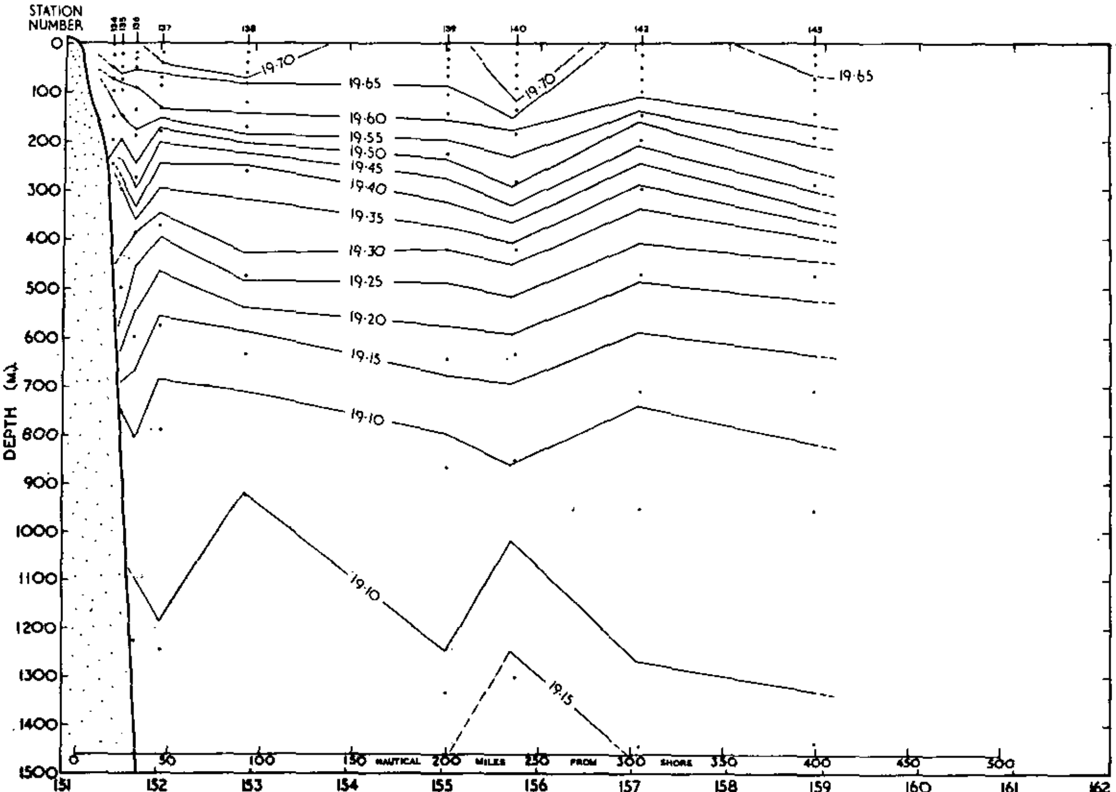

STATION NUMBER
DEPTH (M.)
19·70
19·65
19·60
19·55
19·50
19·45
19·40
19·35
19·30
19·25
19·20
19·15
19·10
NAUTICAL MILES FROM SHORE
LONGITUDE °E.

Fig. 6

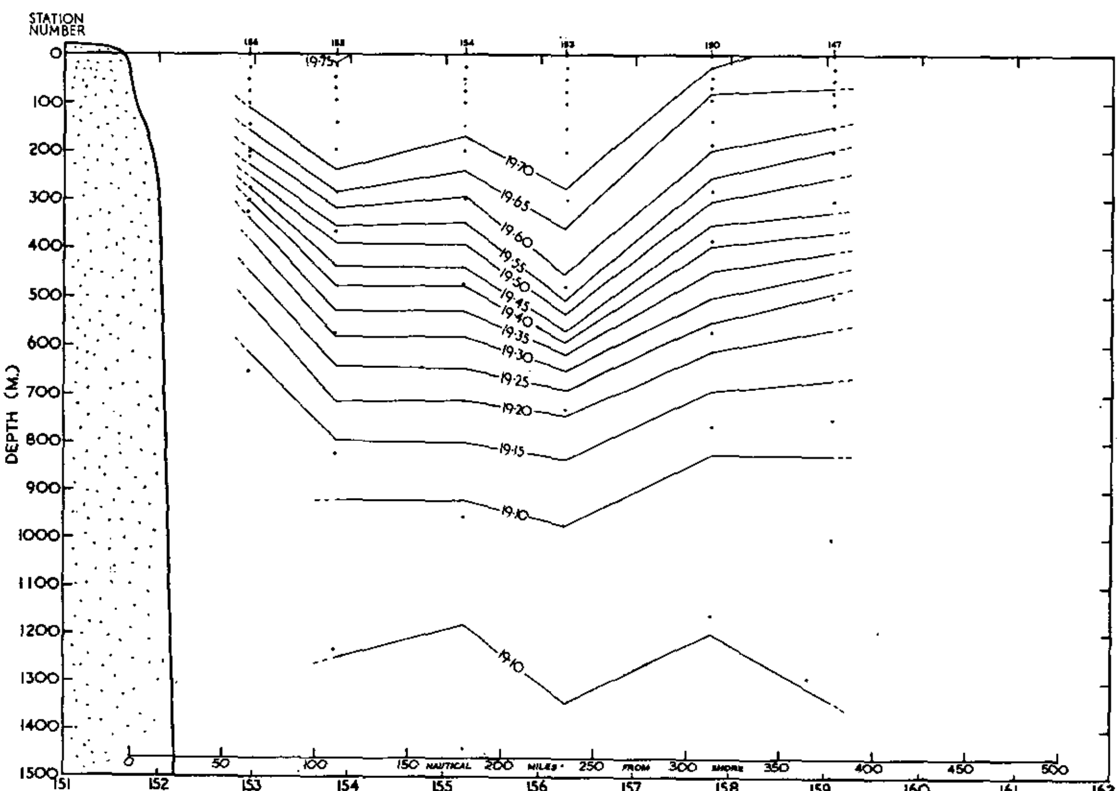
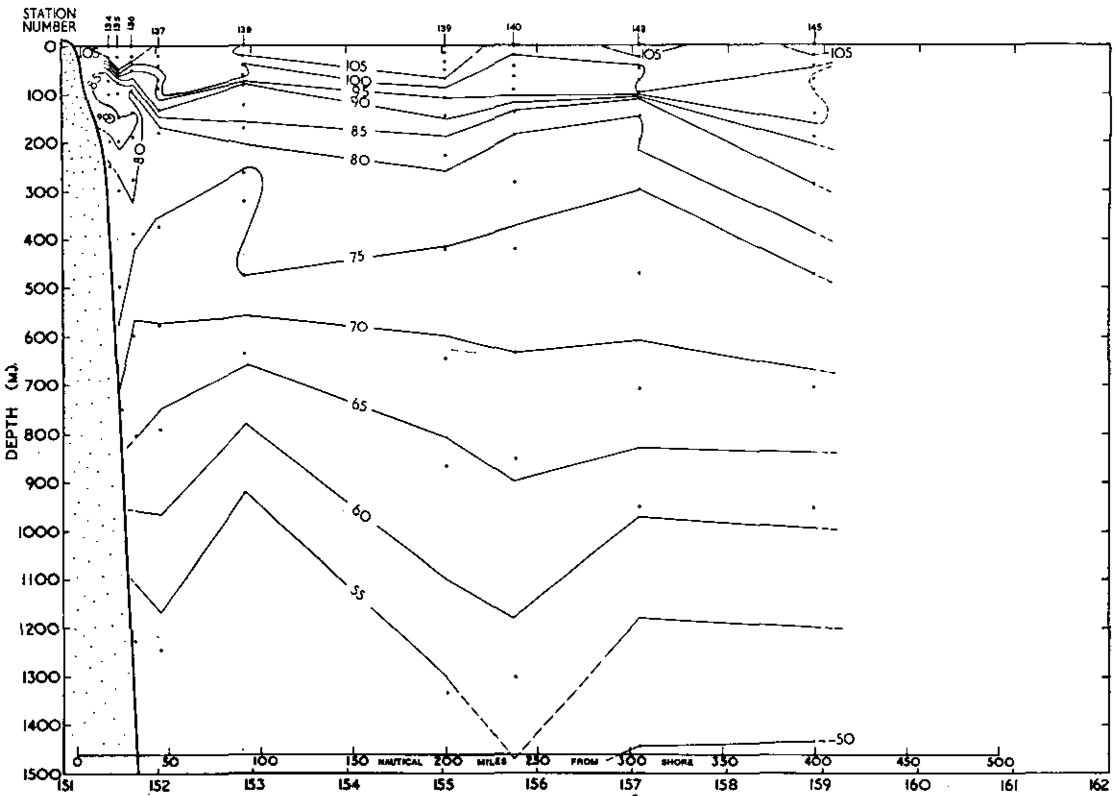
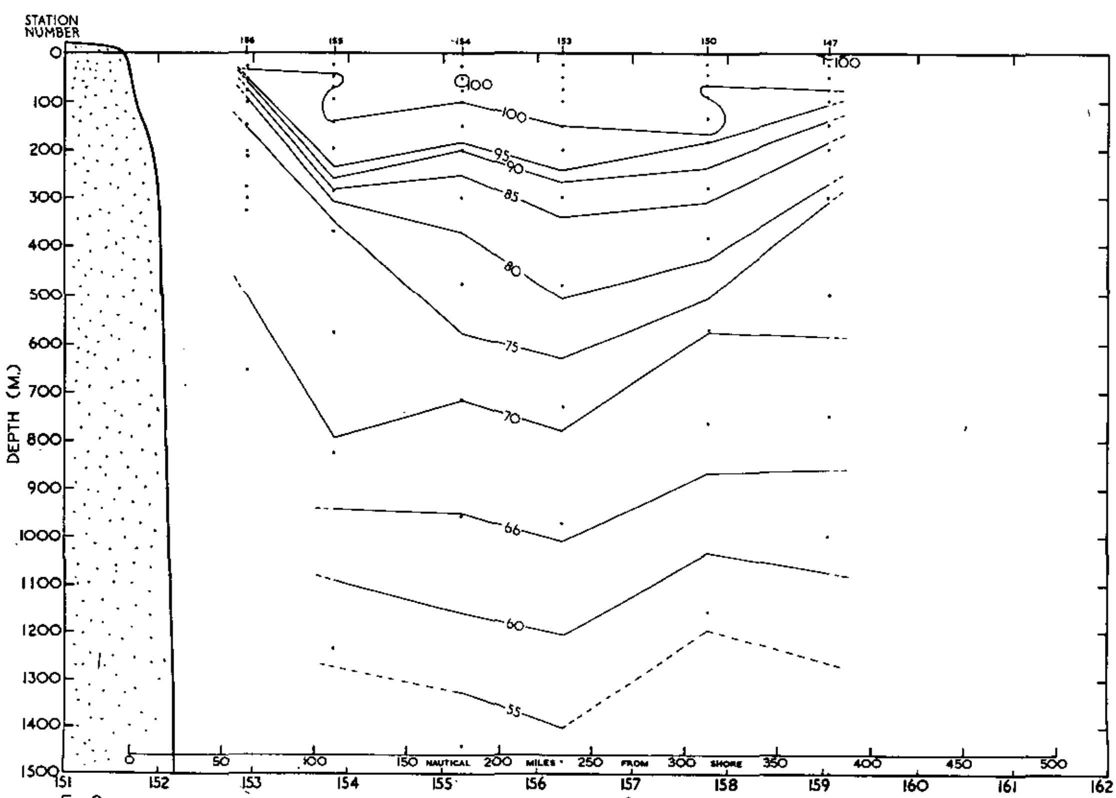

STATION NUMBER
DEPTH (M.)
19·75
19·70
19·65
19·60
19·55
19·50
19·45
19·40
19·35
19·30
19·25
19·20
19·15
19·10
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)

Fig. 7



STATION NUMBER
DEPTH (M.)
LONGITUDE. °E.
NAUTICAL MILES FROM SHORE

Fig. 8



STATION NUMBER
DEPTH (M.)
LONGITUDE (°E.)
NAUTICAL MILES FROM SHORE

Fig. 9

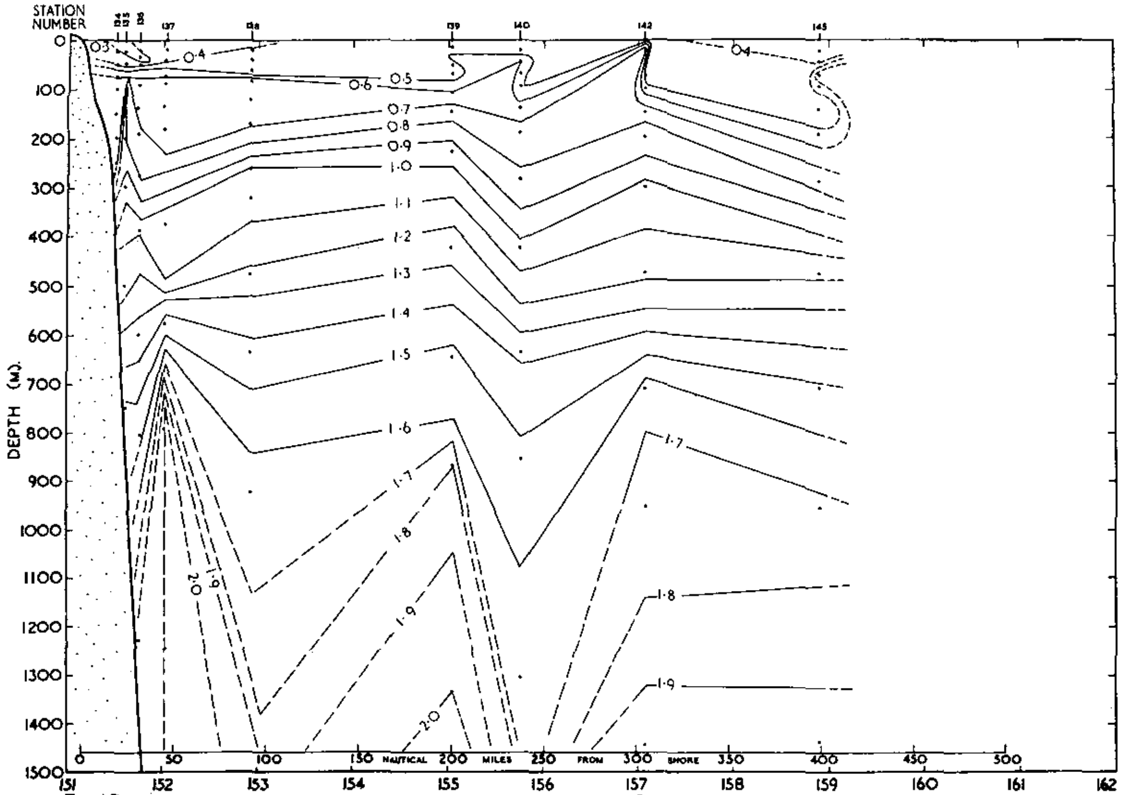

STATION NUMBER
DEPTH (M.)
LONGITUDE °E.
NAUTICAL MILES FROM SHORE

Fig. 10

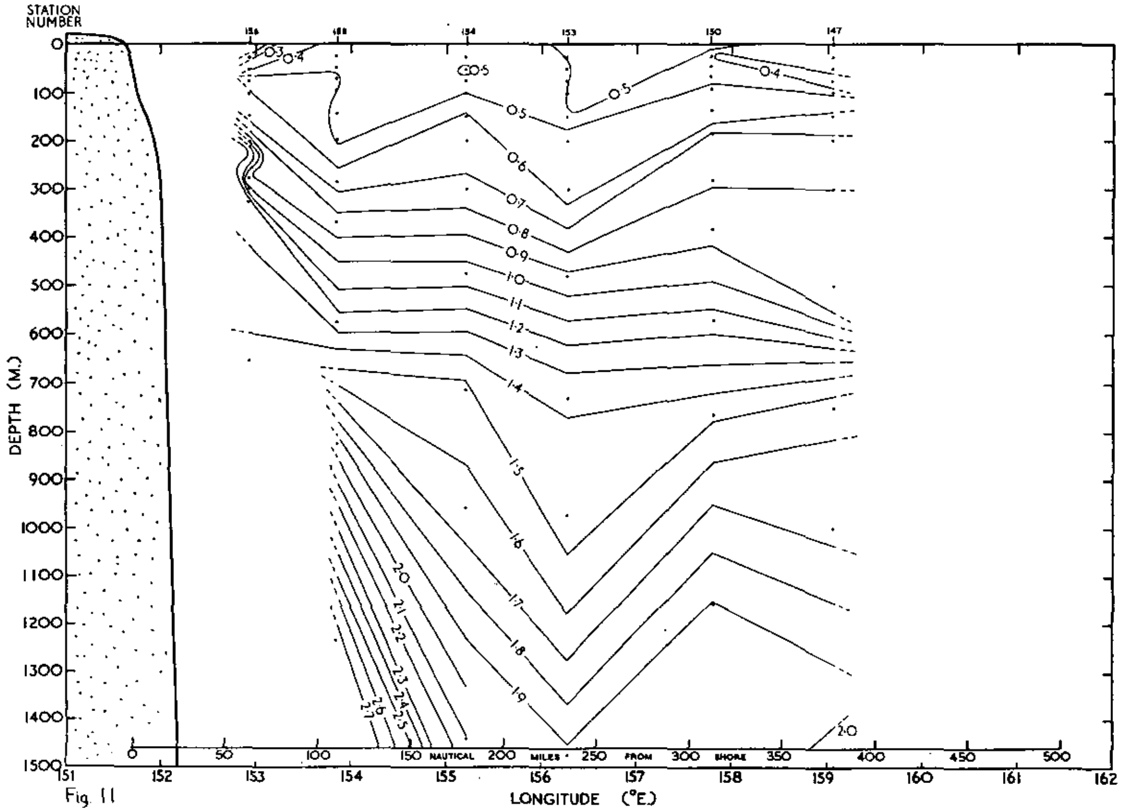
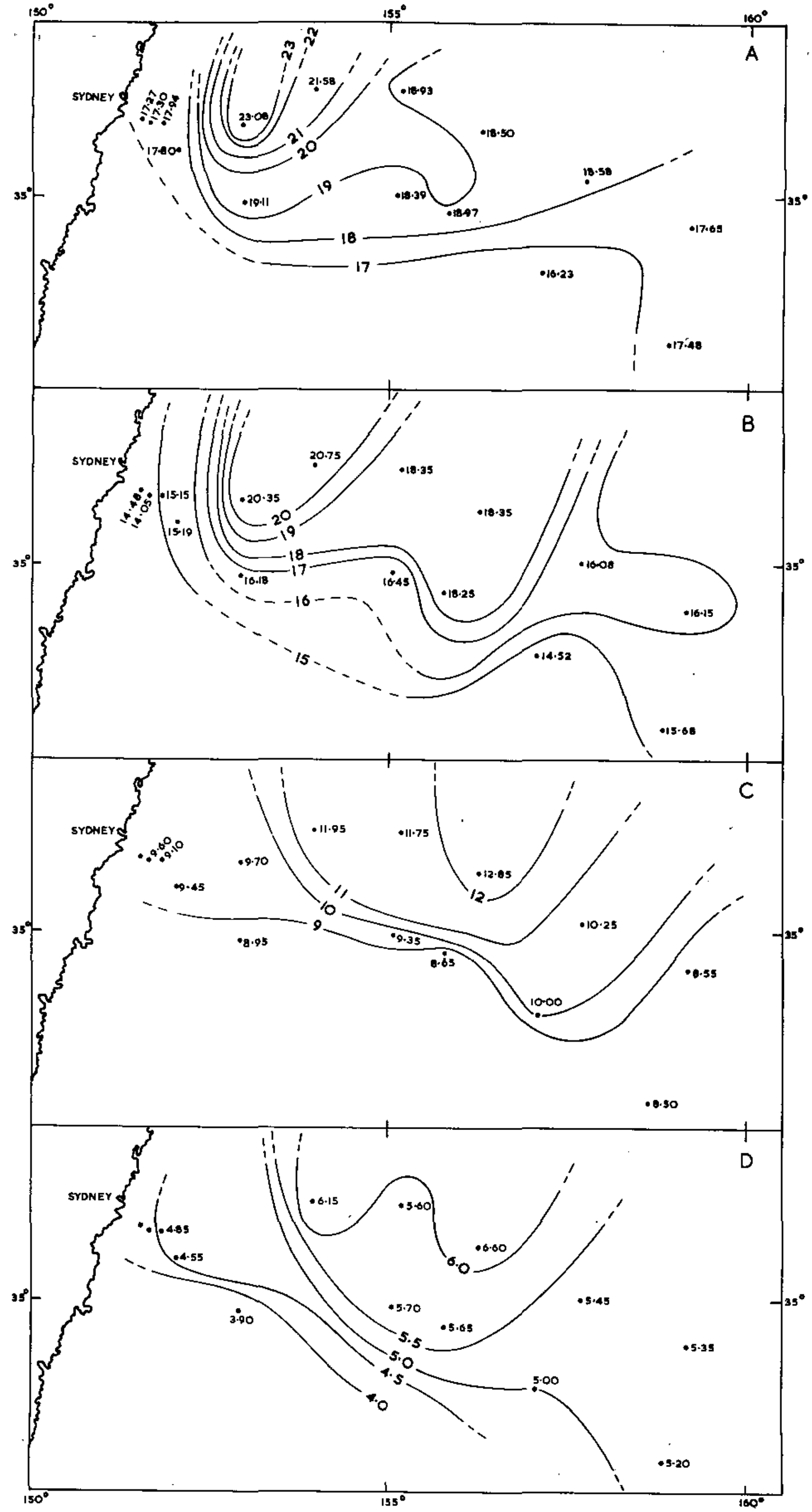
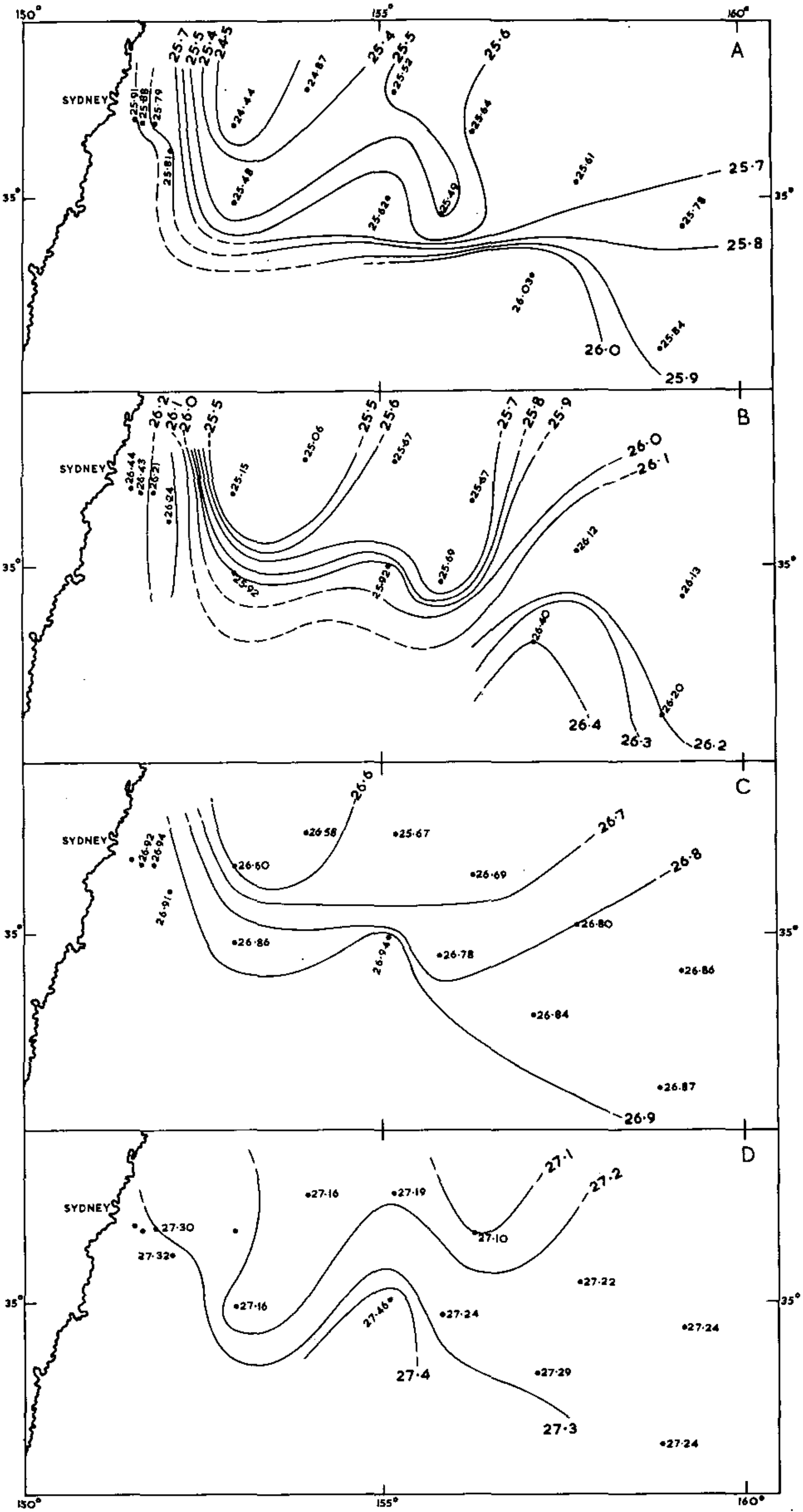

STATION NUMBER
DEPTH (M.)
LONGITUDE (°E.)
NAUTICAL MILES FROM SHORE

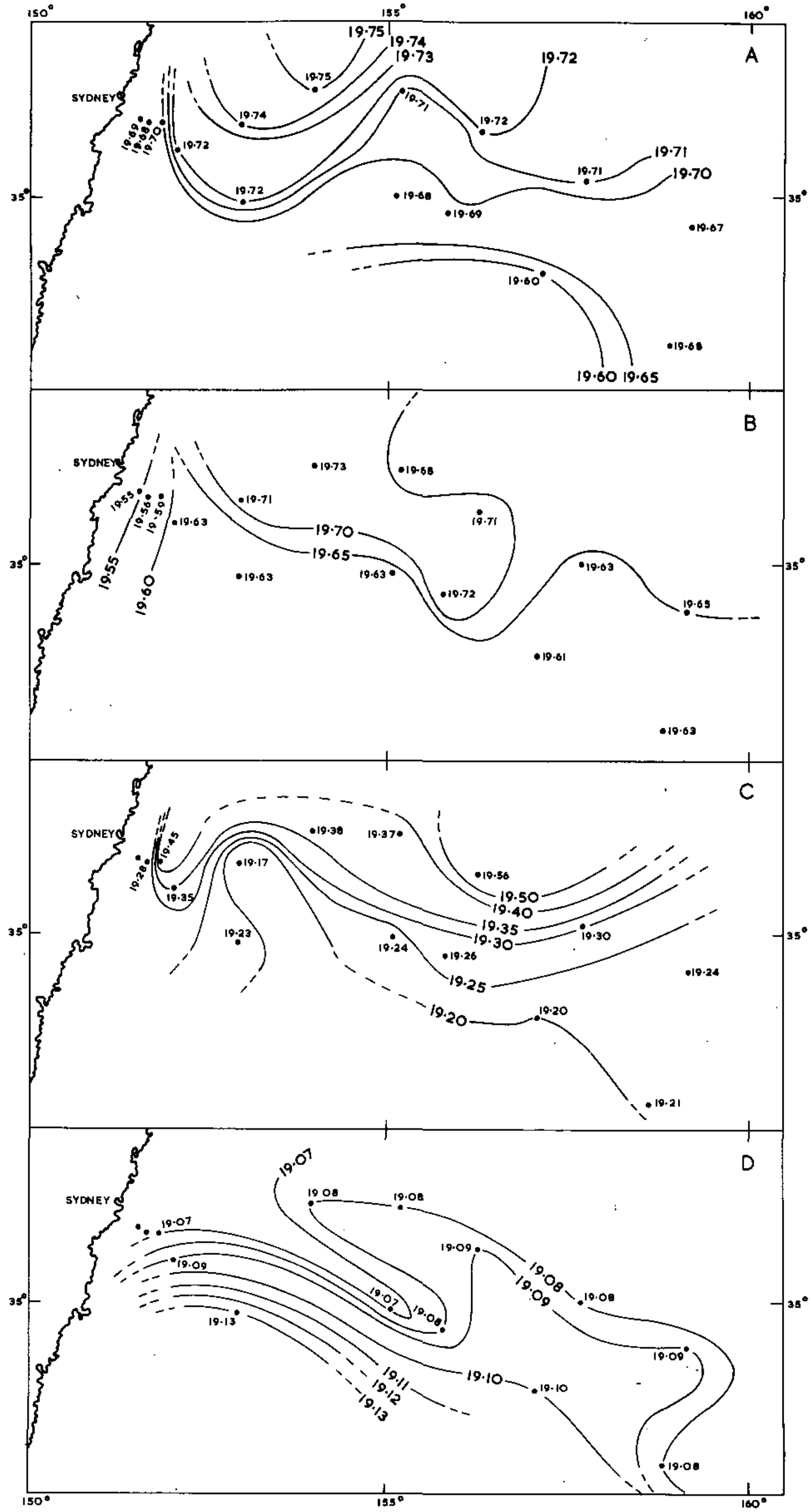
Fig. 11


150°
155°
160°
35°
A
SYDNEY
17·27
17·30
17·94
17·80
23·08
21·58
18·93
18·50
18·58
19·11
18·39
18·97
17·65
16·23
17·48
23
22
21
20
19
18
17
B
SYDNEY
14·48
14·05
15·15
15·19
20·75
20·35
18·35
18·35
16·18
16·45
18·25
16·08
16·15
14·52
15·68
20
19
18
17
16
15
C
SYDNEY
9·60
9·10
9·70
9·45
11·95
11·75
12·85
8·95
9·35
8·65
10·25
8·55
10·00
8·50
12
11
10
9
D
SYDNEY
4·85
4·55
6·15
5·60
6·60
3·90
5·70
5·65
5·45
5·35
5·00
5·20
6·0
5·5
5·0
4·5
4·0
Fig. 12



150°
155°
160°
A
B
C
D
SYDNEY
35°
25·7
25·8
25·9
26·0
26·1
26·2
26·3
26·4
26·6
26·7
26·8
26·9
27·1
27·2
27·3
27·4

Fig. 13



150°
155°
160°
35°
SYDNEY
A
B
C
D
19·75
19·74
19·73
19·72
19·71
19·70
19·60
19·65
19·55
19·50
19·40
19·35
19·30
19·25
19·20
19·07
19·08
19·09
19·10
19·11
19·12
19·13

Fig. 14

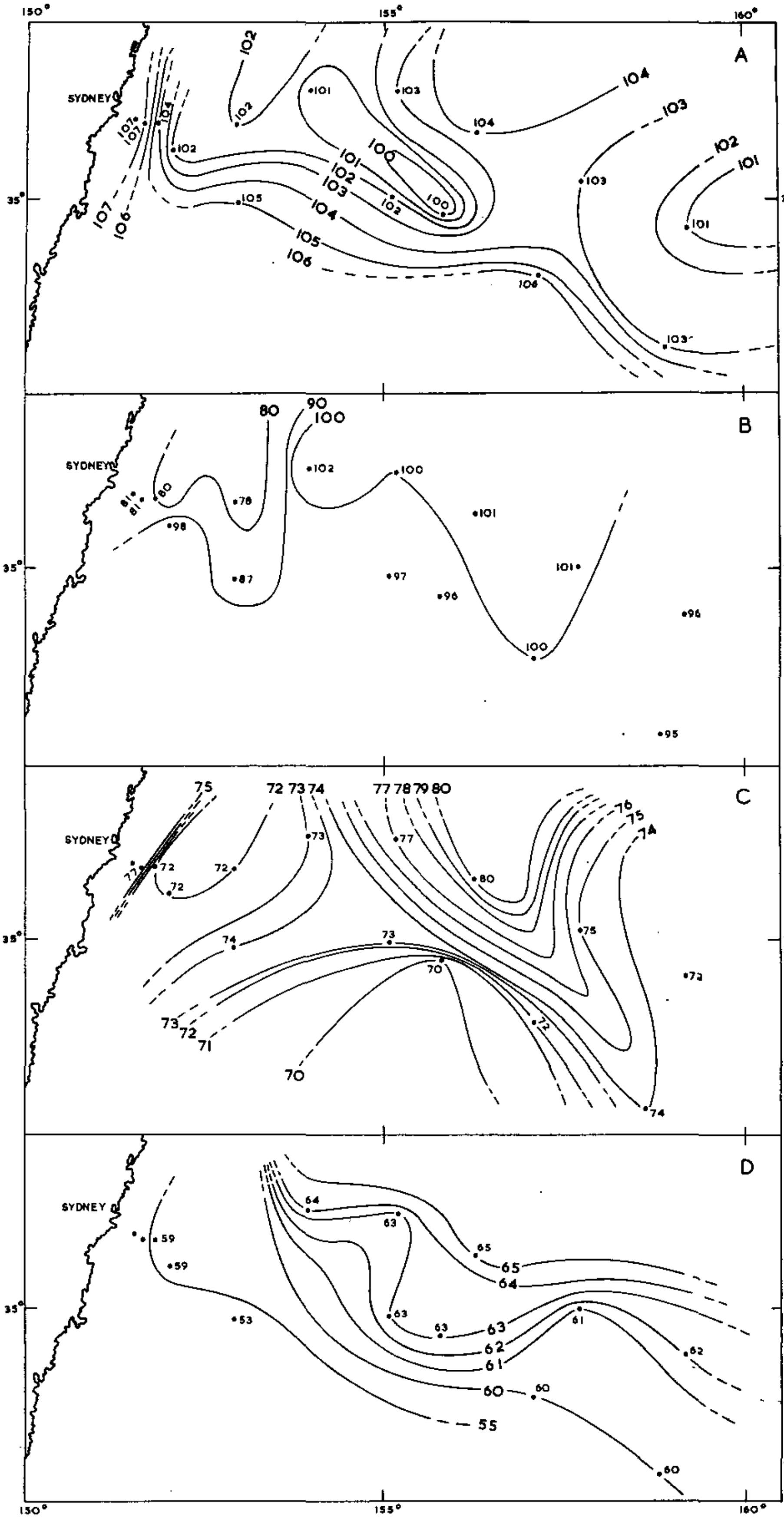
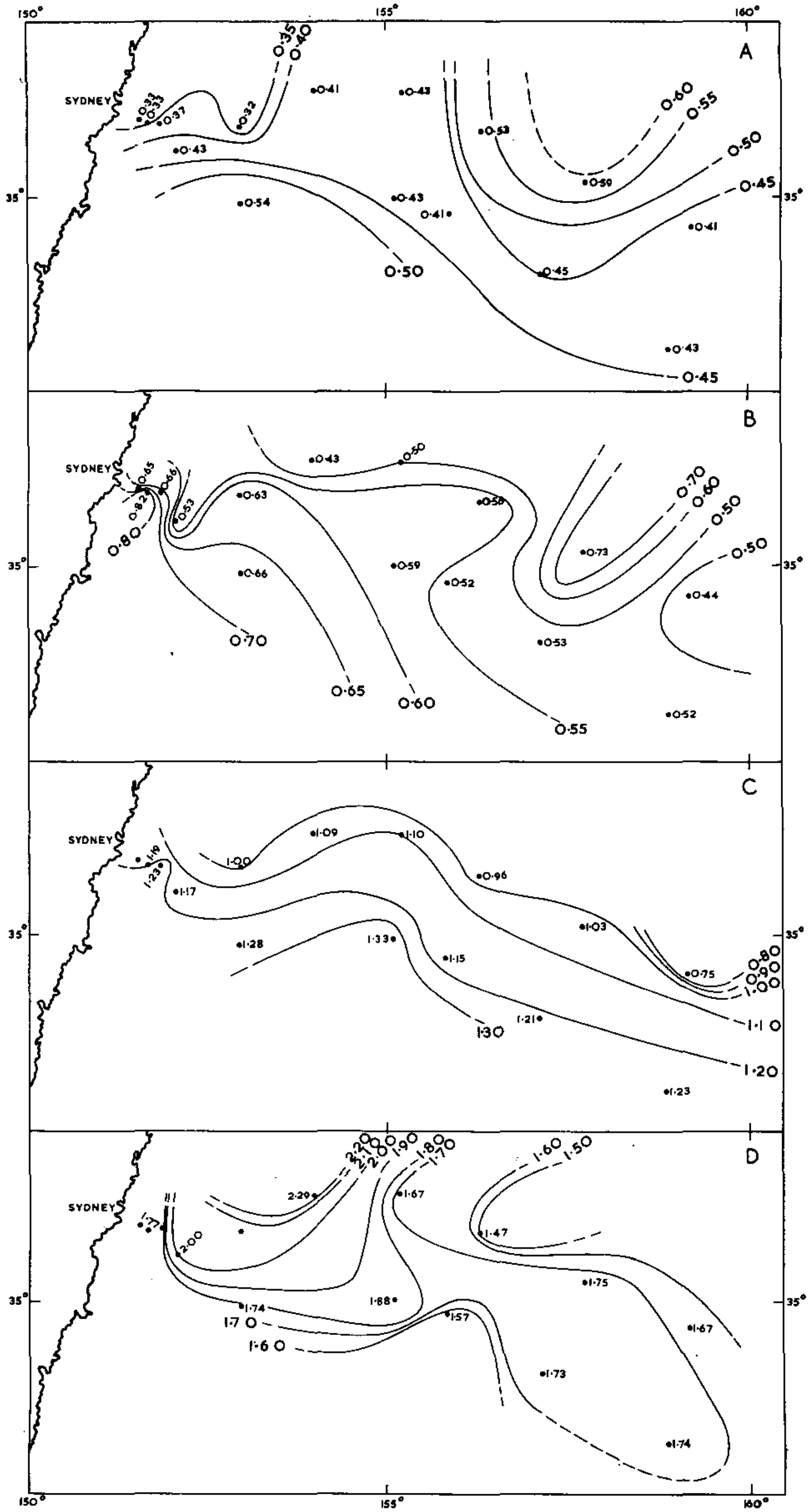
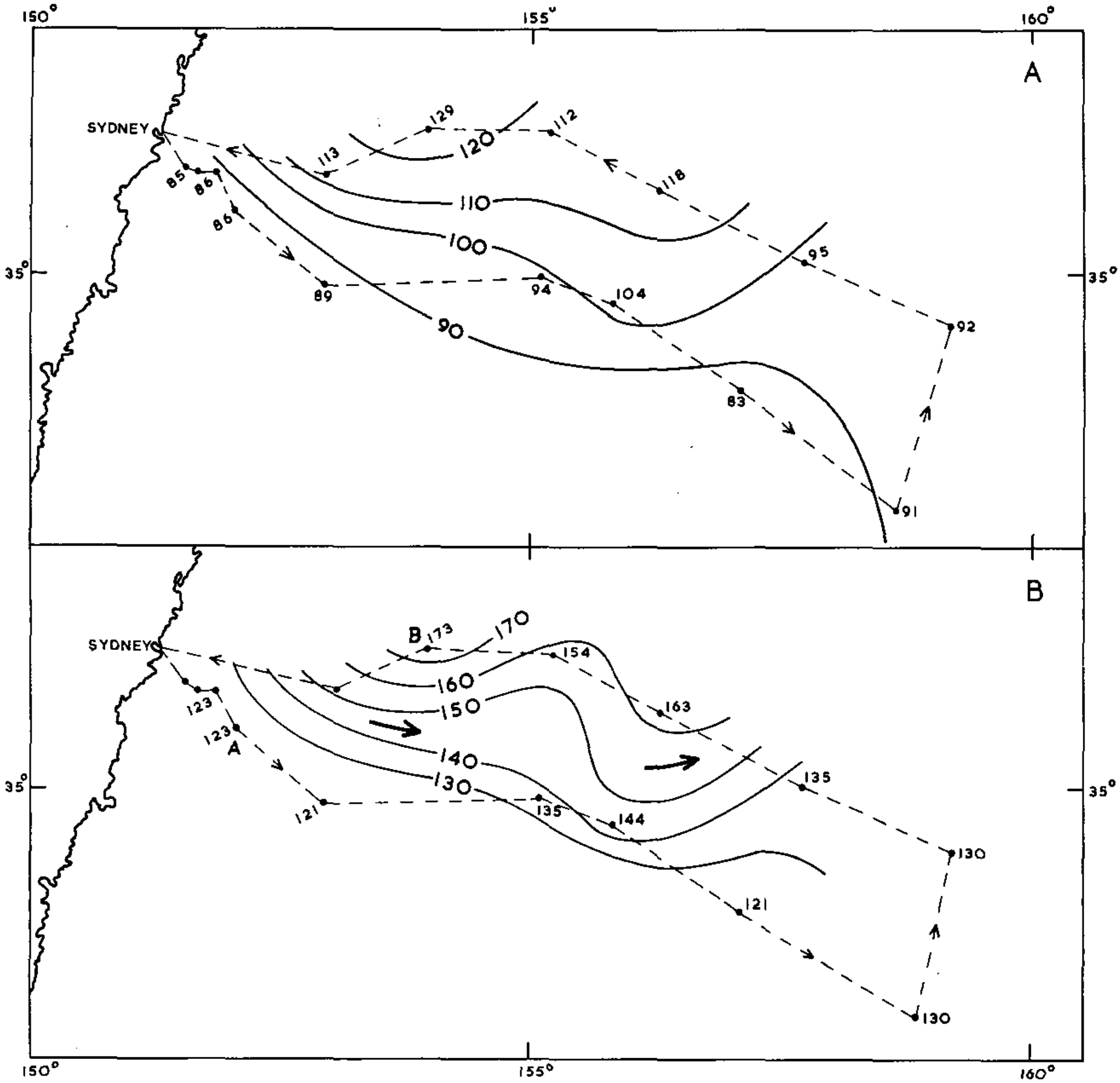


Fig. 15



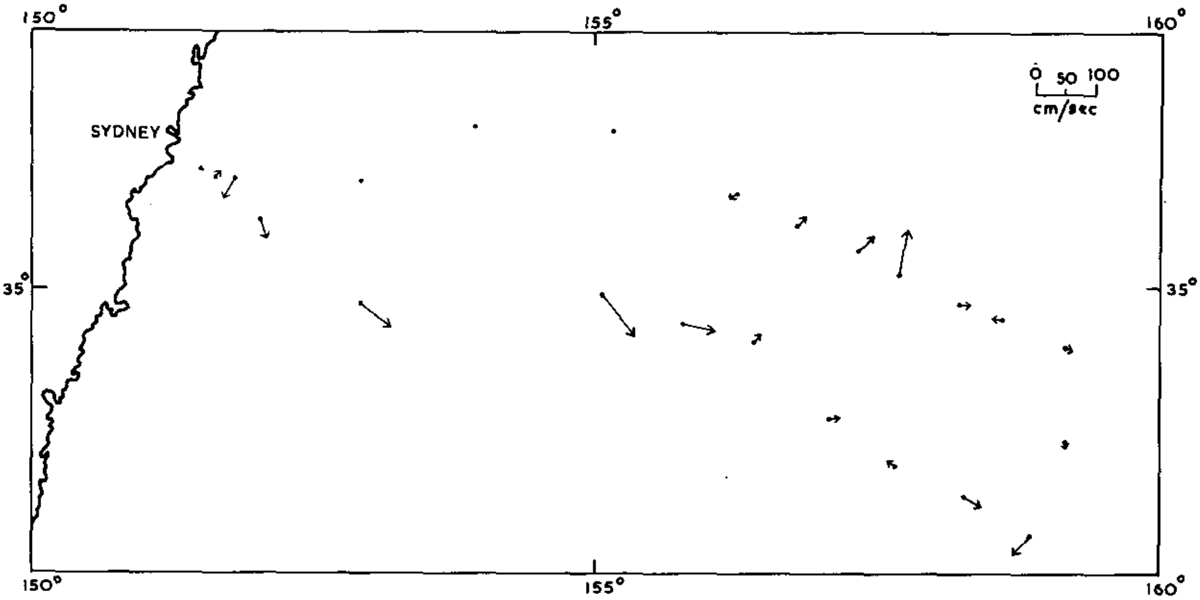
150°
155°
160°
35°
A
B
C
D
SYDNEY
0·35
0·40
0·45
0·50
0·55
0·60
0·70
0·80
0·65
1·00
1·10
1·20
1·30
0·90
1·60
1·70
1·80
1·90
2·00
2·10
2·20
1·50

Fig. 16



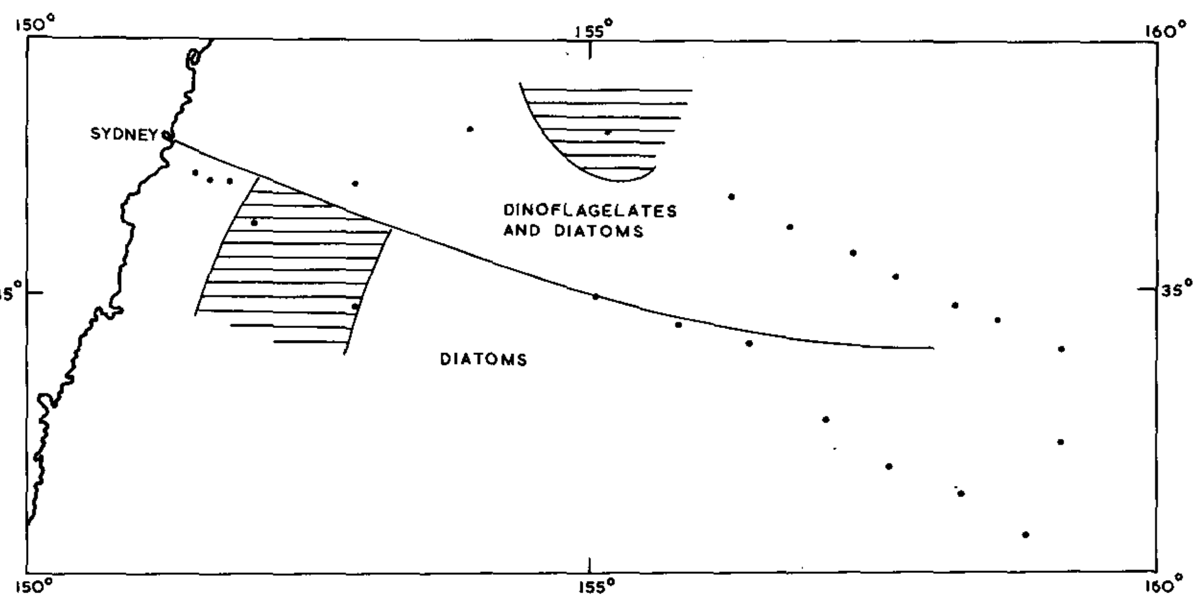
150°
155°
160°
35°
A
SYDNEY
129
112
113
120
118
110
85
86
86
100
95
89
94
104
90
92
83
91
B
SYDNEY
B
173
170
154
160
163
123
150
123
A
140
135
130
121
135
144
130
121
130

Fig. 17



150°
155°
160°
0 50 100
cm/sec
SYDNEY
35°
35°
150°
155°
160°

Fig. 18



150°
155°
160°
SYDNEY
DINOFLAGELATES
AND DIATOMS
35°
35°
DIATOMS
150°
155°
160°

Fig. 19

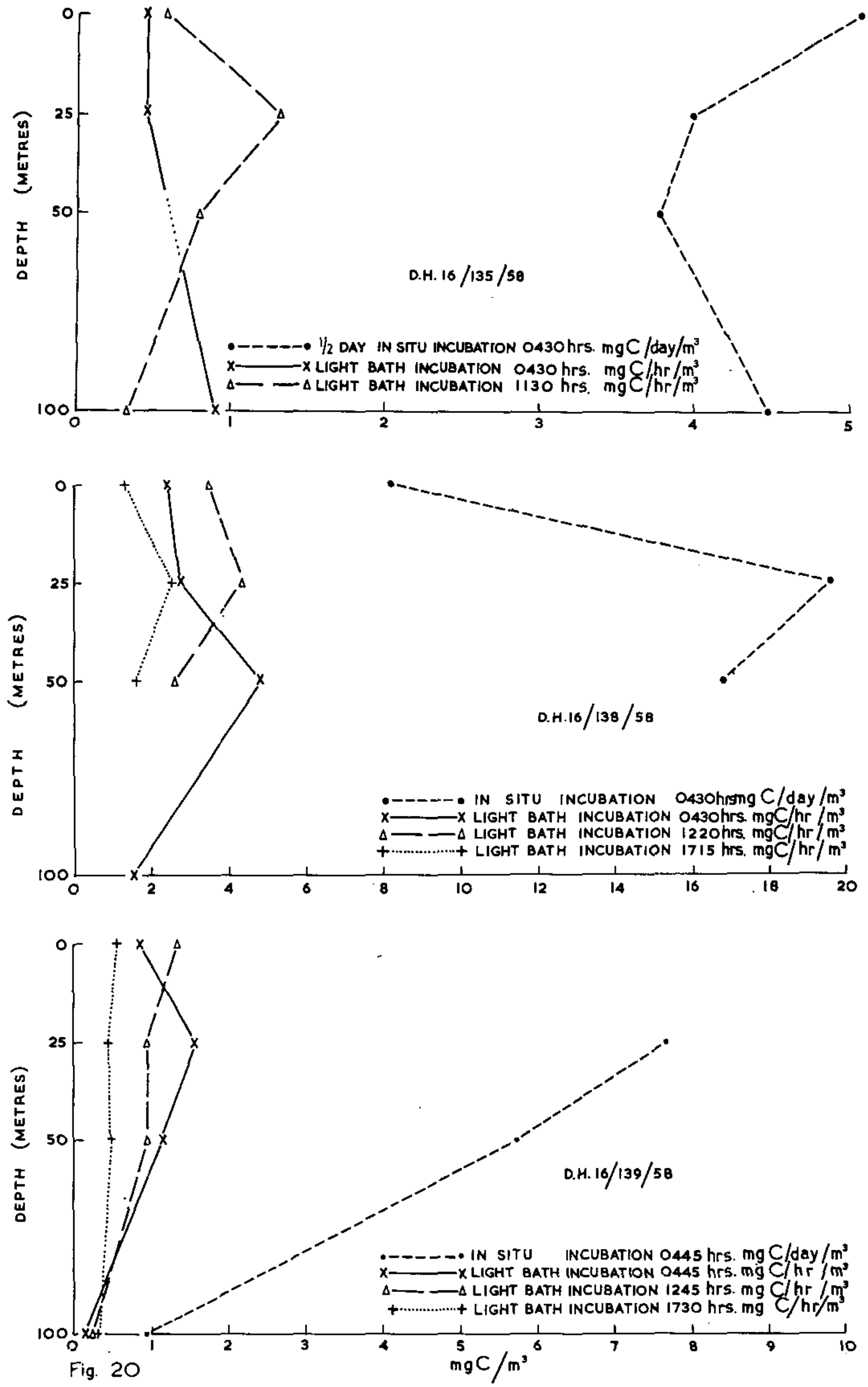
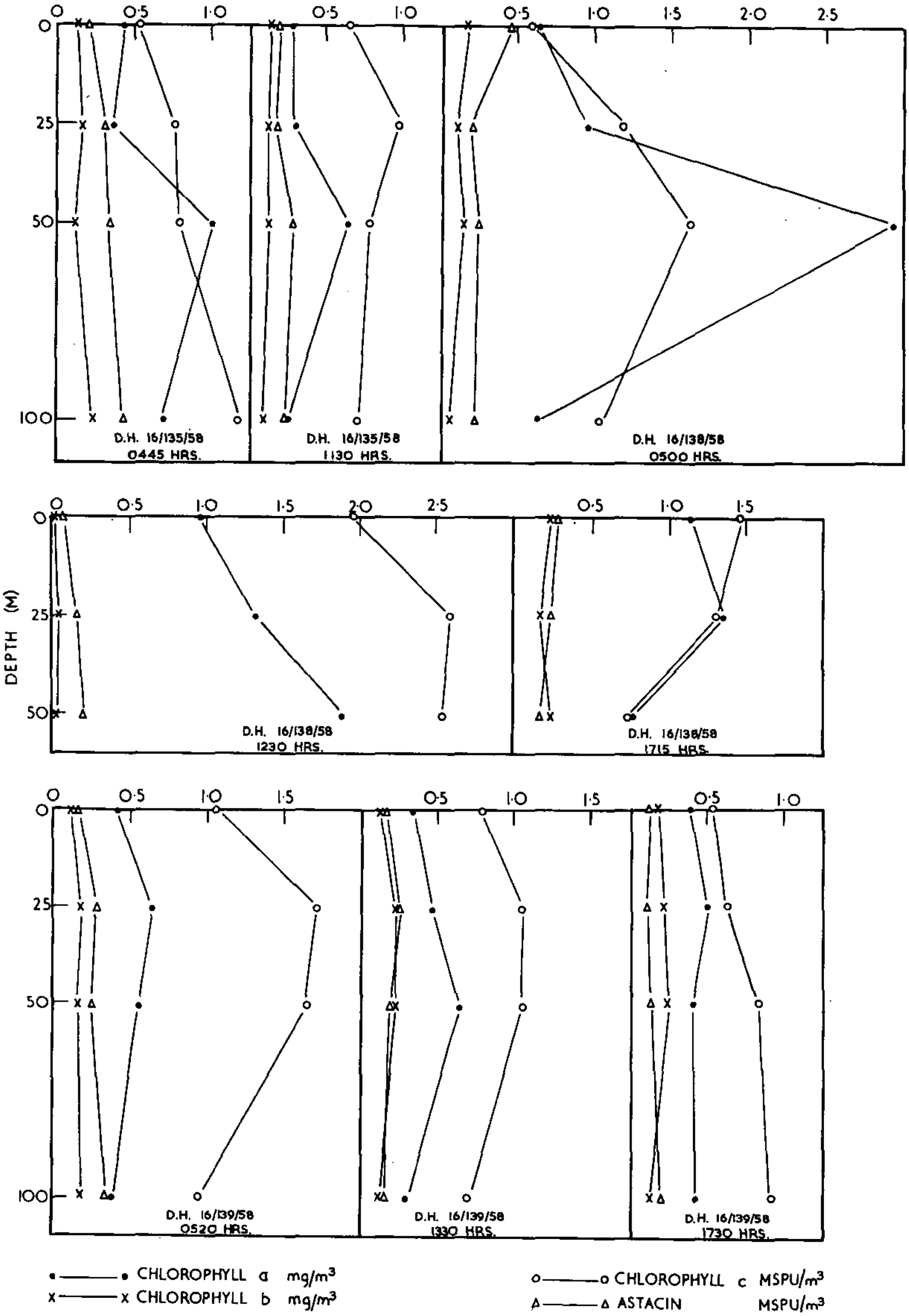

D.H. 16/135/58
1/2 DAY IN SITU INCUBATION 0430 hrs. mgC/day/m³
X LIGHT BATH INCUBATION 0430 hrs. mgC/hr/m³
Δ LIGHT BATH INCUBATION 1130 hrs. mgC/hr/m³
D.H. 16/138/58
IN SITU INCUBATION 0430 hrs mgC/day/m³
X LIGHT BATH INCUBATION 0430 hrs. mgC/hr/m³
Δ LIGHT BATH INCUBATION 1220 hrs. mgC/hr/m³
+ LIGHT BATH INCUBATION 1715 hrs. mgC/hr/m³
D.H. 16/139/58
IN SITU INCUBATION 0445 hrs. mgC/day/m³
X LIGHT BATH INCUBATION 0445 hrs. mgC/hr/m³
Δ LIGHT BATH INCUBATION 1245 hrs. mgC/hr/m³
+ LIGHT BATH INCUBATION 1730 hrs. mgC/hr/m³
DEPTH (METRES)
mgC/m³

Fig. 20



D.H. 16/135/58
0445 HRS.
D.H. 16/135/58
1130 HRS.
D.H. 16/138/58
0500 HRS.
D.H. 16/138/58
1230 HRS.
D.H. 16/138/58
1715 HRS.
D.H. 16/139/58
0520 HRS.
D.H. 16/139/58
1330 HRS.
D.H. 16/139/58
1730 HRS.
DEPTH (M)
CHLOROPHYLL a mg/m³
CHLOROPHYLL b mg/m³
CHLOROPHYLL c MSPU/m³
ASTACIN MSPU/m³

Fig. 21

F.R.V. "DERWENT HUNTER"

SCIENTIFIC REPORT OF CRUISE DH17/58

October 15 - 31, 1958

SCIENTIFIC PERSONNEL

Part 1: N. Dyson (in charge)
Part 2: C. Walker (in charge)

ITINERARY

This is the second of the extended cruises to study the structure and circulation of the East Australian Current. Figure 1 shows the track chart, indicating the four sections planned, and the work done at each station. Adverse weather prevented stations being worked on Section 4.

SCIENTIFIC REPORTS

Hydrological samples were taken at depths of 0, 25, 50, 75, 100, 150, 200, 300, 500, 750, 1000, and 1500 m for chlorinity, dissolved oxygen, and total phosphorus. G.E.K. tows were made and bathythermograph readings taken. Samples for pigments (Chl. a,b,c) and CO_2 uptake were collected at 0, 25, 50, and 100 m. Light penetration measurements were not done on this cruise. Phytoplankton collections were made with the modified Hardy plankton indicator.

(a) HYDROLOGY - A.D. CROOKS

Temperatures to 100 m were measured with protected reversing thermometers. Below 100 m, paired protected and unprotected thermometers were used to calculate the thermometric depth. Sampling was carried out in two casts to 1500 m.

1. Temperature

(a) Section 1 (Fig. 2)

Maximum surface temperature (21.18°C) was recorded at Station DH17/161/58 and minimum (19.78°C) at Station DH17/163/58. Warmer temperatures appeared at the limits of the section with cooler water in the centre. This pattern was observed down to 1500 m. A doming of colder waters was found at all depths at Station DH17/163/58.

(b) Section 2 (Fig. 3)

Maximum surface temperature (23.70°C) was recorded at Station DH17/170/58 and minimum (20.80°C) at Station DH17/165/58. Below the surface, warmer waters occurred between 154° and 156°E. with a slight increase from Stations DH17/166 to 165/58. Minimum temperatures occurred at the western-most station.

(c) Section 3 (Fig. 4)

Maximum surface temperature (23.70°C) occurred at Station DH17/170/58 and minimum (18.40°C) at Station DH17/181/58. Below the surface, to 500 m, maximum temperature was observed at Station DH17/177/58 and minimum at DH17/175/58. Below 500 m the maximum was at Station DH17/177/58 and the minimum at Station DH17/181/58. The temperature of onshore surface water down to 200 m was greater than 19°C.

2. Density (σ_t)
(a) Section 1 (Fig. 5)

Maximum density (25.24 σ_t) occurred at Station DH17/163/58 at the surface and at all depths, and minimum (24.98 σ_t) at Station DH17/161/58 at the surface and down to 1200 m.

(b) Section 2 (Fig. 6)

Maximum density (25.12 σ_t) occurred at the surface at Station DH17/165/58 and minimum (24.28 σ_t) at Station DH17/170/58. Below the surface, waters of minimum density occurred between 154° and 156°E. of maximum density at Station DH17/170/58.

(c) Section 3 (Fig. 7)

Maximum density (25.64 σ_t) occurred at the surface and below the surface at Station DH17/181/58. Minimum density (24.28 σ_t) occurred at the surface at Station DH17/170/58 and below the surface at Station DH17/177/58.

3. Chlorinity
(a) Section 1 (Fig. 8)

Maximum chlorinity at the surface (19.77 ‰) was found at Station DH17/165/58 and minimum (19.66 ‰) at Station DH17/163/58. Below the surface the maximum was at Station DH17/165/58 and the minimum at Station DH17/163/58. The chlorinity distribution paralleled that of density, low chlorinity occurring with high density and high chlorinity with low density.

(b) Section 2 (Fig. 9)

No significant change was found in chlorinity at the surface. The variation was only from 19.70 to 19.75 ‰ down to about 200 m. The highest chlorinities down to about 800 m were at Stations DH17/168-169/58 and below that level at Stations DH17/170/58.

(c) Section 3 (Fig. 10)

Maximum surface chlorinity (19.77 ‰) was observed at Station DH17/170/58 and minimum at Station DH17/181/58. Below the surface, maximum was at Station DH17/177/58 and minimum at Station DH17/181/58. The only anomaly between chlorinity and density occurred in the upper 200 m west of Station DH17/175/58.

4. Percentage Oxygen Saturation

(a) Section 1 (Fig. 11)

Super saturation (maximum 103% at Station DH17/163/58) was found at the surfaces at Stations DH17/160 and 163/58 and undersaturation (minimum 93% at Station DH17/165/58) at Stations DH17/161 and 165/58. Waters of minimum percentage oxygen saturation occurred down to 1500 m at Station DH17/163/58. Below 500 m the oxygen and density fields were in general agreement.

(b) Section 2 (Fig. 12)

Super saturation (101%) was observed at the surface at Stations DH17/166 and 169/58. Minimum percentage oxygen saturation (93%) was observed at Station DH17/165/58. Below the surface maximum was found between 154° and 156°E. and minimum at Station DH17/170/58. The oxygen distribution was closely related to the density distribution only between 600 and 1000 m.

(c) Section 3 (Fig. 13)

Super saturation (101%) occurred at Station DH17/177/58 and undersaturation (94%) at Station DH17/175/58. Below the surface maximum percentage oxygen saturation occurred at

Station DH17/173/58 and minimum at Station DH17/170/58. Generally above 100 m small anomalies occurred between Stations DH17/173 and 175/58 and below 200 m at Station DH17/181/58 some differences occurred.

5. Total Phosphorus

(a) Section 1 (Fig. 14)

At the surface maximum total phosphorus (0.53 µg at./l) was observed at Station DH17/160/58, and minimum (0.39 µg at./l) at Station DH17/165/58. Below the surface, maximum total phosphorus occurred at Station DH17/163/58, and minimum at Station DH17/161/58. There was good agreement between density and total phosphorus distribution between 100 and 1000 m.

(b) Section 2 (Fig. 15)

At the surface maximum total phosphorus (0.41 µg at./l) occurred at Station DH17/169/58 and minimum (0.38 µg at./l) at Station DH17/170/58. The total phosphorus field paralleled that of density except for depths below 600 m at Stations DH17/169 and 170/58.

(c) Section 3 (Fig. 16)

At the surface maximum total phosphorus (0.49 µg at./l) occurred at Station DH17/181/58 and minimum (0.33 µg at./l) at Station DH17/170/58. Below the surface down to 500 m the maximum occurred at Station DH17/181/58 and below 500 m at Station DH17/170/58.

6. Horizontal Distribution of Properties

(a) Temperature (Fig. 17)

In the upper 100 m the warmest water was found in the north-west of the region. At all depths below 100 m a band of relatively high temperature water occurred along a north-south axis which moved eastward with depth. A tongue of low temperature water impinged upon this warm band along the central portion of its eastern boundary.

(b) Sigma-t (Fig. 18)

The distribution of density followed closely that of temperature, with a band of low density waters corresponding with the high temperature band observed at all depths.

TABLE 1

DIATOMS IN PHYTOPLANKTON COLLECTIONS
CRUISE DH17/58

	160	163	165	166	167	170	171	175	177	179	181	183	184
Climacodium frauenfeldianum	+			+	+	+	+	+		+	+	+	
Hemiaulus hauckii	+												
Leptocylindricus danicus		+	+			+			+				
Schroederella delicatula			+										
Planktoniella sol					+								+
Chaetoceros decipiens	+												
Ch. lorenzianum					+		+						
Ch. concavicorne							+						
Ch. secundum										+	+		
Ch. simplex			+										+
Rhizosolenia bergonii												+	
R. alata		+			+		+		+	+		+	
f. gracillima	+		+				+		+		+	+	
R. styliformis		+											
R. stolterforthii					+								
R. setigera											+		
R. acuminata											+		
Bacteriastrum hyalinium			+	+					+				
Thalassiothrix nitzschioides				+			+		+				
T. longissima									+				
Coscinodiscus oculus-iridis							+						
Nitzschia seriata									+				
Lauderia annulata												+	
Stauroneis acuta f. inflata												+	

TABLE 2

DINOFLAGELLATES IN PHYTOPLANKTON COLLECTIONS

CRUISE DH17/58

	160	163	165	166	167	170	171	172	173	175	177	179	181	183	184
Pyrocystis pseudonoctiluca		+	+	+								+			
P. biconica														+	+
Peridinium oblongum		+			+										
P. curtipes		+											+		
P. claudicans														+	
Goniaulax monocantha														+	
Dinophysis schroederi													+		
D. tripos									+	+					
Ceratium tripos	+	+		+			+	+	+	+			+	+	
C. trichoceros	+			+	+			+		+			+	+	
C. furca		+		+	+				+				++	+	
C. fusus		+					+	+	+	+			+	+	
C. massiliense		+							+			+		+	
C. candelabrum		+			+				+						
C. extensum				+	+		+			+				+	
C. hexacanthum					+										
C. contrarium					+										
C. carriense					+			+	+	+			+		
C. setaceum					+										
C. buceros					+										
C. pulchellum					+								+	+	
C. gallicum					+									+	
C. kofoidi					+									+	
C. karstenii					+			+						+	
C. symmetricum						+		+						+	
C. arietinum									+	+					
C. falcatum												+		+	
C. belone												+		+	
C. breve									+						
C. lunula									+						
C. porrectum									+						
Pyrophacus horologicum					+						+		+		

(c) Chlorinity (Fig. 19)

The chlorinity distribution was closely related to the density distribution at all depths. The high temperature band had high chlorinity associated with it and the low temperature eastern tongue, a low chlorinity.

(d) Percentage Oxygen Saturation (Fig. 20)

The distribution of percentage oxygen saturation was closely related to that of density. The cooler, high density waters had low percentages associated with them. The warm water band, had a high percentage oxygen saturation. Waters at the western limits generally had low oxygen saturation values.

(e) Total Phosphorus (Fig. 21)

The total phosphorus field was closely related to the density and temperature fields. The warm water band had relatively low total phosphorus and the cooler waters much higher values. The western-most waters had low total phosphorus at 0 m and 100 m but high values at 500 and 1000 m.

(b) PHYSICS - B.V. HAMON

Dynamics

Figure 22 shows the dynamic heights (in dyn. cm) relative to the 1000 decibar level.

It is not possible to draw meaningful contours in this case. The dynamic heights below 34°S. are consistent with those obtained a few weeks earlier, on Cruise DH16/58. The rather high values at Stations DH17/169 and 168/58 (A and B, Fig. 22) indicate that part of the south-flowing East Australian Current may turn to the east and later the north-east, at about latitude 31°S.

(c) PHYTOPLANKTON - E.J.F. WOOD

On this cruise the phytoplankton species characteristic of Coral Sea water were dominant in the north, and the East Australian Current species occurred in the south. South of Port Stephens was an area in which a few Coral Sea species were collected. To the east was an area of poor phytoplankton, those species present had Central Tasman affinities. Tables 1 and 2 list the species of diatoms and dinoflagellates found in the collections, and Figure 23 illustrates the distribution.

(d) CO_2 UPTAKE - N. DYSON

Samples for the measurement of the rate of CO_2 uptake were collected on Section 2 only. Stations DH17/165 and 168/58 were each occupied for a whole day and the rate of CO_2 uptake determined by both the all day in situ and the light bath incubation methods. The rate of uptake was also measured by the light bath incubation method at Station DH17/166/58.

The results from two methods of measurement at the all day stations are shown in Figure 24. It will be noticed that all samples at Station DH17/168/58 showed similar trends with a maximum value at 50 m in each case. Similar conditions were not found at Station DH17/165/58 which is to be expected in view of the different hydrological conditions found at the two stations.

(f) PIGMENTS - G.F. HUMPHREY

Samples for the determination of plankton pigments were collected at Stations DH17/165, 166, 168/58 at 0, 25, 50, and 100 m. The results are in C.S.I.R.O. Aust. (1960) and are graphed in Figure 25.

LEGENDS FOR FIGURES 1-25 - Cruise DH17/58

Fig. 1. Track chart showing positions of stations.

Fig. 2. Sectional distribution of temperature (°C) to 1500 m along Section 1.

Fig. 3. Sectional distribution of temperature (°C) to 1500 m along Section 2.

Fig. 4. Sectional distribution of temperature (°C) to 1500 m along Section 3.

Fig. 5. Sectional distribution of density (σ_t) to 1500 m along Section 1.

Fig. 6. Sectional distribution of density (σ_t) to 1500 m along Section 2.

Fig. 7. Sectional distribution of density (σ_t) to 1500 m along Section 3.

Fig. 8. Sectional distribution of chlorinity (‰) to 1500 m along Section 1.

Fig. 9. Sectional distribution of chlorinity (‰) to 1500 m along Section 2.

Fig.10. Sectional distribution of chlorinity (‰) to 1500 m along Section 3.

Fig.11. Sectional distribution of oxygen saturation (%) to 1500 m along Section 1.

Fig.12. Sectional distribution of oxygen saturation (%) to 1500 m along Section 2.

Fig.13. Sectional distribution of oxygen saturation (%) to 1500 m along Section 3.

Fig.14. Sectional distribution of total phosphorus (μg at./l) to 1500 m along Section 1.

Fig.15. Sectional distribution of total phosphorus (μg at./l) to 1500 m along Section 2.

Fig.16. Sectional distribution of total phosphorus (μg at./l) to 1500 m along Section 3.

Fig.17. Horizontal distribution of temperature A at 0 m, B at 100 m, C at 500 m, D at 1000 m.

Fig.18. Horizontal distribution of density A at 0 m, B at 100 m, C at 500 m, D at 1000 m.

Fig.19. Horizontal distribution of chlorinity A at 0 m, B at 100 m, C at 500 m, D at 1000 m.

Fig.20. Horizontal distribution of percentage oxygen saturation, A at 0 m, B at 100 m, C at 500 m, D at 1000 m.

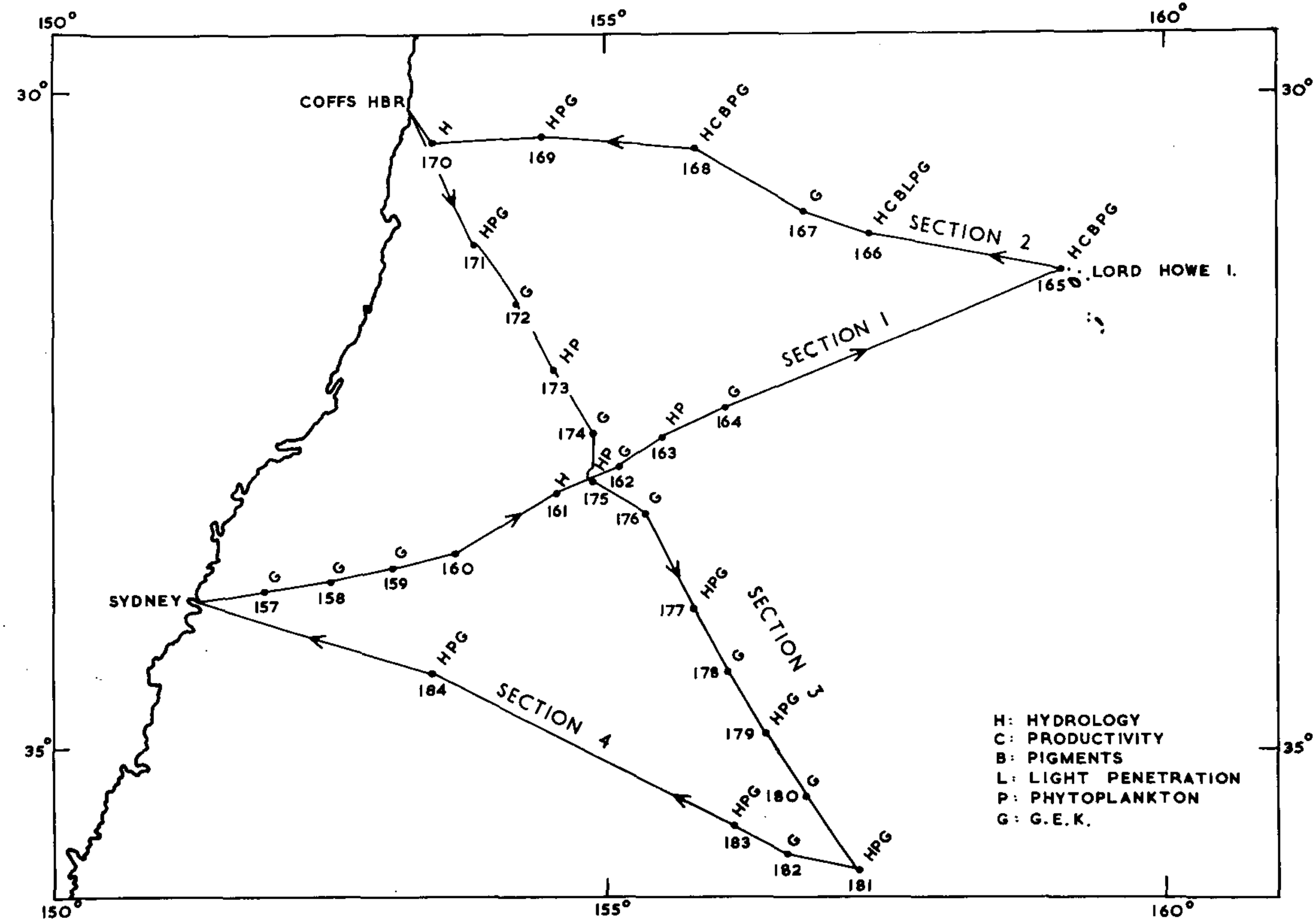
Fig.21. Horizontal distribution of total phosphorus A at 0 m, B at 100 m, C at 500 m, D at 1000 m.

Fig.22. Dynamic heights (dyn. cm) relative to 1000 decibars.

Fig.23. Phytoplankton communities.

Fig.24. Rate of CO_2 uptake at Stations DH17/165 and 168/58.

Fig.25. Depth profiles of pigment concentrations.



150°
155°
160°
30°
35°
COFFS HBR
SYDNEY
LORD HOWE I.
SECTION 1
SECTION 2
SECTION 3
SECTION 4
H: HYDROLOGY
C: PRODUCTIVITY
B: PIGMENTS
L: LIGHT PENETRATION
P: PHYTOPLANKTON
G: G.E.K.

Fig. 1

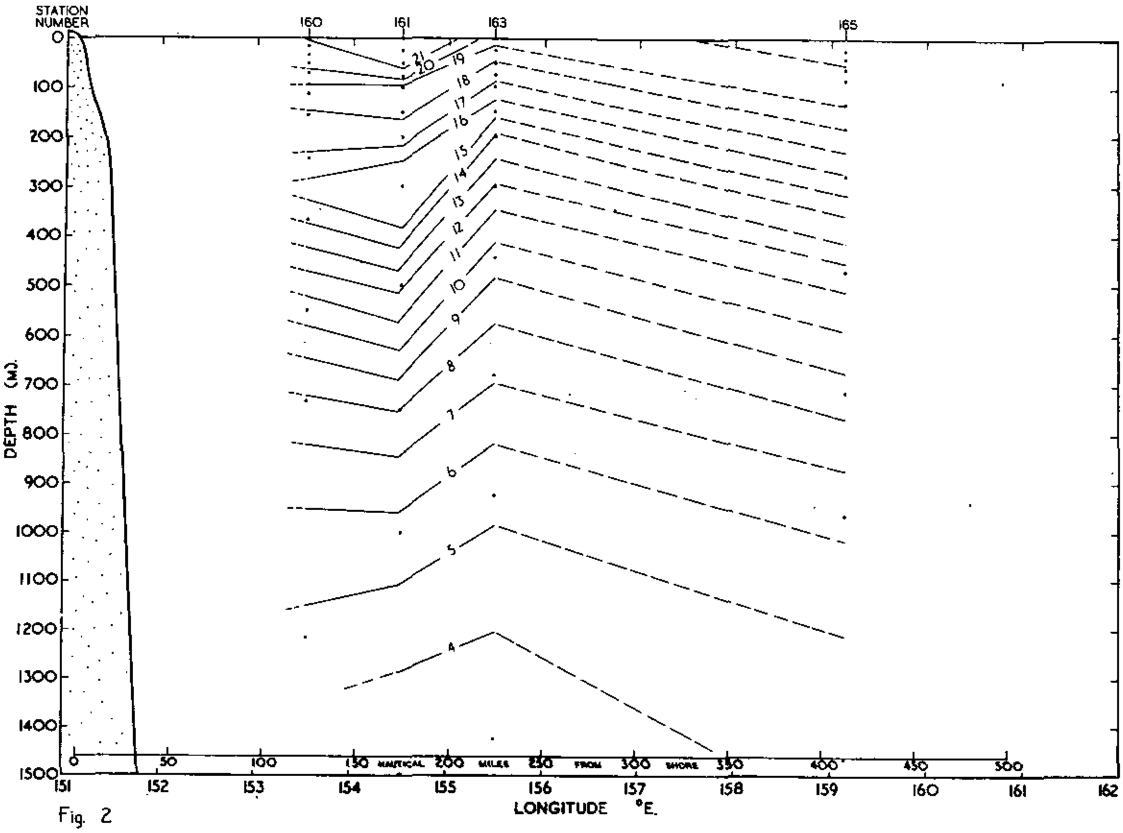

STATION NUMBER
160
161
163
165
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE °E.

Fig. 2

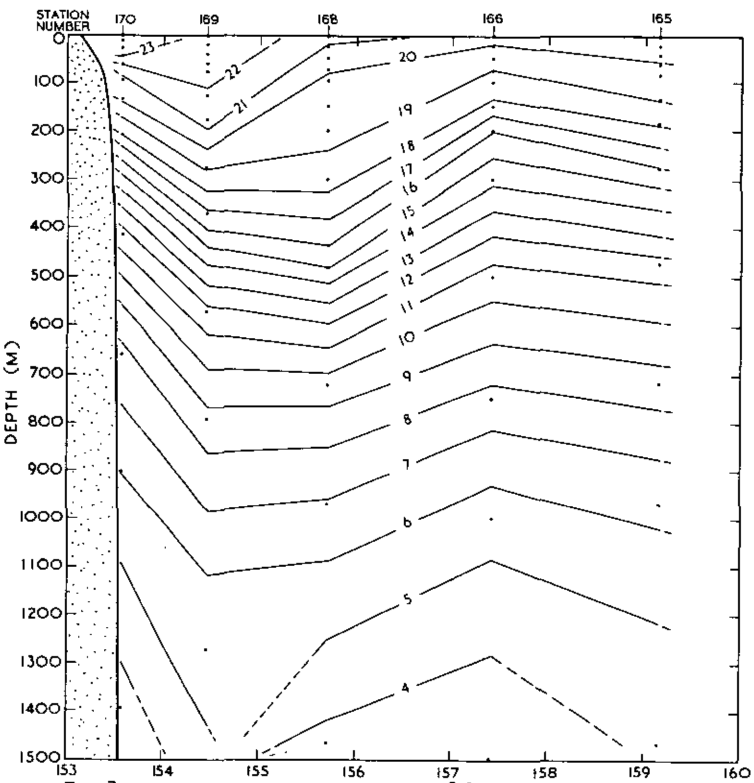
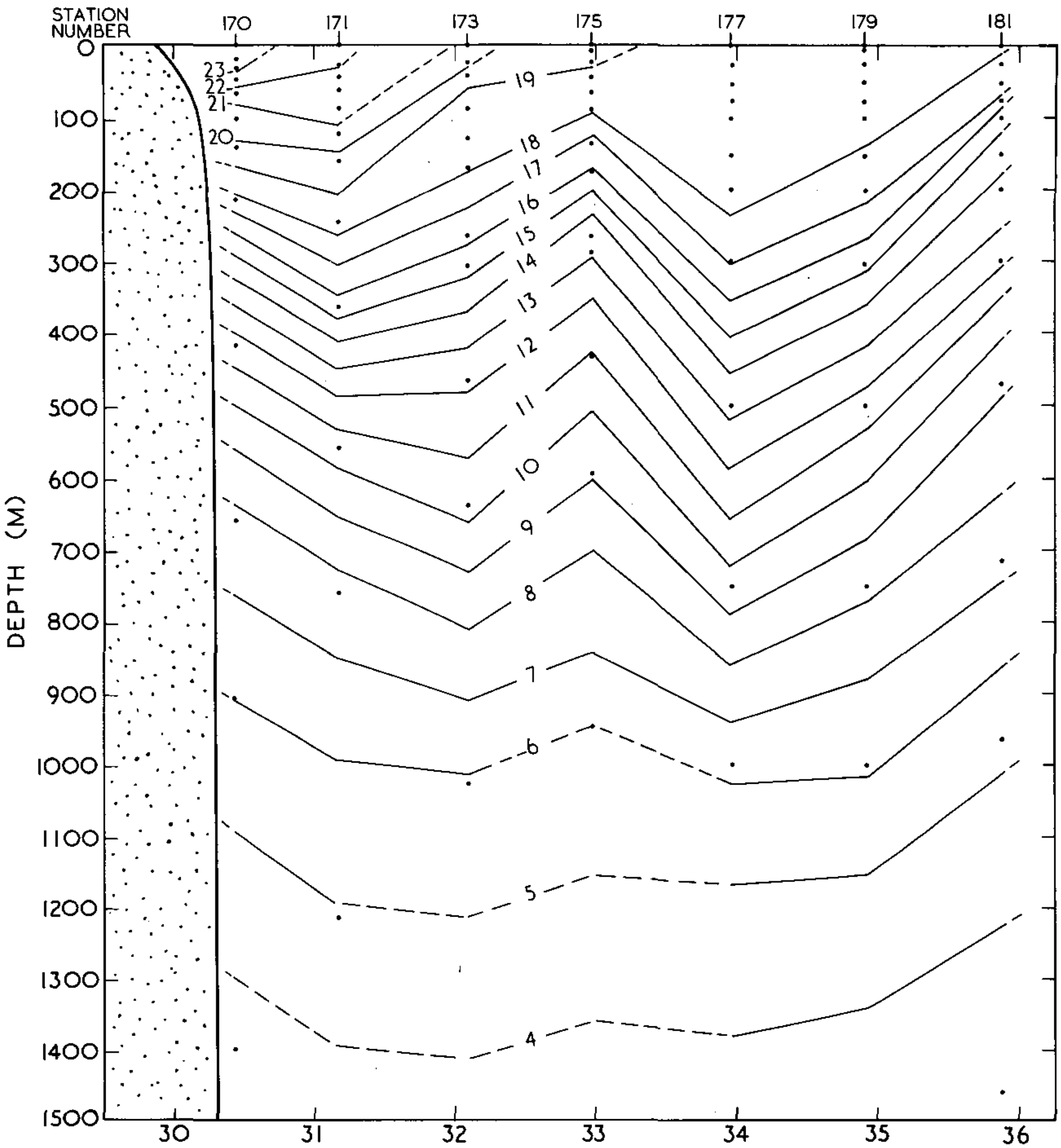
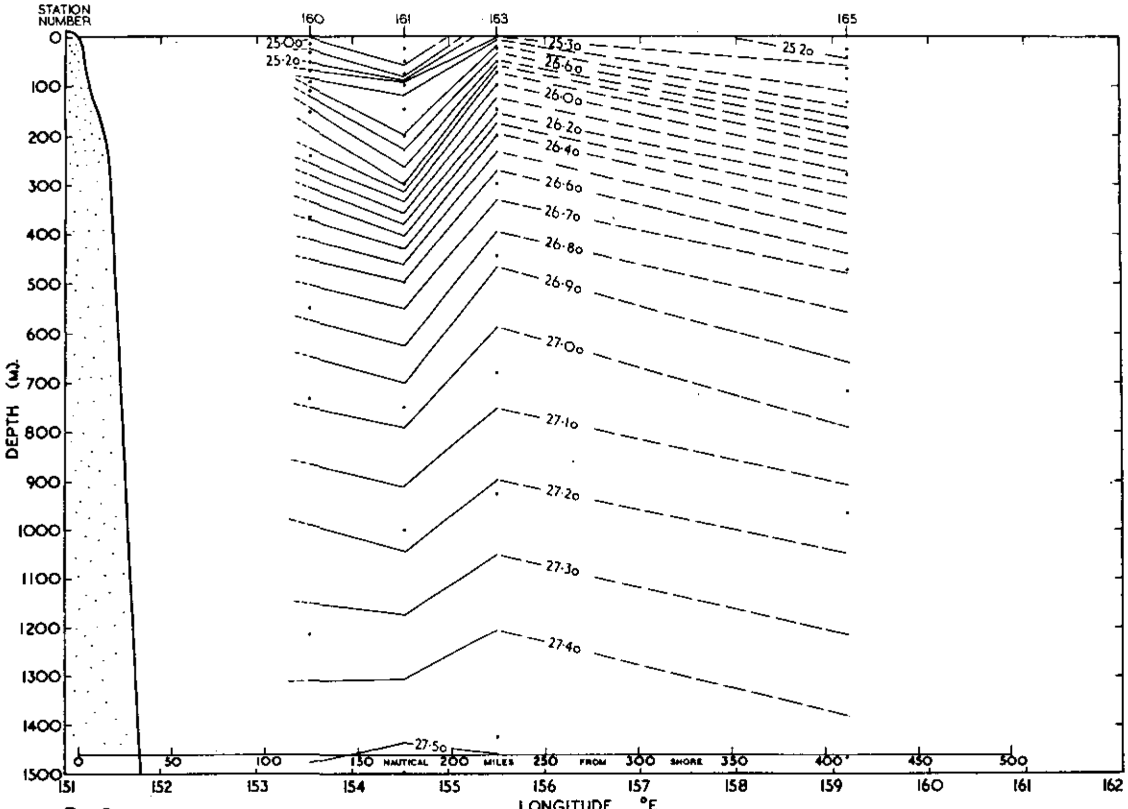

STATION NUMBER
170
169
168
166
165
DEPTH (M)
LONGITUDE (°E)

Fig. 3



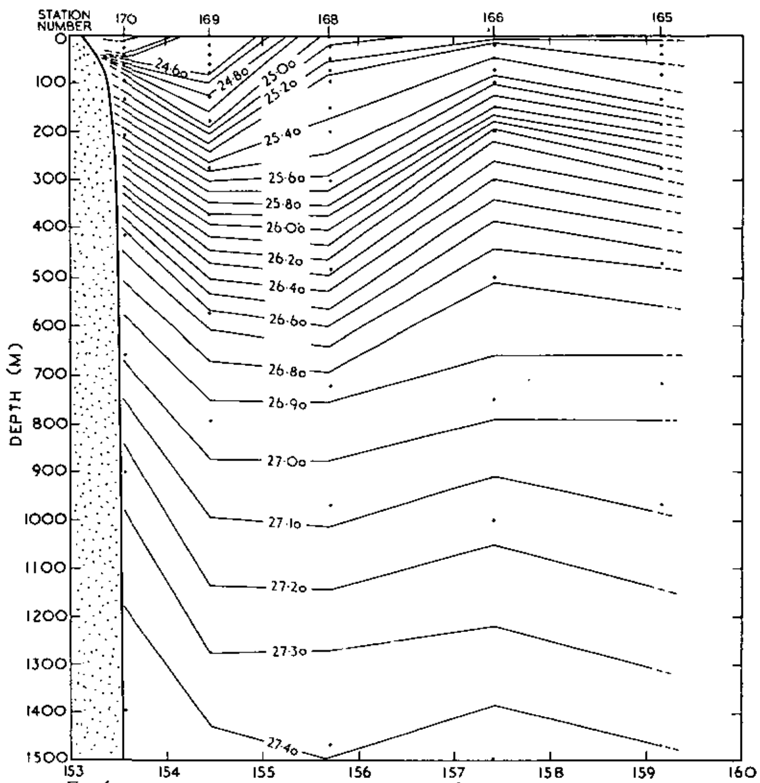
STATION NUMBER
170
171
173
175
177
179
181
DEPTH (M)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
30
31
32
33
34
35
36
LATITUDE (°S)

Fig. 4



STATION NUMBER
160
161
163
165
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE °E.

Fig. 5



STATION NUMBER
170
169
168
166
165
DEPTH (M)
LONGITUDE (°E)

Fig. 6

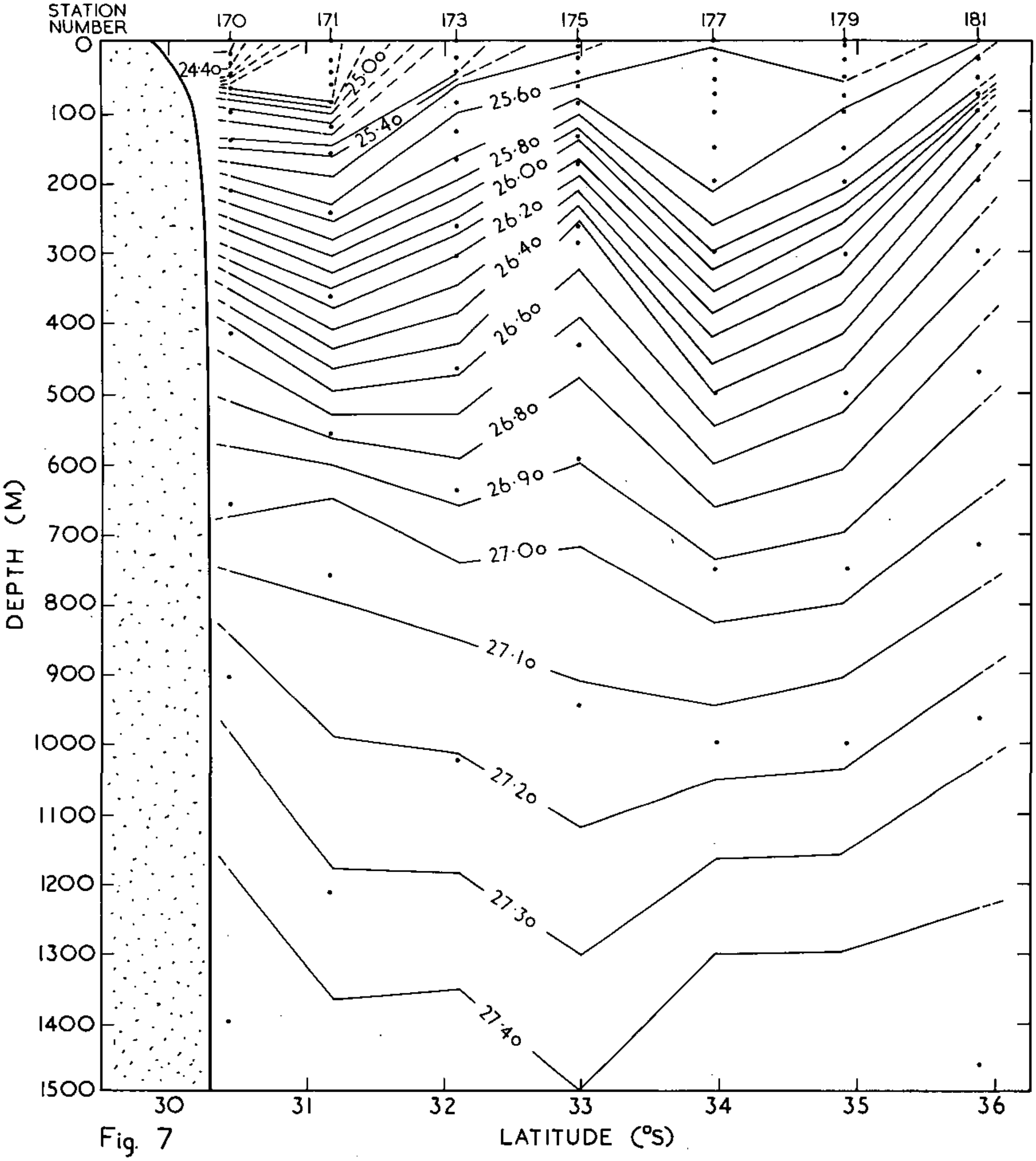

STATION NUMBER
170
171
173
175
177
179
181
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
DEPTH (M)
24·40
25·00
25·40
25·60
25·80
26·00
26·20
26·40
26·60
26·80
26·90
27·00
27·10
27·20
27·30
27·40
30
31
32
33
34
35
36
LATITUDE (°S)

Fig. 7

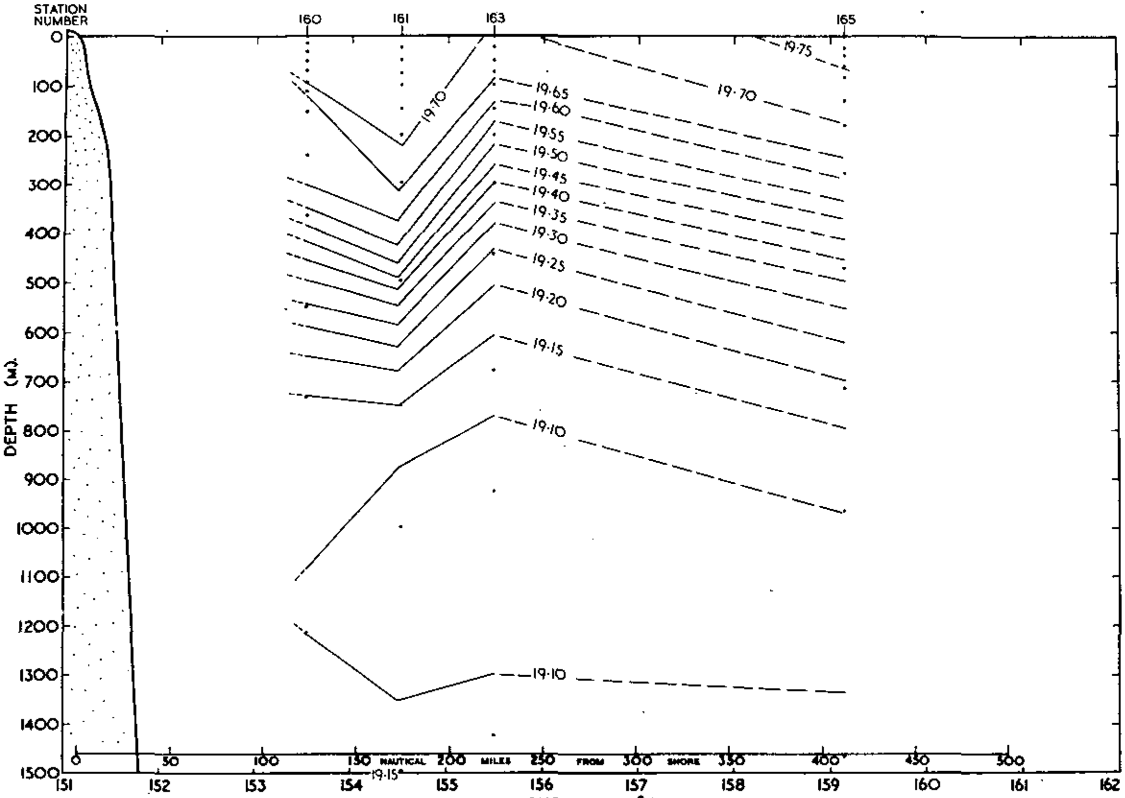

STATION NUMBER
160
161
163
165
19·75
19·70
19·65
19·60
19·55
19·50
19·45
19·40
19·35
19·30
19·25
19·20
19·15
19·10
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE °E.

Fig. 8

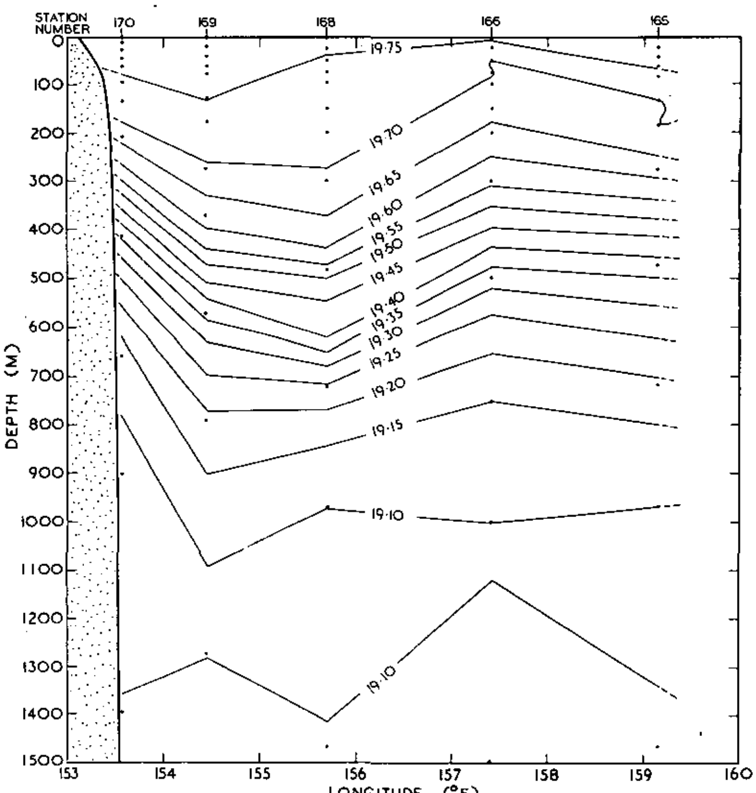

STATION NUMBER
170
169
168
166
165
19·75
19·70
19·65
19·60
19·55
19·50
19·45
19·40
19·35
19·30
19·25
19·20
19·15
19·10
DEPTH (M)
LONGITUDE (°E)

Fig 9

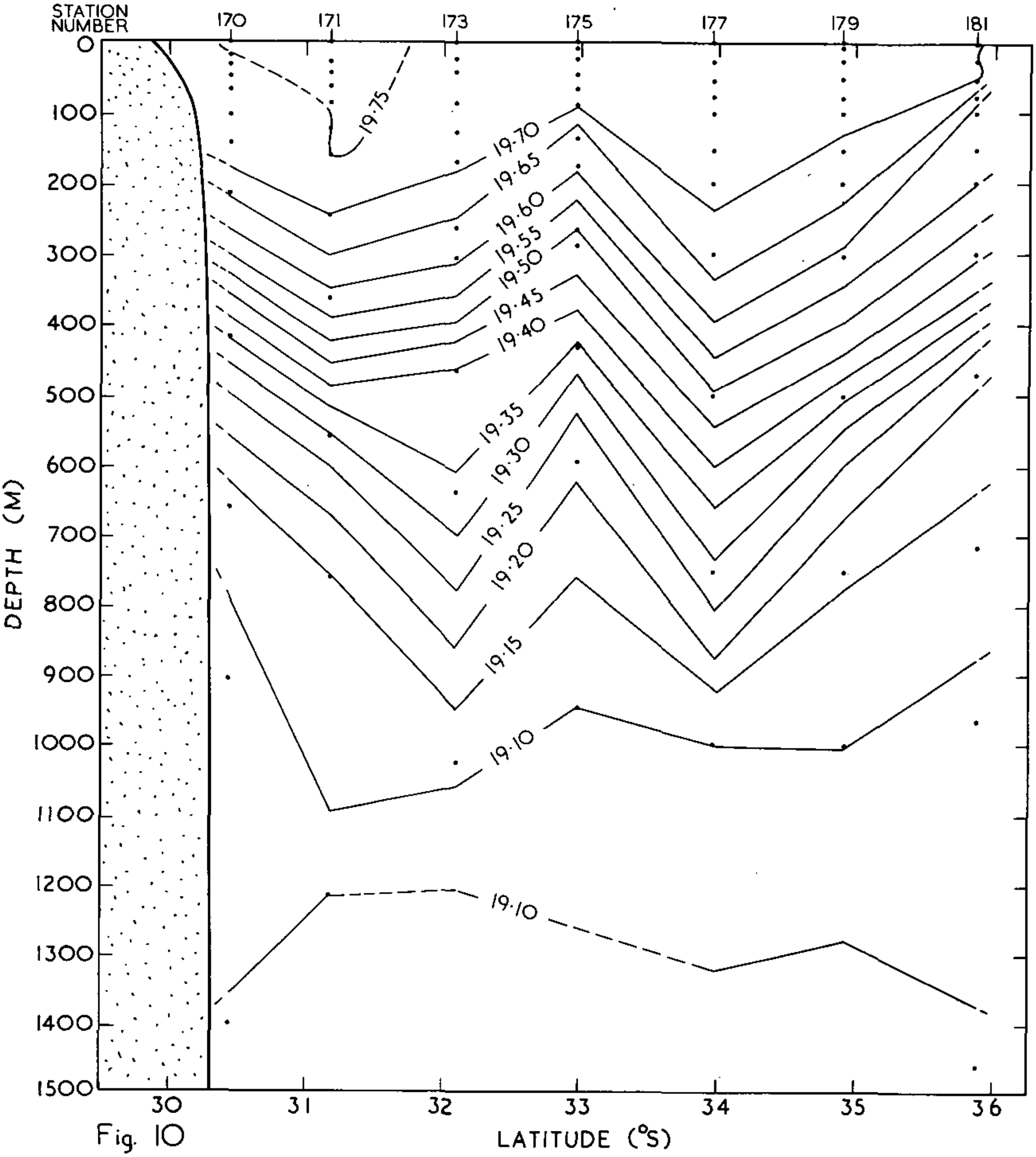

STATION NUMBER
170
171
173
175
177
179
181
DEPTH (M)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
19·75
19·70
19·65
19·60
19·55
19·50
19·45
19·40
19·35
19·30
19·25
19·20
19·15
19·10
19·10
30
31
32
33
34
35
36
LATITUDE (°S)

Fig. 10

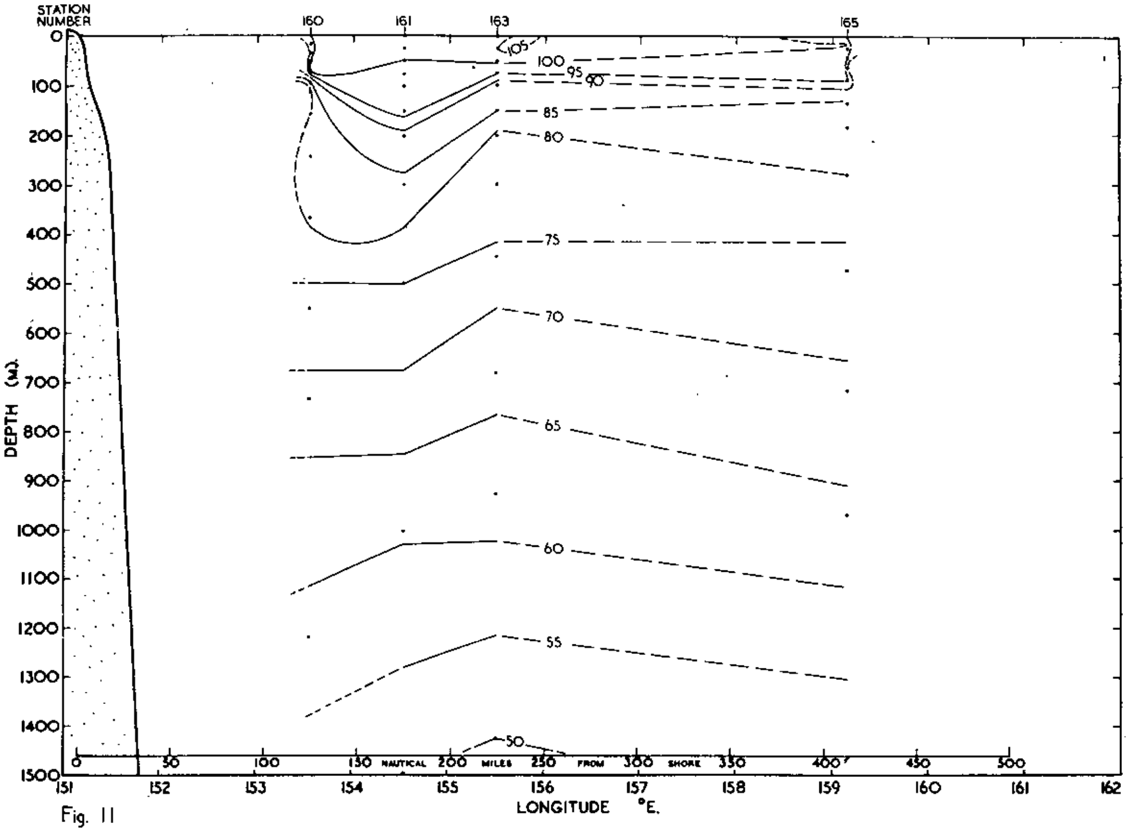

STATION NUMBER
160
161
163
165
105
100
95
90
85
80
75
70
65
60
55
50
DEPTH (M.)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
0 50 100 150 NAUTICAL 200 MILES 250 FROM 300 SHORE 350 400 450 500
151 152 153 154 155 156 157 158 159 160 161 162
LONGITUDE °E.

Fig. 11

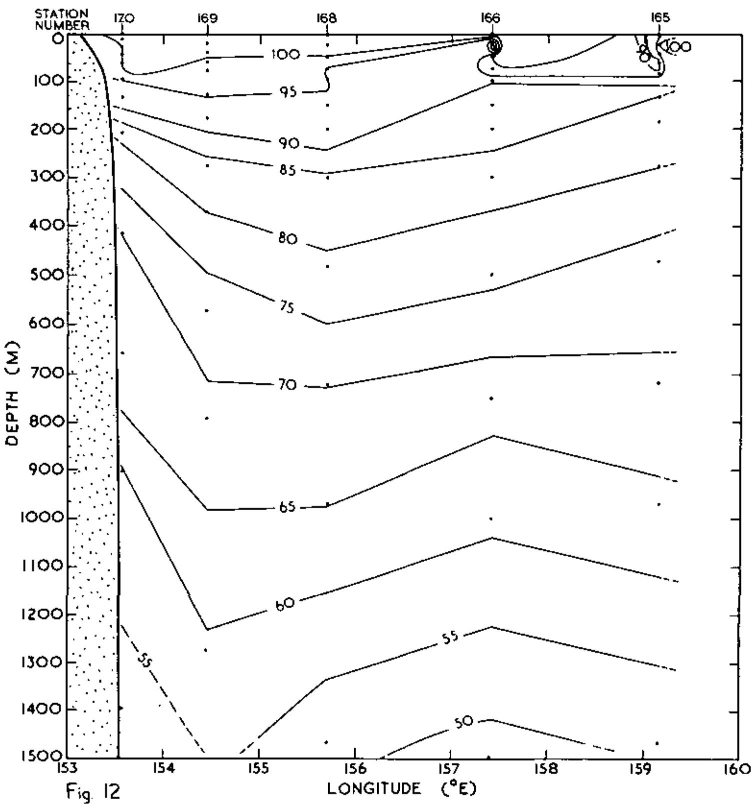

STATION NUMBER
170
169
168
166
165
100
95
90
85
80
75
70
65
60
55
50
DEPTH (M)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
153 154 155 156 157 158 159 160
LONGITUDE (°E)

Fig. 12

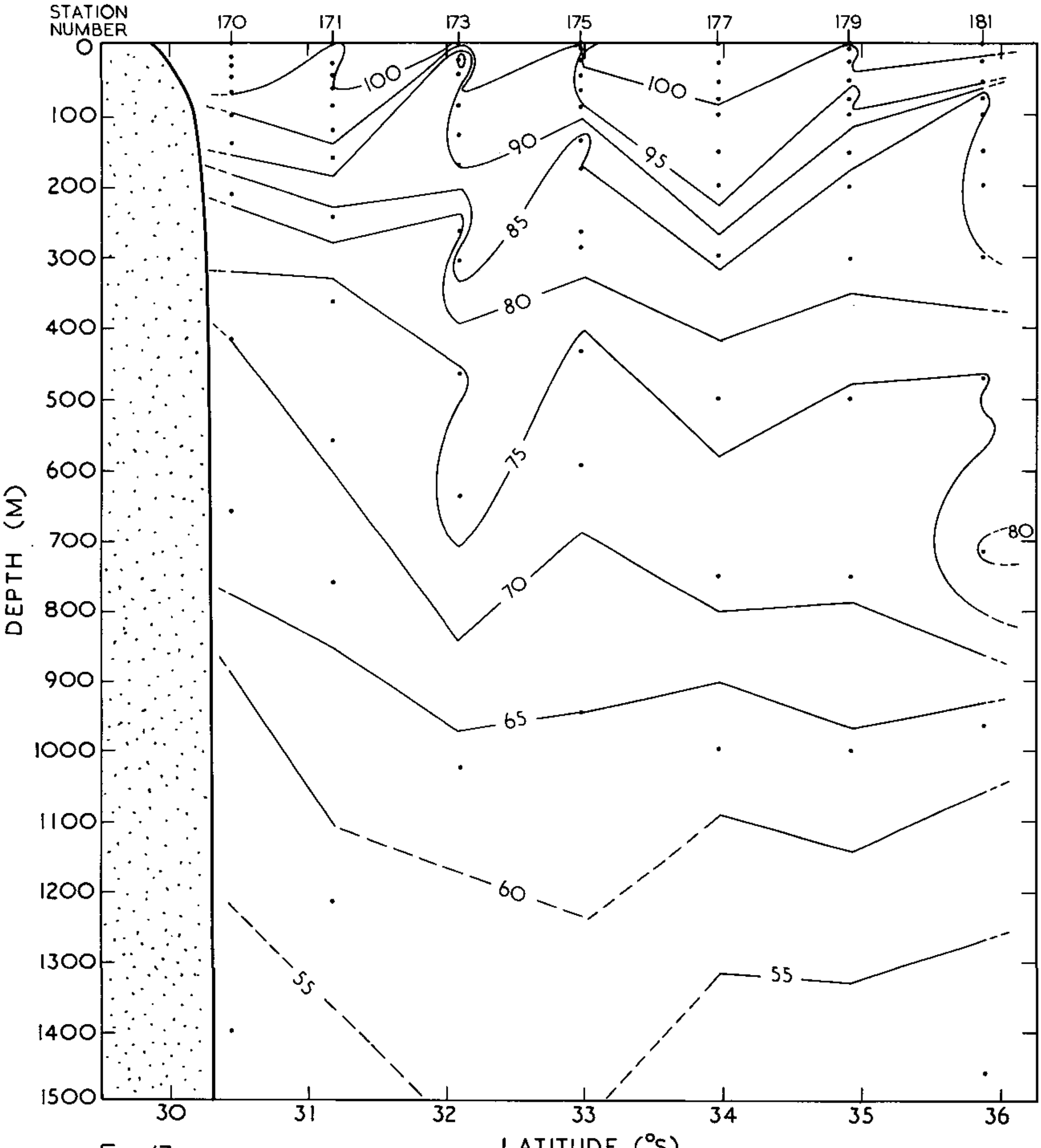

STATION NUMBER
170
171
173
175
177
179
181
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
DEPTH (M)
100
90
85
80
75
70
65
60
55
95
80
30
31
32
33
34
35
36
LATITUDE (°S)

Fig. 13

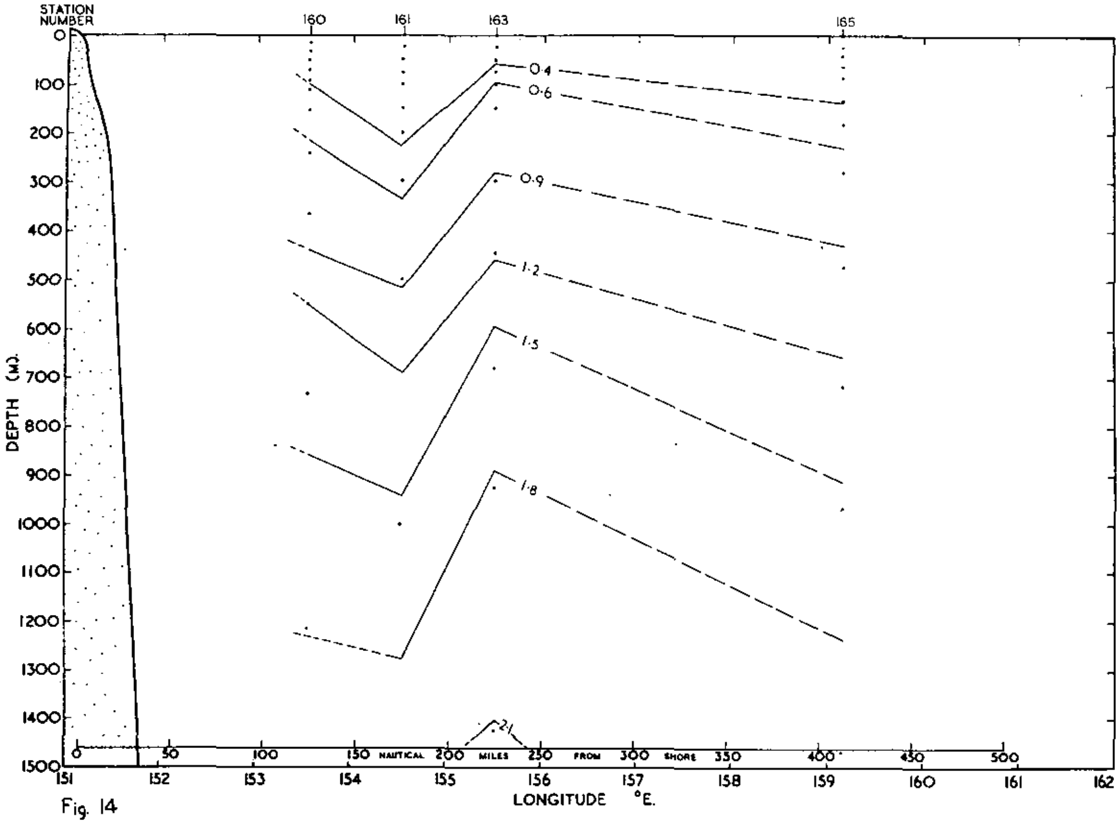

STATION NUMBER
160
161
163
165
0·4
0·6
0·9
1·2
1·5
1·8
2·1
DEPTH (M.)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
0 50 100 150 NAUTICAL 200 MILES 250 FROM 300 SHORE 350 400 450 500
151 152 153 154 155 156 157 158 159 160 161 162
LONGITUDE °E.

Fig. 14

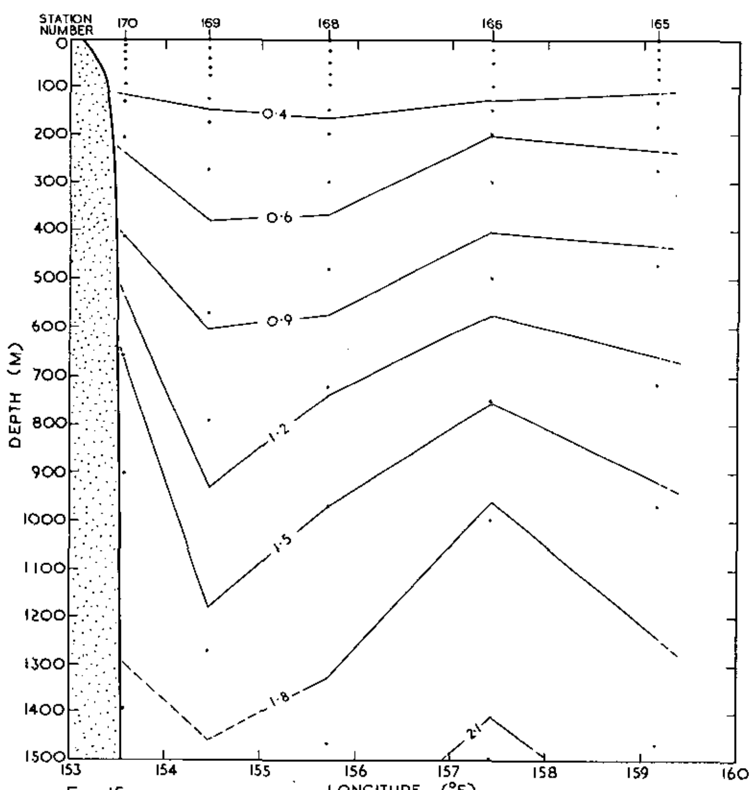

STATION NUMBER
170
169
168
166
165
0·4
0·6
0·9
1·2
1·5
1·8
2·1
DEPTH (M)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
153 154 155 156 157 158 159 160
LONGITUDE (°E)

Fig. 15

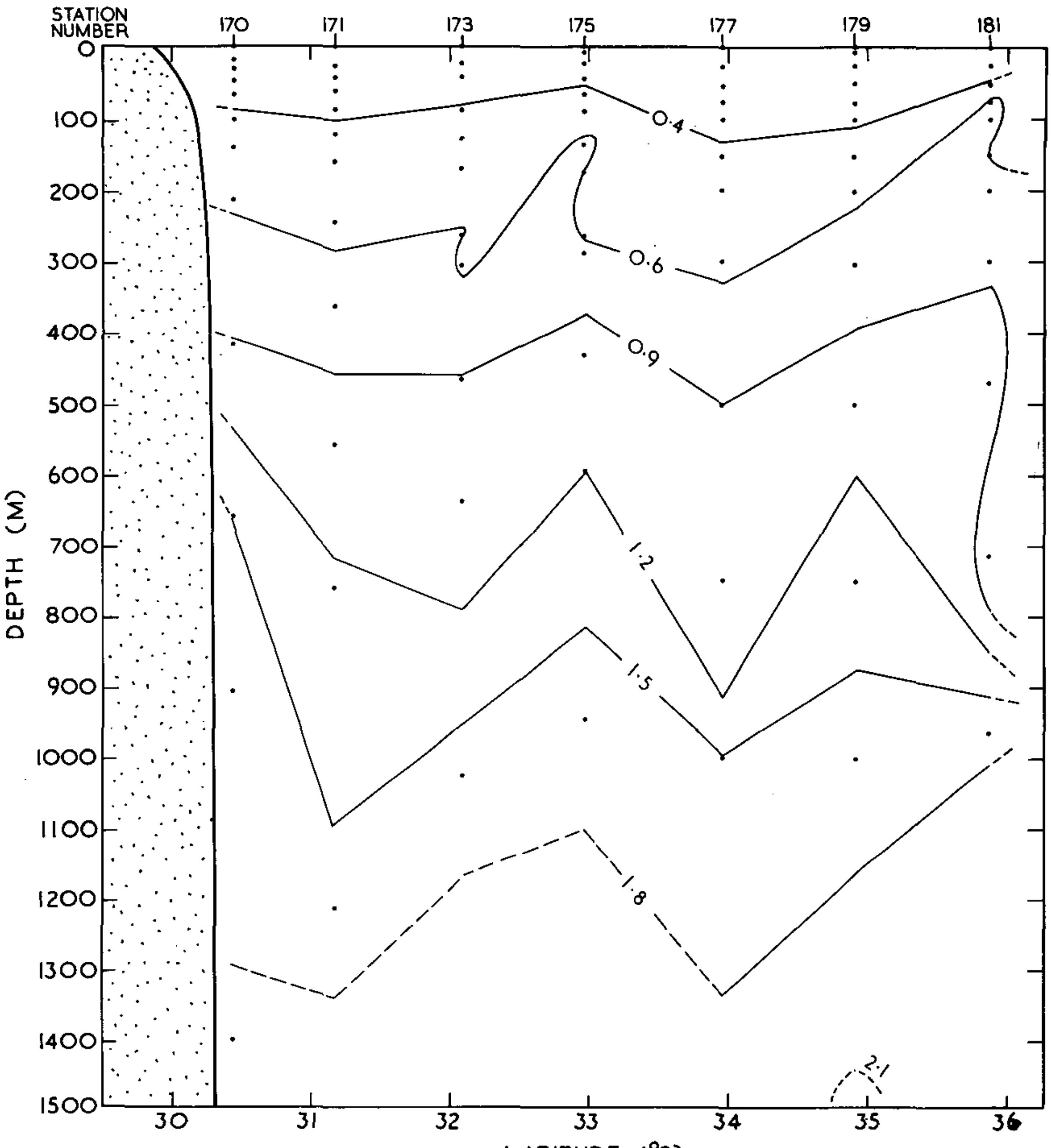

STATION NUMBER
170
171
173
175
177
179
181
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
DEPTH (M)
0·4
0·6
0·9
1·2
1·5
1·8
2·1
30
31
32
33
34
35
36
LATITUDE (°S)

Fig. 16

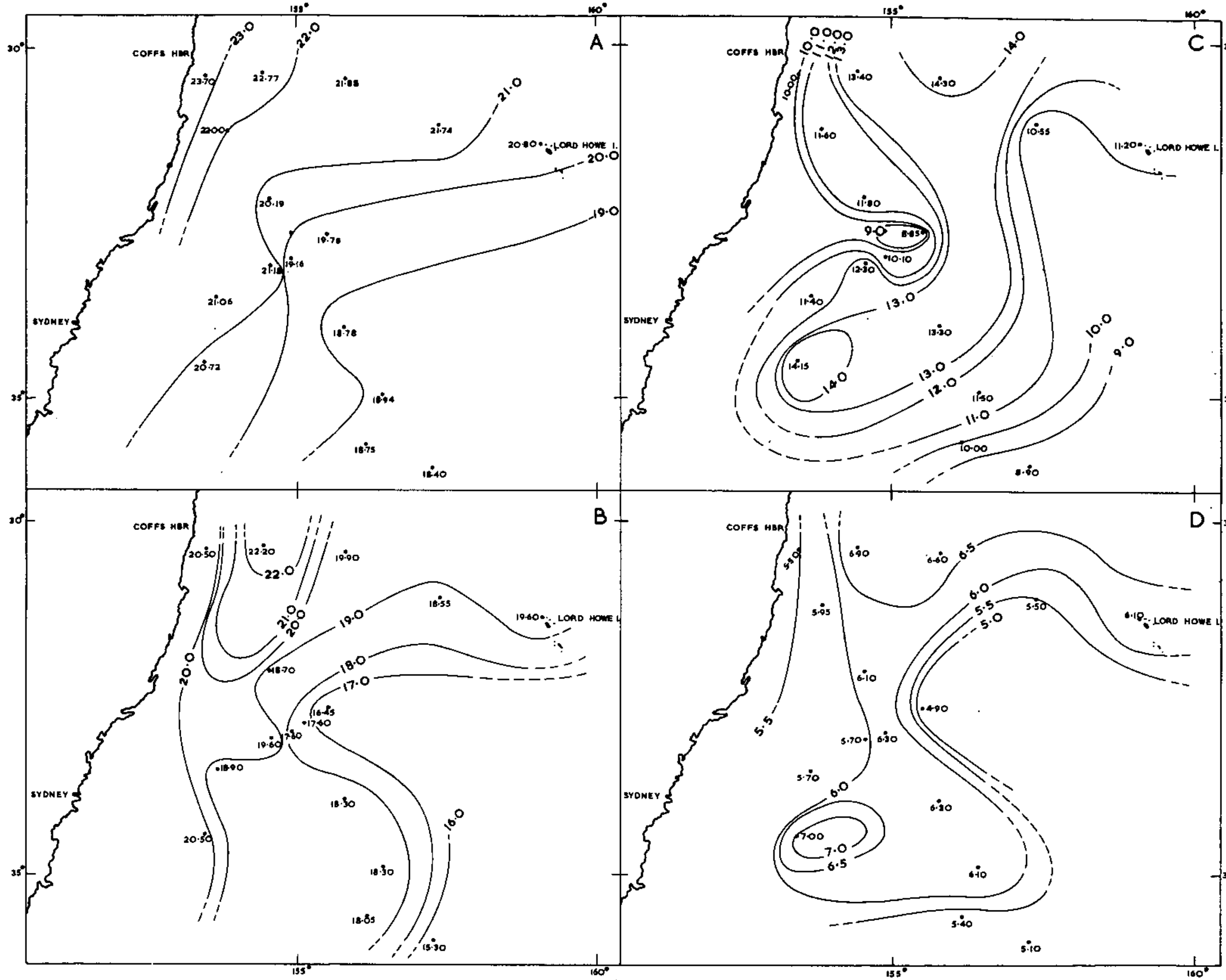


Fig. 17

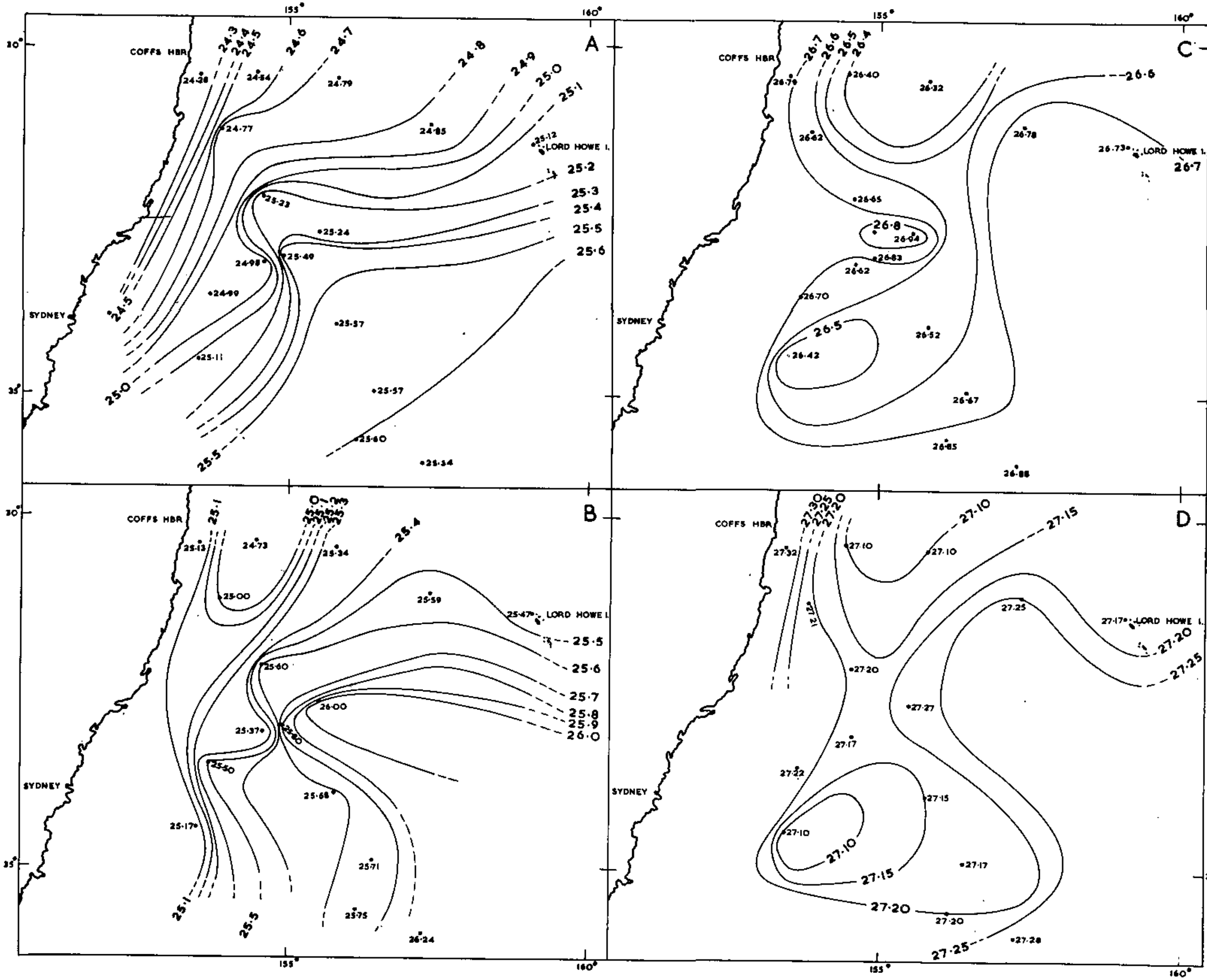


Fig. 18

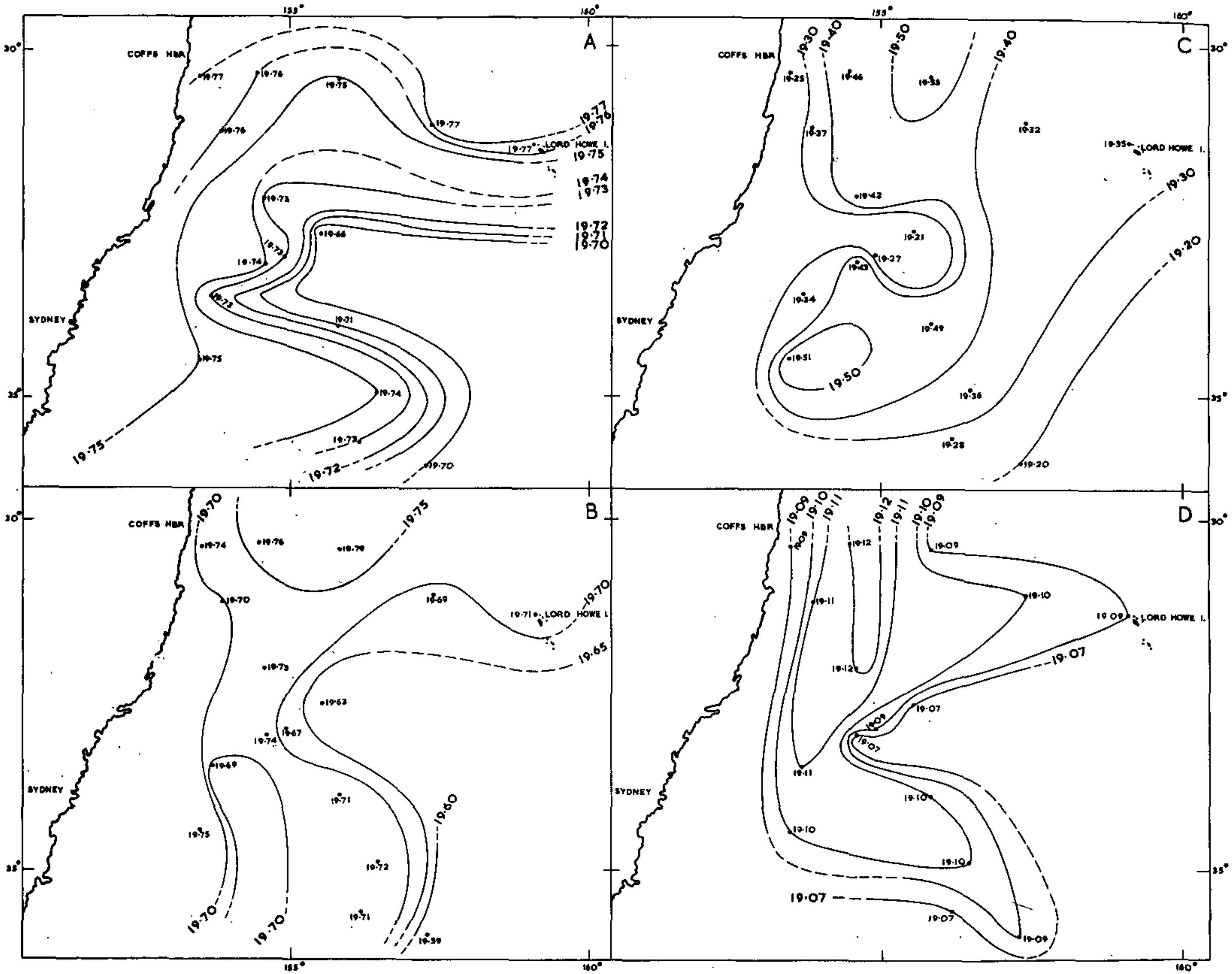


Fig. 19.

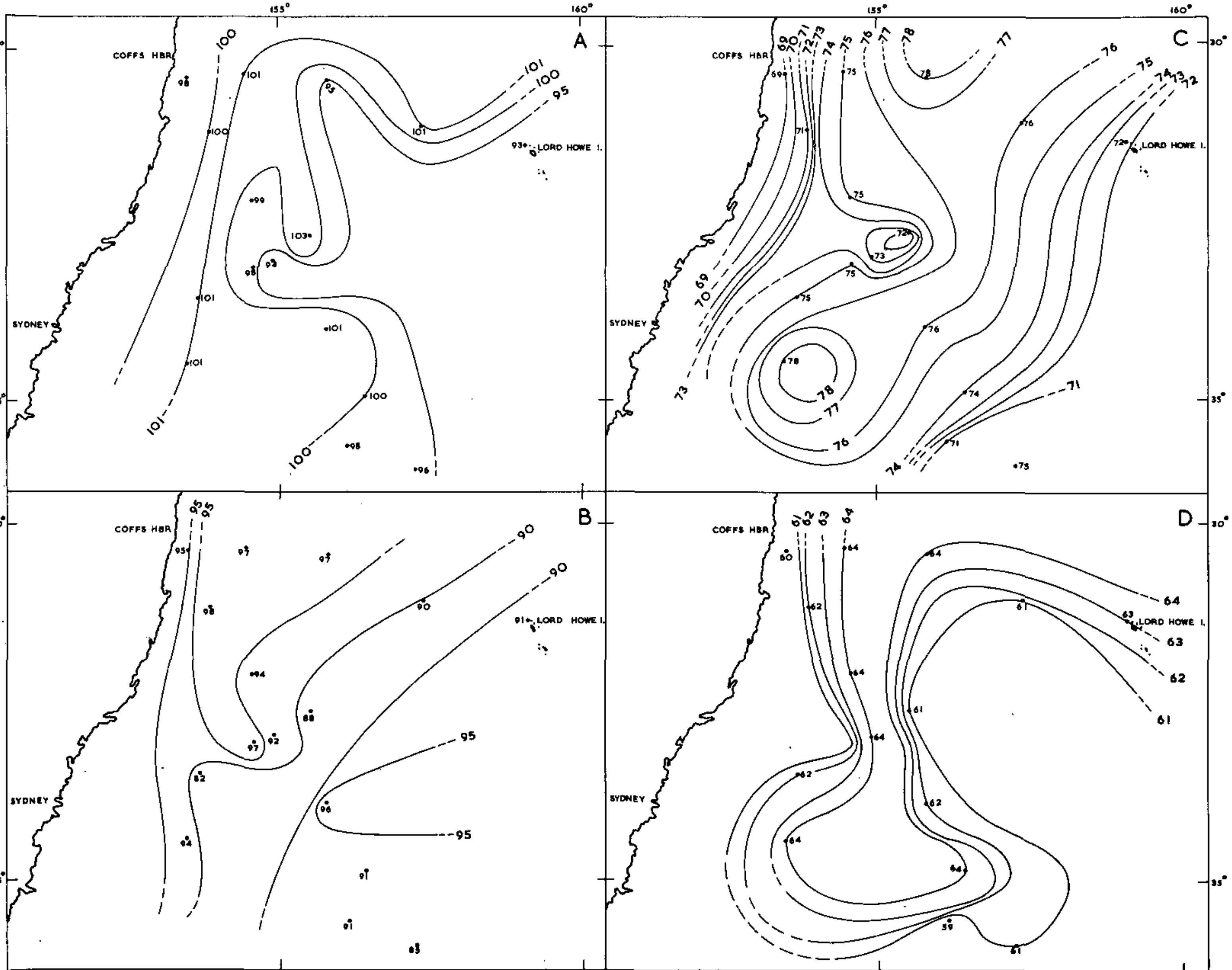


Fig. 20

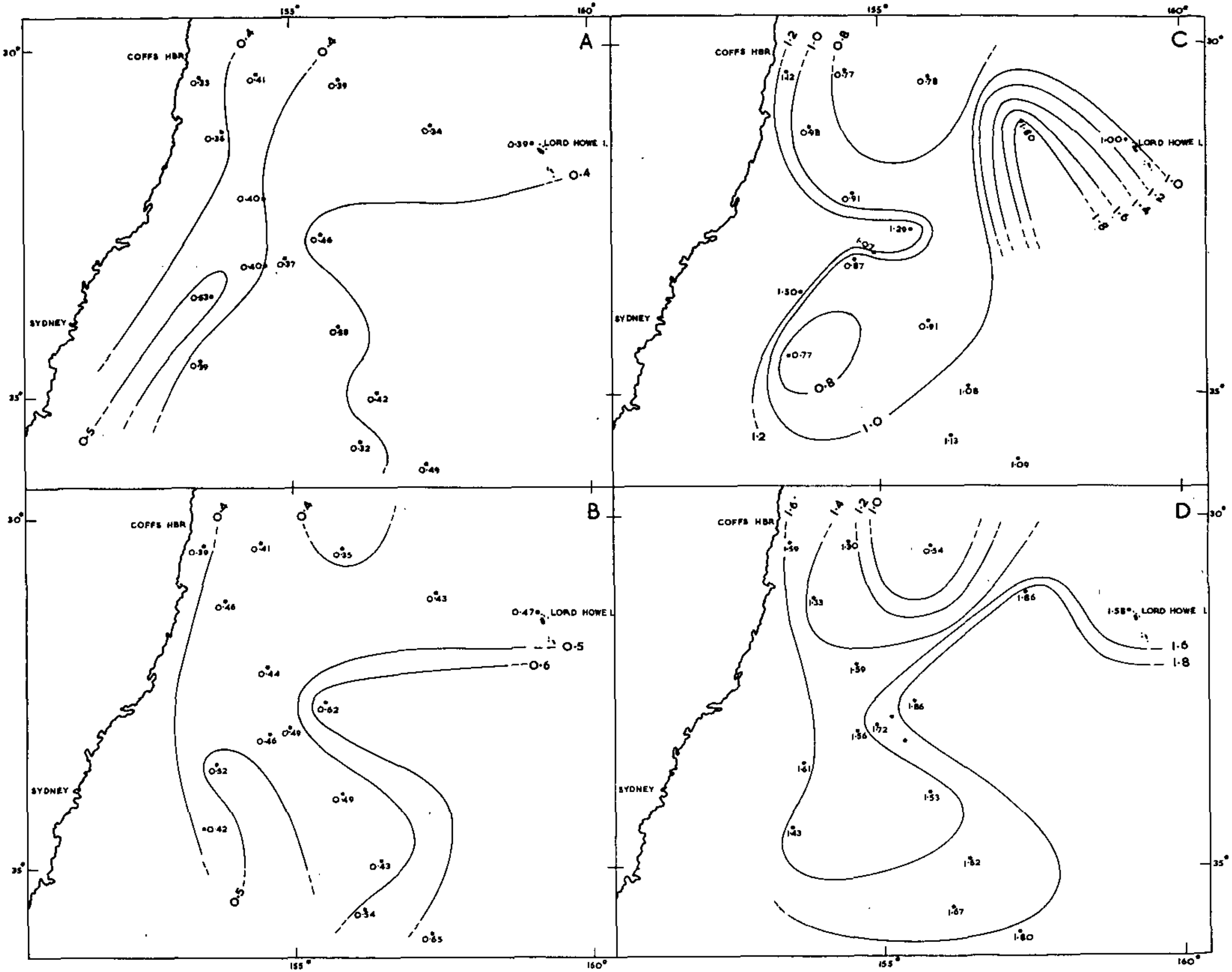


Fig. 21

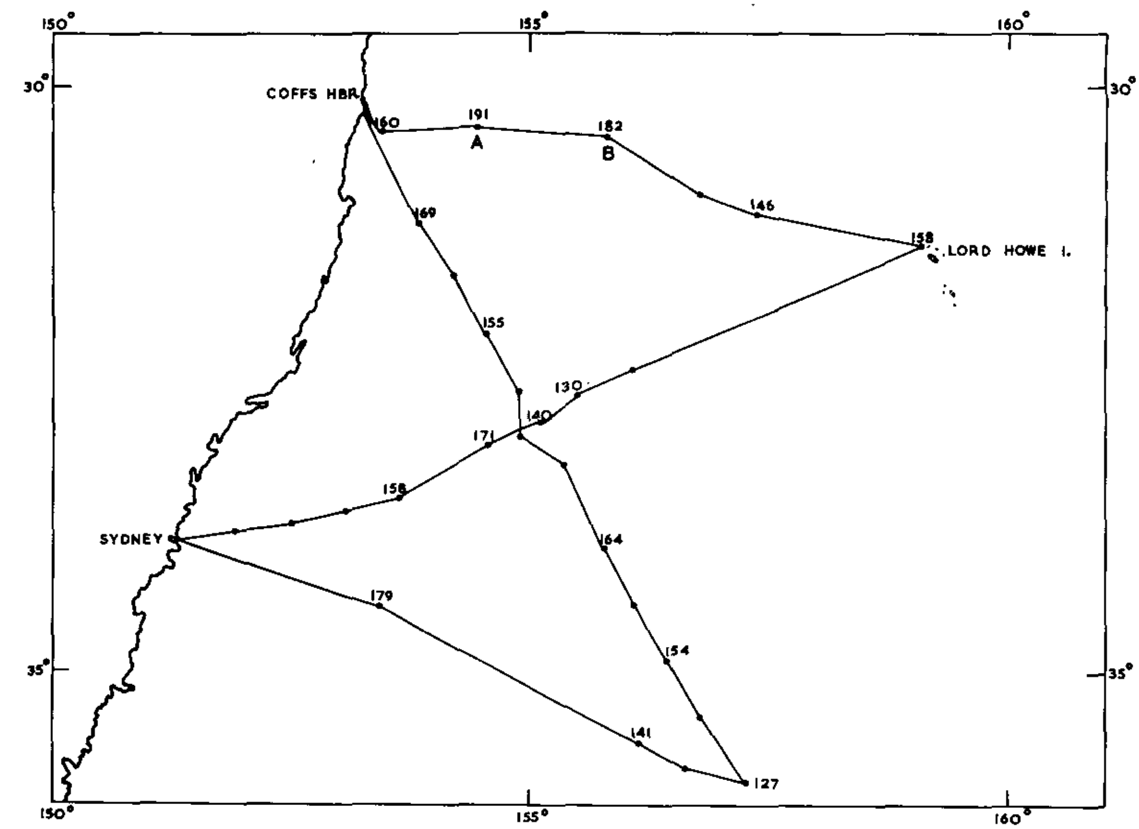

150°
155°
160°
30°
COFFS HBR
160
191
A
182
B
146
158
LORD HOWE I.
169
155
130
140
171
158
SYDNEY
164
179
154
35°
141
127

Fig. 22

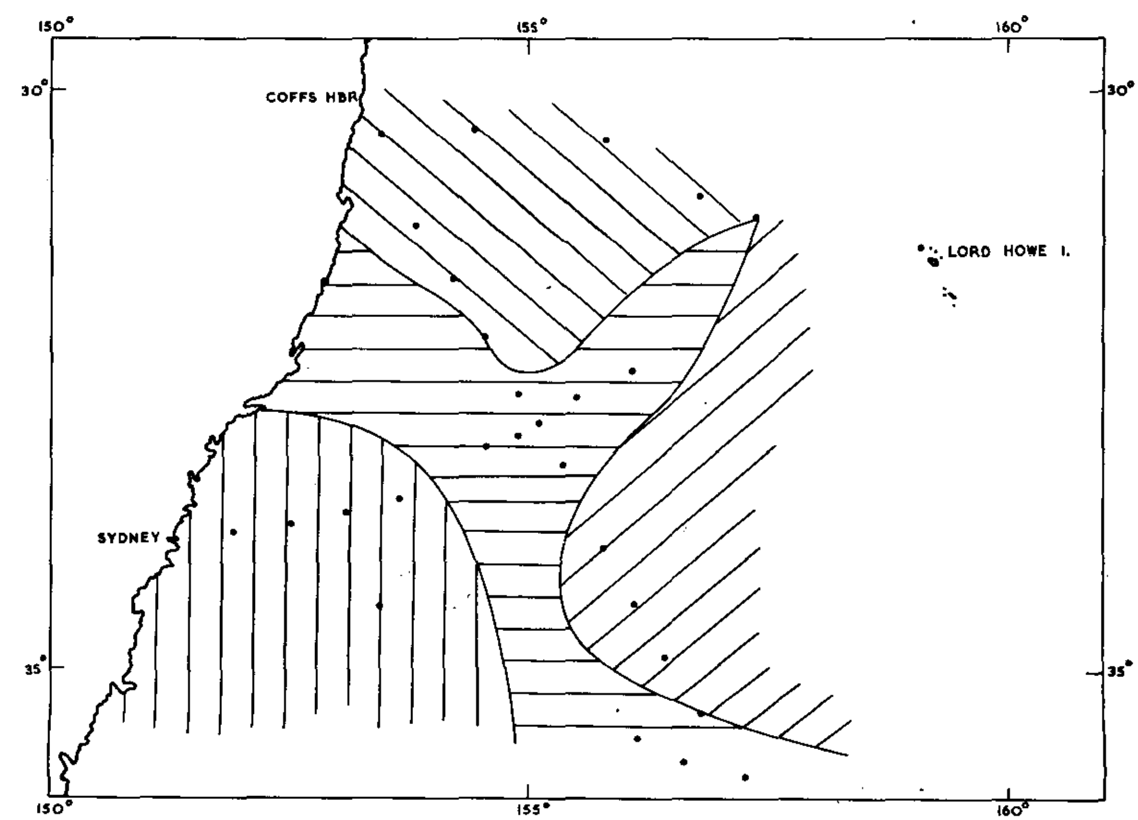

150°
155°
160°
30°
COFFS HBR
LORD HOWE I.
SYDNEY
35°

Fig. 23

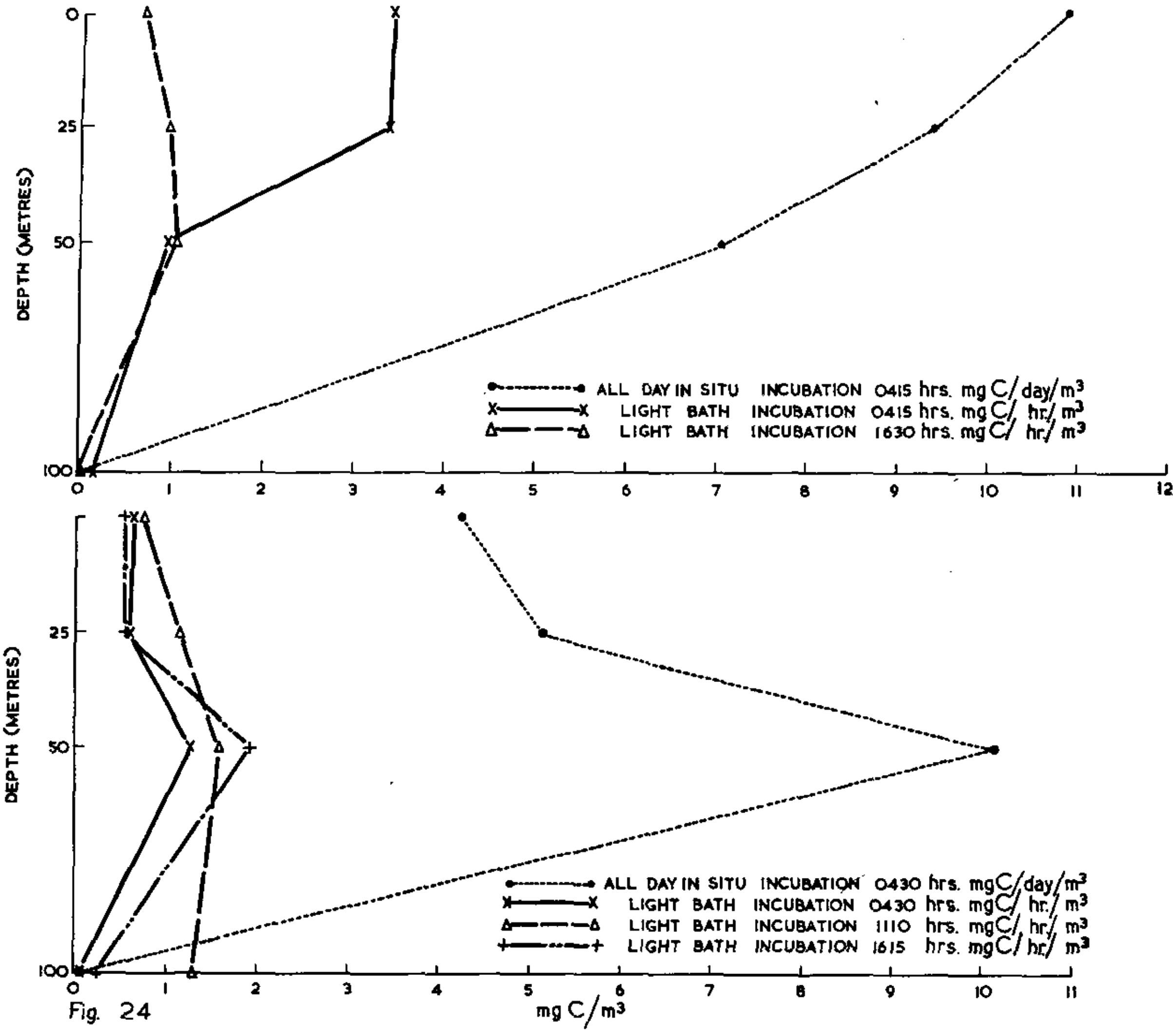

DEPTH (METRES)
ALL DAY IN SITU INCUBATION 0415 hrs. mg C/day/m³
LIGHT BATH INCUBATION 0415 hrs. mg C/ hr./ m³
LIGHT BATH INCUBATION 1630 hrs. mg C/ hr./ m³
ALL DAY IN SITU INCUBATION 0430 hrs. mgC/day/m³
LIGHT BATH INCUBATION 0430 hrs. mgC/ hr./ m³
LIGHT BATH INCUBATION 1110 hrs. mgC/ hr./ m³
LIGHT BATH INCUBATION 1615 hrs. mgC/ hr./ m³
mg C/m³

Fig. 24

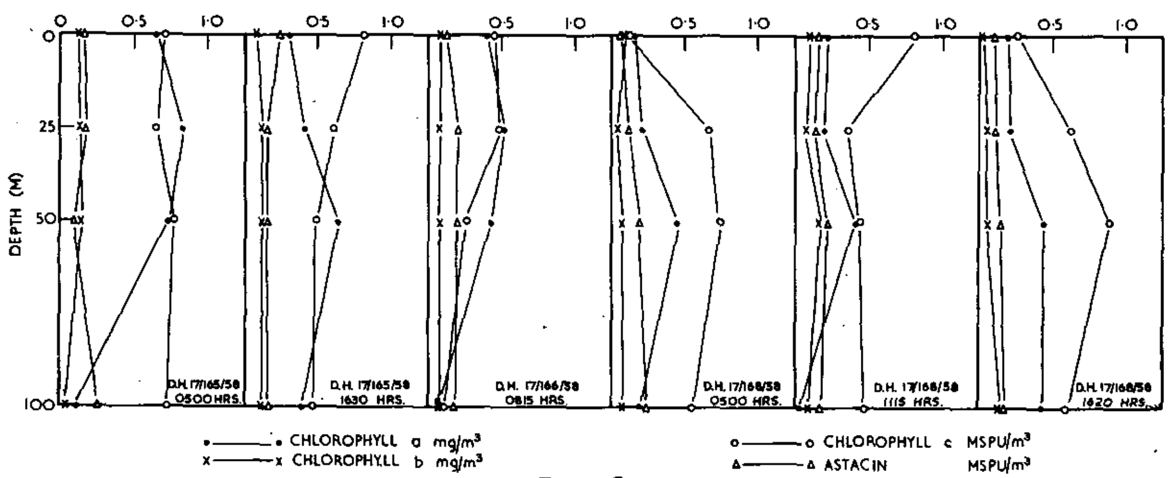

DEPTH (M)
D.H. 17/165/58 0500 HRS.
D.H. 17/165/58 1630 HRS.
D.H. 17/166/58 0815 HRS.
D.H. 17/168/58 0500 HRS.
D.H. 17/168/58 1115 HRS.
D.H. 17/168/58 1620 HRS.
CHLOROPHYLL a mg/m³
CHLOROPHYLL b mg/m³
CHLOROPHYLL c MSPU/m³
ASTACIN MSPU/m³

Fig. 25

F.R.V. "DERWENT HUNTER"

SCIENTIFIC REPORT OF CRUISE DH18/58

November 4 - 7, 1958

SCIENTIFIC PERSONNEL

N. Dyson (in charge)

ITINERARY

Figure 1 shows the position of the station worked.

SCIENTIFIC REPORTS

This was a special productivity cruise planned to investigate the diurnal variation in photosynthesis of phytoplankton and the correlation between rate of production and phytoplankton pigments. A station approximately 50 miles from the coast was occupied for 48 hours and sampling carried out every two hours. Duplicate samples were collected from 0, 25, and 50 m for CO_2 uptake and from 0 and 25 m for pigment estimation.

(a) HYDROLOGY - A.D. CROOKS

Water samples were taken at the surface approximately every 2 hours for temperature, chlorinity, and total phosphorus. Bathythermograph readings to 270 m were taken every 2 hours.

Temperature

Figure 2 shows the water temperatures recorded by bathythermograph and Figure 3 the surface temperatures. Maximum surface temperature (23.1°C) was recorded at 2400 hours on November 11 and minimum (21.5°C) at 1800 hours on November 6. At 250 m low temperatures (14°C) were recorded at about 1000 hours each day and were probably tidal in nature.

Chlorinity

Figure 4 shows that surface chlorinity varied only .03 ‰ in 48 hours. The low temperature at 1800 hours on November 6 was accompanied by a slightly lower chlorinity.

Total Phosphorus

Maximum total phosphorus was observed at 1200 hours on November 6 and minimum at 1400 hours on November 5.

(b) CO_2 UPTAKE - N. DYSON

Figure 5 shows that a marked diurnal variation of CO_2 uptake was found. Though this variation was found at all depths, there were marked differences in the magnitude and times of the cycles at each depth. On the first day there were two well separated peaks at 0600 and 1800 hours, whilst on the second day the two peaks were close, being at 1000 and 1400 hours.

(c) PIGMENTS - G.F. HUMPHREY

Samples for the determination of plankton pigments were collected at two hourly intervals from 0030 hours on November 5 to 0010 hours on November 7 at 0 and 25 m. Results are in C.S.I.R.O. Aust. (1960) and are graphed in Figure 5.

LEGENDS FOR FIGURES 1-5 - Cruise DH18/58

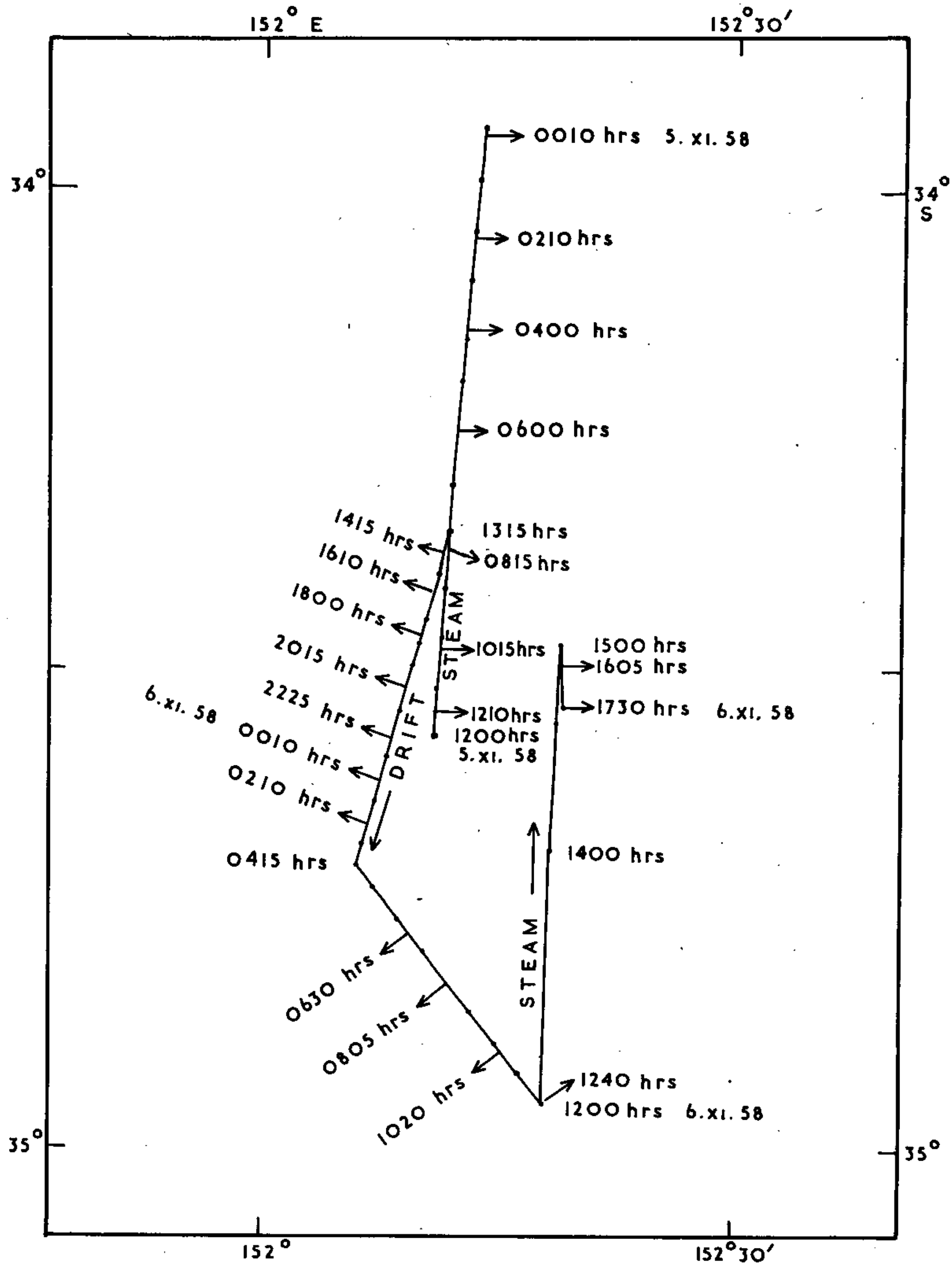
Fig. 1. Chart showing position of station worked.

Fig. 2. Temperature at 0 m to 250 m recorded by bathythermograph.

Fig. 3. Curves showing variations in chlorinity, surface temperature, and total phosphorus during the cruise.

Fig. 4. Variation in rate of CO_2 uptake at Station DH18/185/58.

Fig. 5. Depth profiles of pigment concentrations.



152° E
152°30′
34°
34° S
35°
35°
152°
152°30′
0010 hrs 5. xi. 58
0210 hrs
0400 hrs
0600 hrs
1315 hrs
0815 hrs
1415 hrs
1610 hrs
1800 hrs
2015 hrs
2225 hrs
6.xi. 58
0010 hrs
0210 hrs
0415 hrs
STEAM
1015hrs
1210hrs
1200hrs
5.xi. 58
DRIFT
1500 hrs
1605 hrs
1730 hrs 6.xi. 58
1400 hrs
STEAM
0630 hrs
0805 hrs
1020 hrs
1240 hrs
1200 hrs 6.xi. 58

Fig. 1

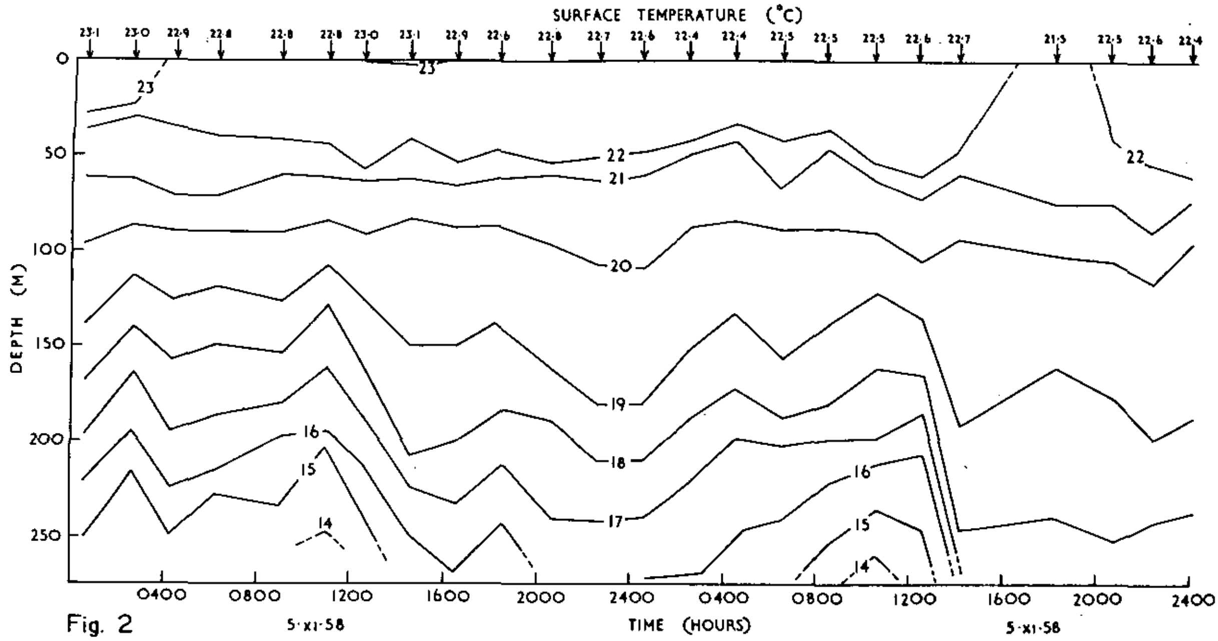

SURFACE TEMPERATURE (°C)
23·1 23·0 22·9 22·8 22·8 22·8 23·0 23·1 22·9 22·6 22·8 22·7 22·6 22·4 22·4 22·5 22·5 22·5 22·6 22·7 21·5 22·5 22·6 22·4
DEPTH (M)
0 50 100 150 200 250
23 22 21 20 19 18 17 16 15 14
0400 0800 1200 1600 2000 2400 0400 0800 1200 1600 2000 2400
5·xi·58
TIME (HOURS)
5·xi·58

Fig. 2

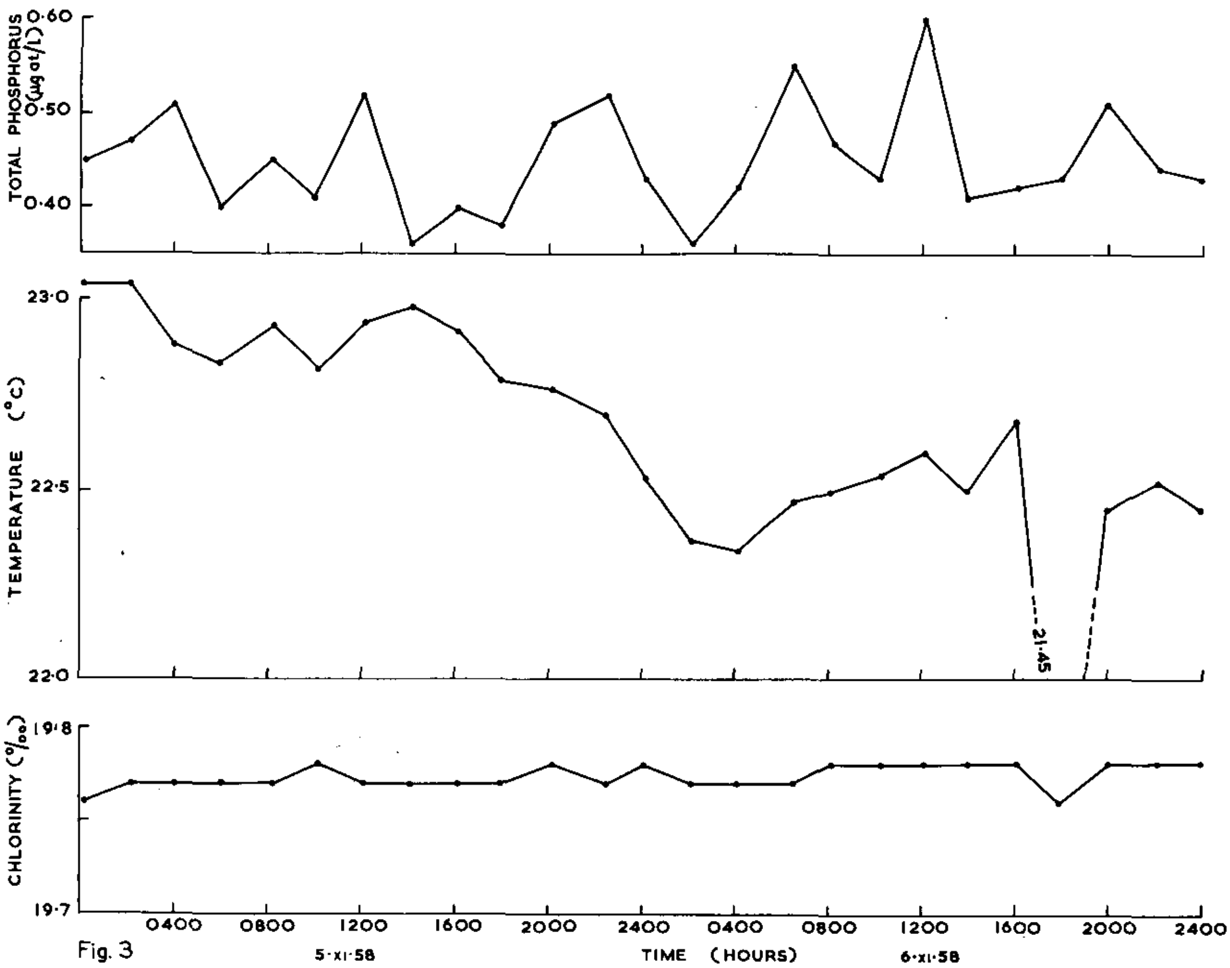
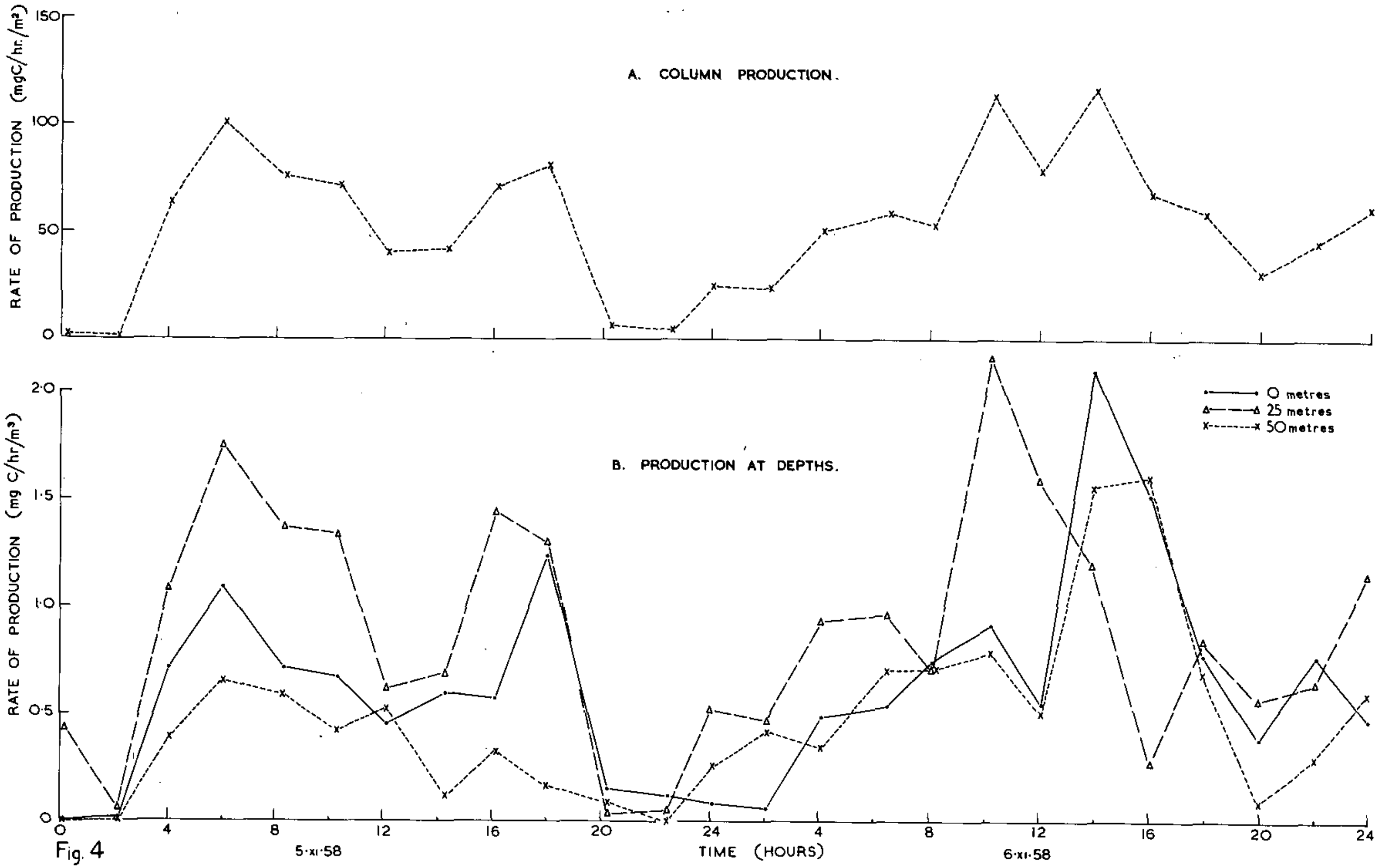

TOTAL PHOSPHORUS (µg at/l)
0·60 0·50 0·40
TEMPERATURE (°C)
23·0 22·5 22·0
21·45
CHLORINITY (°/oo)
19·8 19·7
0400 0800 1200 1600 2000 2400 0400 0800 1200 1600 2000 2400
5·xi·58
TIME (HOURS)
6·xi·58

Fig. 3



A. COLUMN PRODUCTION.
RATE OF PRODUCTION (mgC/hr/m²)
150
100
50
0
B. PRODUCTION AT DEPTHS.
RATE OF PRODUCTION (mg C/hr/m³)
2·0
1·5
1·0
0·5
0
0 metres
25 metres
50 metres
0
4
8
12
16
20
24
4
8
12
16
20
24
TIME (HOURS)
5·xi·58
6·xi·58

Fig. 4

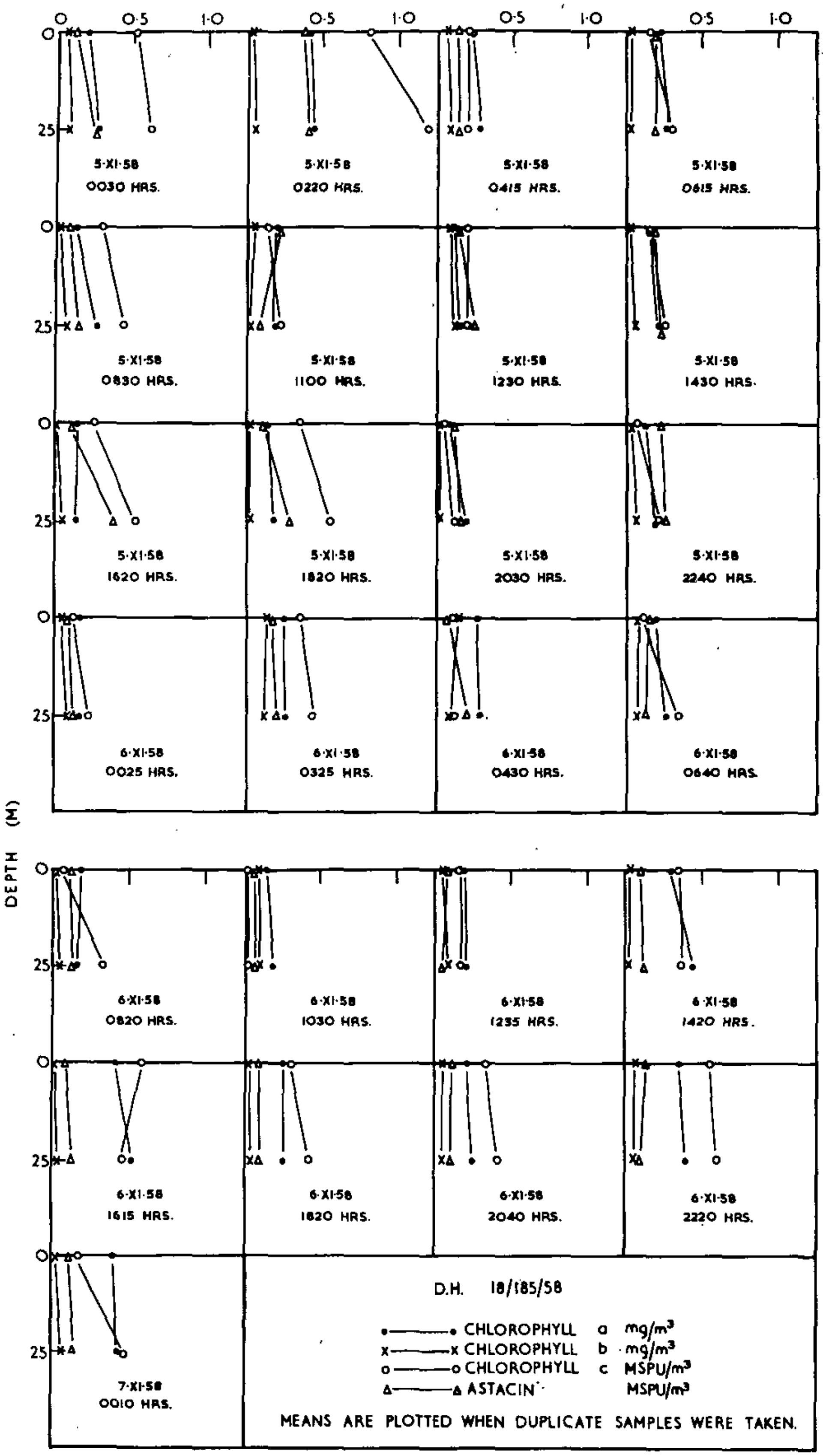

0
0.5
1.0
25
DEPTH (M)
5·XI·58
0030 HRS.
5·XI·58
0220 HRS.
5·XI·58
0415 HRS.
5·XI·58
0615 HRS.
5·XI·58
0830 HRS.
5·XI·58
1100 HRS.
5·XI·58
1230 HRS.
5·XI·58
1430 HRS.
5·XI·58
1620 HRS.
5·XI·58
1820 HRS.
5·XI·58
2030 HRS.
5·XI·58
2240 HRS.
6·XI·58
0025 HRS.
6·XI·58
0325 HRS.
6·XI·58
0430 HRS.
6·XI·58
0640 HRS.
6·XI·58
0820 HRS.
6·XI·58
1030 HRS.
6·XI·58
1235 HRS.
6·XI·58
1420 HRS.
6·XI·58
1615 HRS.
6·XI·58
1820 HRS.
6·XI·58
2040 HRS.
6·XI·58
2220 HRS.
7·XI·58
0010 HRS.
D.H. 18/185/58
CHLOROPHYLL a mg/m³
CHLOROPHYLL b mg/m³
CHLOROPHYLL c MSPU/m³
ASTACIN MSPU/m³
MEANS ARE PLOTTED WHEN DUPLICATE SAMPLES WERE TAKEN.

Fig. 5

F.R.V. "DERWENT HUNTER"

SCIENTIFIC REPORT OF CRUISE DH20/58

December 1 - 17, 1958

SCIENTIFIC PERSONNEL

First Part: N. Dyson (in charge)
Second Part: J. Staniforth (in charge)

ITINERARY

This was the third extended cruise to study the chemical, physical, and biological properties of the East Australian Current. The four sections were successfully worked on this cruise. Figure 1 shows the track chart with the positions of stations and the work done at each station.

SCIENTIFIC REPORTS

Twenty-one stations were worked on the four section lines. Samples were taken for salinity (Section (a) 3), dissolved oxygen, and total phosphorus at depths 0, 25, 50, 75, 100, 150, 200, 300, 500, 750, 1000, and 1500 m. G.E.K. tows were made and bathythermograph readings taken. Samples for plankton pigments and CO_2 uptake were collected at 0, 25, 50, and 100 m. Light penetration measurements were made. Phytoplankton samples were taken with the modified Hardy Indicator.

(a) HYDROLOGY - A.D. CROOKS

Paired protected and unprotected thermometers were used below 100 m to determine depth of sampling.

1. Temperature
   (a) Section 1 (Fig. 2)

Maximum surface temperature (24.95°C) was observed at Station DH20/188/58 and a minimum temperature (21.45°C) at Station DH20/191/58. Below the surface, maximum temperatures occurred at Station DH20/201/58 and minimum temperatures at Station DH20/186/68. The dominant feature of the section was the column of warm water between 153°E. and 156°E. There was also an increase in temperature from Station DH20/191/58, to the east.

(b) Section 2 (Fig. 3)

A maximum surface temperature (25.60°C) was recorded at Station DH20/199/58 and a minimum temperature (22.75°C) at Station DH20/194/58. Below the surface, maximum temperature was recorded at Station DH20/198/58 and minimum at Station DH20/196/58.

(c) Section 3 (Fig. 4)

A maximum surface temperature (25.60°C) was recorded at Station DH20/199/58 and a minimum temperature (20.98°C) at Station DH20/205/58. Below the surface maximum temperature occurred at Station DH20/201/58, and minimum at Station DH20/205/58.

(d) Section 4 (Fig. 5)

A maximum surface temperature (23.10°C) was recorded at Station DH20/214/58 and a minimum temperature (21.08°C) at Station DH20/213/58. Below the surface maximum temperature was recorded at Station DH20/208/58 and minimum temperature at Station DH20/209/58. There was a notable increase in temperature at the extreme ends of the section.

2. Density (σ_t)

(a) Section 1 (Fig. 6)

A maximum surface density (24.87 σ_t) occurred at Station DH20/191/58 and a minimum (23.98 σ_t) at Station DH20/188/58. Below the surface maximum density occurred at Station DH20/186/58 and minimum density at Station DH20/201/58. There was a pycnocline at Station DH20/186/58, between 0 m and 100 m. The vertical gradient was 0.02 σ_t/m. A pycnocline also occurred at Stations DH20/191 and 193/58 but the depth, in these cases, was less. In the warmer water, the pycnocline was very much weaker.

(b) Section 2 (Fig. 7)

A maximum surface density (24.60 σ_t) was observed at Station DH20/197/58 and a minimum density (23.79 σ_t) at Station DH20/199/58. Maximum density occurred at Station DH20/196/58 at all depths, minimum density at Station DH20/194/58. A well developed pycnocline was observed, varying, in depth from 200 m at Station DH20/198/58 to

50 m at Station DH20/196/58. Maximum vertical gradient was 0.05 σ_t/m at Station DH20/196/58. In the warmer water at Station DH20/194/58, the pycnocline was much weaker.

(c) Section 3 (Fig. 8)

A maximum surface density (24.93 σ_t) was observed at Station DH20/208/58 and a minimum density of (23.79 σ_t) at Station DH20/199/58. Below the surface, maximum density occurred at Station DH20/205/58 and minimum at Station DH20/201/58.

A well developed pycnocline appeared at a depth of 50 m at Station DH20/205/58 but in the surrounding, warmer, water it weakened considerably. The vertical gradient was 0.04 σ_t/m.

(d) Section 4 (Fig. 9)

A maximum surface density (25.01 σ_t) was observed at Station DH20/213/85 and a minimum density (24.49 σ_t) at Station DH20/214/58. Below 100 m maximum density occurred at Station DH20/209/58 and minimum density at Station DH20/208/58. A very well developed pycnocline occurred at Station DH20/211/58 at 60 m. The vertical gradient was 0.06 σ_t/m. A pycnocline with vertical gradient of 0.02 σ_t/m was observed in the upper 100 m at Stations DH20/209 and 213/58.

3. Salinity

Salinity has been recorded in preference to chlorinity in the report of this cruise. Chlorinity is first determined using a temperature-chlorinity meter, and is then converted to salinity using Knudsen's 1948 tables.

(a) Section 1 (Fig. 10)

Maximum surface salinity (35.81 ‰) was observed at Station DH20/189/58 and minimum salinity (35.57 ‰) at Station DH20/186/58. Waters of high salinity extended to maximum depths at Station DH20/201/58 and to minimum depths at Station DH20/186/58. The salinity distribution closely resembled the density distribution. The depth of the salinity minimum varied between 1250 m at Station DH20/201/58 and 930 m at Station DH20/186/58.

(b) Section 2 (Fig. 11)

Maximum surface salinity (35.81 ‰) occurred at Station DH20/199/58 and minimum salinity (35.68 ‰) at Station DH20/196/58. High salinity water extended to maximum depths at Station DH20/198/58 and to minimum depths at Station DH20/196/58. The salinity distribution closely resembled the density distribution. The depth of the salinity minimum varied between 1150 m at Station DH20/198/58 and 880 m at Station DH20/196/58.

(c) Section 3 (Fig. 12)

Maximum surface salinity (35.81 ‰) was recorded at Station DH20/199/58 and minimum salinity (35.64 ‰) at Station DH20/205/58. Below the surface maximum salinity was observed at Station DH20/201/58, and minimum salinity at Station DH20/205/58. The salinity and density distributions were very closely related except above 400 m at Station DH20/190/58. The depth of the salinity minimum varied between 1200 m at Station DH20/200/58 and 850 m at Station DH/205/58.

(d) Section 4 (Fig. 13)

Maximum surface salinity (35.75 ‰) was observed at Station DH20/214/58 and minimum salinity (35.66 ‰) at Station DH20/213/58. Below the surface maximum salinity occurred at Station DH20/208/58 and minimum salinity at Station DH20/209/58. Higher salinity waters extended to maximum depths at both ends of the section, Stations DH20/208/58 and DH20/214/58. The salinity distribution closely resembled the density distribution. The depth of the salinity minimum varied between 920 m at Station DH20/209/58 and 1050 m at Station DH20/208/58.

4. Percentage Oxygen Saturation

(a) Section 1 (Fig. 14)

A maximum surface percentage oxygen saturation of 10 per cent. was observed at Station DH20/186/58 and a minimum oxygen of 93 per cent. at Station DH20/191/58. Below the surface maximum percentages occurred between Stations DH20/188 and 190/58 and minimum at Station DH20/191/58. High values were associated with the warm column between 153°E. and 156°E. at Station DH20/194/58.

Waters of higher percentage oxygen saturation extended to deeper levels between Stations DH 20/189 and 190/58 than elsewhere. The close similarity of the oxygen and density fields in this region, indicates that a dynamical effect was responsible.

There were three areas of oxygen saturated water, one around Station DH20/104/58, a fairly deep area (100 m) between Stations DH20/188 and 190/58 and a shallow area between Stations DH20/193 and 194/58.

(b) <u>Section 2</u> (Fig. 15)

A maximum surface percentage oxygen saturation of 102 per cent. was observed at Station DH20/196/58 and a minimum oxygen of 98 per cent. at Station DH20/199/58. Below the surface maximum values were recorded at Station DH20/198/58 and a minimum oxygen at Station DH20/196/58. Oxygen saturated surface waters occurred east of Station DH20/198/58 to an average depth of 30 m. Between Stations DH20/196 and 197/58 the degree of oxygen saturation varied considerably between about 40 m - 50 m. This was associated withs the pycnocline between these stations. The well oxygenated column of water between 153°E. and 155°E. was associated with the warm water column. On this section there was agreement between the oxygen and density fields.

(c) <u>Section 3</u> (Fig. 16)

A maximum percentage oxygen saturation of 101 per cent. occurred at several stations and a minimum of 98 per cent. at Station DH20/199/58. From 0 m to 400 m, the distribution was complex and no distinctive maxima or minima occurred. Below 400 m a maximum was observed at Station DH20/203/58 and a minimum at Station DH20/205/58. Above 400 m, there was not a great deal of agreement between the percentage oxygen saturation and density distributions though some similarities did exist. Below 400 m however there was a good agreement.

(d) <u>Section 4</u> (Fig. 17)

In the upper 50 m a region of 105 per cent. oxygen saturation was observed at Stations DH20/211 and 213/58 and a minimum (95 per cent.) at Station DH20/208/58. Waters of relatively high saturation were found to maximum depths at

Station DH20/208/58 and to minimum depths at Station DH20/209/58. Station DH20/208/58 was the only station at which saturated waters were not observed at any depth. Below 400 m, there was good agreement between the percentage oxygen saturation and density distributions, but above 400 m many anomalies existed, particularly at Stations DH20/211, 213, 214/58.

5. Total Phosphorus

(a) Section 1 (Fig. 18)

A maximum surface total phosphorus (0.52 µg at./l) was observed at Station DH20/201/58 and a minimum (0.29 µg at./l) at Station DH20/194/58. Below the surface maximum total phosphorus occurred at Station DH20/191/58 and minimum at Station DH20/201/58. The total phosphorus distribution closely resembled the density distribution except for some small anomalies at Stations DH20/189, 190, 201/58.

(b) Section 2 (Fig. 19)

A maximum surface total phosphorus (0.55 µg at./l) occurred at Station DH20/198/58 and minimum (0.29 µg at./l) at Station DH20/194/58. A doming of total phosphorus rich waters occurred between Stations DH20/196 and 197/58. There was a fairly close relationship between the total phosphorus and density distributions over the whole section.

(c) Section 3 (Fig. 20)

A maximum surface total phosphorus (0.52 µg at./l) occurred at Station DH20/201/58 and a minimum (0.28 µg at./l) at Stations DH20/200 and 207/58. Below the surface the distribution was fairly complex to 500 m, but maximum total phosphorus occurred generally at Station DH20/205/58 and minimum at Station DH20/201/58. There was a reasonably good relationship between the density and total phosphorus distribution.

(d) Section 4 (Fig. 21)

A maximum surface total phosphorus (0.64 µg at./l) occurred at Station DH20/214/58 and a minimum (0.34 µg at./l) at Station DH20/208/58. In general the total phosphorus decreased at all depths towards the eastern limit of the section. The distributions of total phosphorus and density were closely related except for an anomaly below 500 m at Station DH20/209/58.

6. Horizontal Distribution of Properties

(a) Temperature (Fig. 22)

The dominant surface feature was an area of warm water, in the north-west and central regions. Two cold water tongues were also evident. The first, near the coast, with axis south-north and the second to the south-east of the area with axis south-east - north-west.

At 100 m, the warm water was in the form of a tongue with axis north-south. The cooler tongue in the south-east had a much more definite formation and its axis was south-north. The onshore cold tongue was still present.

At 500 m, the warm tongue and the onshore cold tongue were still present, but the second cold tongue was not present, although there was a band of colder water along the 156°E. meridian.

At 1000 m, warm water was present in the north-west of the area, in the form of a tongue with axis approximately north-south. A cold tongue appeared in the south, with axis south-west to north-east.

(b) Density (Fig. 23)

The distribution of density was very similar to that of temperature at all depths.

(c) Salinity (Fig. 24)

At the surface the warm water was associated with high salinity and the cold tongues with low salinity. The same situation occurred at 100 m and 500 m.

At 1000 m the warm water in the north-west, had high salinity as did the cold tongue in the south. These were separated by a band of lower salinity water eastward of Sydney.

(d) Percentage Oxygen Saturation (Fig. 25)

At the surface, high percentage oxygen saturation was found in the north and south of the area. Low saturation values were found in the centre of the area, and were generally associated with the warm water, high values were associated with the cold onshore water.

At 100 and 500 m, however, high percentage oxygen saturation was always associated with the warm tongue and low values with the cold tongue.

At 1000 m, high values were found along the western margin. The cold tongue in the south was associated with low values as was the area of cold water in the central-north of the area.

There was a close relationship between the percentage oxygen saturation and density distributions at 100 and 500 m, but not at 0 m and 1000 m.

(d) Total Phosphorus (Fig. 26)

At the surface high total phosphorus was associated with the northern part of the warm water, and low total phosphorus with the southern. Low total phosphorus was found in the east of the area and high total phosphorus in the south-west.

At 100 m, low total phosphorus was associated with the warm tongue, and high total phosphorus with the two cold water tongues.

At 500 m, low total phosphorus was found along the western margin and high total phosphorus associated with the low temperature water. High total phosphorus was found in the north-east of the area.

At 1000 m, low total phosphorus was associated with the warm water and high total phosphorus with the colder waters.

(b) PHYSICS - B.V. HAMON

Dynamics

Figures 27 A and B show the contours of dynamic heights (in dyn. cm) relative to, A. 500; B. 1000 decibar levels.

The dynamic height contours suggest the existence of a large anticyclonic eddy centred at about 33°S., 154°30'E. The eddy appears to be elongated in a north-south direction. The details of the south flowing part of the eddy, near the coast, are very much in doubt due to lack of observation, one observation at Station DH20/214/58 (A, Fig. 27A) suggests an appreciable flow of water into the eddy from the south just off the continental shelf near Sydney.

TABLE 1

DIATOMS IN PHYTOPLANKTON COLLECTIONS

CRUISE DH20/58

	185	187	188	189	190	192	193	195	196	197	198	199	201	203	205	207	208
Chaetoceros coarctatum	+																
Ch. decipiens		+															
Ch. peruvianum		+								+							
Ch. cincta												+					
Ch. socialis												+					
Ch. vanheurckii												+					
Ch. concavicorne														+			
Climacodium frauenfeldianum	+	+	+	+	+		+	+		+		+		+		+	+
Rhizosolenia styliformis		+		+						+					+		
R. alata		+			+			+		+	+	+		+	+	+	
R. imbricata				+						+	+	+		+			
R. calcar avis							+										
R. acuminata										+							
R. clevei														+			
Hemiaulus sinensis		+															
H. membranaceus									+								
H. indicus											+			+			
Nitzschia seriata		+															
Thalassiothrix longissima		+												+			
Thal. frauenfeldii										+							
Cerataulina pelagica										+							
Guinardia flaccida										+							

TABLE 2

DINOFLAGELLATES IN PHYTOPLANKTON COLLECTIONS

CRUISE DH20/58

	185	187	188	189	190	192	193	195	196	197	198	199	201	203	205	207	208
Pyrophacus horologicum		+									+						
Dinophysis caudata	+																+
Amphisolenia bidentata		+															
Peridinium globulus	+		+							+							
P. divergens	+							+	+					+		+	
P. brochi		+	+					+									+
P. grande				+					+				+				+
P. steini	+																
P. oceanicum									+								
P. murrayi																+	
Podolampas spinifer								+									
P. bipes															+		
Ornithocercus magnificus				+													
O. splendidus												+					
O. quadratus					+												
O. steini												+			+		
Pyrocystis hamulus f. circularis				+										+			
P. fusiformis v. biconica															+		
Goniaulax birostris			+														
Ceratium symmetricum	+		+														+
C. massiliense	+				+			+	+	+							+
C. tripos	+	+	+	+	+		+	+	+	+	+	+		+	+		+
C. fusus	+				+										+	+	+
C. gallicum	+	+								+			+				+
C. gibberum		+															
C. extensum			+	+						+							+
C. contrarium				+									+	+			+
C. concilians				+	+												

TABLE 2 (Contd)

DINOFLAGELLATES IN PHYTOPLANKTON COLLECTIONS

CRUISE DH20/58

	185	187	188	189	190	192	193	195	196	197	198	199	201	203	205	207	208
C. setaceum				+										+			
C. candelabrum				+	+		+		+	+				+			+
C. falcatum				+	+												
C. horridum					+										+		
C. hexacanthum					+						+	+					+
C. karstenii					+							+			+	+	
C. kofoidi					+												
C. bigelowi								+									
C. furca									+	+				+			+
C. trichoceros									+	+						+	
C. buceros										+				+		+	+
C. breve										+				+			
C. schmidtii										+							
C. declinatum										+	+						
C. carriense												+		+			
C. belone												+	+				
C. longirostrum																+	
C. gravidum														+		+	
C. teres												+		+	+		
C. pulchellum f. semipulchellum																+	
Ceratocorys horrida								+	+								
Dinophysis caudata									+								
Diplopsalis lenticula									+								
Phalacroma operculatum																+	

The volume transport above 1000 m between Stations DH20/201 and 205/58 (B and C, Fig. 27B) was found to be 35 x 10^6 m^3/sec, towards north-east, and the geostrophic surface current between Stations DH20/203-205/58 (C and D, Fig. 27B) was found to be 65 cm/sec in the same direction, and it is not possible to say if the eddy is in fact closed at the northern end.

(c) PHYTOPLANKTON - E.J.F. WOOD

The presence of *Climacodium frauenfeldianum* at Stations DH20/185-189, 195-197, 201, 203, 207-8/58 suggests the presence of Coral Sea water. The occurrence of *Ceratium horridum* at Stations DH20/190 and 205/58 indicates the influence of cool temperate water moving northwards. The presence of *Amphisolenia bidentata*, *Ceratium extensum*, and *C. contrarium* at Stations DH20/188-9/58 suggests the intrusion of water from the Lord Howe region. Numerous tropical species especially of *Ceratium*, are in the collections, and suggest a mixture of East Australian Current and Coral Sea water. At Station DH20/201/58 the collections contained very few specimens of only a few species. Tables 1 and 2 give the detail of the species of diatoms and dinoflagellates found in the collections from all stations.

(d) CO_2 UPTAKE - N. DYSON

On this cruise CO_2 uptake measurements by the light bath incubation method were made at five stations on Section 1 and at four stations on Section 2. At three stations on Section 2 the rate of CO_2 uptake was measured by the *in situ* method of incubation. For this purpose, Station DH20/194/58 was occupied for half-day and Stations DH20/196 and 197/58 for one day. The results of the two incubation methods used at the *in situ* stations are shown in Figure 28. It will be noticed that generally the bath incubation samples show a similar trend, and also that a sub-surface maximum existed as was found in this area on a previous cruise. The rate of production per day per column of water under one metre square at each station was calculated and the results shown in Figure 29 as gC/day/m^2.

(e) LIGHT PENETRATION - N. DYSON

Light penetration measurements were made using both submarine and deck photometers at each of the three *in situ* stations. The results were calculated to give the depth of penetration of one per cent. of surface light and are shown in Figure 29. In all cases the results show a greater penetration than 100 m.

(f) PIGMENTS - G.F. HUMPHREY

Samples for the determination of plankton pigments were collected at 0, 25, 50, and 100 m at ten stations. The results of the determinations are given in C.S.I.R.O. Aust. (1960) and are graphed in Figure 30.

LEGENDS FOR FIGURES 1-30 - Cruise DH20/58

Fig. 1. Track chart showing positions of stations on Sections 1-4.

Fig. 2. Sectional distribution of temperature (°C) to 1500 m along Section 1.

Fig. 3. Sectional distribution of temperature (°C) to 1500 m along Section 2.

Fig. 4. Sectional distribution of temperature (°C) to 1500 m along Section 3.

Fig. 5. Sectional distribution of temperature (°C) to 1500 m along Section 4.

Fig. 6. Sectional distribution of density (σ_t) to 1500 m along Section 1.

Fig. 7. Sectional distribution of density (σ_t) to 1500 m along Section 2.

Fig. 8. Sectional distribution of density (σ_t) to 1500 m along Section 3.

Fig. 9. Sectional distribution of density (σ_t) to 1500 m along Section 4.

Fig.10. Sectional distribution of salinity (‰) to 1500 m along Section 1.

Fig.11. Sectional distribution of salinity (‰) to 1500 m along Section 2.

Fig.12. Sectional distribution of salinity (‰) to 1500 m along Section 3.

Fig.13. Sectional distribution of salinity (‰) to 1500 m along Section 4.

Fig.14. Sectional distribution of oxygen saturation (%) to 1500 m along Section 1.

Fig.15. Sectional distribution of oxygen saturation (%) to 1500 m along Section 2.

Fig.16. Sectional distribution of oxygen saturation (%) to 1500 m along Section 3.

Fig.17. Sectional distribution of oxygen saturation (%) to 1500 m along Section 4.

Fig.18. Sectional distribution of total phosphorus (µg at./l) to 1500 m along Section 1.

Fig.19. Sectional distribution of total phosphorus (µg at./l) to 1500 m along Section 2.

Fig.20. Sectional distribution of total phosphorus (µg at./l) to 1500 m along Section 3.

Fig.21. Sectional distribution of total phosphorus (µg at./l) to 1500 m along Section 4.

Fig.22. Horizontal distribution of temperature A at 0 m, B at 100 m, C at 500 m, D at 1000 m.

Fig.23. Horizontal distribution of density A at 0 m, B at 100 m, C at 500 m, D at 1000 m.

Fig.24. Horizontal distribution of salinity A at 0 m, B at 100 m, C at 500 m, D at 1000 m.

Fig.25. Horizontal distribution of percentage oxygen saturation, A at 0 m, B at 100 m, C at 500 m, D at 1000 m.

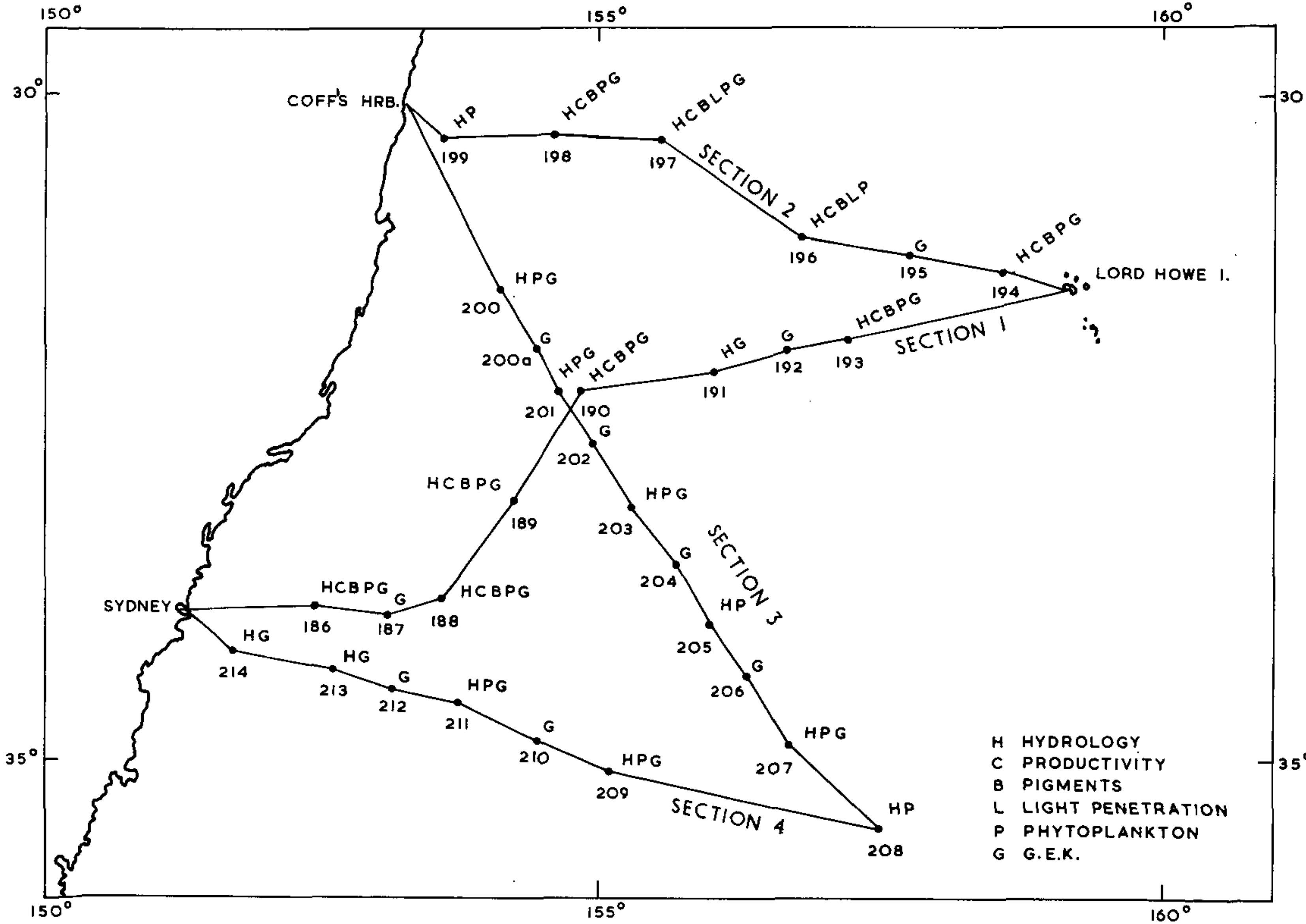
Fig.26. Horizontal distribution of total phosphorus A at 0 m, B at 100 m, C at 500 m, D at 1000 m.

Fig.27. Dynamic heights (dyn. cm) A at 500, B at 1000 decibars.

Fig.28. Rate of CO_2 uptake at Stations DH20/196 and 197/58.

Fig.29. Rate of production of C/day/m^2 and depth of penetration of 1% of surface light.

Fig.30. Depth profiles of pigment concentrations.


150°
155°
160°
30°
35°
COFFS HRB.
SYDNEY
LORD HOWE I.
SECTION 1
SECTION 2
SECTION 3
SECTION 4
HP
199
HCBPG
198
HCBLPG
197
HCBLP
196
G
195
HCBPG
194
HPG
200
G
200a
HPG
201
HCBPG
190
HG
191
G
192
HCBPG
193
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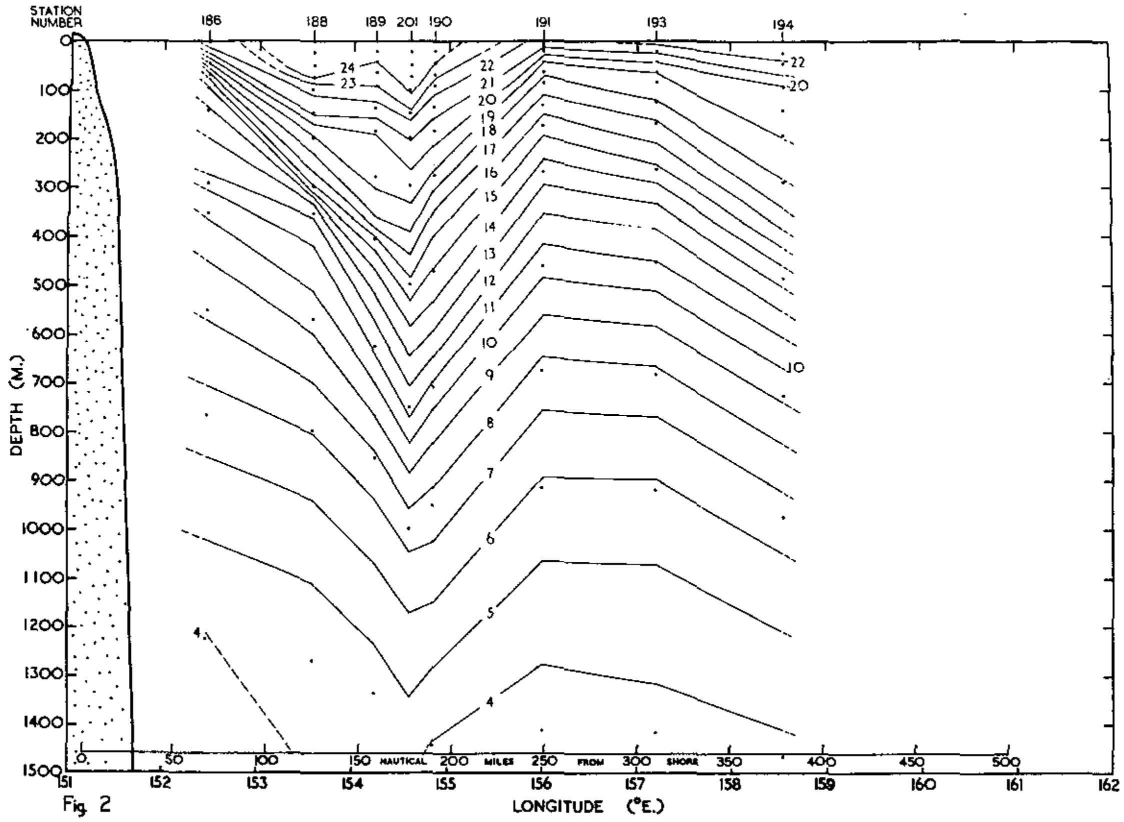
204
HP
205
G
206
HPG
207
HP
208
HCBPG
186
G
187
HCBPG
188
HG
214
HG
213
G
212
HPG
211
G
210
HPG
209
H HYDROLOGY
C PRODUCTIVITY
B PIGMENTS
L LIGHT PENETRATION
P PHYTOPLANKTON
G G.E.K.

Fig. 1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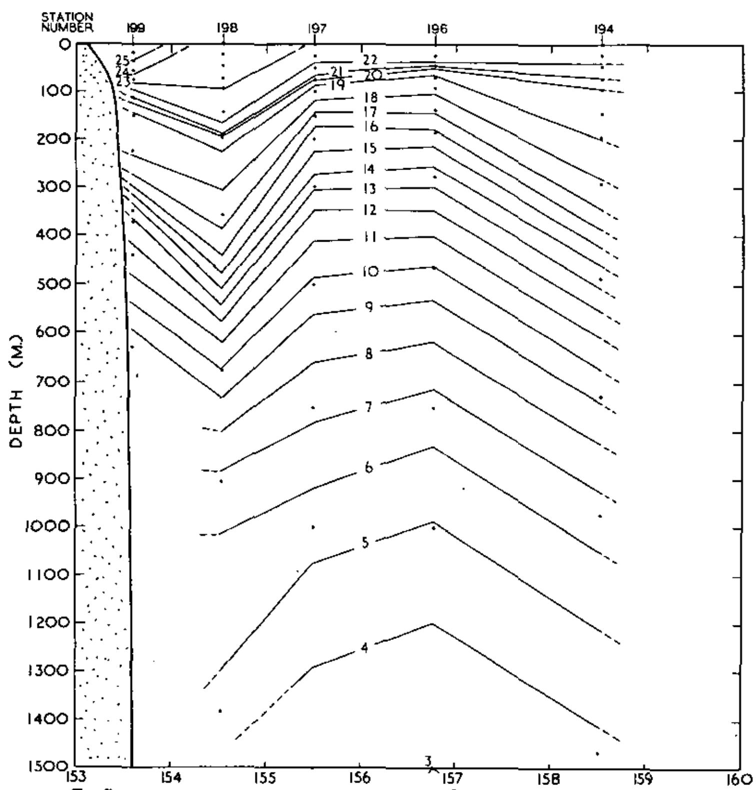
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)

Fig. 2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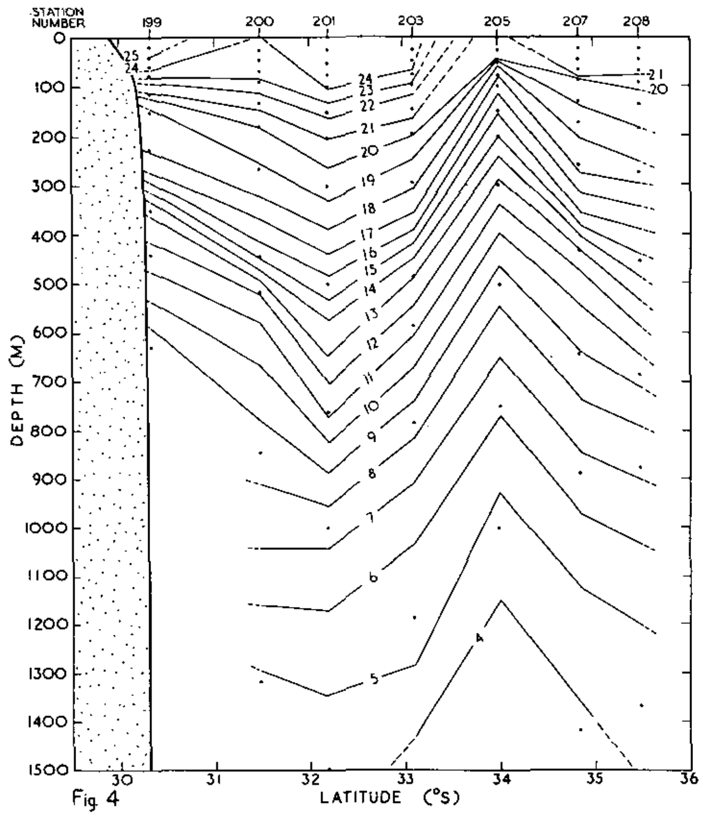
DEPTH (M.)
LONGITUDE (°E.)

Fig. 3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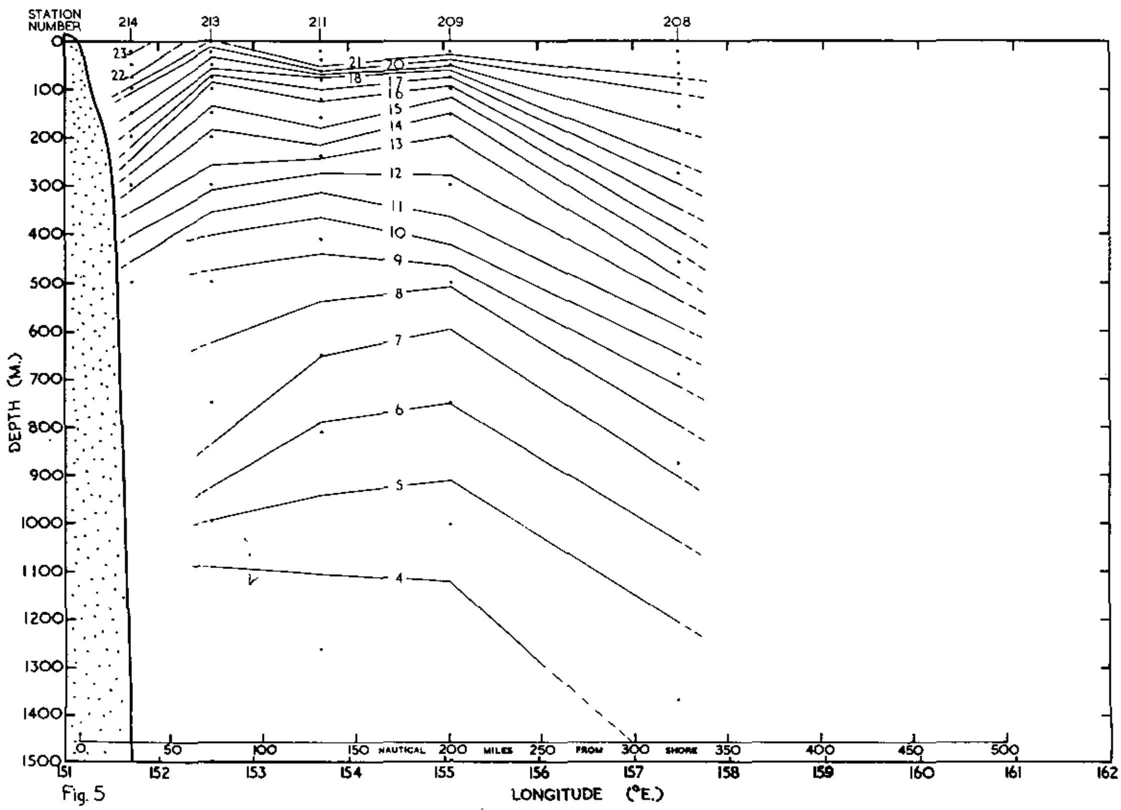
200
201
203
205
207
208
DEPTH (M)
LATITUDE (°S)

Fig. 4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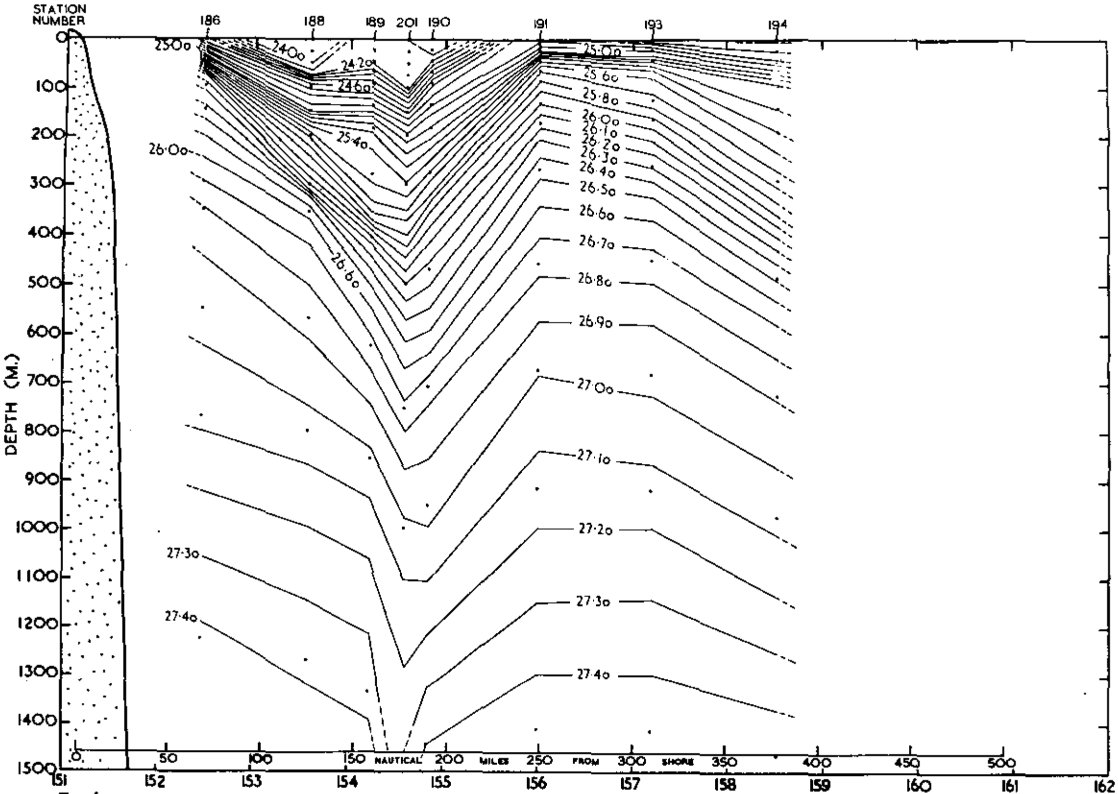
213
211
209
208
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)

Fig. 5



STATION NUMBER
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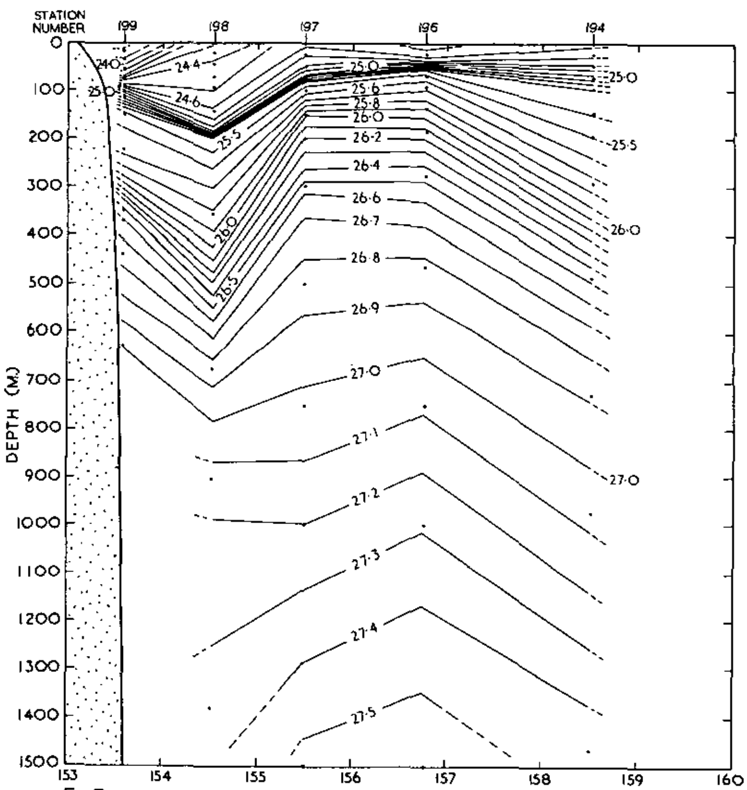
188
189
201
190
191
193
194
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)

Fig. 6



STATION NUMBER
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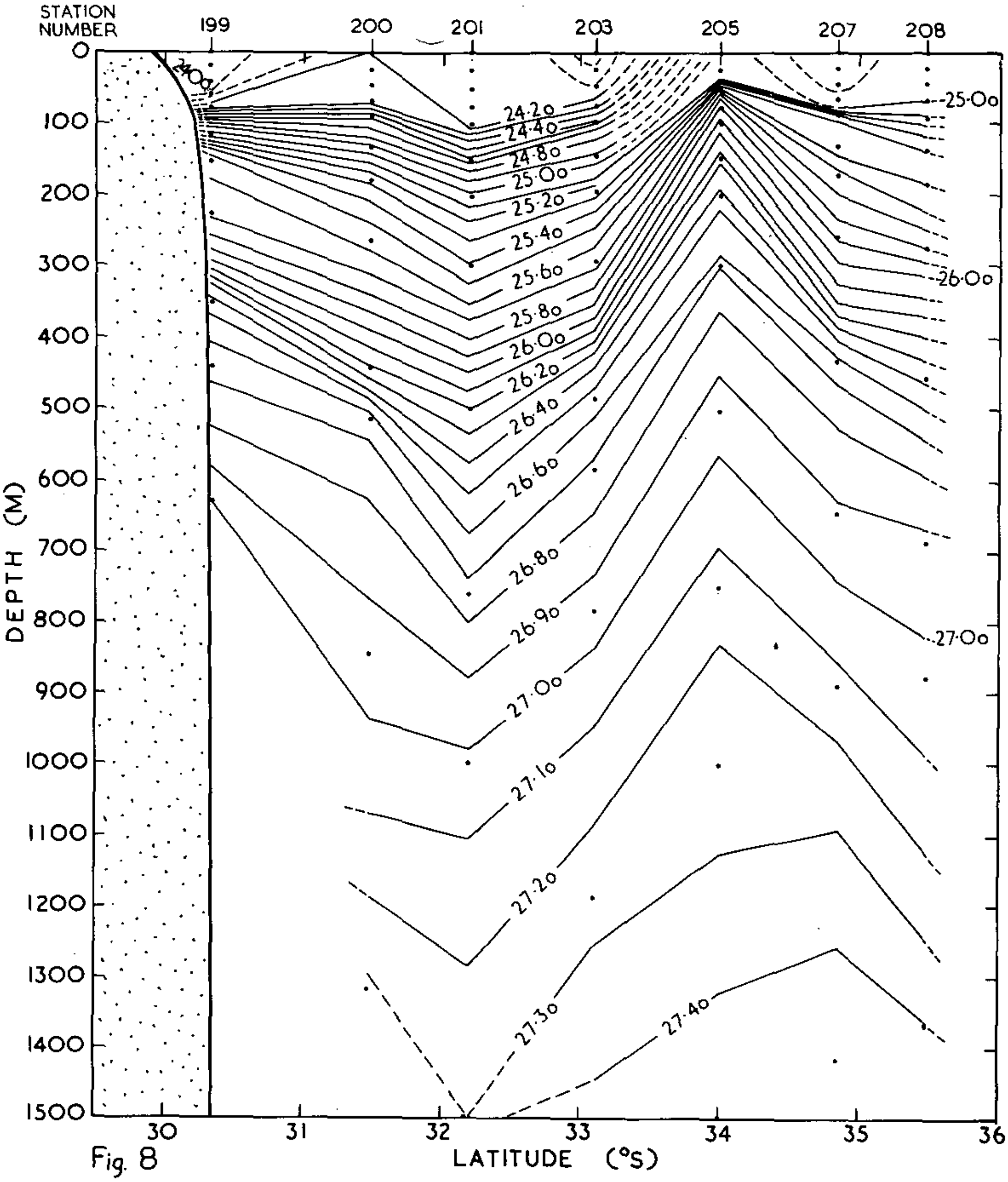
198
197
196
194
DEPTH (M.)
LONGITUDE (°E.)

Fig. 7


STATION NUMBER
199
200
201
203
205
207
208
DEPTH (M)
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100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
24·0σ
24·2σ
24·4σ
24·8σ
25·0σ
25·2σ
25·4σ
25·6σ
25·8σ
26·0σ
26·2σ
26·4σ
26·6σ
26·8σ
26·9σ
27·0σ
27·1σ
27·2σ
27·3σ
27·4σ
25·0σ
26·0σ
27·0σ
30
31
32
33
34
35
36
LATITUDE (°S)

Fig. 8

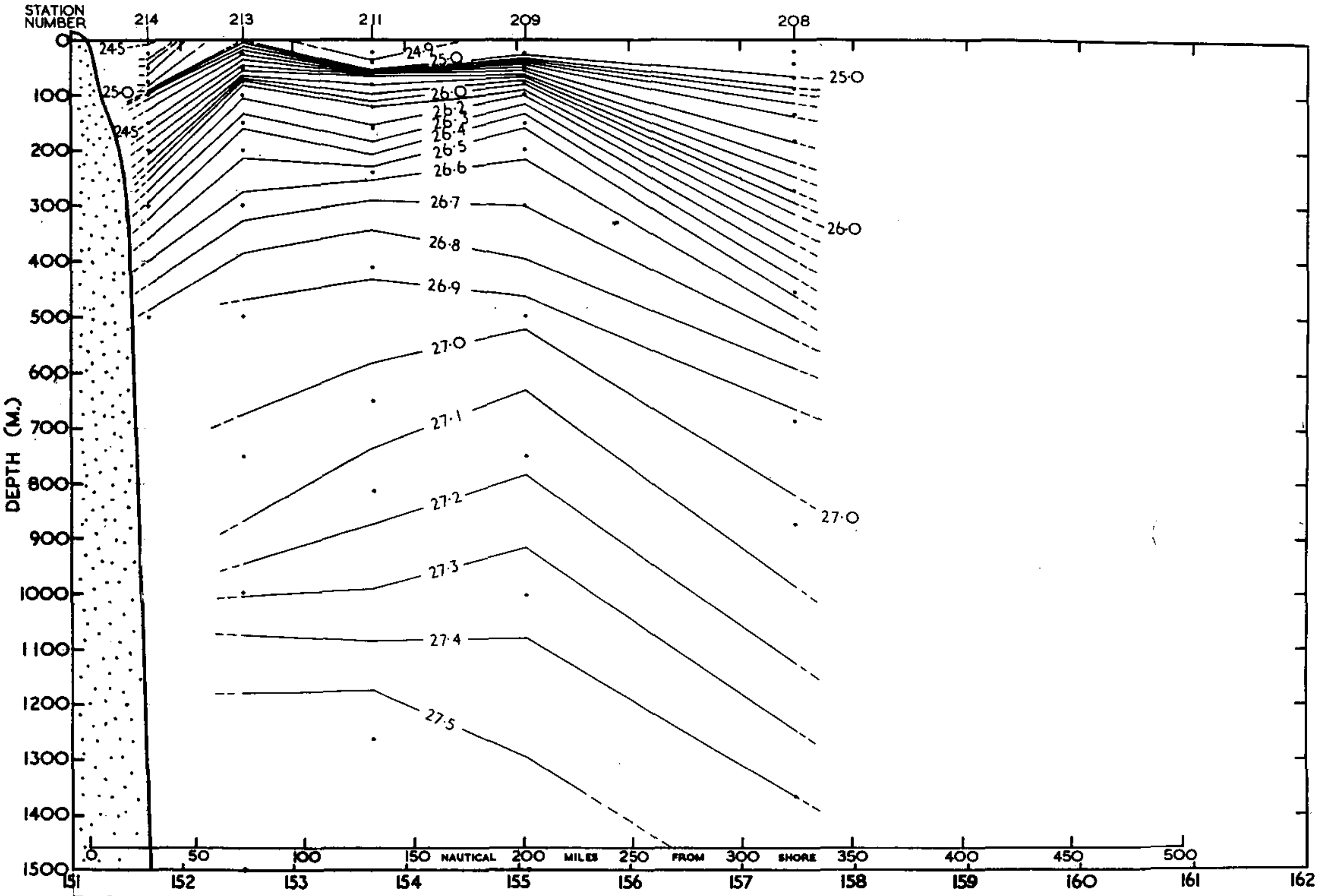
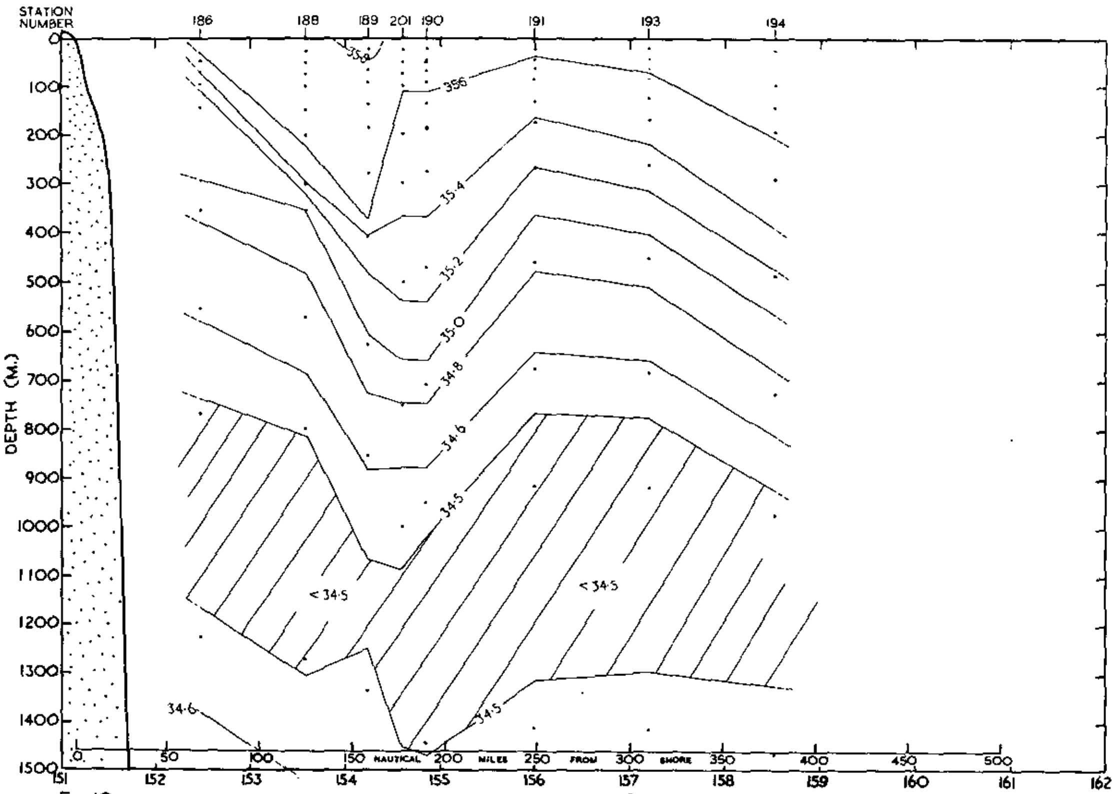

STATION NUMBER
214
213
211
209
208
DEPTH (M.)
24·5
25·0
24·9
26·0
26·2
26·3
26·4
26·5
26·6
26·7
26·8
26·9
27·0
27·1
27·2
27·3
27·4
27·5
0 50 100 150 NAUTICAL 200 MILES 250 FROM 300 SHORE 350 400 450 500
LONGITUDE (°E.)

Fig. 9


STATION NUMBER
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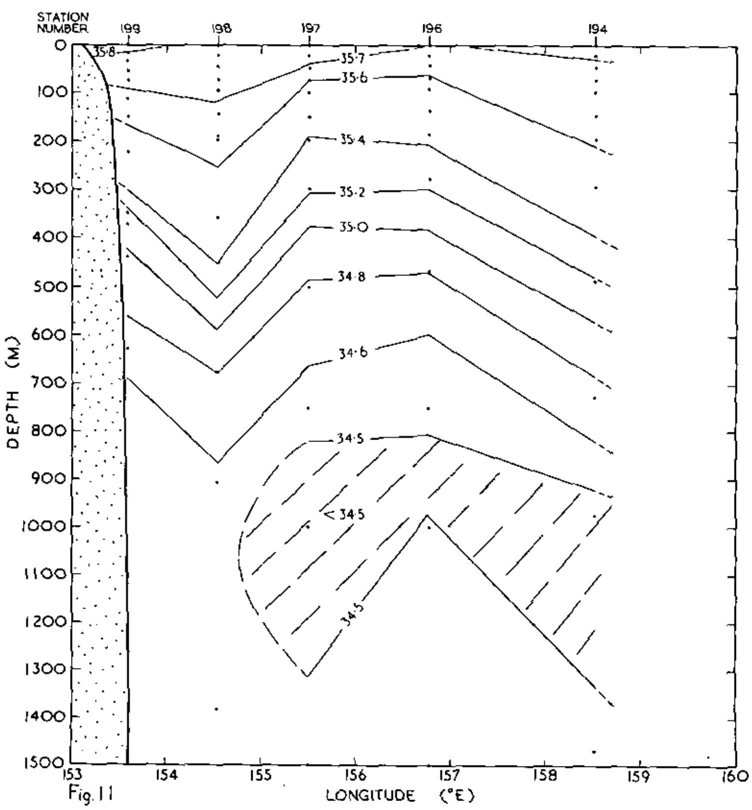
188
189
201
190
191
193
194
DEPTH (M.)
35·8
35·6
35·4
35·2
35·0
34·8
34·6
34·5
< 34·5
< 34·5
34·6
34·5
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)

Fig. 10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199
198
197
196
194
DEPTH (M.)
35·8
35·7
35·6
35·4
35·2
35·0
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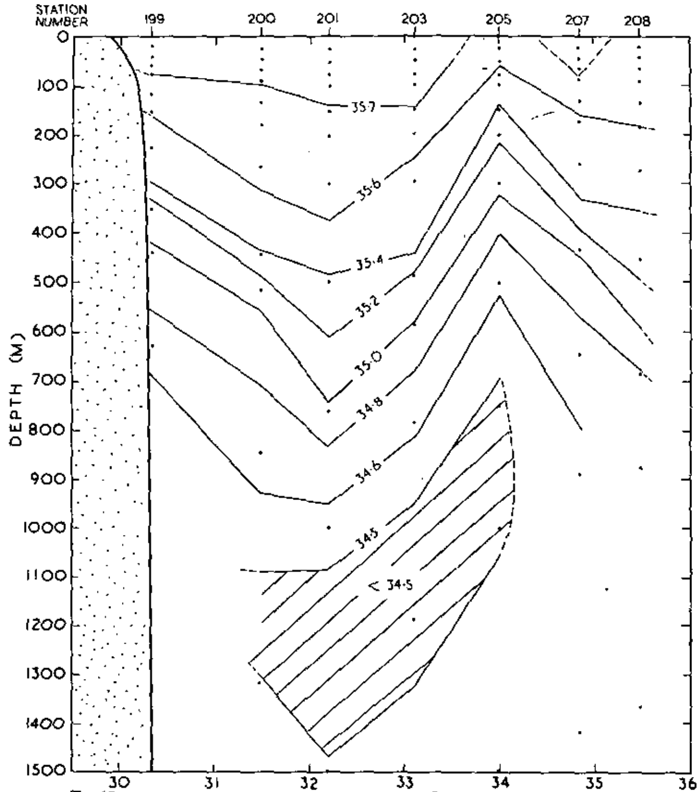
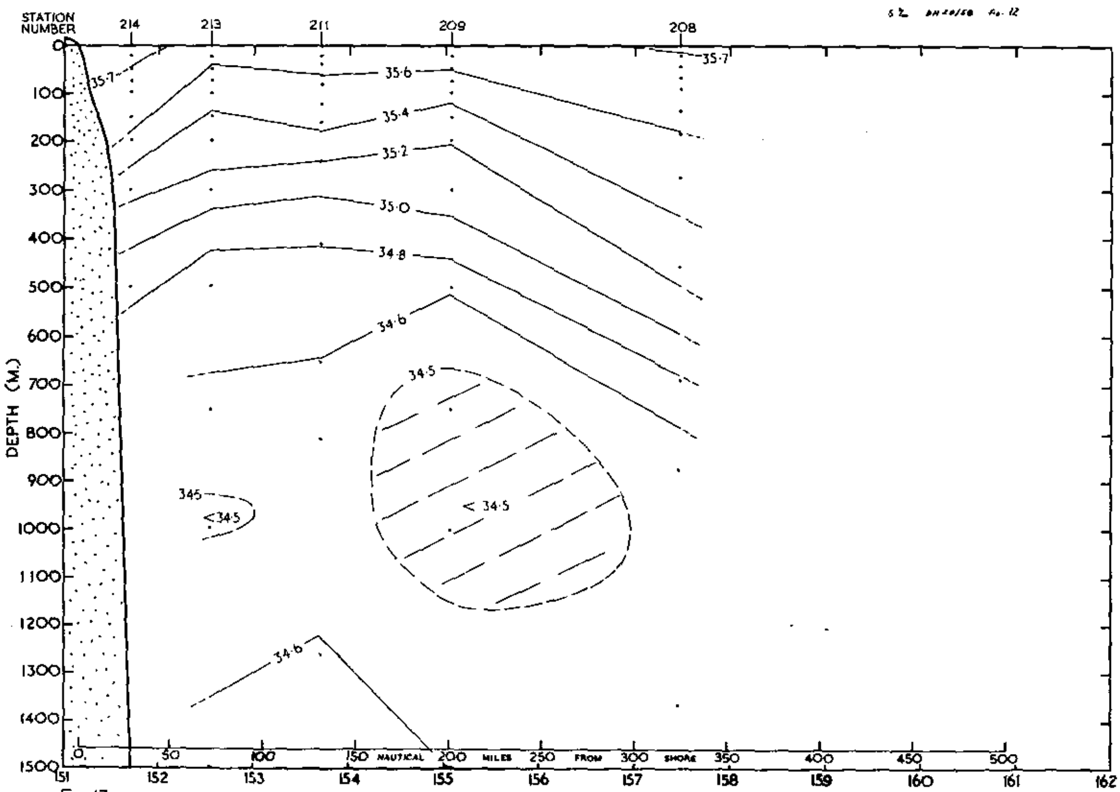
34·5
LONGITUDE (°E)

Fig. 11


STATION NUMBER
199
200
201
203
205
207
208
35·7
35·6
35·4
35·2
35·0
34·8
34·6
34·5
< 34·5
DEPTH (M)
LATITUDE (°S)
Fig. 12


STATION NUMBER
214
213
211
209
208
35·7
35·6
35·4
35·2
35·0
34·8
34·6
34·5
< 34·5
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)
Fig. 13

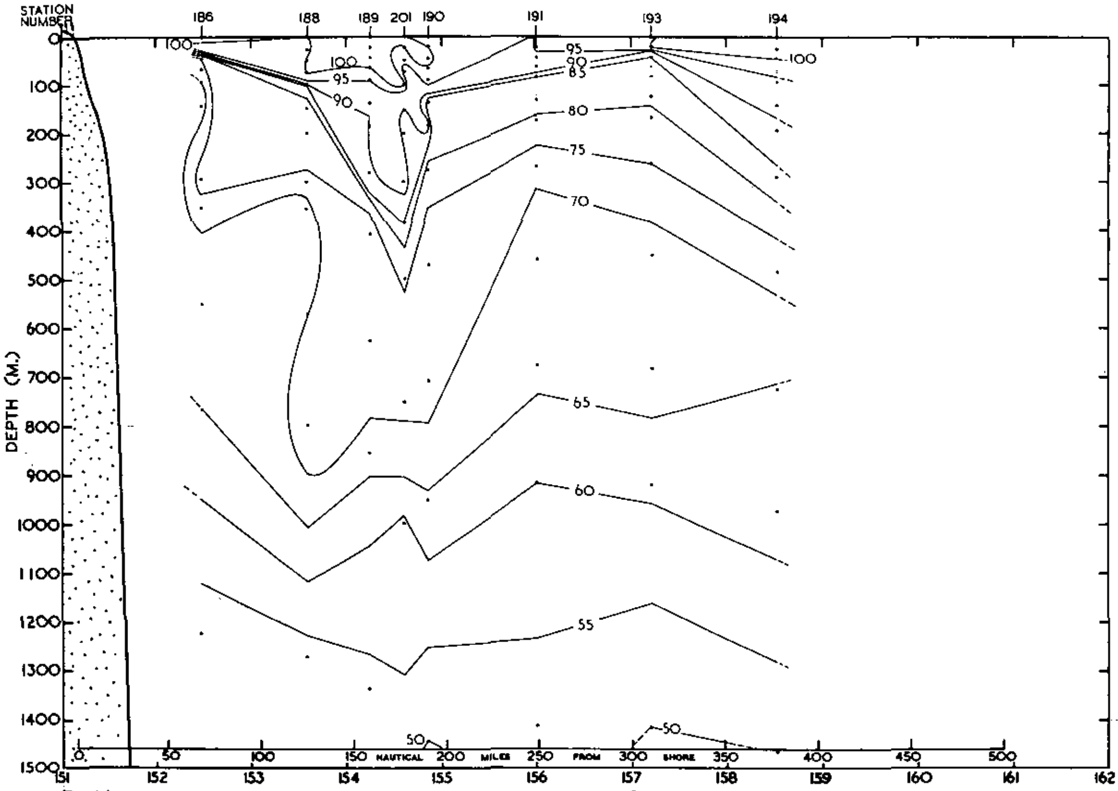

STATION NUMBER
186
188
189
201
190
191
193
194
DEPTH (M.)
NAUTICAL MILES FROM SHORE
LONGITUDE (°E.)

Fig. 14

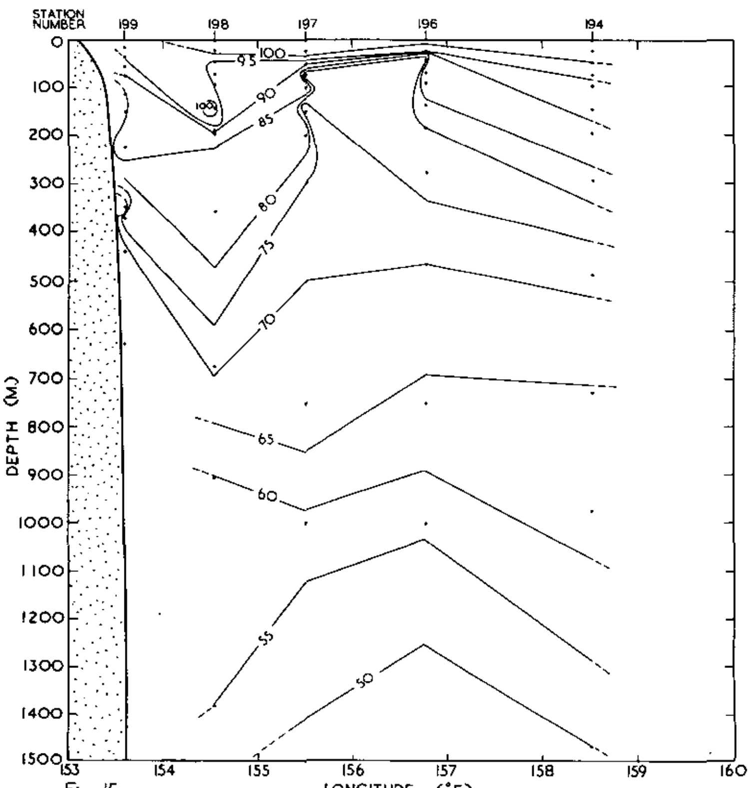

STATION NUMBER
199
198
197
196
194
DEPTH (M.)
LONGITUDE (°E.)

Fig. 15

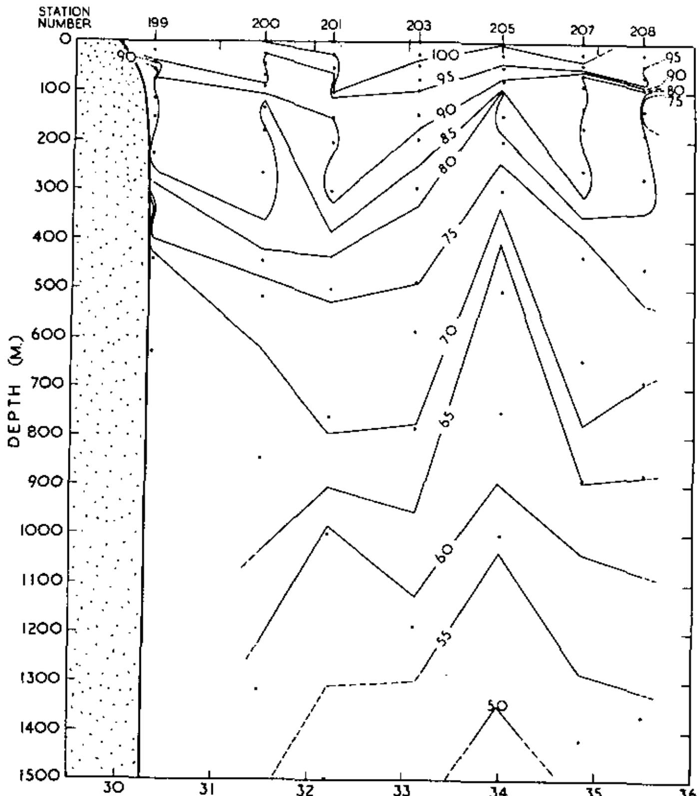

STATION NUMBER
199
200
201
203
205
207
208
DEPTH (M.)
LATITUDE (°S.)
100
95
90
85
80
75
70
65
60
55
50

Fig 16

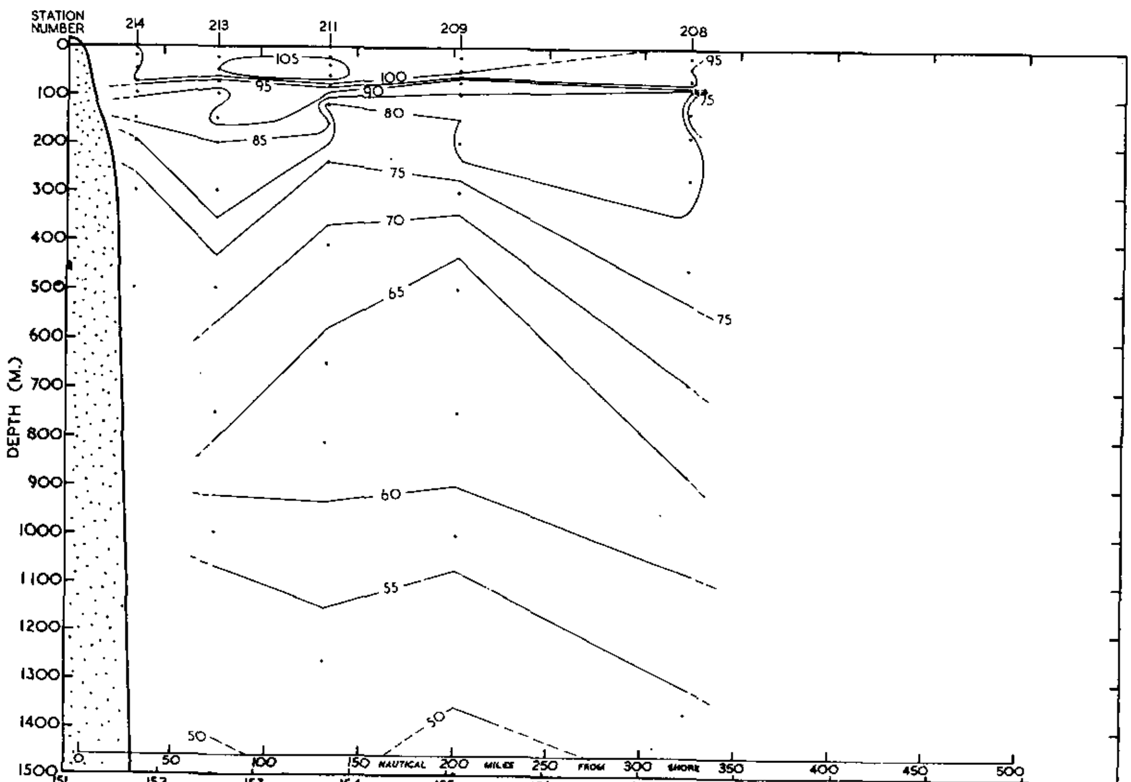
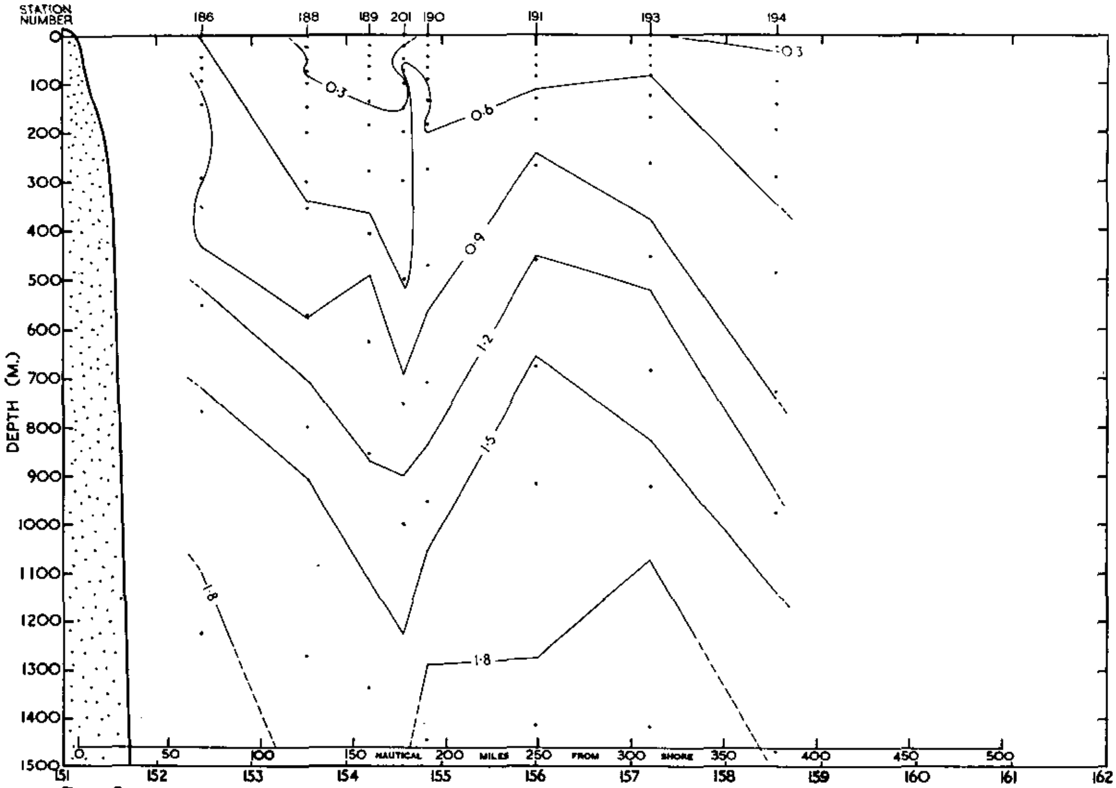
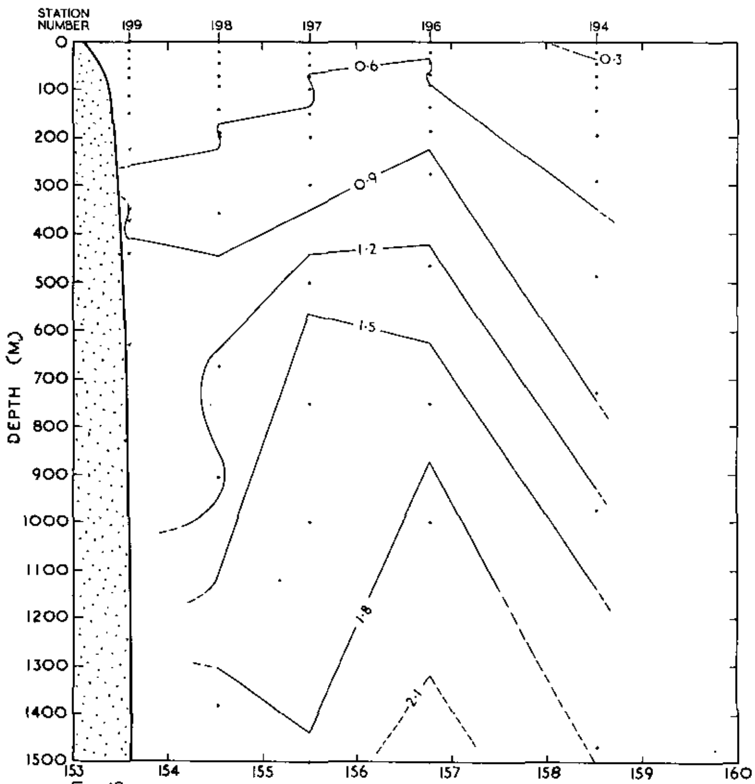

STATION NUMBER
214
213
211
209
208
DEPTH (M.)
LONGITUDE (°E.)
NAUTICAL MILES FROM SHORE
105
100
95
90
85
80
75
70
65
60
55
50

Fig 17


STATION NUMBER
186
188
189
201
190
191
193
194
DEPTH (M.)
0·3
0·6
0·9
1·2
1·5
1·8
0 50 100 150 NAUTICAL 200 MILES 250 FROM 300 SHORE 350 400 450 500
151 152 153 154 155 156 157 158 159 160 161 162
LONGITUDE (°E.)
Fig. 18


STATION NUMBER
199
198
197
196
194
DEPTH (M.)
0·3
0·6
0·9
1·2
1·5
1·8
2·1
153 154 155 156 157 158 159 160
LONGITUDE (°E.)
Fig. 19

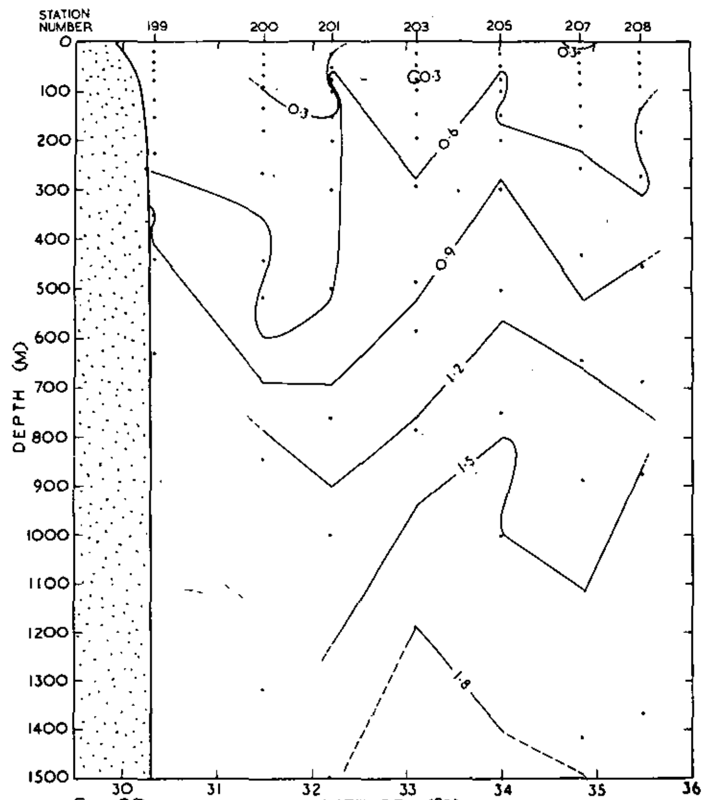

STATION NUMBER
199
200
201
203
205
207
208
0·3
0·6
0·9
1·2
1·5
1·8
DEPTH (M)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
30
31
32
33
34
35
36
LATITUDE (°S)

Fig. 20

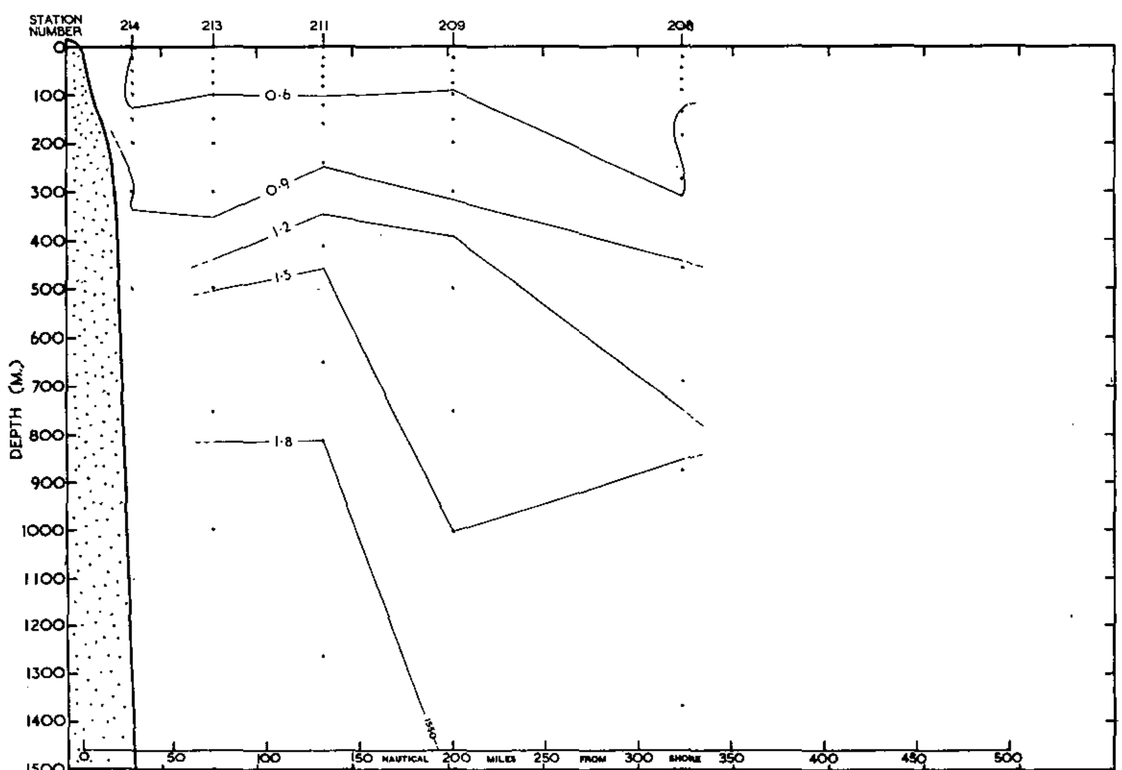

STATION NUMBER
214
213
211
209
208
0·6
0·9
1·2
1·5
1·8
DEPTH (M.)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
0
50
100
150 NAUTICAL 200 MILES 250 FROM 300 SHORE 350
400
450
500
151
152
153
154
155
156
157
158
159
160
161
162
LONGITUDE (°E.)

Fig. 21

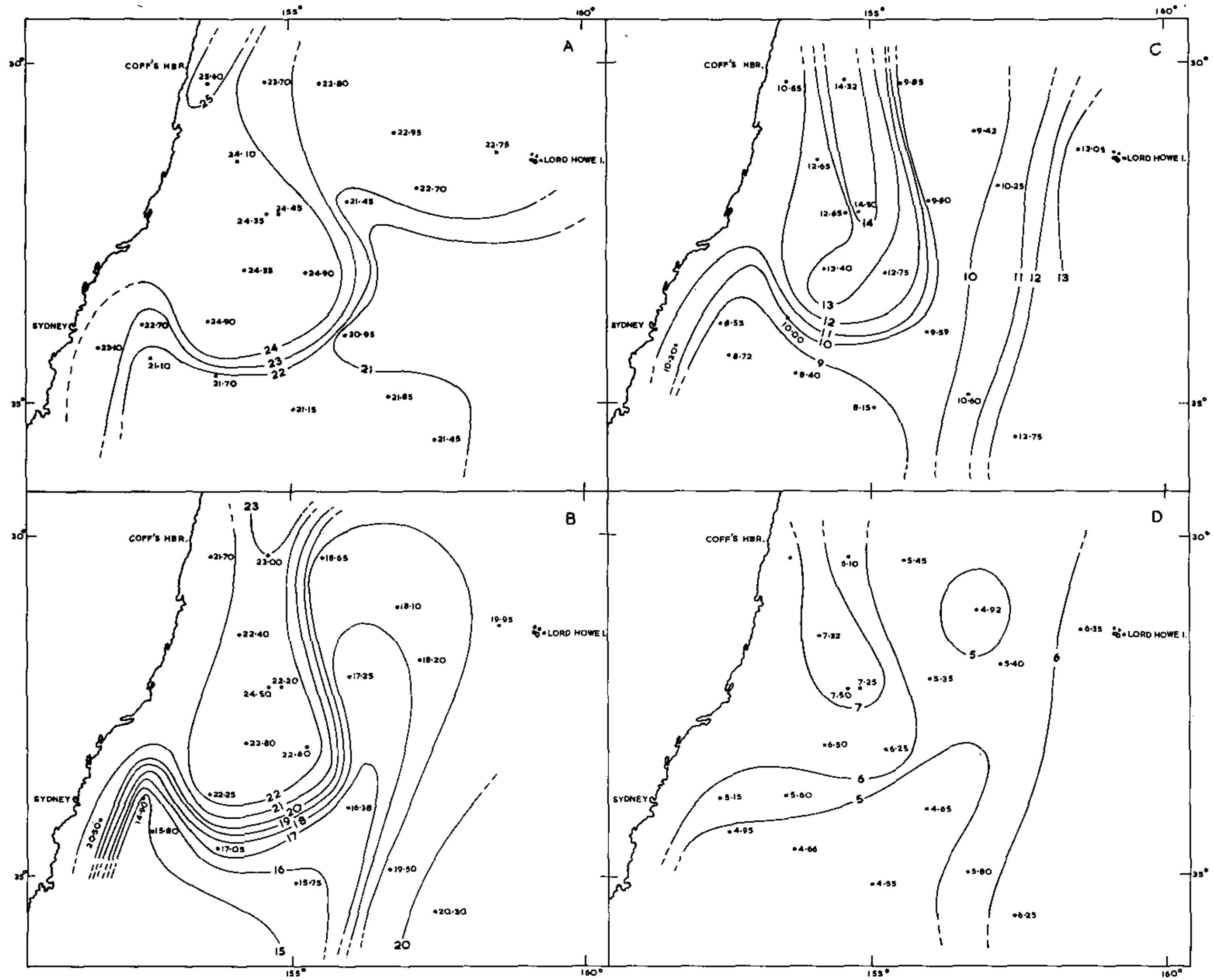


Fig. 22

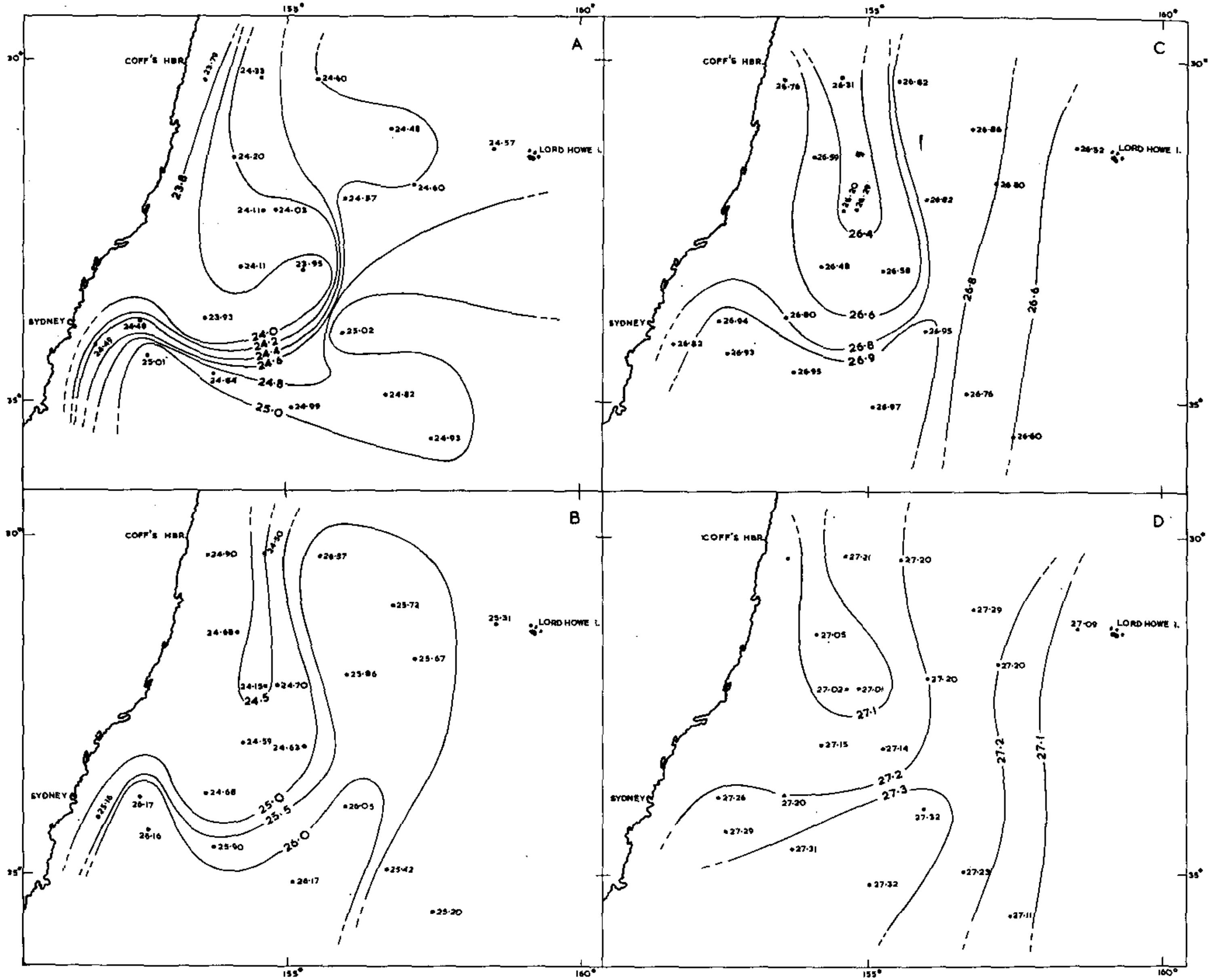


Fig. 23

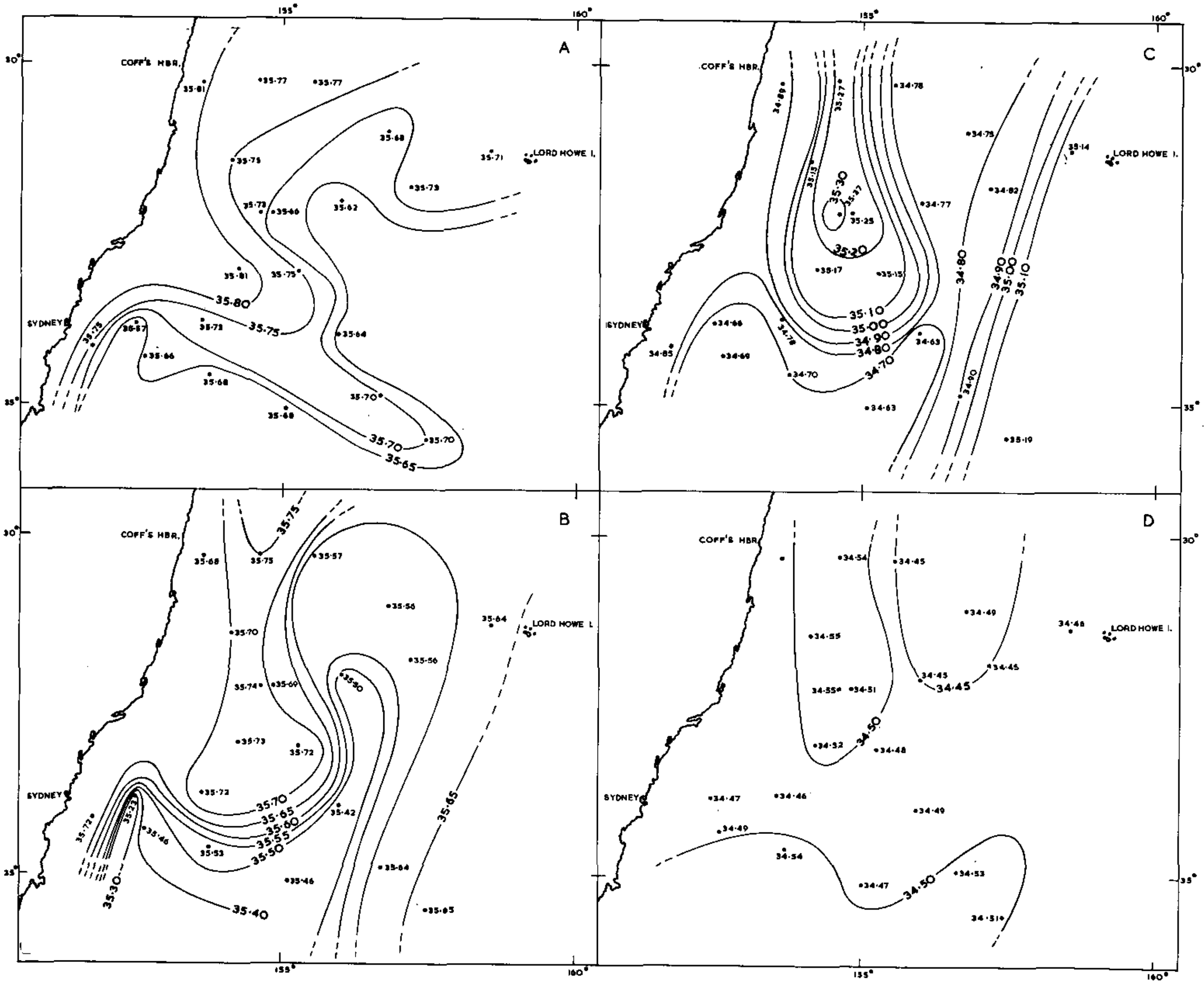


Fig. 24

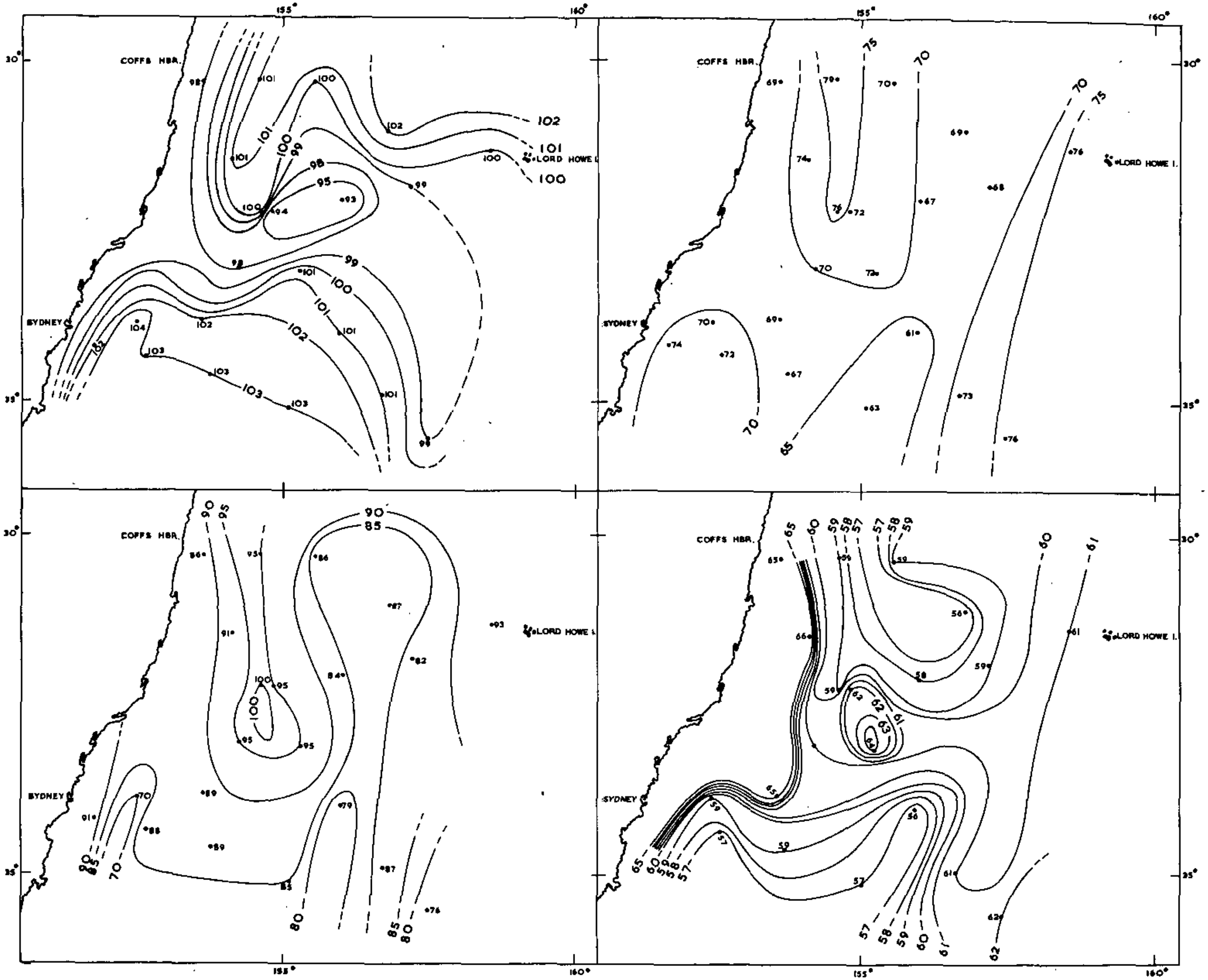


Fig. 25

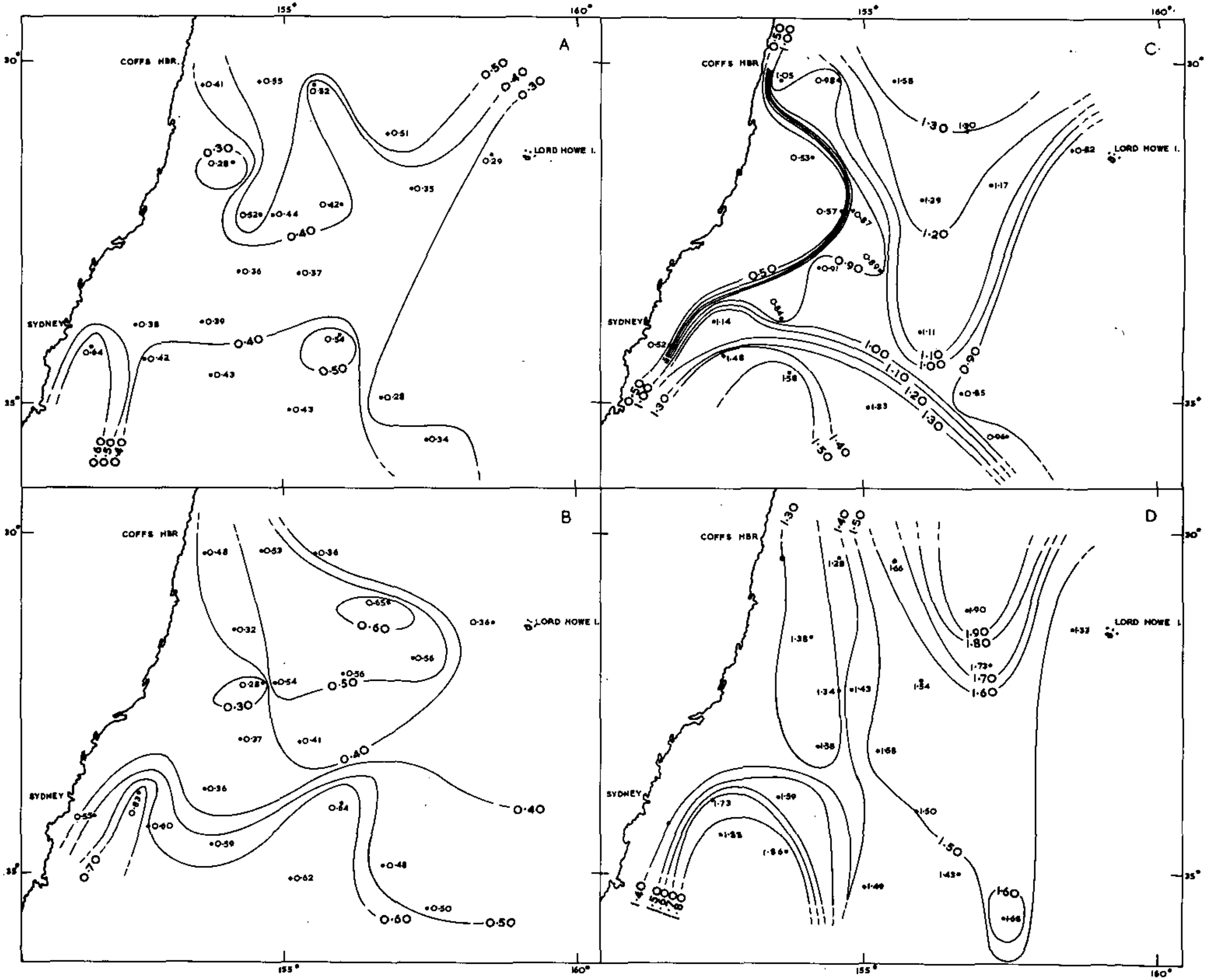


Fig. 26

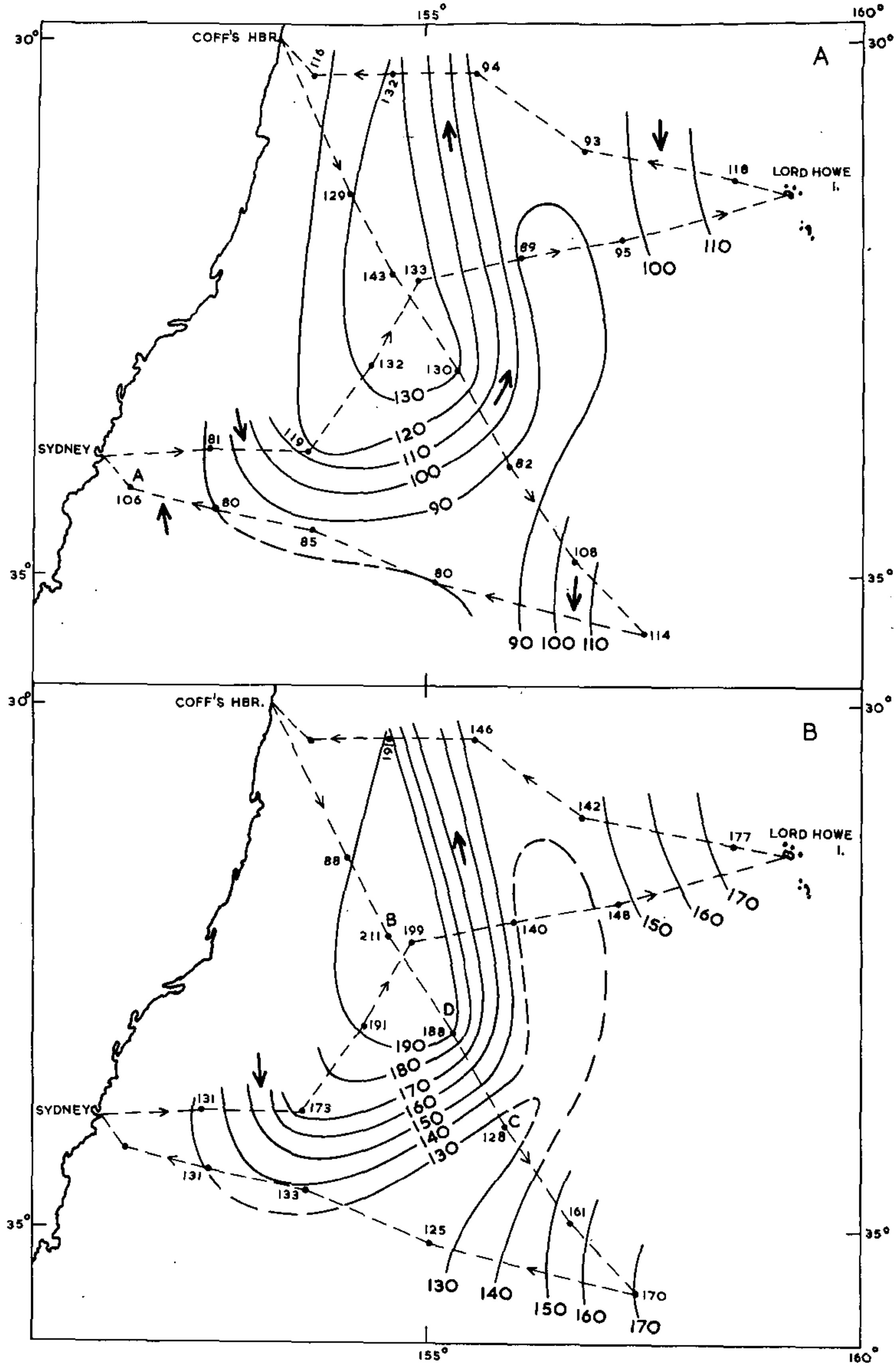
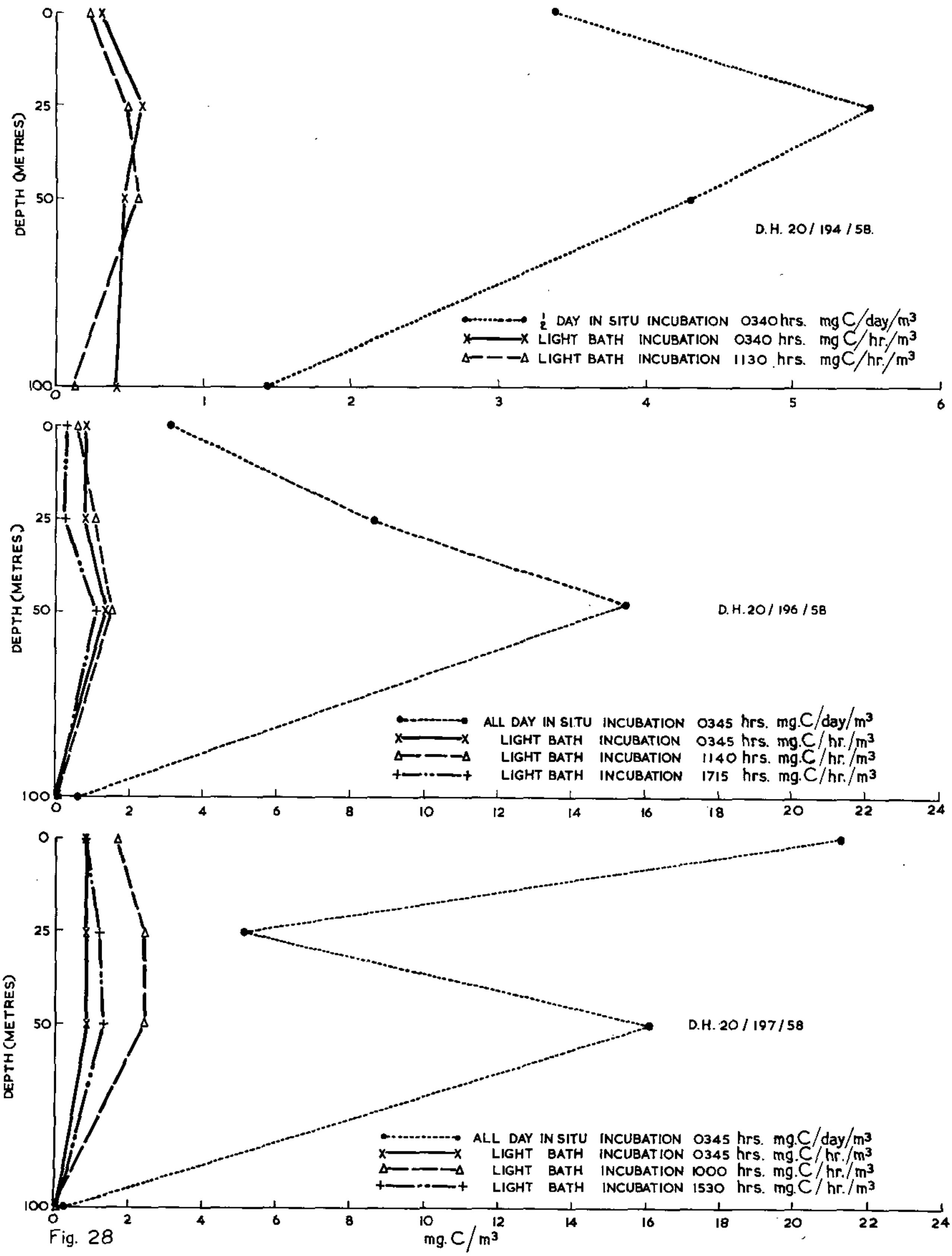
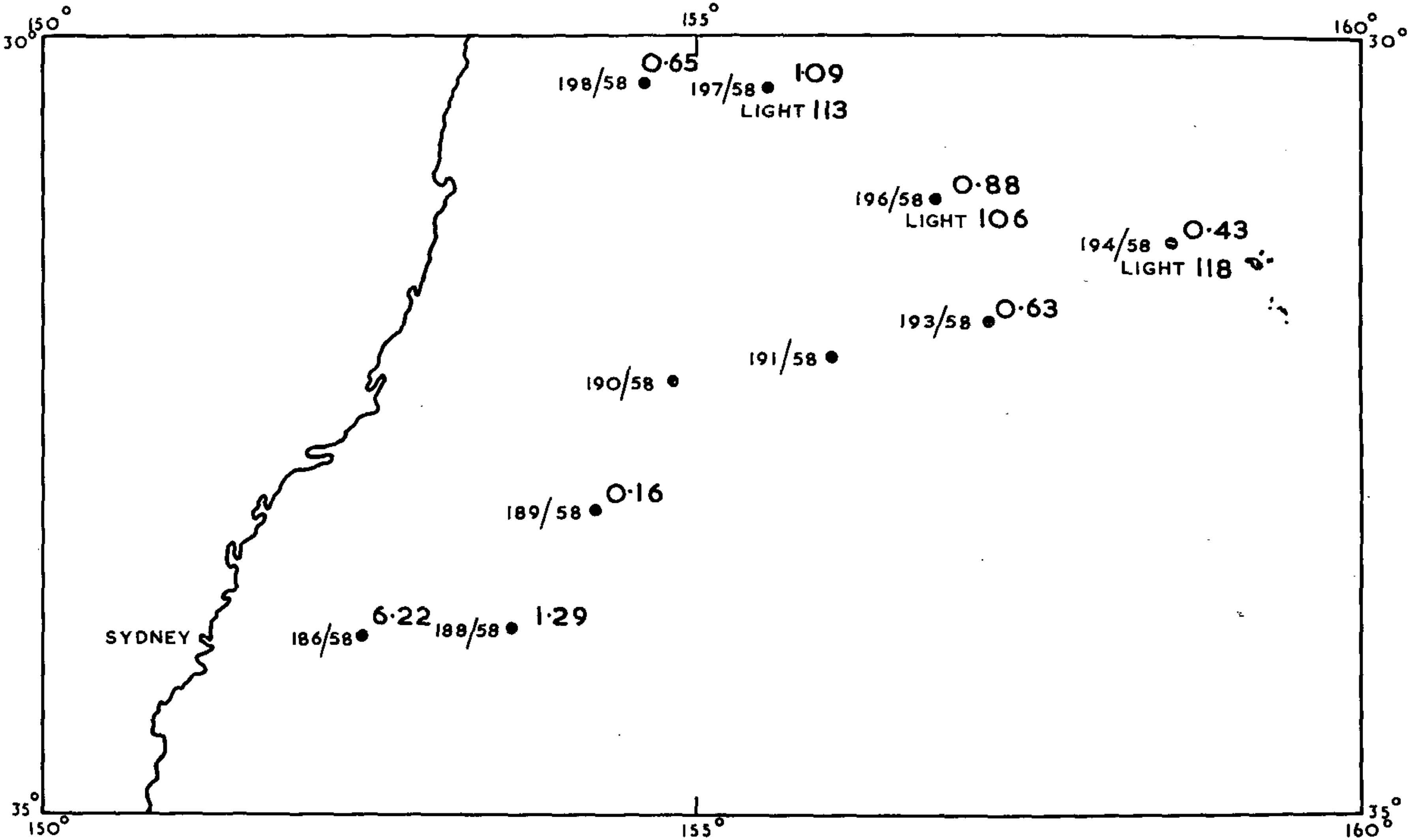

155°
160°
30°
35°
COFF'S HBR.
LORD HOWE I.
SYDNEY
A
B
C
D
116
132
94
93
118
129
143
133
89
95
100
110
132
130
120
119
81
82
106
80
90
85
108
114
146
142
177
88
211
199
140
148
150
160
170
191
188
190
180
173
131
128
133
125
161
130

Fig. 27



DEPTH (METRES)
D.H. 20/194/58.
½ DAY IN SITU INCUBATION 0340 hrs. mg C/day/m³
LIGHT BATH INCUBATION 0340 hrs. mg C/hr./m³
LIGHT BATH INCUBATION 1130 hrs. mgC/hr./m³
D.H. 20/196/58
ALL DAY IN SITU INCUBATION 0345 hrs. mg.C/day/m³
LIGHT BATH INCUBATION 0345 hrs. mg.C/hr./m³
LIGHT BATH INCUBATION 1140 hrs. mg.C/hr./m³
LIGHT BATH INCUBATION 1715 hrs. mg.C/hr./m³
D.H. 20/197/58
ALL DAY IN SITU INCUBATION 0345 hrs. mg.C/day/m³
LIGHT BATH INCUBATION 0345 hrs. mg.C/hr./m³
LIGHT BATH INCUBATION 1000 hrs. mg.C/hr./m³
LIGHT BATH INCUBATION 1530 hrs. mg.C/hr./m³
mg. C/m³

Fig. 28



150°
155°
160°
30°
30°
0·65
198/58
197/58
1·09
LIGHT 113
0·88
196/58
LIGHT 106
194/58
0·43
LIGHT 118
193/58
0·63
191/58
190/58
189/58
0·16
186/58
6·22
188/58
1·29
SYDNEY
35°
35°
150°
155°
160°

Fig. 29

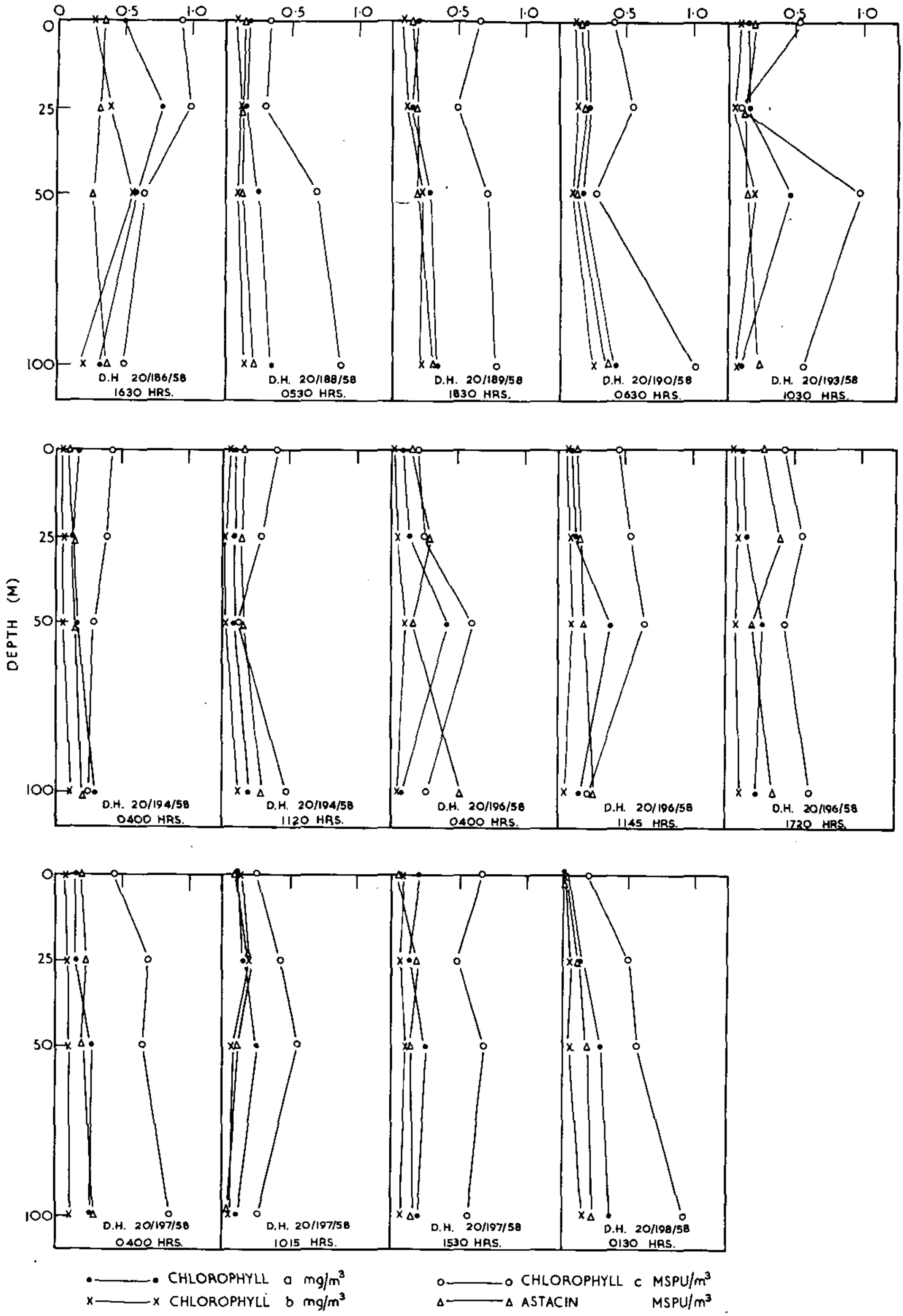

0
0·5
1·0
DEPTH (M)
0
25
50
100
D.H 20/186/58
1630 HRS.
D.H. 20/188/58
0530 HRS.
D.H. 20/189/58
1830 HRS.
D.H. 20/190/58
0630 HRS.
D.H. 20/193/58
1030 HRS.
D.H. 20/194/58
0400 HRS.
D.H. 20/194/58
1120 HRS.
D.H. 20/196/58
0400 HRS.
D.H. 20/196/58
1145 HRS.
D.H. 20/196/58
1720 HRS.
D.H. 20/197/58
0400 HRS.
D.H. 20/197/58
1015 HRS.
D.H. 20/197/58
1530 HRS.
D.H. 20/198/58
0130 HRS.
CHLOROPHYLL a mg/m³
CHLOROPHYLL b mg/m³
CHLOROPHYLL c MSPU/m³
ASTACIN MSPU/m³

Fig. 30

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21. F.R.V. "Derwent Hunter" Scientific Reports of Cruises DH13/57 - DH16/57.

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