COMMONWEALTH OF AUSTRALIA

Commonwealth Scientific and Industrial Research Organization

Division of Fisheries and Oceanography

REPORT 19

F.R.V. "DERWENT HUNTER"

Scientific Report of Cruise 5/57
July 11-17, 1957

Scientific Report of Cruise 6/57
July 23-28, 1957

Scientific Report of Cruise 7/57
August 4-8, 1957

Cruise 8/57 (No report)
August 10-15, 1957

Marine Biological Laboratory
Cronulla Sydney
1958

F.R.V. "DERWENT HUNTER"

Fisheries Research Vessel "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 24D and a Type 24E. The deck winch is hydraulically operated.

CREW

Master	-	Captain R.M. Davies
Mate	-	R.W. Spaulding
Engineer	-	C.F. Hill
Deckhands	-	W. Elsmore
		G.A. Ross
Cook	-	A. Jackson
Oceanographical Assistant	-	J. Staniforth

Scientific Report DH5/57 deals with the section planned to study the structure and dynamics of the East Australian Current off Sydney. Cruise DH6/57 was a productivity cruise concerned with the measurement of CO_2 uptake by the ^{14}C method. Cruise DH7/57 was designed to study the movement of slope waters off Port Hacking. Cruise DH8/57 was listed as a section cruise but owing to very heavy weather it was abandoned after only three stations had been worked. No further mention is made of Cruise DH8/57 in this report.

When citing this report abbreviate as follows:
C.S.I.R.O. Aust. Div. Fish. Oceanogr. Rep. No. 19.

F.R.V. "DERWENT HUNTER"

SCIENTIFIC REPORT OF CRUISE DH5/57

July 11-17, 1957

SCIENTIFIC PERSONNEL

J. Staniforth (in charge)

ITINERARY

This is the third cruise to study the East Australian Current off Sydney. Lines of stations were occupied along the 110°T and 290°T courses (Fig. 1).

SCIENTIFIC REPORTS

The sampling depths, properties analysed, and thermometer arrangements were as described for Cruise DH3/57 in Report No. 15. At Stations DH5/129-133/57 special samples were collected for ^{14}C estimation of carbon fixation when only surface water samples and temperatures were taken.

The stations at which zooplankton hauls were made are indicated in Figure 1. One oblique haul from 200 m to the surface was made at each station using a Clarke-Bumpus plankton sampler with silk mesh 25/cm. As a basis of comparison, each haul was adjusted to equal 10 cubic m of sea-water filtered.

The stations at which phytoplankton hauls were made are indicated in Figure 1. A surface tow of 20 minutes' duration was made using a small net with a 6" diameter mouth and silk mesh of 160 meshes/in.

(a) HYDROLOGY - D.J. ROCHFORD

(1) Temperature - 110°T Section Line (Fig. 2)

The warmest surface waters (19.5°C) were found in a very narrow band over the continental slope. A thermally well mixed layer to about 100 m of temperature 18-18.2°C formed the eastern boundary of this warm water and extended east to about 153°30'E. Minimum surface temperatures (16.9°C) were found around 154°E. No thermocline was found on this section.

The warmest waters below 500 m were found at 152°30'E. beneath the well mixed surface layer.

(2) Temperature - 290°T Section Line (Fig. 3)

Surface waters warmer (20-20.25°C) than those on the 110° section were found on the 290° line between 154° and 155°E. No thermocline was present on this section.

(3) Density (σ_t) 110°T Section Line (Fig. 4).

The lightest waters (σ_t 24.35) occurred over the continental slope. A layer of homogeneous density (σ_t 25.70-25.80) to 100 m or more was found east of this for about 70 miles. This was followed by a zone of maximum density (σ_t 25.90-26.00) to longitude 157°E. No pycnocline was detected on this section during this cruise.

(4) Density (σ_t) 290° Section Line (Fig. 5)

Conditions in the upper 50 m were similar to those on the 110° section, with the lightest water (σ_t 24.90) at the western end, separated from the heaviest (σ_t 25.90) by a 60-70 mile wide band of homogeneous density (σ_t 25.20-25.30) to 100 m. No pycnocline was found.

(5) Percentage Oxygen Saturation 110°T Section Line (Fig. 6)

Oxygen saturation at the surface was below normal except at the extreme eastern end of the section, (Station DH5/121/57) where supersaturation to 106 per cent. occurred. Saturation values also occurred at 100-200 m at Station DH5/117/57. Along the continental slope, saturation values were relatively low in the 200-300 m stratum at Station DH5/114/57. This was not associated with a dynamic uplift of any extent (Fig. 4). In most cases the subsurface oxygen saturation values varied independently of the density field (Fig. 4).

(6) Percentage Oxygen Saturation 290°T Section Line (Fig. 7)

Surface oxygen saturation was more extensive on this section and a region of supersaturation occurred at depths at Stations DH5/125-126/57, this was probably continuous with the saturated subsurface waters at Station DH5/117/57 (Fig. 6) on the 110° section line. Generally the subsurface oxygen saturation was not related to density distribution.

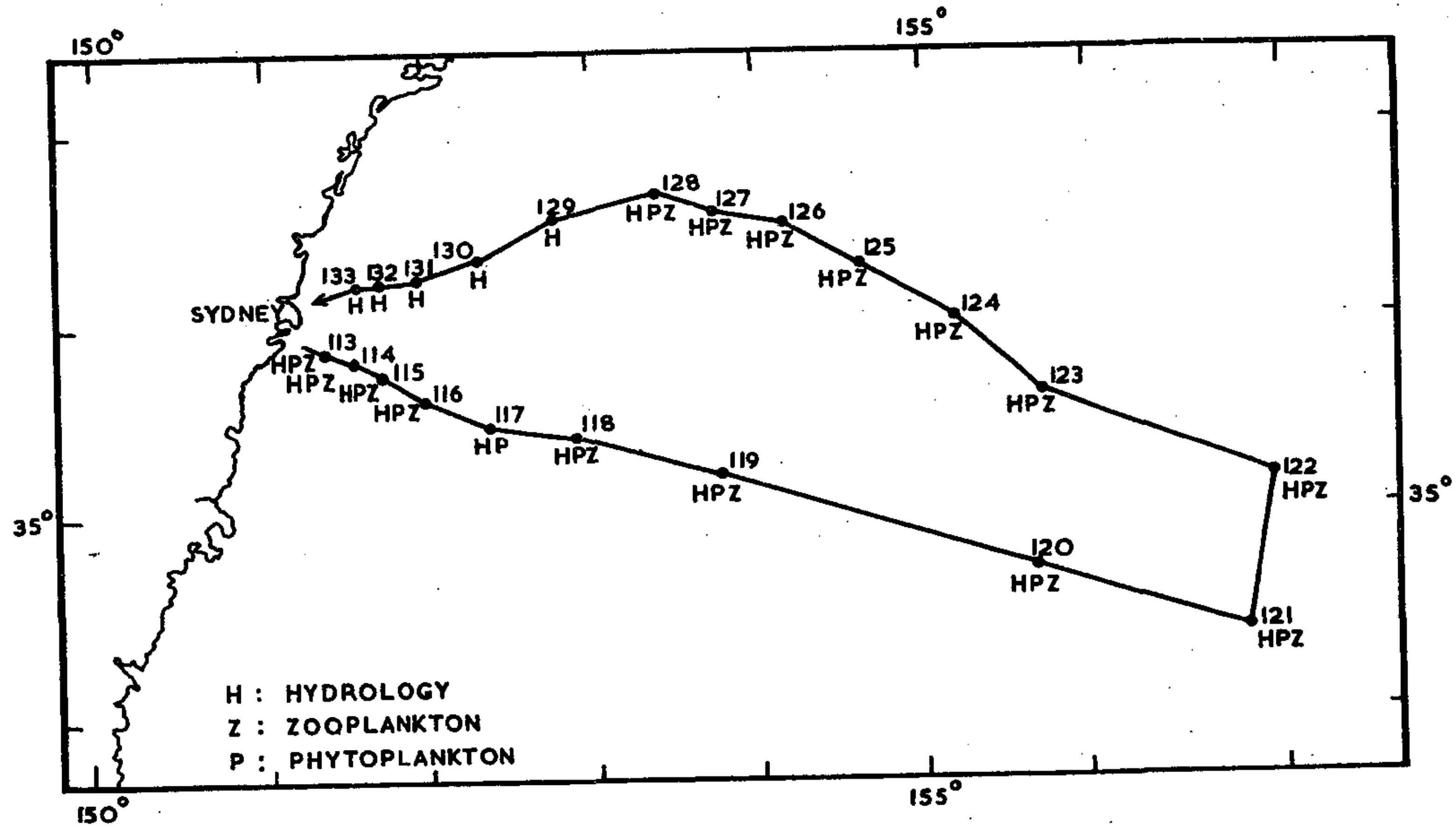

Fig.1. Cruise DH5/57. Track chart showing positions all stations.

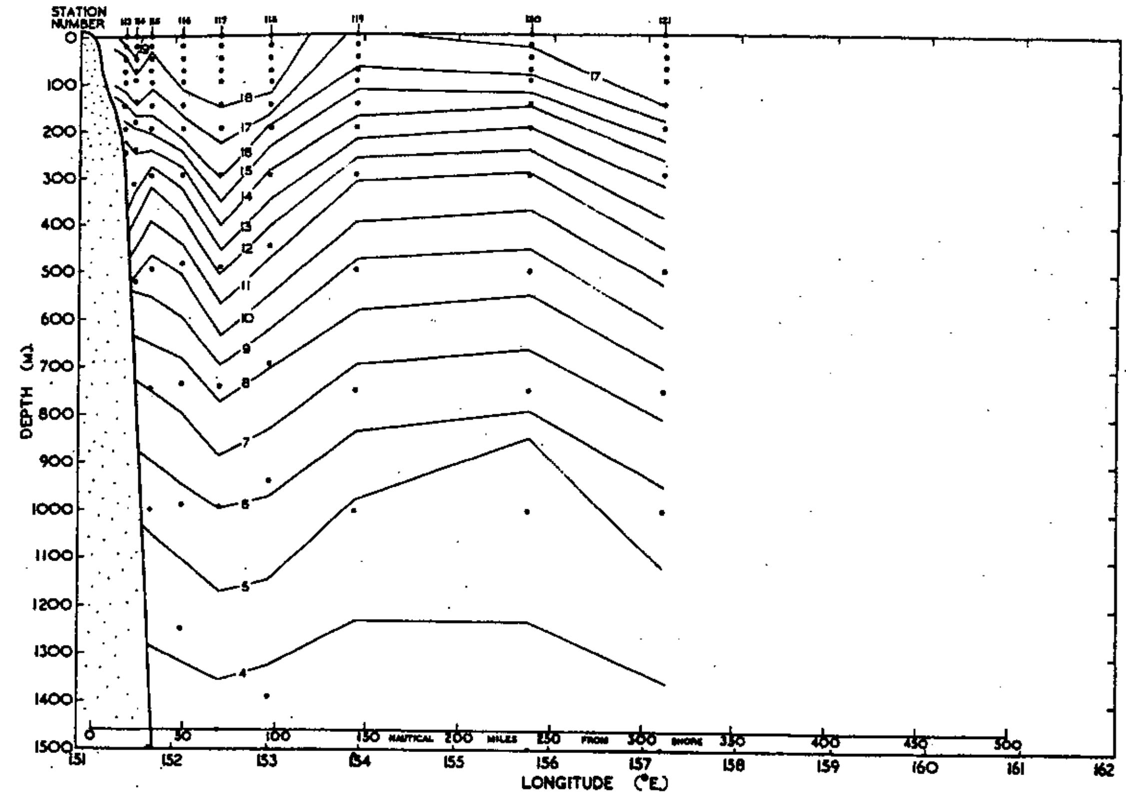

Fig.2. Sectional distribution of temperature (°C) along 110°T line to 1500 m.

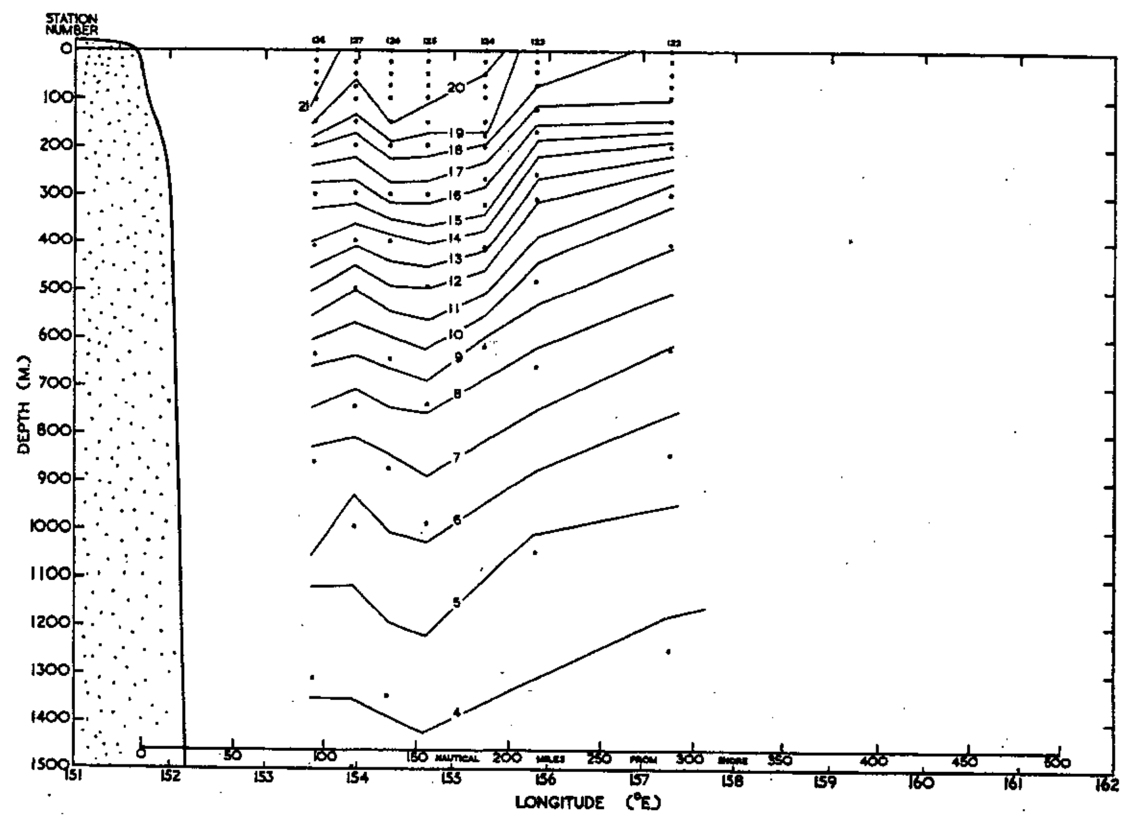

Fig.3. Sectional distribution of temperature (°C) along 290°T line to 1500 m.

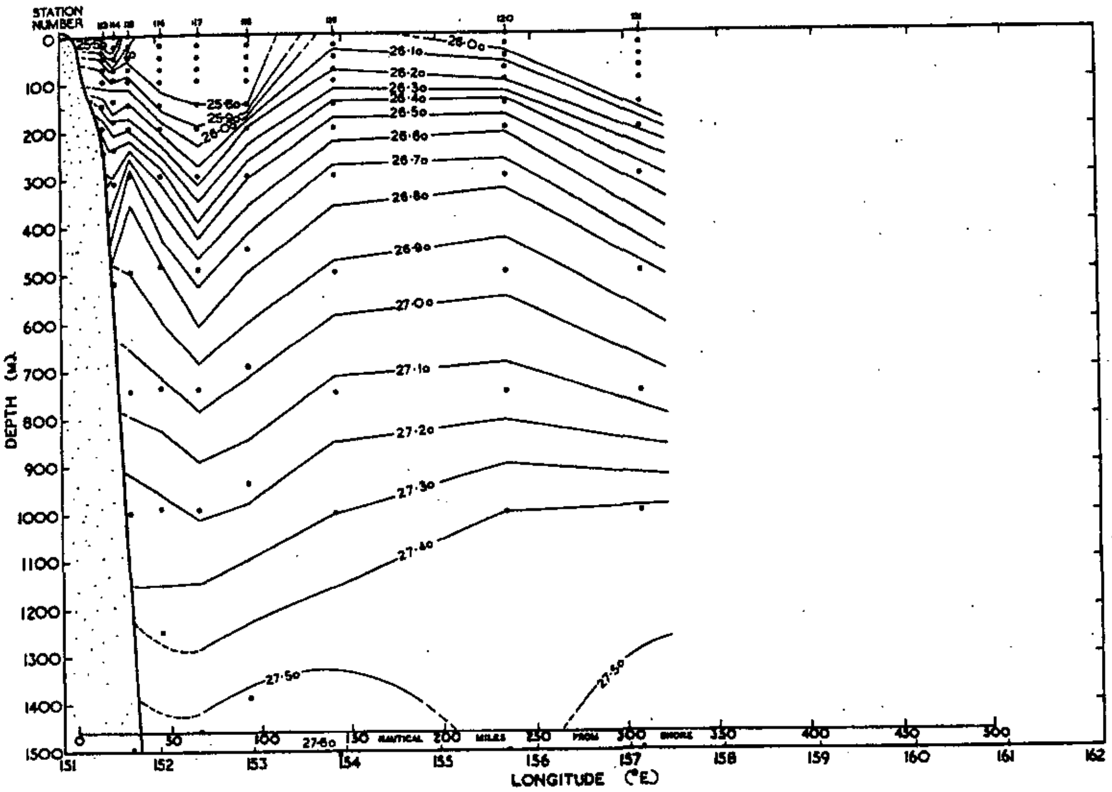

Fig.4. Sectional distribution of σ_t along 110°T line to 1600 m.

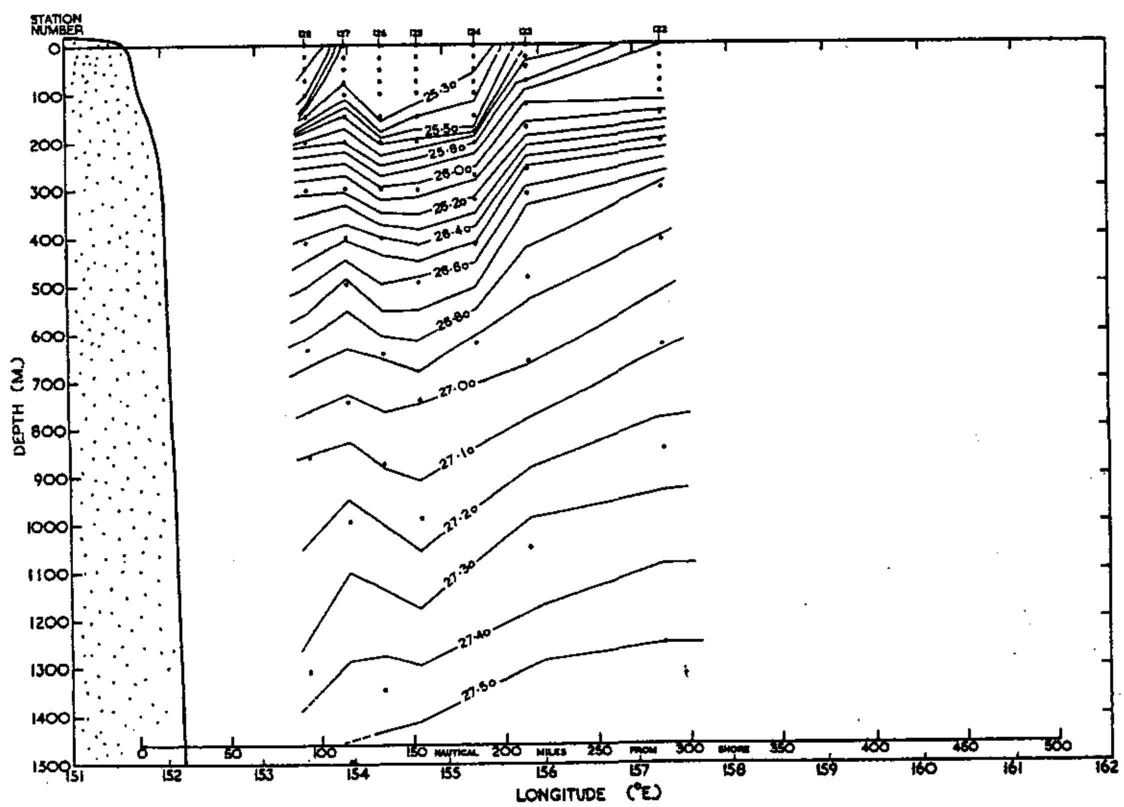

Fig.5. Sectional distribution of σ_t along 290°T line to 1600 m.

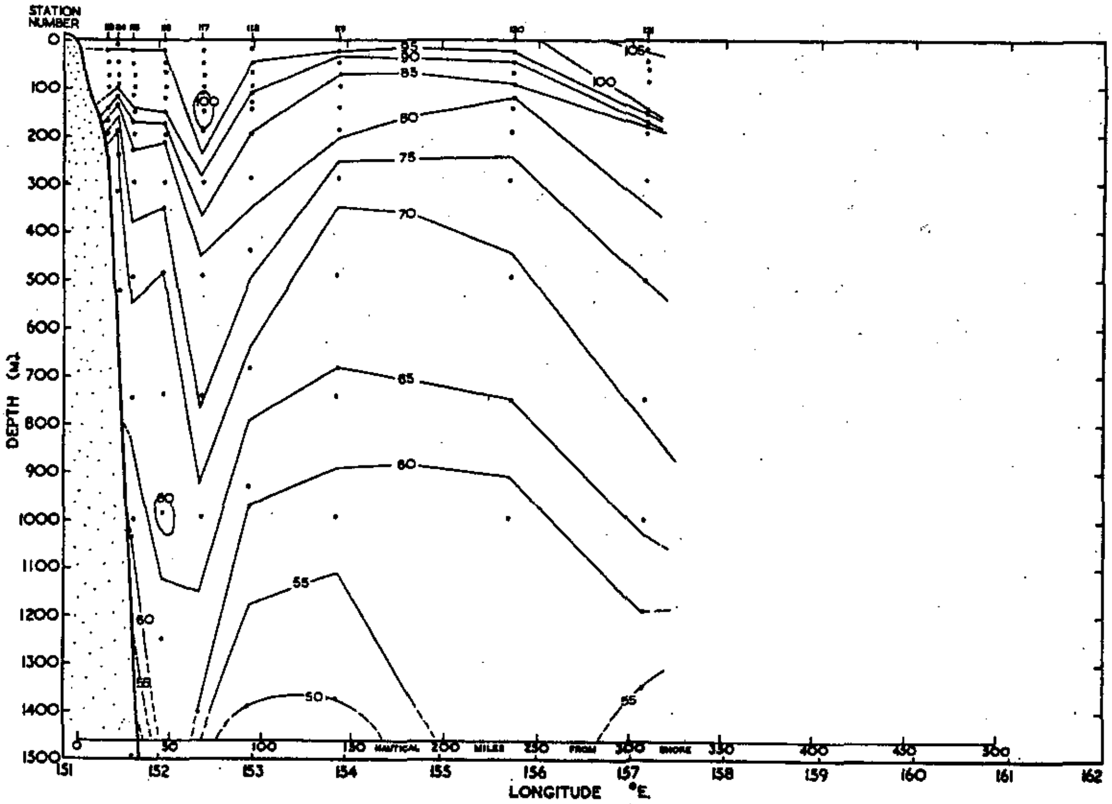

Fig. 6. Sectional distribution of oxygen saturation (%) along 110°T line to 1600 m.

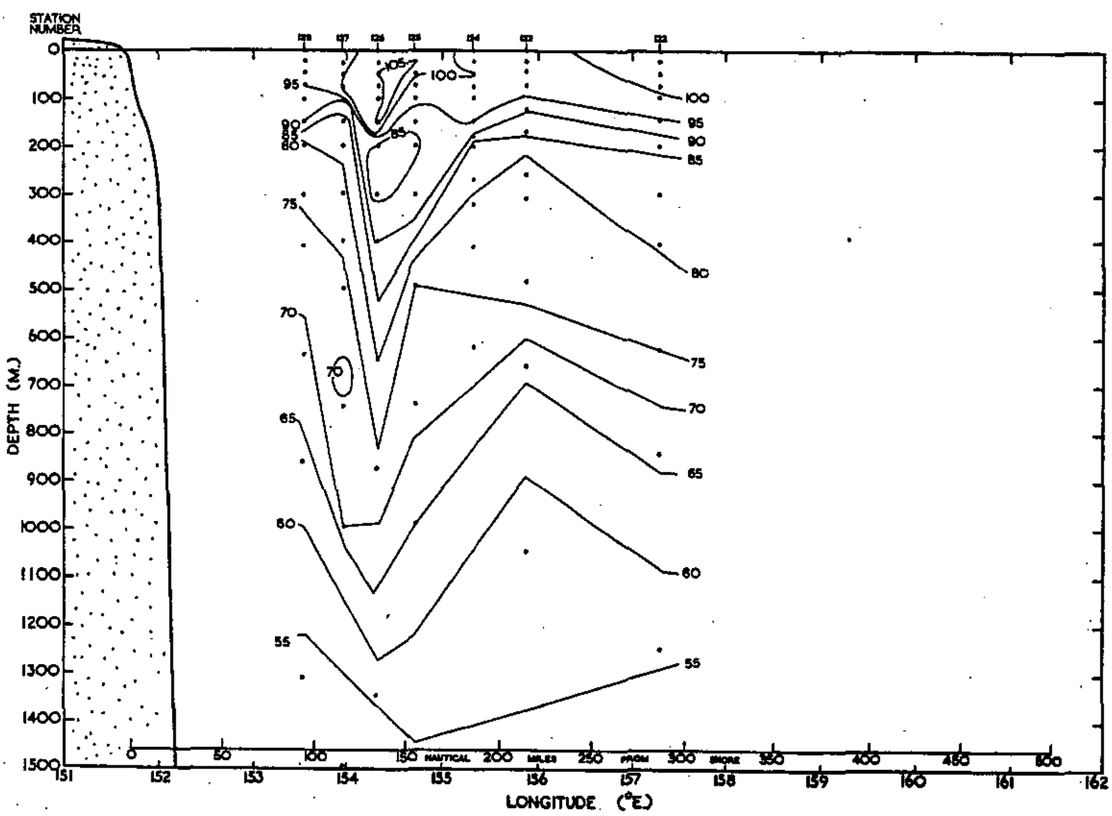

Fig. 7. Sectional distribution of oxygen saturation (%) along 290°T line to 1600 m.

(7) Total Phosphorus 110°T Section Line (Fig. 8)

The highest value of total phosphorus (20 μg/l) was found at the extreme western end of the section line. Elsewhere at the surface, values varied between 10 and 14 μg/l. To depths of about 500 m the distribution of total phosphorus, with some anomalies at Station DH5/117/57, paralleled the field of density. Beneath this depth the total phosphorus and density field (Fig. 4) were not in agreement, particularly offshore from Station DH5/119/57.

(8) Total Phosphorus 290°T Section Line (Fig. 9)

Offshore to Station DH5/124/57 the total phosphorus values at the surface were constant at about 10 μg/l. The depth at which this value occurred decreased and a band of water with higher total phosphorus values (16 μg/l) was found around longitude 156°E. Offshore from that position the values decreased to 10 μg/l. There was good agreement between the distribution of total phosphorus and the density field down to depths of 800-1000 m (Fig. 5). At the lowest depths at Station DH5/126/57 values were much lower for the same density than those elsewhere.

(9) Horizontal Distribution of Properties

(a) Percentage Oxygen Saturation (Fig. 10)

At the surface (Fig. 10A) a band of undersaturated water extended east of Sydney and was probably part of the general circulation pattern (Fig. 12). Along the offshore margin of this easterly moving water a region of supersaturation occurred. At depths of 100 and 300 m (Figs. 10B and 10C) the distribution of oxygen saturation paralleled that at the surface. At 300 m, however, contrary to the surface condition, the maximum values occurred along the inshore margin of the eastward movement.

(b) Total Phosphorus (Fig. 11)

At the surface, (Fig. 11A) a tongue of water with total phosphorus about 10 μg/l extended east and was separated from offshore waters with similar total phosphorus values by a band of water with higher total phosphorus values (14-16 μg/l). This band was the result of dynamic uplift of deeper waters (Figs. 4 and 5). At depths of 100 and 300 m (Figs. 11B and 11C) the pattern of total phosphorus distribution was similar to that at the surface, but at 300 m, the band of maximum values was displaced south and east. The maximum values at 300 m were associated with the maximum dynamic uplift of deeper waters (Figs. 4 & 5) but at 100 m this relationship was only partly true.

(b) PHYSICS - B.V. HAMON

Dynamics

The dynamic heights relative to the 1000 decibar level were computed from the thermosteric anomalies* for Stations DH5/115/57 to DH5/128/57. The value given for Station DH5/124/57 involved extrapolation of the σ_t - depth graph from 625 to 1000 metres.

Figure 12 shows the contours of dynamic heights (in dyn. cm) and the general trend of the surface circulation, as far as can be judged from only two lines of stations. The marked easterly trend in the offshore circulation is supported by the values of the ship's drift in this area.

The following components of surface currents and volume transports have been computed.

Stations	Distances Offshore (in Miles)	Surface Current (cm/sec)	Volume Transport ($X10^7m^3$/sec)	Direction
115	31			
		35	1.1	S.S.W.
117	72			
		30	1.4	N.N.E.
119	140			
		35	1.6	E.S.E.
125	140			

* Montgomery, R.B., and Wooster, W.S. (1954).- Thermosteric anomaly and the analysis of serial oceanographic data. Deep Sea Res. 1.63-70.

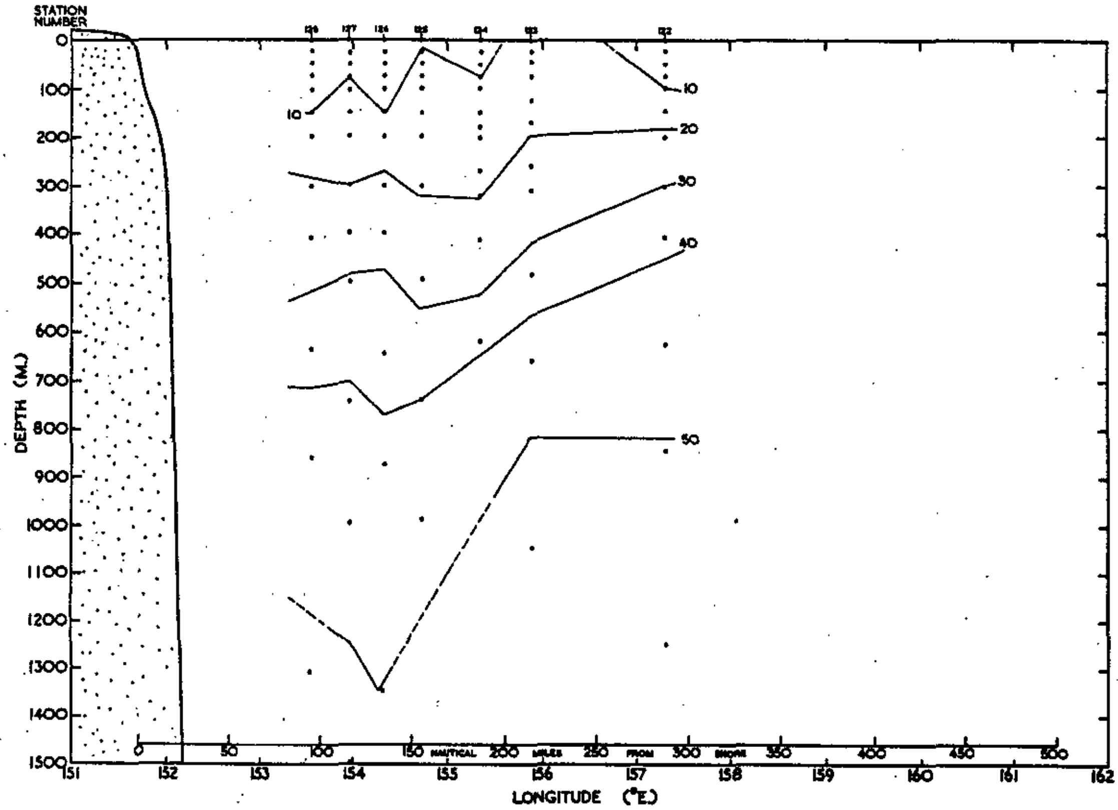

Fig.8. Sectional distribution of total phosphorus along 110°T line to 1600 m.

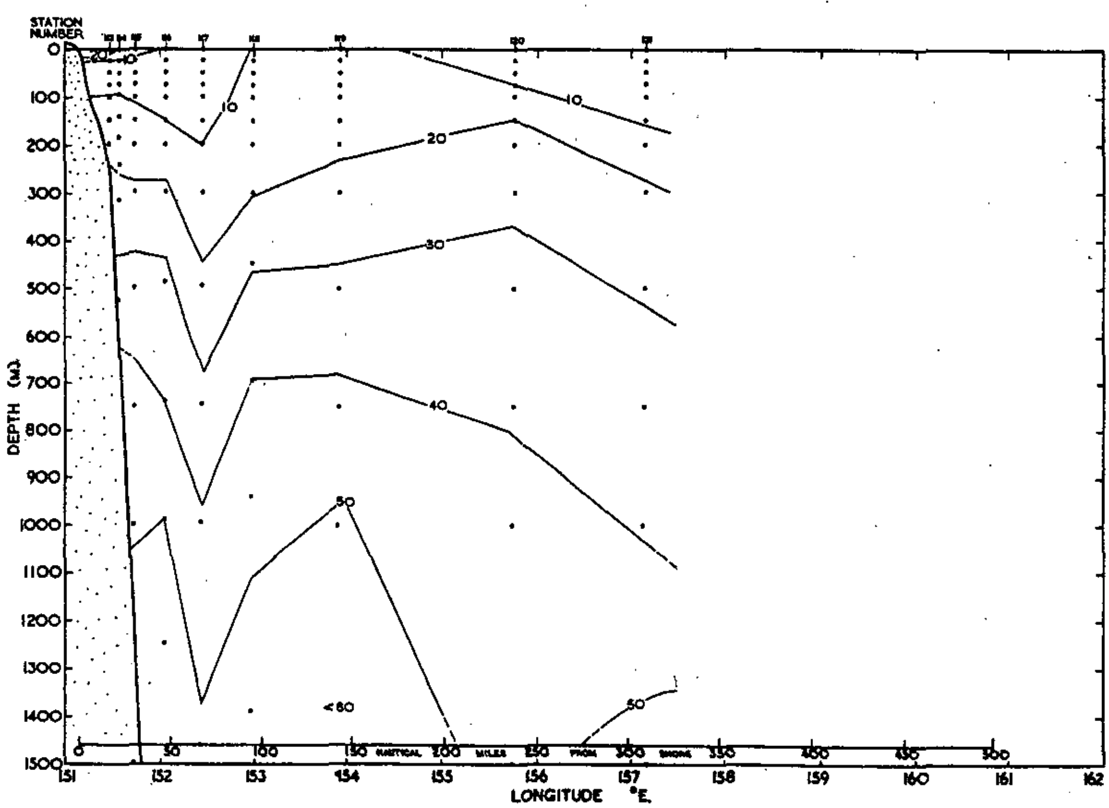

Fig.9. Sectional distribution of total phosphorus along 290°T line to 1600 m.

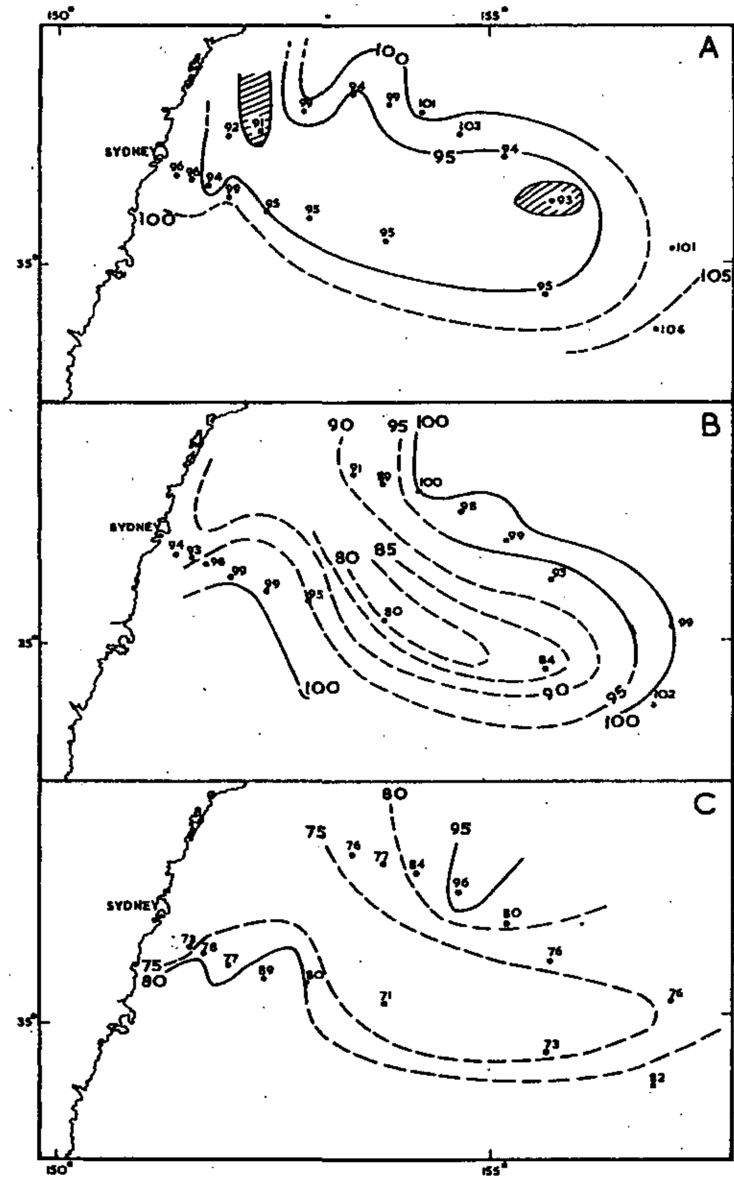

Fig.10. Horizontal distribution of oxygen saturation (%) A. at 0 m, B. at 100 m, C. at 300 m.

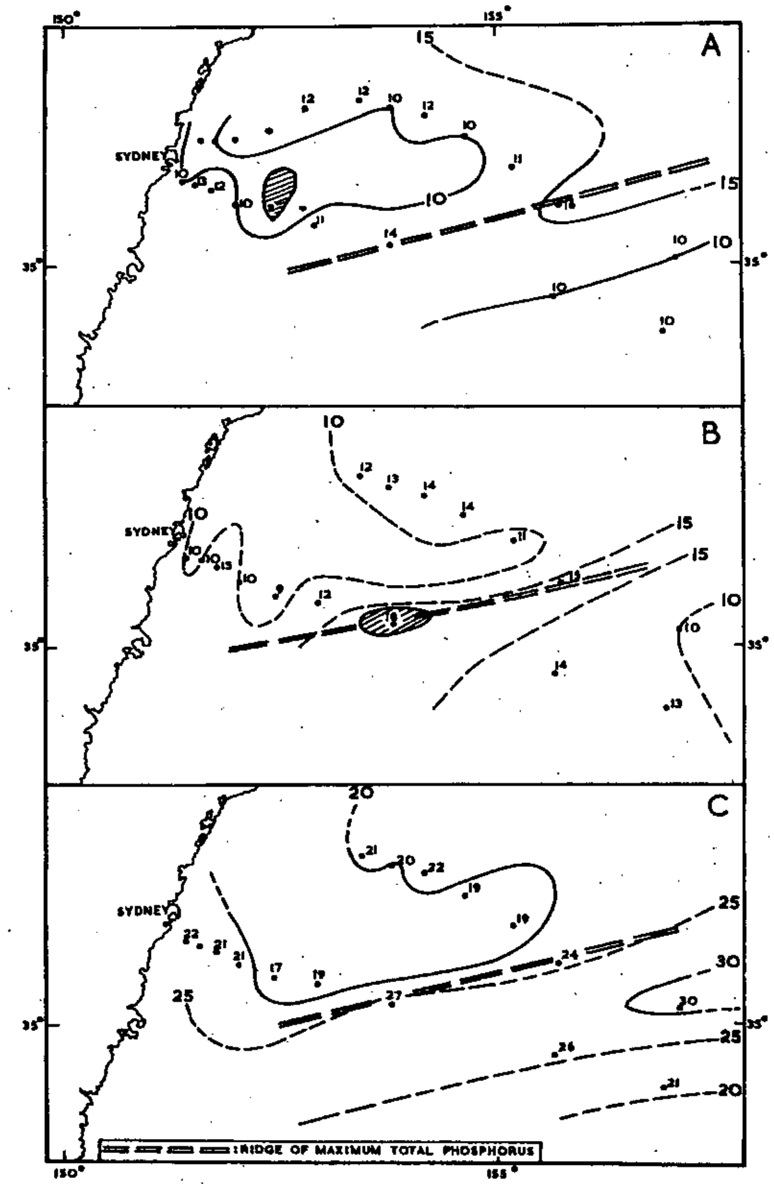

Fig.11. Horizontal distribution of total phosphorus A. at 0 m, B. at 100 m, C. at 300 m.

(c) ZOOPLANKTON - W. DALL

It has already been noted (Report No. 15) that zooplankton hauls for Cruise DH3/57 could not be reported because of a labelling error, so particulars are given here of the method to be adopted for these collections. It is proposed to indicate graphically the distribution of copepod species taken at the various stations, and to graph the quantitative distribution of all zooplankton showing the number of organisms, the number of species, and the volume of plankton in $ml/10m^3$ of sea-water filtered.

In this report, Figure 13A indicates the distribution of copepod species, the narrow band shows presence, the wider band indicates that the species was abundant, and a break in the column indicates absence. Figure 13B shows the number of organisms, the number of species, and the volumes of the hauls at all stations. The arrows indicate the sequence of the stations at which hauls were made.

(d) PHYTOPLANKTON - E.J.F. WOOD (Tables 1 & 2)

It is proposed in the reports on phytoplankton taken during the cruises to study the East Australian Current, to indicate in tables the species of phytoplankton found in the collections from each station, and to indicate the phytoplankton communities which may prove useful as indicators of water with particular characteristics.

In July the cool temperate flora from the Bass Strait - Tasmania area (indicators *Ceratium horridum*, *Rhizosolenia hebetata* f.*hiemalis*) mixed with the East Australian current flora roughly to latitude 38°S. North of this there was no evidence of the southern element (Fig. 14). At this time there was little of the larger phytoplankton close inshore but another relatively infertile area with *Amphisolenia bidentata* suggesting Central Tasman affinities. It would seem that this water mixed with the East Australian water to some extent east of Station DH5/114/57.

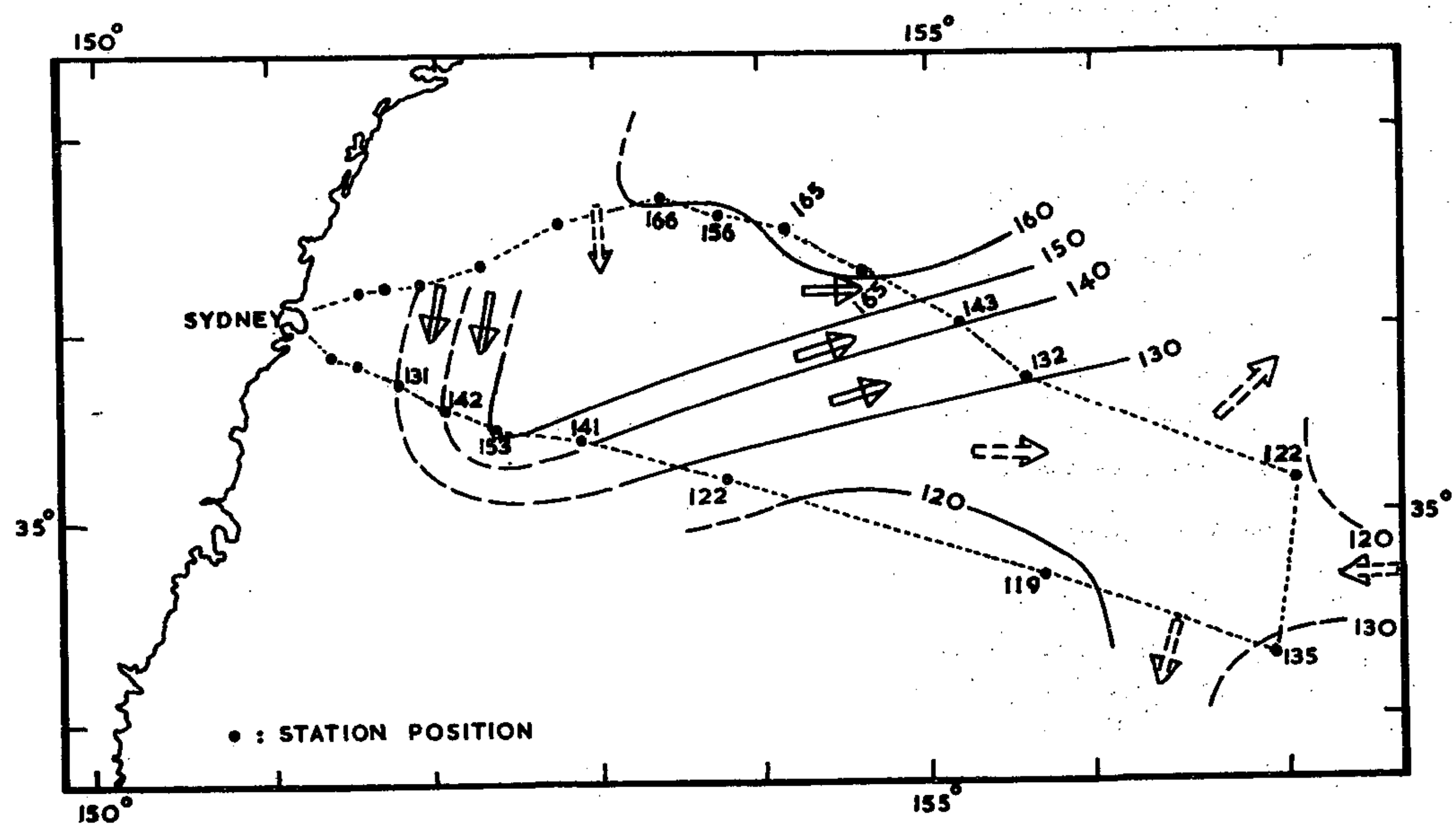

Fig.12. Contours of dynamic height relative to 1000 decibars.

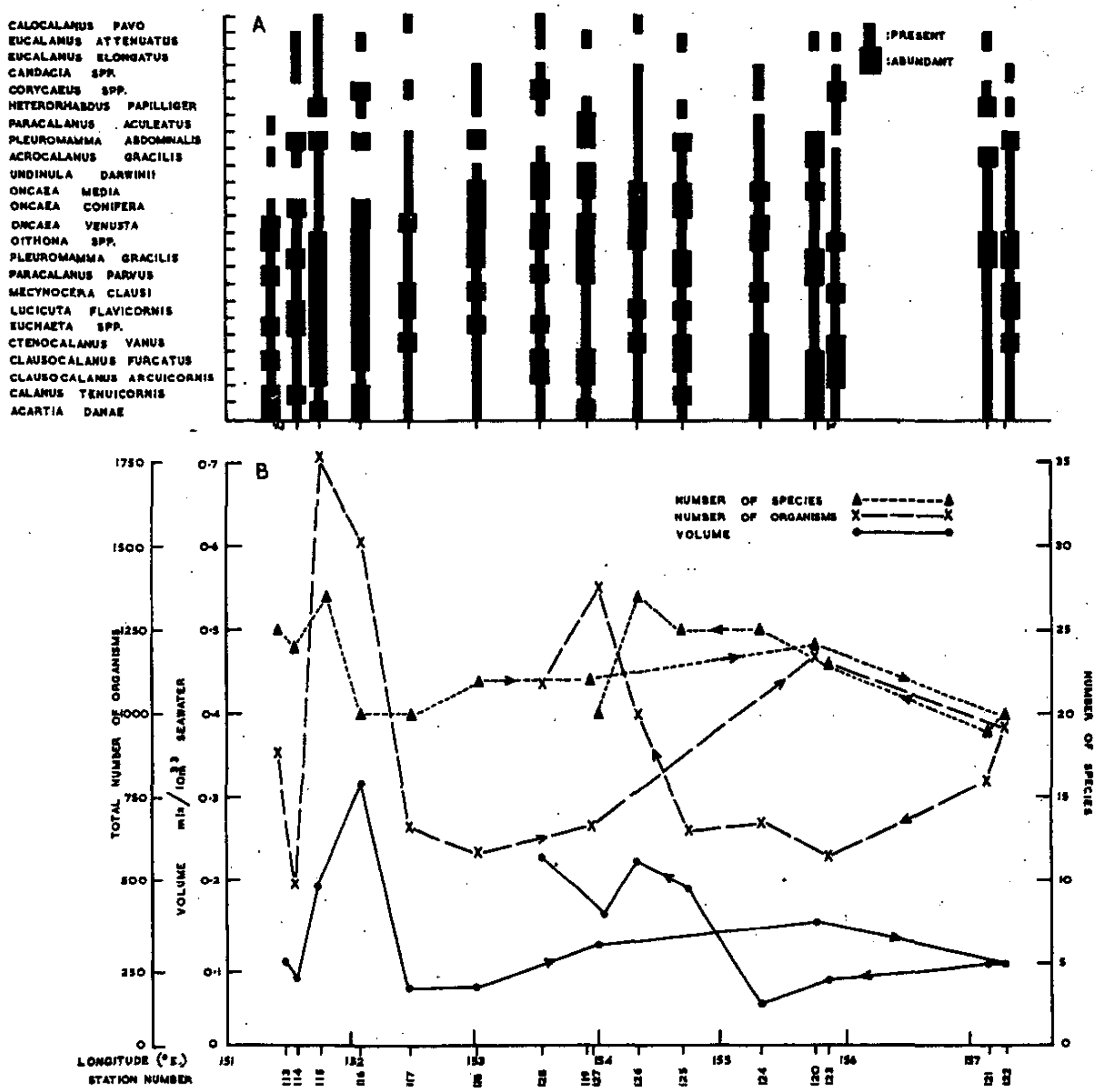

Fig.13. A. Distribution of copepod species collected at stations on 110°T and 290°T section lines.

B. Quantitative distribution of zooplankton collected at stations on 110°T and 290°T section lines.

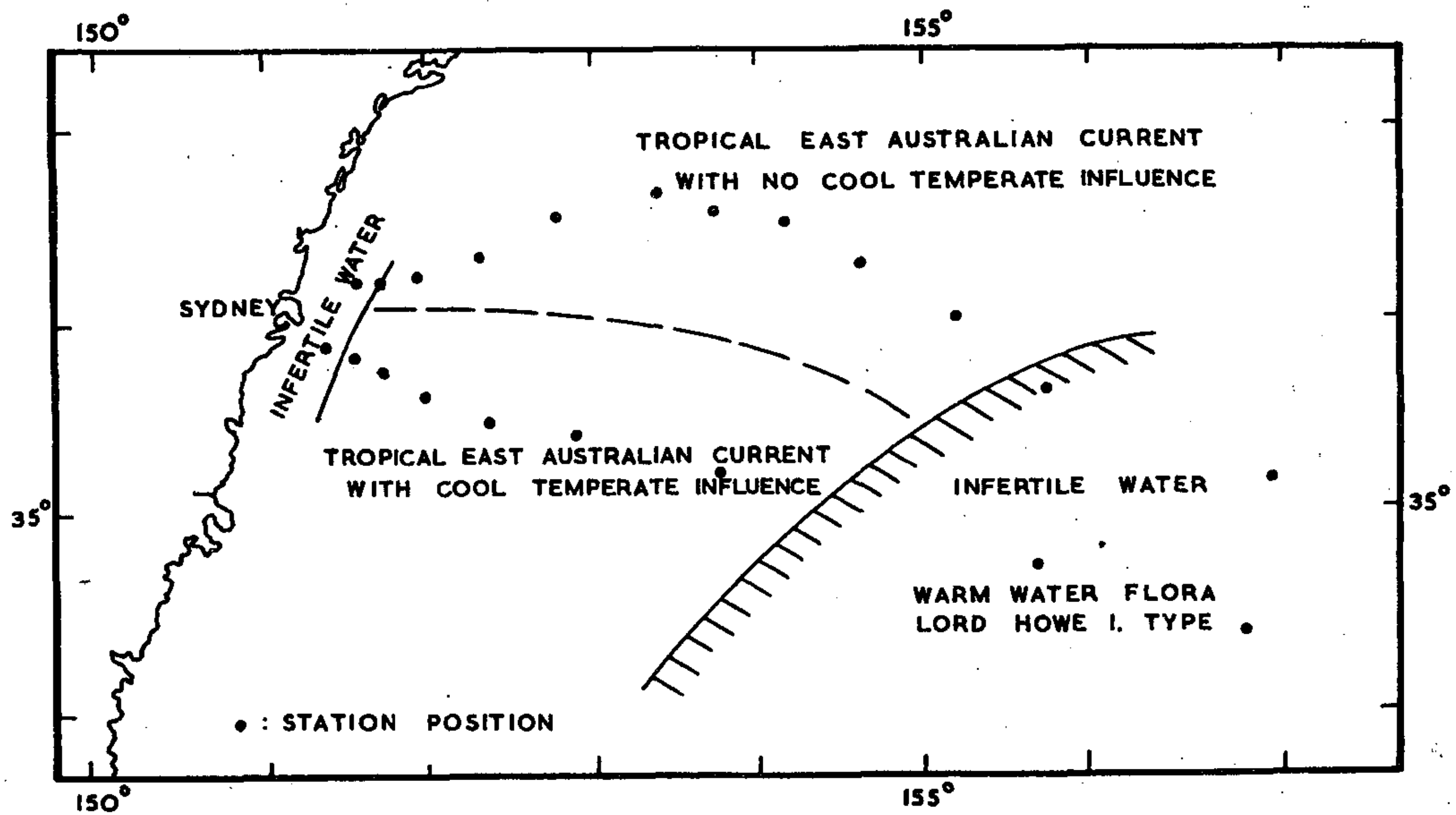

Fig.14. Phytoplankton communities determined from collections at stations on 110°T and 290°T section lines.

TABLE 1

DIATOMS TAKEN DURING CRUISE

Stations	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128
Coscinodiscus radiatus		+	+			+					+			+		+
C. marginatus				+		+			+	+						+
C. concinnus		+				+					+			+	+	+
Hyalodiscus stelliger			+	+												
Planktoniella sol		+	+	+	+	+	+			+	+	+	+	+	+	+
Thalassiosira decipiens		+	+	+	+						+	+		+		+
T. hyalina											+					
Lauderia annulata																+
Detonula confervacea		+														
Chaetoceros teres			+												+	+
Ch. coarctatum	+	+		+							+	+		+	−	+
Ch. eibenii		+	+												+	
Ch. atlanticum v. neapolitanum											+				+	
Ch. concavicorne	+	+	+			+					+			+		
Ch. vanheurckii		+	+	+							+					+
Ch. lorenzianum														+	+	+
Skeletonema costatum															+	
Bacteriastrum delicatulum											+				−	+
B. varians			+								+				+	
Rhizosolenia alata	+	+	++	+	+	+	+		+	+	+	+		+	+	+
R. styliformis				+		+					+	+		+	+	+
R. hebetata f. hiemalis		+				+										
R. acuminata		+													+	+
R. setigera		+														
R. imbricata				+												
R. stolterforthii						+										+
R. calcar-avis																+
R. delicatulum															+	

TABLE 1 CONT.

Stations	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128
Climacodium frauenfeldianum		+		+												
Guinardia flaccida				+												+
Lithodesmium undulatum			+													
Streptotheca indica											+					+
Schroederella licatula											+		+			
Hemiaulus sinensis																+
Hemidiscus cunieformis												+		+		
Gossleriella tropica			+													+
Thalassiothrix longissima			+													+
T. frauenfeldii											+					+

TABLE 2

DINOFLAGELLATES TAKEN DURING CRUISE

Stations	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128
Peridinium grande				+												
P. oceanicum	+		+	+		+										+
P. curtipes	+													+		
P. brochii										+						
P. granii													+			
P. claudicans		+														
P. ovatum		+														
Amphisolenia bidentata			+	+	+	+	+				+		+		+	
Ornithocercus magnificus		+														+
O. steinii							+									
Dinophysis tripos		+	+	+		+	+				+					
D. fortii							+									
Phalacroma favus						+								+		
P. doryphorum				+												+
P. mitra																
P. ovum																
Ceratium falcatum			+													
C. teres			+													
C. candelabrum		+													+	+
C. furca			+	+												
C. fusus	+	+					+							+		+
C. extensum	+	+		+	+	+	+			+		+	+		+	+
C. tripos		+				+						+	+		+	+
C. pulchellum						+										
C. buceros		+		+		+				+			+			
C. horridum		+	+	+		+	+									
C. trichoceros		+	+	+	+	+	+	+			+	+	+			+
C. arietinum		+		+	+	+										+
C. symmetricum		+														+
C. lunula						+							+			
C. gallicum		+	+	+						+			+			+

TABLE 2 CONT.

Stations	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128
Ceratium gravidum		+		+		+										
C. hexacanthum		+	+	+		+	+				+	+			+	
C. massiliense		+				+					+	+		+		+
C. breve		+		+												+
C. conciliens		+		+												+
C. setaceum		+											+			
C. platycorne		+														
C. euarcuatum		+				+										
C. karsteni			+	+										+		
C. gibberum			+													
C. pentagonum				+			+									
C. vultur				+											+	
C. declinatum										+						
C. ranipes											+					
C. incisum														+		
C. schmidtii															+	
Oxytoxum scolopax															+	
Pyrocystis hamulus																+
P. lunula					+		+									
P. noctiluca												+	+	+	+	+
P. fusiformis					+											+
Goniodoma polyedricum		+		+	+						+					
Ceratocorys horridum	+	+		+												+
Pyrophacus horologicum	+	+														

F.R.V. "DERWENT HUNTER"

SCIENTIFIC REPORT OF CRUISE DH6/57

July 23-28, 1957

SCIENTIFIC PERSONNEL

H. Jitts (in charge), N. Dyson

ITINERARY

Figure 1 shows the position of the stations and the track followed on this cruise.

SCIENTIFIC REPORTS

The purpose of this cruise was to study the rate of production of organic matter, the amount of submarine light, and the hydrological conditions of the waters to the east of Port Hacking. This was the first of a series of cruises, which are scheduled to be made as soon as possible after the hydrological cruises studying the East Australian Current. On each productivity cruise, sufficient hydrological data are to be collected to allow comparison with the section data.

(a) PRODUCTIVITY - N. DYSON

The measurements of the rate of production of organic matter were made by the ^{14}C method using the techniques and equipment of Jitts (1957) and of Doty (1956). Light penetration was measured with a submarine photometer (Jitts 1959).

(1) CO_2 uptake in situ

At Stations DH6/137-139/58, CO_2 uptake was measured *in situ* by incubation from sunrise to sunset, of samples from 0, 25, 50, and 100 metres. For these *in situ* measurements, the method used was that of Jitts (1957). Results were calculated by means of the following formula:-

$$\frac{\text{Net Activity}}{\text{Added Activity}} \times (\text{Total } CO_2) \times \frac{12}{44} \times 1000 \text{ mg C/day/m}^3$$

i.e., Net Activity x 0.00983 mg C/day/m^3 assuming the total CO_2 content of all samples to be 90 mg CO_2/l.

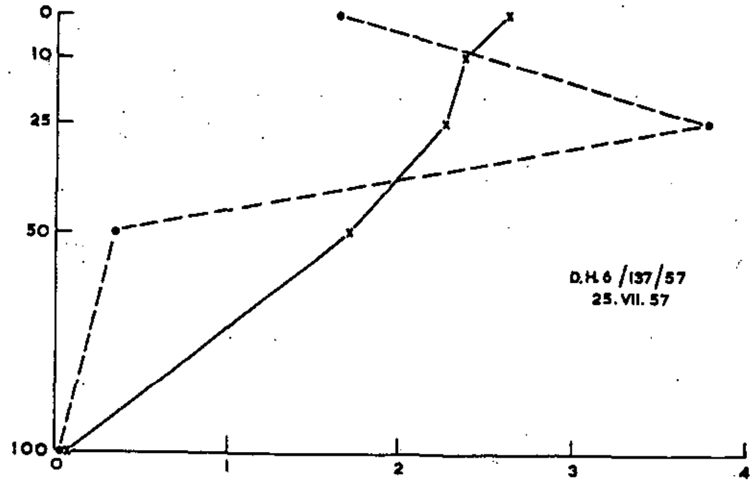

Fig.2.

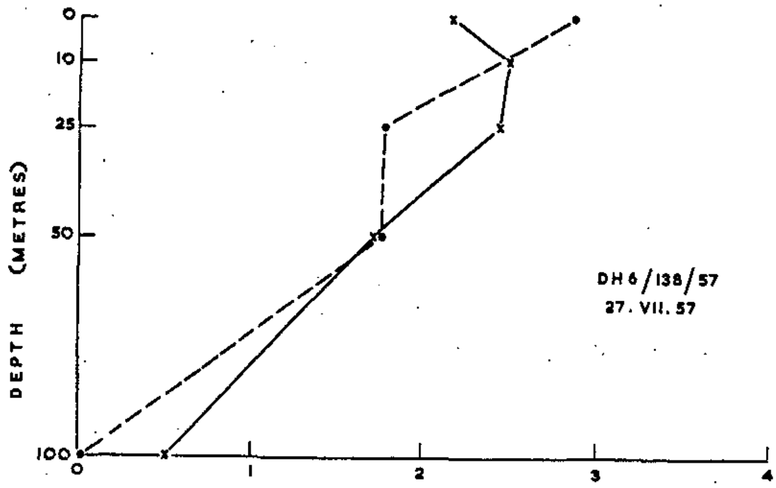

Fig.3.

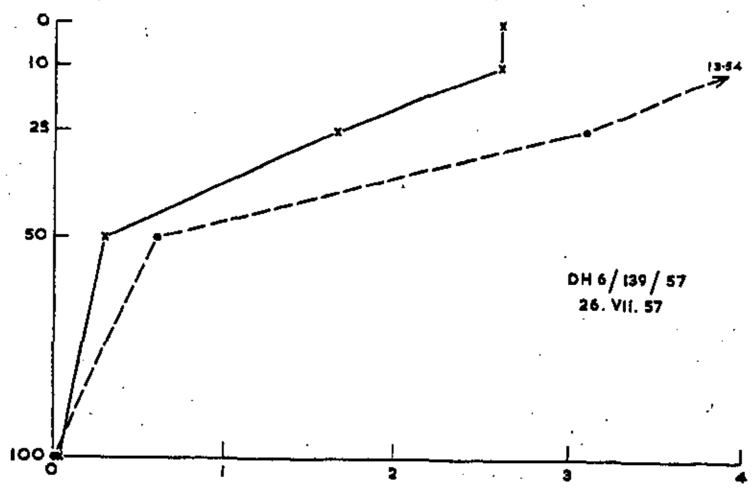

Fig.4.

HOURLY RATE OF CO_2 UPTAKE BY LIGHT BATH INCUBATION (mgC/hr/m³) x——x
DAILY RATE OF CO_2 UPTAKE BY IN SITU INCUBATION (mgC/day/m³) •— — —•

Figs. 2,3,4. Rates of CO_2 uptake at DH6/137/57, DH6/138/159 and DH6/139/57.

The daily rate of production per m^2 of the water column was estimated by the formula:-

$$\frac{25\left(\frac{a+b}{2}\right)+25\left(\frac{b+c}{2}\right)+50\left(\frac{c+d}{2}\right)}{1{,}000} \text{ g C/day/m}^2$$

where a, b, c, and d are the daily rates of production in mg per m^3 at 0, 25, 50, and 100 m below the surface respectively.

(2) CO_2 uptake by Light Bath Incubation

CO_2 uptake was measured by incubation of samples, taken with a plastic sampler (van Dorn type) in reagent bottles in Doty's light bath. The samples were collected from 0, 10, 25, 50, and 100 m at 0700 hours, and incubated for four hours from 0900 hours.

For these measurements the method used was that of Doty (1956). The hourly rate of production was calculated by the formula:-

$$\frac{\text{Net Activity}}{\text{Added Activity}} \times \frac{\text{Total } CO_2}{\text{Hrs of Incubation}} \times \frac{12}{44} \times 1000 \text{ mg C/hr/m}^3$$

For the daily rate of production per m^2, the euphotic layer was assumed to be 100 m throughout, and the daily production equal to ten times the hourly rate. Assuming also that the rate is uniform throughout the euphotic zone, calculation was made by the formula:-

$$\left(\frac{a+b}{2}\right) \times \frac{100}{2} \times \frac{1}{1000} \text{ g C/day/m}^2$$

$$\text{i.e. } \frac{1}{4}(a+b) \text{ g C/day/m}^2$$

where a and b are the hourly rates of production in mg C/hr/m^3 at 0 and 25 m respectively.

At Stations DH6/140-146/57 samples were taken at the surface with a plastic bucket and kept in bottles for subsequent CO_2 uptake measurements by Doty's method and for chlorophyll and phytoplankton measurements.

The values for fixation /m^3 (Figs. 2, 3, & 4) show a poor correlation between the two methods of measurement. With the exception of the surface sample at Station DH6/139/57, the hourly rate of CO_2 uptake was of the same order as the daily rate of uptake measured in situ. This suggests that the treatment and high light intensity of the light bath method have increased the rate of CO_2 uptake several fold over the levels found under the more natural conditions of the in situ method.

The daily rates of production per m^2 of the water column are shown in Figure 5. The higher values at Stations DH6/139, 140, and 141/57 suggest that the rate of production is being raised by the proximity of the continental shelf.

(3) Light Penetration

Light penetration measurements were made at 1400 hours each day with a submarine photometer as described by Jitts (1959). Light intensity was measured at 10 metre intervals to 80 metres and the results calculated as percentage of surface light. Extrapolation of these gave the depth of penetration of 1 per cent. of surface light.

The values (Fig. 5) are consistent with the rates of production found at these stations. At each of the three stations the rate of CO_2 uptake at 100 metres was almost zero which suggests that the depth of the euphotic layer was less than 100 metres. The light penetration measurements showed this depth to vary between 66 and 80 metres.

(b) HYDROLOGY - D.J. ROCHFORD

Bathythermograph lowerings were made at 0700, 1200, and 1700 hours while drifting on station. Hydrology samples were collected from standard depths to 300 metres.

Water Mass Structure of Surface Waters

The density (σ_t) to total phosphorus relationships (Fig. 6) show that a minimum of three water masses were present. At the surface the Coral Sea and Central Tasman water masses of Rochford (1957) were the dominants. Figure 7 shows their distribution at the surface. Stations DH6/137 and 138/57 were pure Central Tasman but DH6/139/57 had some Coral Sea intermixing.

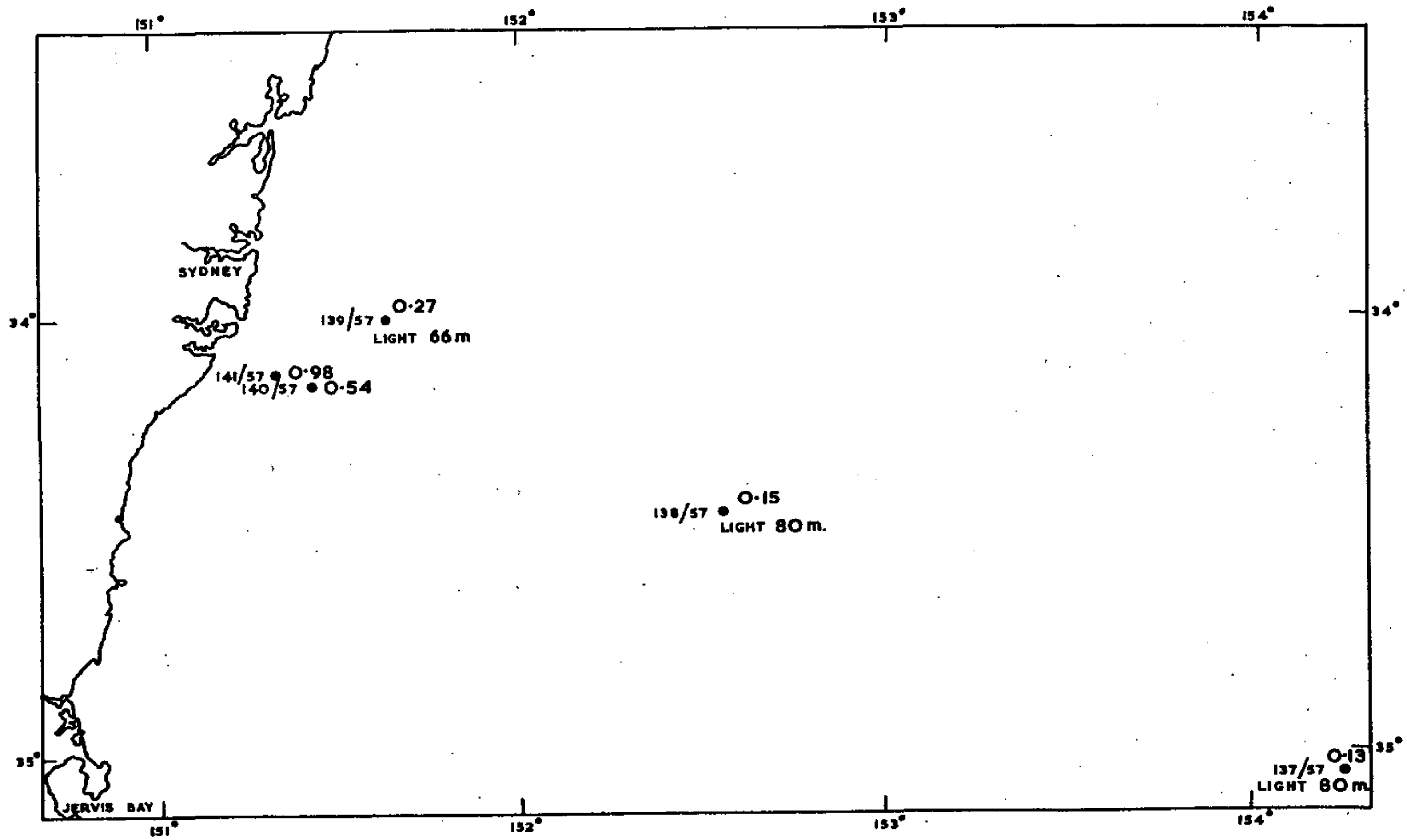

Fig.5. Rates of production per m^2 of water column and depth of penetration of 1% of surface light.

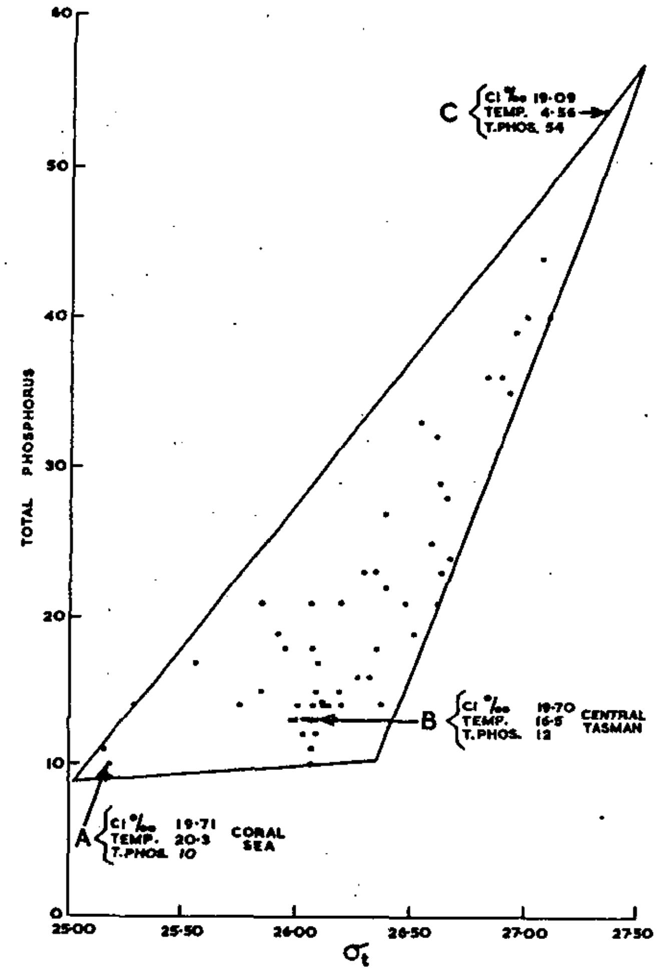

Fig. 6. Relationship of density (σ_t) to total phosphorus.

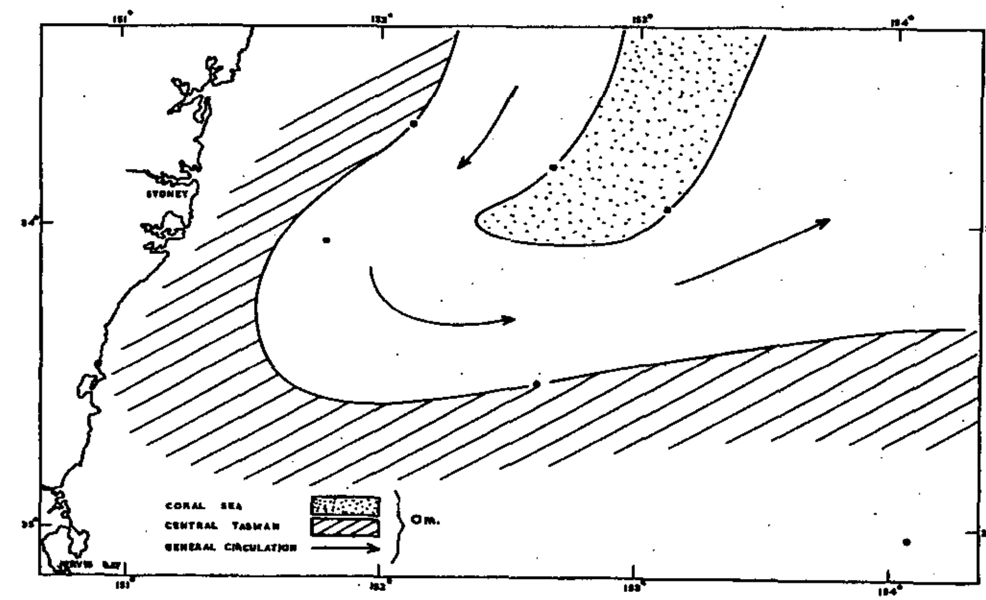

Fig. 7. Surface water mass distribution.

REFERENCES

Doty, M.S. (1956).- Current status of carbon-fourteen method of assaying productivity of the ocean. Progress Report. (Univ. of Hawaii, Botany Department).

Jitts, H.R. (1957).- The ^{14}C method for measuring CO_2 uptake in marine productivity studies. C.S.I.R.O. Aust. Div. Fish. Oceanogr. Rep. No.8.

Jitts, H.R. (1959).- Measurements of light penetration in the Tasman Sea during 1955-56-57. C.S.I.R.O. Aust. Div. Fish. Oceanogr. Tech. Pap. No.6.

Rochford, D.J. (1957).- The identification and nomenclature of the surface water masses in the Tasman Sea (data to end of 1954). Aust. J. Mar. Freshw. Res. 8: 369-413.

F.R.V. "DERWENT HUNTER"

SCIENTIFIC REPORT OF CRUISE DH7/57

August 4-8, 1958

SCIENTIFIC PERSONNEL

J. Staniforth (in charge)

ITINERARY

Figure 1 shows the positions of stations worked during this cruise.

SCIENTIFIC REPORTS

This cruise was planned to investigate the short term changes in hydrological conditions off Port Hacking and to determine the factors responsible for onshore movements of slope waters. Opportunity was taken of a break in the winter programme of F.R.V. "Derwent Hunter" to plan this cruise at a time when purely negative evidence on slope movement could be expected.

The "Derwent Hunter" worked daily stations to 750 m at stations at the following positions - 34°10'S., 151°28'E; 34°11'S., 151°34'E; 34°14'S., 151°46'E. and 34°20'S., 152°08'E. (Fig. 1).

Two onshore stations to 100 m at positions 34°05'S., 150°13'E. and 34°05'30 S., 151°18'E. (Fig. 1) were worked by F.R.V. "Jay Bee" at times to correspond to the daily morning station of the "Derwent Hunter."

Sampling for chlorinity, dissolved oxygen, and total phosphorus was carried out at all stations. Thermometer arrangements and other details were those used on previous cruises.

Drift cards were released daily by "Jay Bee" at the onshore stations and by "Derwent Hunter" at the second and fourth stations (Fig. 1). Daily G.E.K. towings were made at four stations by "Derwent Hunter."

(a) HYDROLOGY - D.J. ROCHFORD

(1) Density (σ_t)

The daily distribution of density along the section and its degree of variation are shown in Figure 2.

(2) Percentage Oxygen Saturation

The daily distribution of oxygen saturation and its degree of variation along the section are shown in Figure 3.

(3) Total Phosphorus

Figure 4 shows the daily distribution of total phosphorus and its degree of variation.

(4) Daily Variations

The 26.20 isopycnal has been selected (Fig. 2) as representative of the upper 200 m. During the period of the cruise the depth of this isopycnal varied considerably (Fig. 5). There seems to be some connection between wind direction and the onshore shallowing of this density surface (Fig. 6). Drift cards recovered from those released by "Jay Bee" during this period gave evidence of an onshore drift for only the first three days (Fig. 6). No cards were recovered from the other batches released by "Jay Bee" nor from those released by "Derwent Hunter."

The values of oxygen saturation and total phosphorus at the surface during this period (Fig. 7) in general follow the vertical movements of the 26.20 isopycnal, with low total phosphorus and oxygen saturation associated with its deeper distribution and high total phosphorus and oxygen saturation with its shallow distribution. This association is quite unexpected and cannot be explained in terms of direct dynamic processes. During the period of the cruise, except on August 8, practically no uplift occurred of slope waters into coastal regions (Fig. 2).

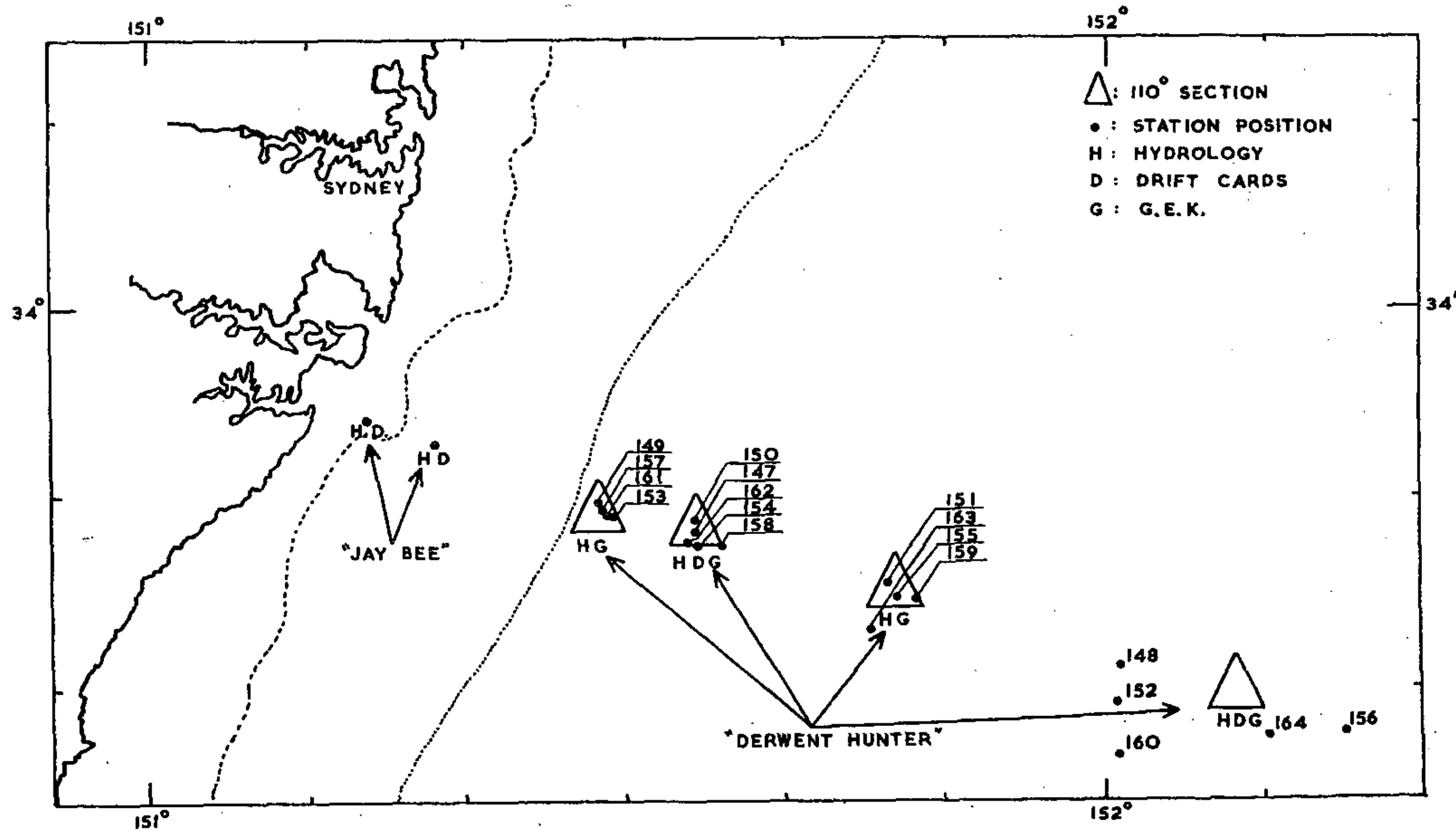

Fig.1. Positions of stations worked by F.R.V. "Jay Bee" and F.R.V. "Derwent Hunter."

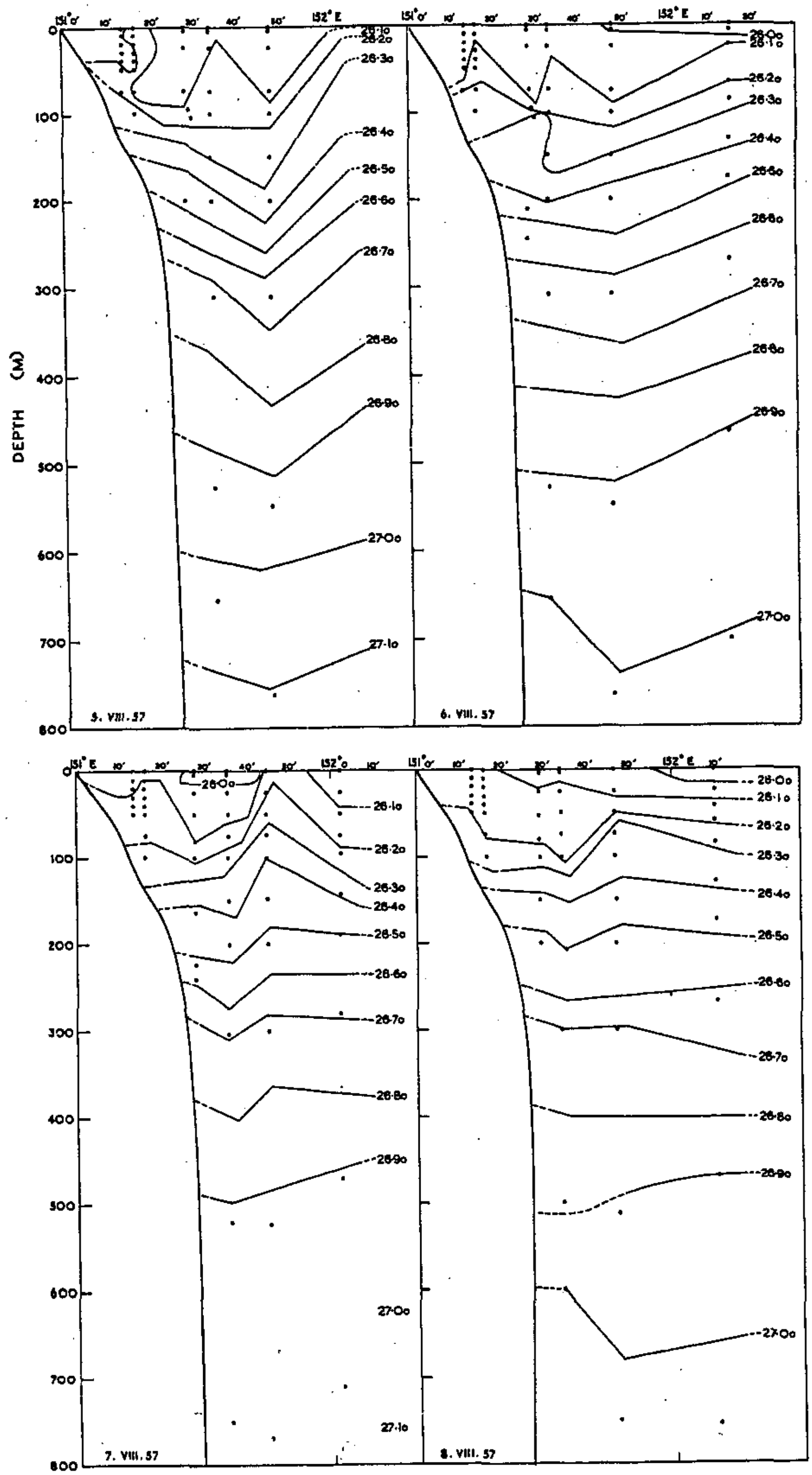

Fig.2. Daily distribution of density (σ_t).

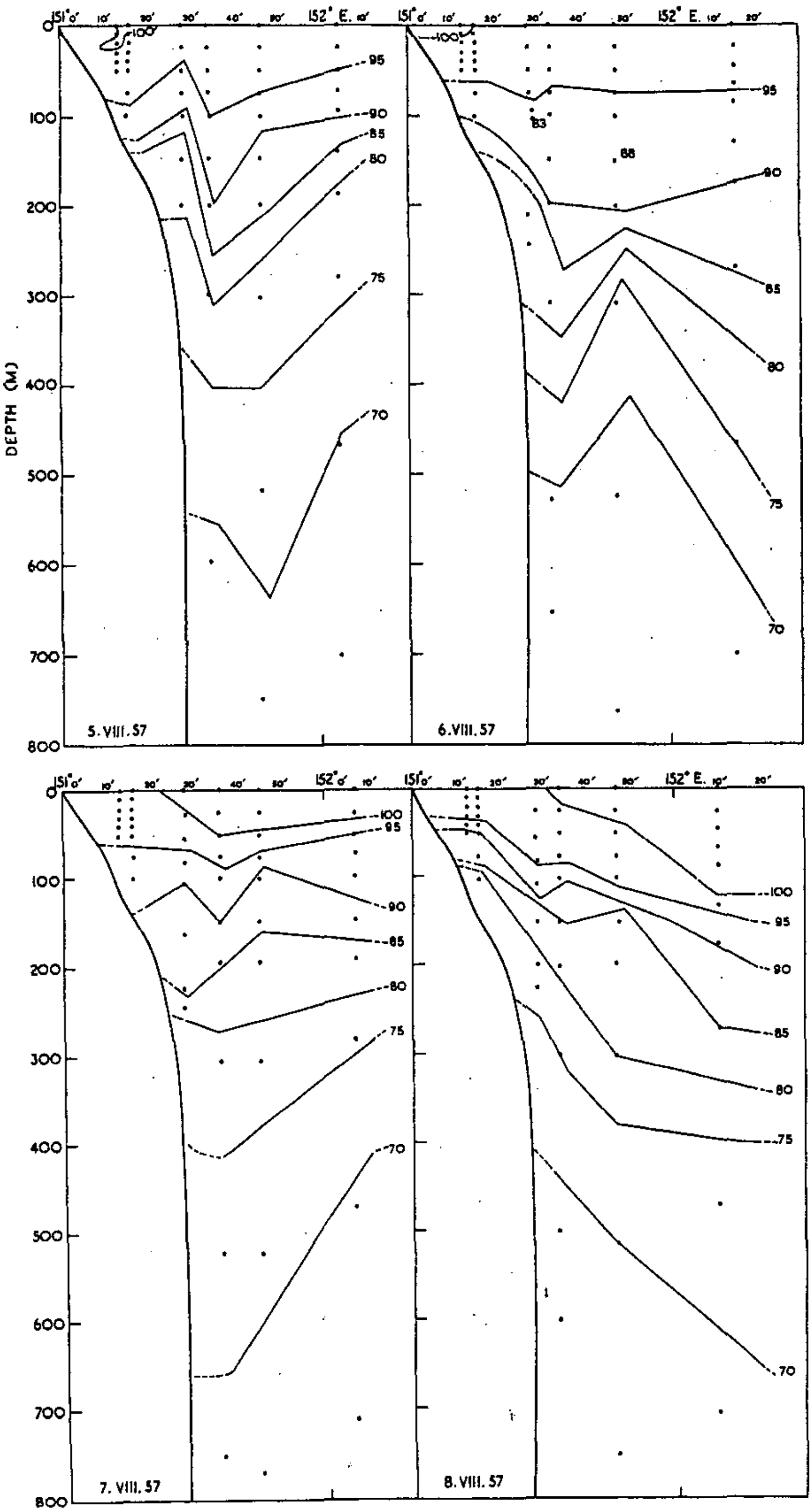

Fig. 3. Daily distribution of oxygen saturation (%).

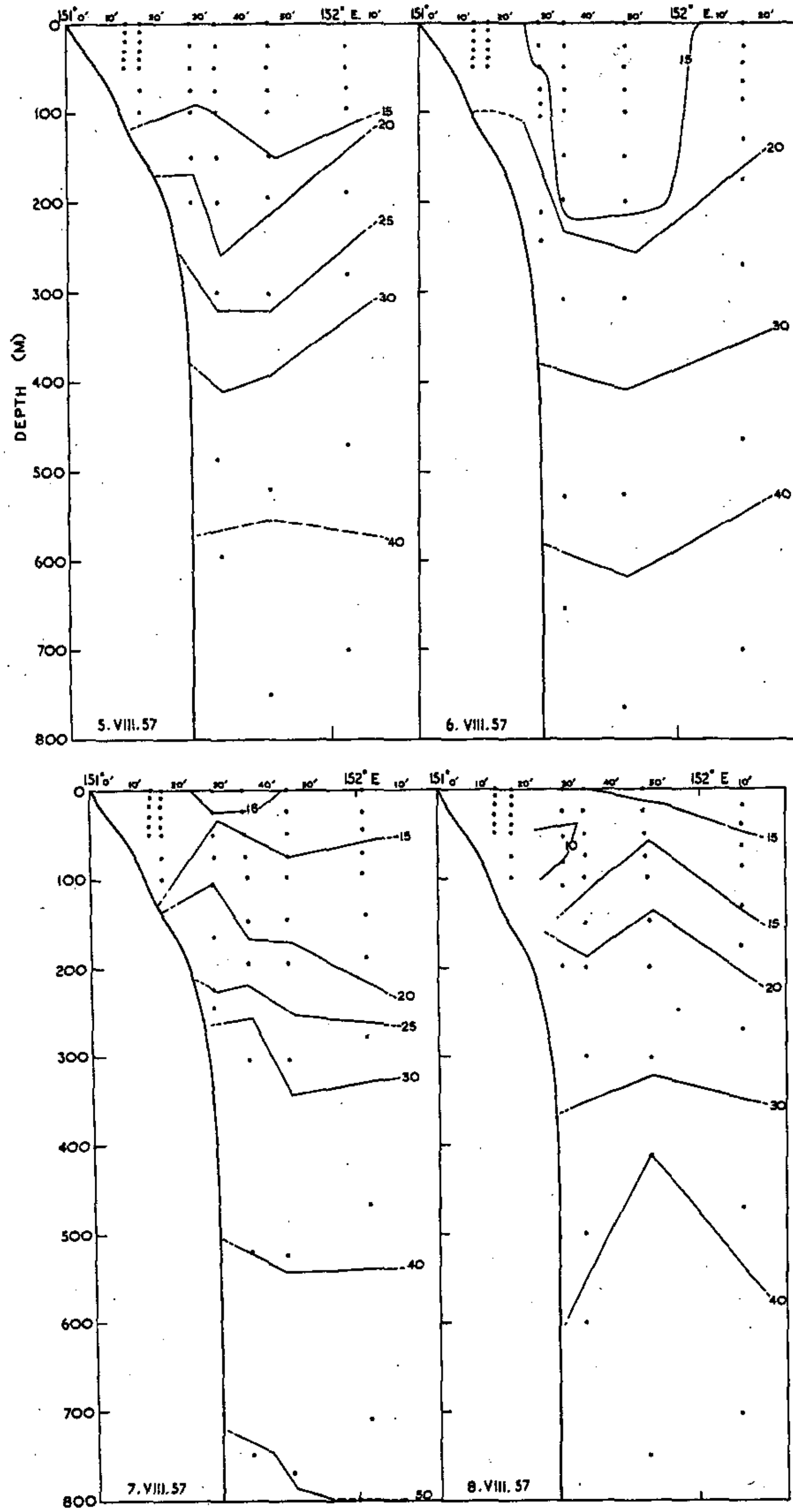

Fig.4. Daily distribution of total phosphorus.

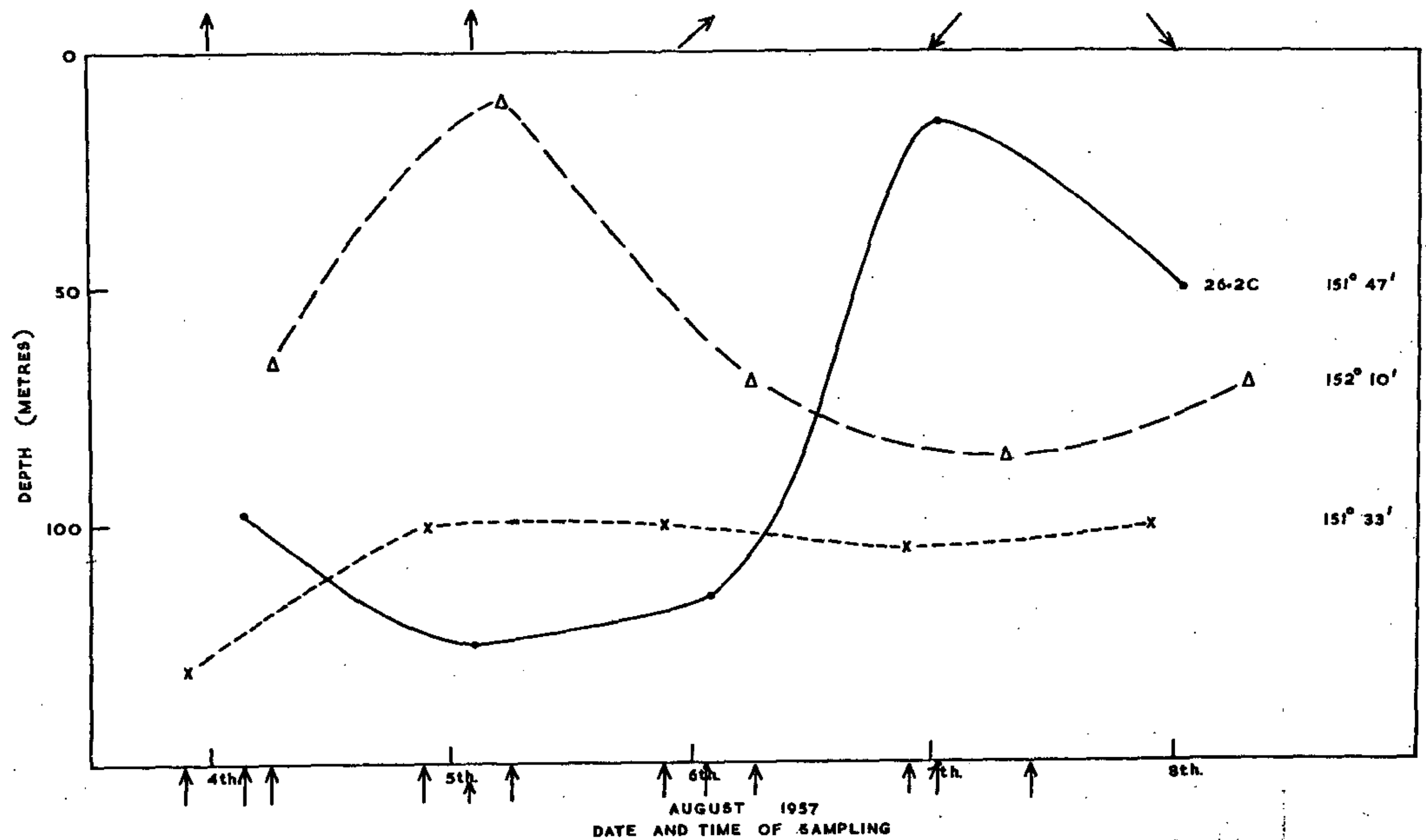

Fig.5. Variation in depth of occurrence of the 20.26 isopycnal at stations approximately on longitudes indicated.

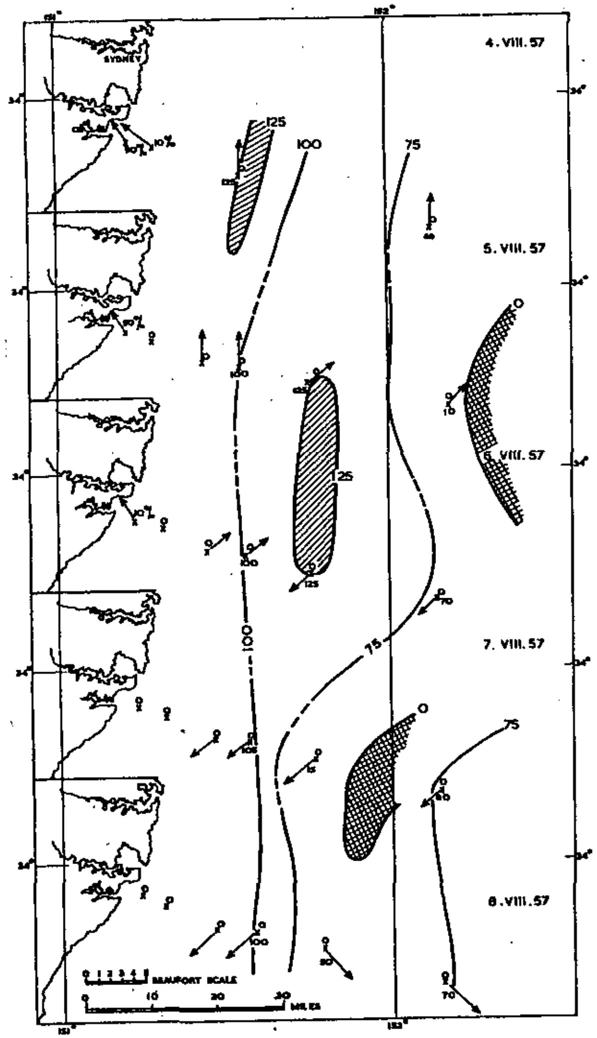

Fig. 6. Daily variation in the depth of the 26.20 sigma t surface in relation to wind direction and speed (⟶). Upper values show percentage of onshore drift card recoveries; lower values depth of isopycnal. Hatched areas show maximum, and cross hatched minimum depths of occurrence.

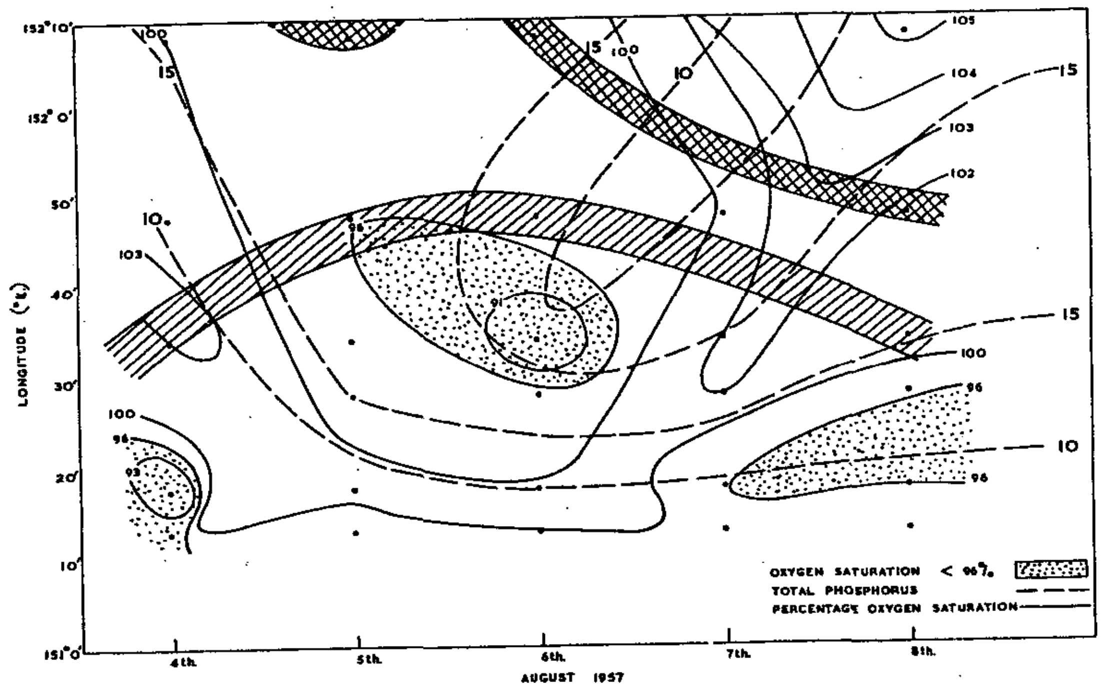

Fig. 7. Daily variation in the values of oxygen saturation and total phosphorus on the 26.20 isopycnal. Maximum and minimum depths of this isopycnal are shown by hatching and cross hatching respectively.

DIVISION OF FISHERIES AND OCEANOGRAPHY

REPORTS

1. Thomson, J.M. (1956).- Fluctuations in catch of yellow eye mullet *Aldrichetta forsteri* (Cuvier and Valenciennes) (Mugilidae).

2. Nicholls, A.G. (1957).- The Tasmanian trout fishery. I. Sources of information and treatment of data. (For limited circulation: not available for exchange).

3. Nicholls, A.G. (1957).- The Tasmanian trout fishery. II. The fishery of the north west rivers. (For limited circulation: not available for exchange).

4. Chittleborough, R.G. (1957).- An analysis of recent catches of humpback whales from the stocks in Groups IV and V. Prepared for the International Commission on Whaling.

5. F.R.V. "Derwent Hunter" Scientific Reports of Cruises DH3/56, DH4/56, DH5/56.

6. Cowper, T.R., and Downie, R.J. (1957).- A line fishing survey of the fishes of the south-eastern Australian continental slope.

7. Davis, P.S. (1957).- A method for the determination of chlorophyll in sea-water.

8. Jitts, H.R. (1957).- The ^{14}C method for measuring CO_2 uptake in marine productivity.

9. Hamon, B.V. (1957).- Mean sea level variations on the east Australian coast.

10. Nicholls, A.G. (1957).- The Tasmanian Trout Fishery. III. The rivers of the north and east. (For limited circulation: not available for exchange).

11. Nicholls, A.G. (1957).- The population of a trout stream and the survival of released fish. (For limited circulation: not available for exchange).

REPORTS CONT.

12. F.R.V. "Derwent Hunter" Scientific Report of Cruise DH6/56.

13. Chau, Y.K.- The coastal circulation of New South Wales from drift card results 1953-56.

14. Kott, Patricia.- Zooplankton of East Australian waters 1945-54.

15. F.R.V. "Derwent Hunter" Scientific Reports of Cruises DH1/57, DH2/57, DH3/57, DH4/57.

16. Rochford, D.J. (1958).- The seasonal circulation of the surface water masses of the Tasman and Coral Seas.

17. Chittleborough, R.G. (1958).- Australian catches of humpback whales 1957. Prepared for the International Commission on Whaling.

18. Australian documents prepared for the Unesco Conference on the Oceanography of the Tasman and Coral Seas held at Cronulla August 9-14, 1958.

19. F.R.V. "Derwent Hunter" Scientific Reports of Cruises DH5/57, DH6/57, DH7/57, DH8/57.