ISSN 2538-1016; 56

NEW ZEALAND
DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

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Hydrology of the Southern Kermadec Trench Region

by
N. M. RIDGWAY

New Zealand Oceanographic Institute
Memoir No. 56

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Price $1.00

This publication should be referred to as:
Bull. N.Z. Dep. scient. ind. Res. 205

MS Completed for Publication: October 1968

A. R. SHEARER, GOVERNMENT PRINTER, WELLINGTON, NEW ZEALAND—1970

FOREWORD

The present study is one of a number of detailed hydrological studies of the ocean surrounding New Zealand carried out by the Institute since 1963. These results greatly extend our knowledge of the hydrological situation that affects the local ocean circulation in the northern and eastern portions of New Zealand.

The memoir was prepared for publication by Miss B. J. Davison.

J. W. BRODIE, Director,

New Zealand Oceanographic Institute,

Wellington.

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HYDROLOGY OF THE SOUTHERN KERMADEC TRENCH REGION

by

N. M. Ridgway

New Zealand Oceanographic Institute

ABSTRACT

This hydrological survey, the third of a series made in the ocean waters surrounding New Zealand during consecutive summers, has revealed the temperature and salinity characteristics of an area to the north-east of New Zealand. The geopotential topography of the sea surface with respect to 1,000 decibars is discussed and some views are presented on the nature of the East Auckland and East Cape Currents systems; these appeared to be a discontinuous series of eddies. Calculations of the velocity of sound are made from the observed data, and velocity corrections for echo sounding are derived for a northern and a southern station.

INTRODUCTION

During the late summer of 1965 a temperature and salinity survey was conducted from the Institute's research vessel, m.v. *Taranui*, in the region of the southern Kermadec Trench. This survey was the third of a series conducted in successive summers. The results of the first two cruises have been published (Garner 1967a,b) and the surveys will eventually cover the oceans around New Zealand to approximately 500 miles off shore.

In the present survey 32 serial stations were occupied between 24 February and 13 March 1965. Twenty-nine of these were in the main survey area lying between latitudes 34° and 38°S and longitudes 178° E and 174° W. Three additional stations, situated to the south of this main block, were occupied on the return passage to Wellington.

Bathymetric features of the western part of the survey area are the southern ends of the Kermadec Trench and the Havre Trough separated by the Kermadec Ridge. Most of the stations were located over the western margins of the deep and rather featureless Southwestern Pacific Basin. Station positions are plotted in Fig. 1, which shows the bathymetry of the region.

Winds were moderately calm throughout the cruise period with the exception of a 5-day period

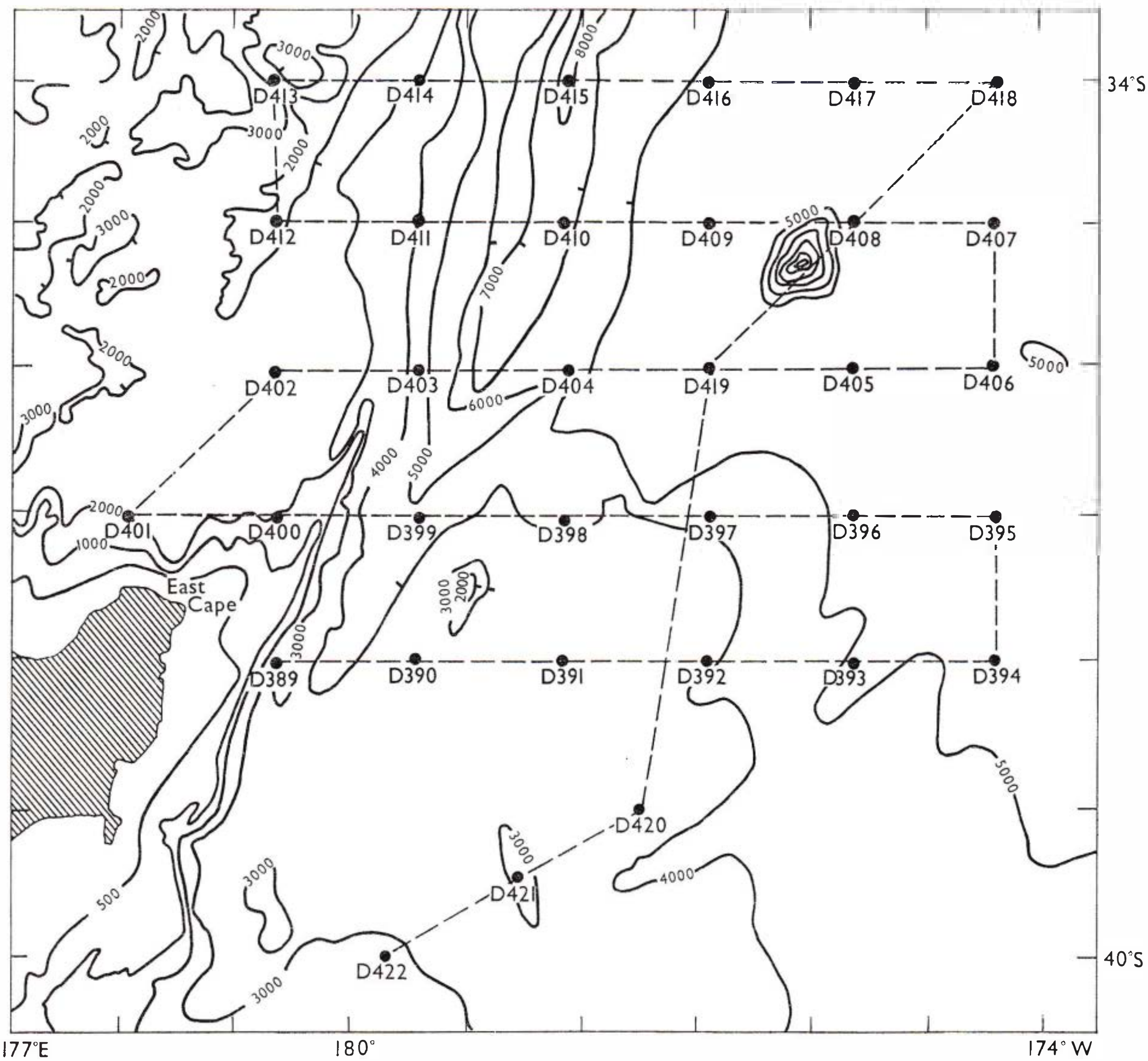

FIG. 1. Chart showing station positions and general bathymetry of the survey area. Depths expressed in metres.

from 2–7 March 1965 when strong winds and rough seas were encountered (Sta. D 404–411). Strong winds again prevailed during 12–13 March 1965 (Sta. D 420–422).

DATA COLLECTION

Knudsen reversing water bottles were used to collect water samples at each station. Normally, a single cast of 22 bottles was employed, the bottles being attached at irregular intervals along the 2,500 m wire. At some stations, however, up to five casts were necessary. These multiple casts were necessitated by bad weather conditions or by the presence of dense aggregations of *Pyrosoma*, which drifted on to the sounding wire and interfered with the bottle release mechanism by cushioning the impact of the messenger.

Water samples were stored in glass bottles in a temperature-controlled room where salinity analyses were made on the following day. This procedure ensured that temperature equilibrium existed between the samples, the Copenhagen Standard Sea Water, and the inductive type salinometer used (Brown and Hamon, 1961).

The temperature and pressure of the water at the depth of sampling were measured by Negretti and Zambra reversing thermometers. Corrected temperatures and depths were derived from these measurements in the manner described by Eger (1962). For the first part of the cruise an unprotected thermometer was used on each bottle at wire lengths of 50 m or more. At Sta. D 412 the wire parted when it fouled the bottom, and 11 bottles were lost, leaving only 5 serviceable unprotected thermometers. These thermometers were placed at wire lengths of 500, 1,000, 1,500, 2,000, and 2,500 m. Intermediate depths were derived from plots of wire lengths against the difference between wire lengths and thermometric depths. These plots were not consistent for stations D 406, D 409, D 417, D 418, and D 421. Data for the first two of these stations were completely rejected, but for the remaining three stations the thermometric depths only were rejected, since correlation of the temperature and salinity data was considered to be good. The measured values of temperature, salinity, and potential density for these three stations (D 417, D 418, and D 421) are listed in Appendix 1. Wire-angle depths (i.e., product of wire length and cosine of the wire angle at the surface) are shown also for these stations.

Bathythermograph soundings were taken at each station and provided details of the temperature structure in the upper 270 m of ocean. These soundings were made immediately the messenger had been released to trip the reversing bottles.

Surface temperature was recorded throughout the cruise by a thermograph, the sensing element being located in the intake pipe for the engine cooling water approximately 2 m below the sea surface.

TABLE 1. Station Circumstances.
Air (screen) temperature and wind properties estimated at bridge level.

Station No.	N.Z. Date/Time		Air Temp. (°C)	Wind		Latitude (South)	Longitude (West Unless Otherwise Indicated)
	Start	Finish		Dirn. (°T)	Speed (kt)		
	Feb/March 1965						
D 389	24/1236	24/1626	18.3	100	02	38°00′	179°20′E
D 390	24/2244	25/0208	18.6	060	02	38°00′	179°25′
D 391	25/0807	25/1337	18.5	040	02	38°00′	178°10.5′
D 392	25/1935	25/2314	19.0	270	01	38°00′	176°55′
D 393	26/0523	26/0733	19.3	280	06	38°00′	175°40′
D 394	26/1303	26/1528	20.3	300	08	38°00′	174°25′
D 395	26/2115	26/2358	19.2	200	02	37°00′	174°25′
D 396	27/0608	27/1005	19.6	120	09	37°00′	175°40′
D 397	27/1545	27/1759	19.5	120	11	37°00′	176°55′
D 398	27/2237	28/0201	18.7	050	17	37°00′	178°10′
D 399	28/0756	28/1114	19.6	050	15	37°00′	179°25′
D 400	28/1706	28/1913	20.0	060	12	37°00′	179°20′E
D 401	1/0757	1/1021	17.5	150	15	37°00′	178°00′E
D 402	1/1950	1/2156	18.9	v'ble	02	36°00′	179°20′E
D 403	2/0428	2/1030	19.0	270	12	36°00′	179°25′
D 404	2/1553	2/2018	18.6	270	25	36°00′	178°10′
D 405	3/0827	3/1220	17.0	v'ble	02	36°00′	175°40′
D 407	4/2217	5/0325	19.6	310	20	35°00′	174°25′
D 408	5/2104	6/0005	18.2	260	20	35°00′	175°40′
D 410	7/0049	7/0335	17.7	210	20	35°00′	178°10′
D 411	7/1142	7/1822	19.0	260	15	35°00′	179°24′
D 412	8/0217	8/0420	18.8	290	05	35°00′	179°20′E
D 413	8/1044	8/1617	19.3	250	07	34°00′	179°20′E
D 414	8/2255	9/0129	19.7	v'ble	02	34°00′	179°26′
D 415	9/0907	9/1140	21.8	000	02	34°00′	178°10′
D 416	9/1827	9/2121	19.7	100	03	34°05′	176°55′
D 417	10/0418	10/1110	20.0	120	09	34°00′	175°40′
D 418	10/1835	10/2215	19.7	140	13	34°00′	174°25′
D 419	11/1619	11/2027	18.5	120	07	36°00′	176°55′
D 420	12/1836	13/0107	17.2	120	15	39°00′	176°26′
D 421	13/0700	13/1057	17.0	090	14	39°31′	178°32′
D 422	13/1638	13/1833	17.5	040	14	40°01′	179°38′
	November 1965						
D 469	5/1318	5/1508	16.0	300	12	37°50′	179°23′E
D 470	5/1523	5/1712	15.7	300	12	37°50′	179°18′E
D 471	5/1750	5/1922	15.5	300	13	37°50′	179°13′E
D 472	5/2014	5/2125	15.5	300	13	37°51′	179°08′E
D 473	5/2152	5/2335	15.1	300	12	37°52′	179°03.5′E
D 474	6/0024	6/0200	14.9	310	08	37°49.5′	178°59′E

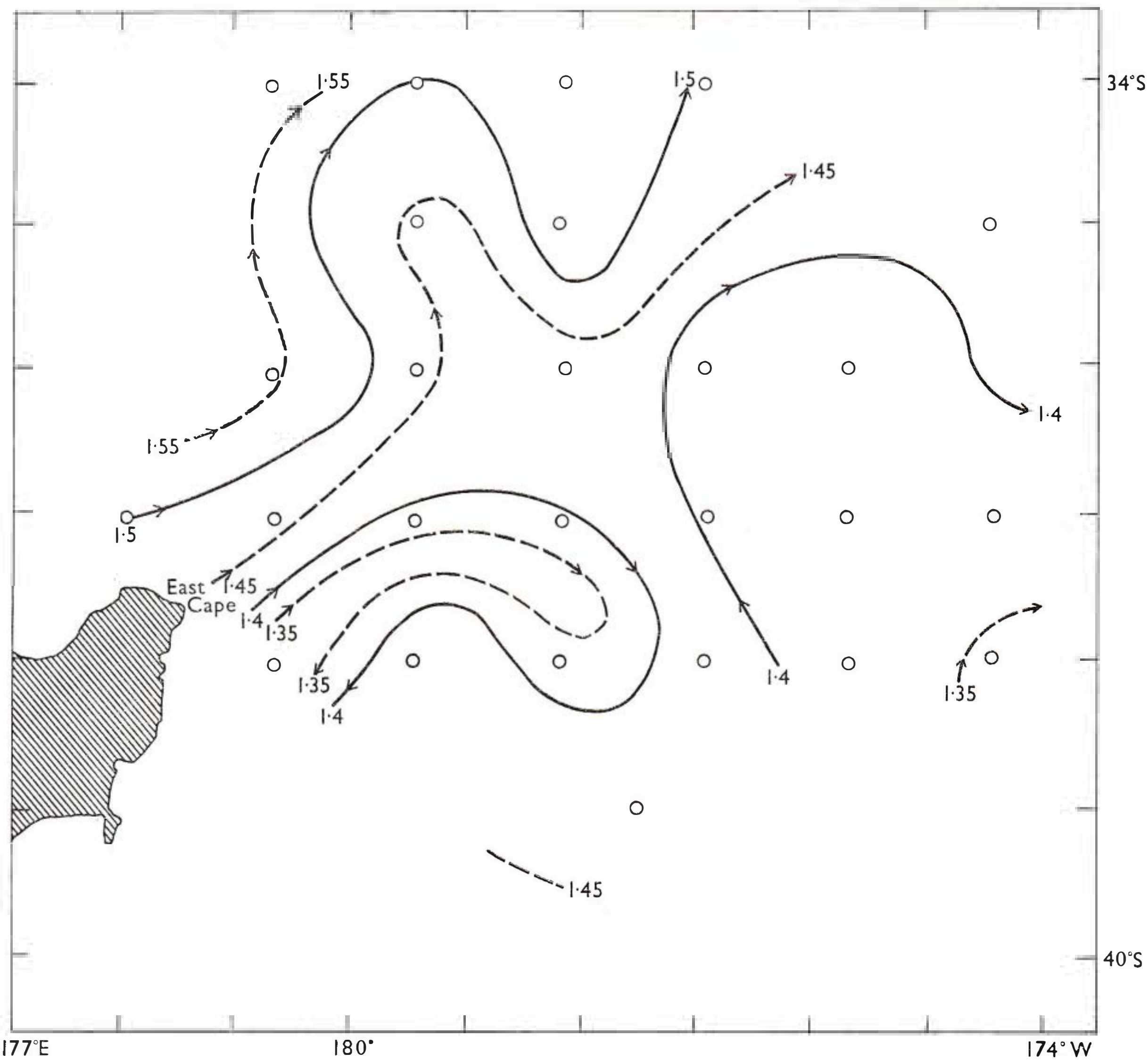

FIG. 2. Geopotential topography of the sea surface relative to 1,000 decibars. Contour values expressed in dynamic metres. Contours also represent streamlines of the geostrophic circulation in the sense shown by the arrows.

DATA PRESENTATION

The observed values of depth, temperature, and salinity are listed in Appendix 1 with computed values of potential density, geopotential anomaly, and sound velocity. Potential densities and geopotential anomalies were obtained from the tables of LaFond (1951) and sound velocities from the tables of Bark *et al.* (1964). Also listed in the Appendix are data obtained at six shallow stations occupied on 5–6 November 1965 at intervals of 5 miles along latitude 37°50′ S (approx.) to the east of East Cape, North Island. Station circumstances are described in Table 1, and in Table 2 the corrections to be applied to echo sounders calibrated for a velocity of sound of 1,500 m sec^{-1} are shown for two selected stations.

The geopotential topography of the sea surface with respect to 1,000 decibars is shown in Fig. 2, and surface isotherms and isohalines are shown in Figs 3 and 4 respectively. Isohalines constructed from the minimum salinity values at each station are shown in Fig. 5.

Cross sections illustrating the vertical distribution of temperature and salinity are shown for north-south and east-west directions (Figs 6, 7). The vertical distribution of sound velocity is illustrated in Fig. 8. The location of this cross section is the same as that shown in Fig. 6. Bathythermograph traces are

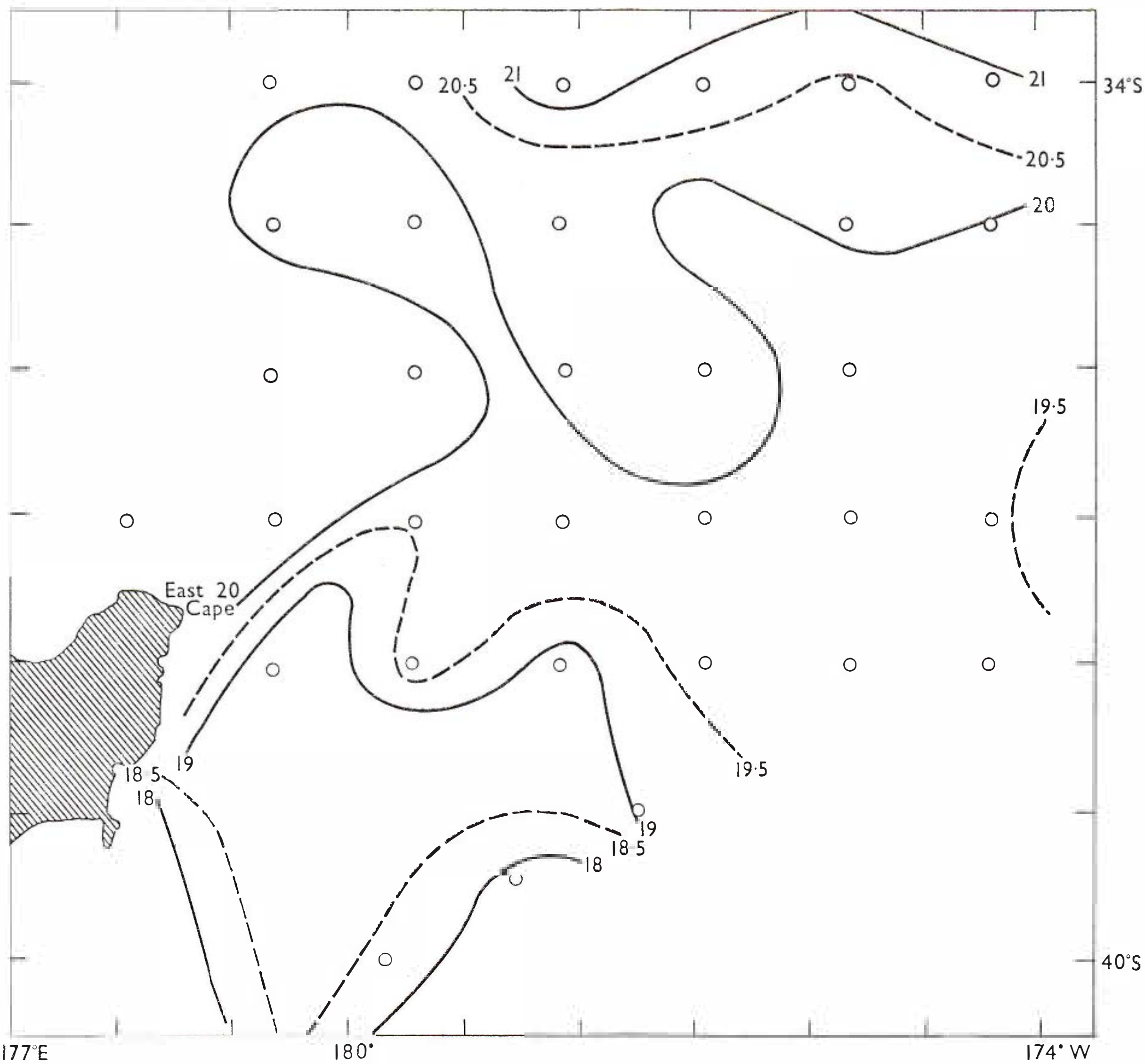

FIG. 3. Distribution of surface isotherms (°C).

reproduced in Fig. 9 and contours of the upper mixed layer depth in Fig. 10.

Two further cross sections showing the vertical distribution of temperature and salinity are illustrated in Fig. 11. These sections were constructed from the data obtained at the six shallow stations occupied off East Cape on 5–6 November 1965.

PREVIOUS WORK

Before the present survey, no systematic hydrological investigation of the area discussed here had taken place. Only five hydrological stations were occupied before 1955 (Garner, 1962), the first of these dating back to the cruise of HMS *Challenger* in 1874.

One station was worked during the winter of 1956 and two more in the summer of 1957 in the area (Garner and Ridgway, 1965).

In the summer of 1958 the Soviet research ship *Vitiaz* occupied three stations within the survey area (Dobrovolsky *et al*., 1960).

Garner (1967a) reported the results of a hydrological survey in the southern region of the Hikurangi Trench, immediately south of the present survey region. Garner showed that a tongue of relatively warm and saline subtropical water associated with the East Cape Current extended southwards off the east coast of the North Island. One aim of the present survey was to determine the source of this water.

DISCUSSION

DYNAMIC TOPOGRAPHY AND GEOSTROPHIC CIRCULATION

The geopotential topography of the sea surface with respect to 1,000 decibars (Fig. 2) shows the geostrophic flow at the sea surface relative to any motion at a depth of approximately 1,000 m. (For a general account of the geostrophic method see, for example, Von Arx, 1962, Ch. 9.) This particular reference surface was chosen partly to permit comparison with the geostrophic circulation shown by Garner (1967a) for the southern Hikurangi Trench region and partly because less data were available for deeper reference surfaces. The geopotential topography with respect to 500, 1,500, 2,000, and 2,500 decibars was examined; differences using these reference surfaces instead of 1,000 decibars were not significant.

The dynamic overall structure was very weak, but the strongest geostrophic flow was in the west of the survey area. In the north-west, the flow was directed north-eastwards. South of this region two topographic troughs had geopotential anomalies of less than 1.4 dyn. m and, south of these again, anomalies somewhat greater than 1.4 dyn. m were found. A ridge separated the two troughs and connected the elevated regions lying to the north and south.

The north-easterly flow of water (indicated by the 1.5 dyn. m contour in Fig. 2) is maintained by water from a region between north and north-west of East Cape. A later hydrological survey in this series, conducted in an area north-west of New Zealand, showed a 1.5 dyn. m contour extending south-westwards past North Cape (Garner, 1970). It is likely that this contour approximately parallels the coast and continues through the survey area as shown in Fig. 2. If this is so, a generally south-easterly current along the east coast of the Auckland Peninsula is indicated. This current would be deflected to the north-east by the eastern Bay of Plenty coastline. The existence of such a current has previously been suggested by Brodie (1960) from drift-card movements. He named it the East Auckland Current.

The two topographic troughs shown south-east of East Cape in Fig. 2 may represent cyclonic eddies associated with the north-easterly deflection of the East Auckland Current. The geopotential anomalies found to the south of these troughs are comparable with those found in the same region by Garner (1967a), who also noted an extensive, anticyclonic eddy centred over the Hikurangi Trench east of Cape Palliser; dynamic elevations at the centre exceeded 1.6 dyn. m.

If the results of the two surveys can be considered as synoptic, this large, anticyclonic eddy would represent water which had separated from the East Auckland Current on being deflected to the north-east.

An analogy may be drawn between the situation described above and that found off the east coast of Australia. There, the East Australian Current flows south to between latitudes 30° and 35°S where it turns to the east. In the process of turning, large anticyclonic eddies are shed off and these drift south along the Australian coast (Wyrtki, 1962a, Fig. 1; Hamon, 1965, Fig. 1).

As mentioned earlier, one aim of the present cruise was to determine the source of that subtropical water appearing in plots of surface properties as a tongue of comparatively warm and saline water extending southwards of the east coast of North Island, e.g., Burling (1961), Garner and Ridgway (1965), Garner (1967a). This feature was associated by Fleming (1952) with a south-going movement of water which he described as the East Cape Current. The present survey gives no evidence of any *direct* flow of water from the East Auckland Current past East Cape, and the vertical cross sections of temperature and salinity constructed from the data obtained on 5–6 November 1965 (Fig. 11) show no structural evidence of any significant geostrophic flow normal to the sections. The geopotential anomalies derived for these stations (see Appendix) may be extrapolated to 1,000 m, and the values referred to this depth are found to be typical of those in the western topographic trough shown in Fig. 2 rather than of the more elevated regions characterising the flow of warm water.

If the anticyclonic eddy found by Garner (1967a) represented water which had earlier separated from the East Auckland Current, then the East Cape Current can be thought of as the integration over a period of the intermittent southward movement of such eddies.

SURFACE TEMPERATURE AND SALINITY

Surface isotherms and isohalines are shown in Figs 3 and 4. The contour patterns are rather diffuse, although the intrusion of comparatively warm, saline water from the north-west and north is

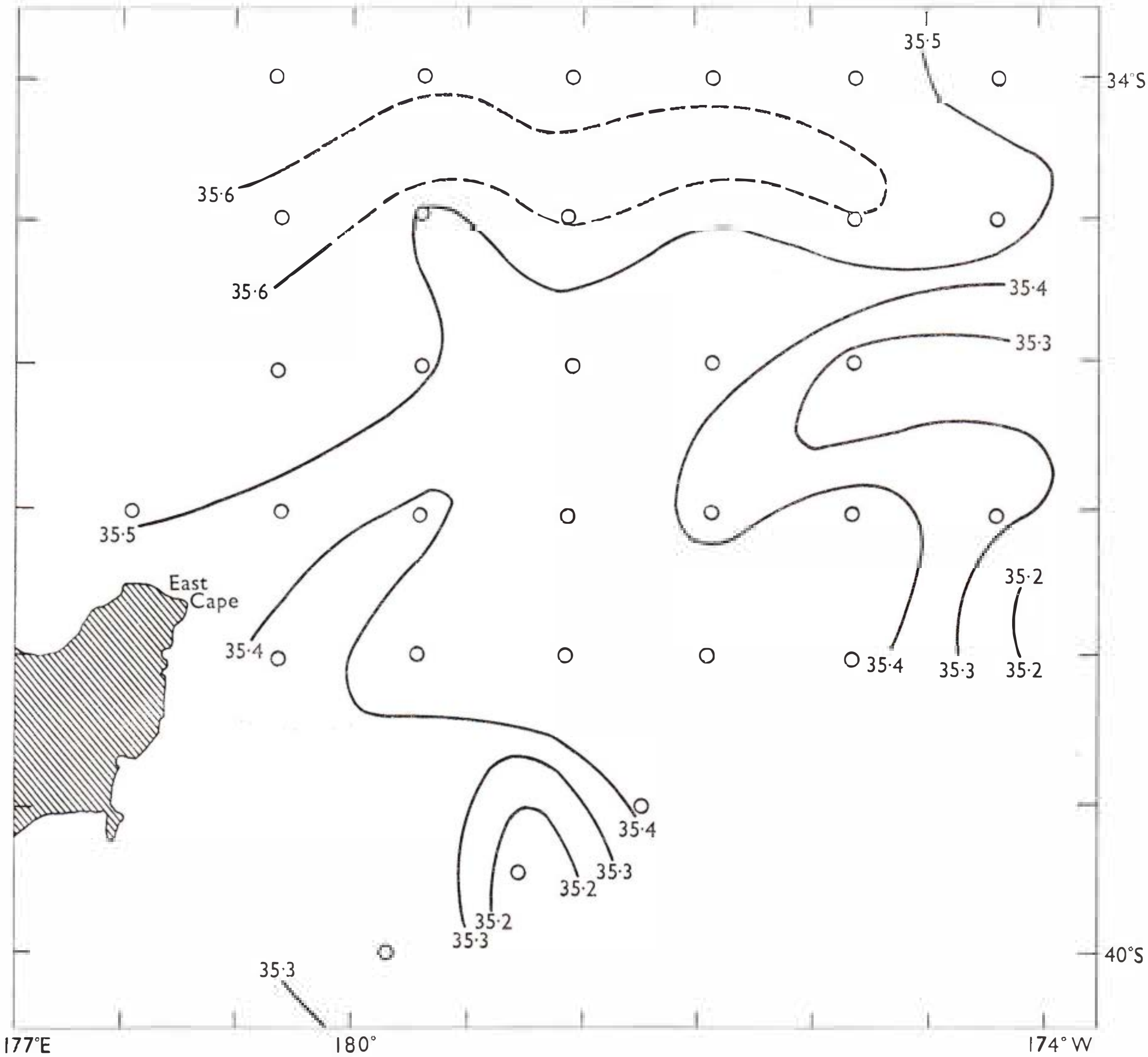

FIG. 4. Distribution of surface isohalines (‰).

illustrated by the 20°C and 35.5‰ isolines. The shape and position of the 35.6‰ isohaline as shown in Fig. 4 is somewhat subjective and may be modified when further data are available from the north-west of the survey area.

Surface temperature and salinity ranged from 18.0°C and 35.2‰ in the south to 21°C and 35.6‰ in the north. In the southern Hikurangi Trench region (Garner, 1967a) these surface properties ranged from 15°C and 34.5‰ in the south to 21°C and 35.6‰ in the north. The similarity between the values found in the north of both survey areas is striking and suggests that the areas are similar hydrologically. The eddy described by Garner contained essentially the same water type as that sampled in the present survey and derived as suggested in the previous section.

UPPER MIXED LAYER

The presence of an upper mixed layer in which the temperature remains almost constant is clearly indicated by the bathythermograph traces reproduced in Fig. 9. This layer was noted at all stations, but the depth of mixing varied as illustrated in Fig. 10, which shows the bathymetry of the mixed layer depth. Some relationship between this bathymetry and the geopotential topography of the sea surface (Fig. 2) is evident. The mixed layer was deepest in the north-west of the survey area where

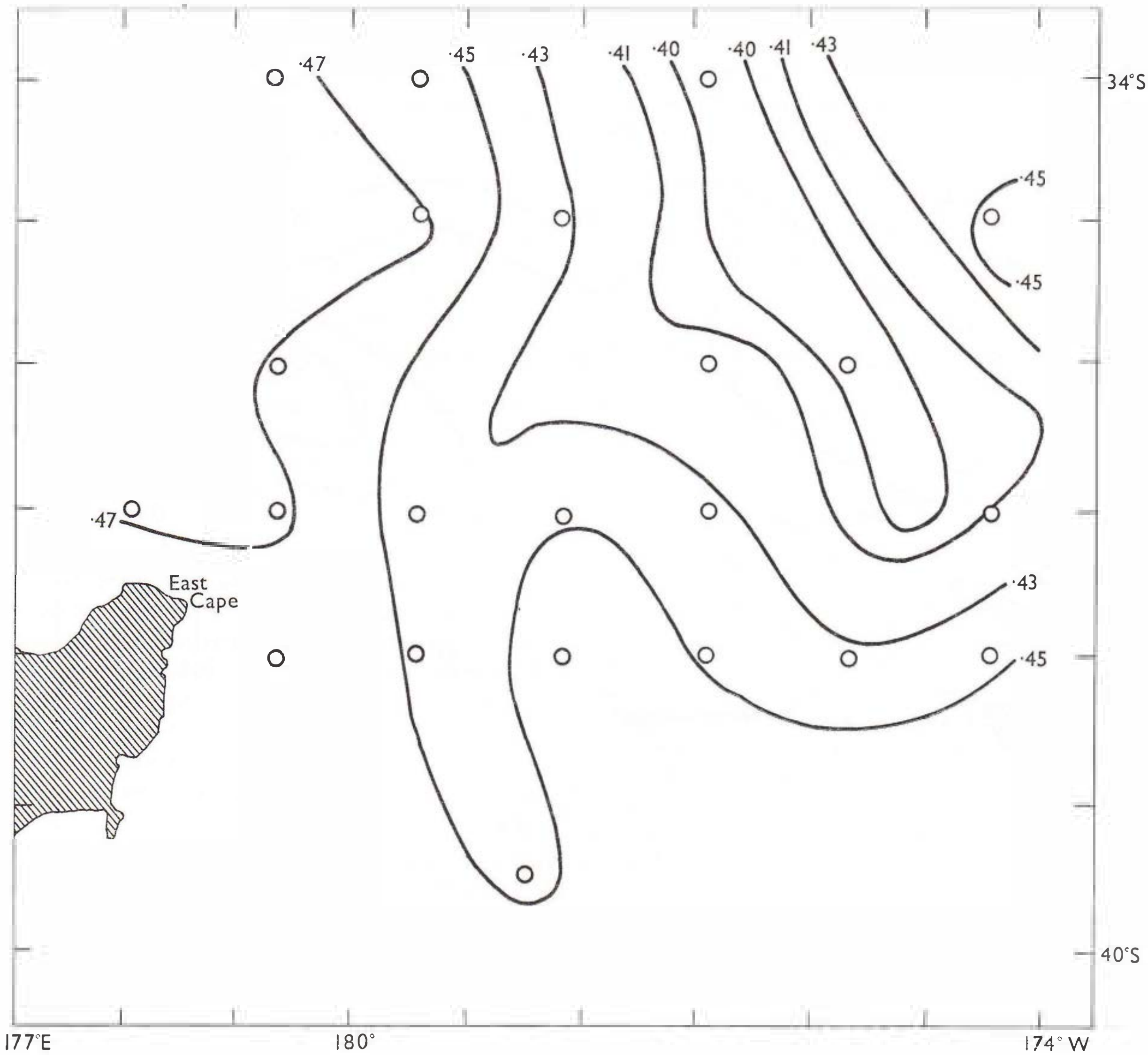

FIG. 5. Distribution of isohalines of minimum salinity. Contour values should be increased by 34‰.

the geopotential anomalies are highest and was shallowest in those regions with topographic troughs. This relationship suggests that the depth of the upper mixed layer is controlled by the dynamics of flow rather than by local mixing agencies and reflects the geostrophic balance of the density structure and the velocity field (see, for example, Defant, 1961, p. 464).

SUBSURFACE TEMPERATURES

The vertical distribution of temperature along two cross sections is illustrated in Figs 6 and 7.

In the north-south section (Fig. 6) a well developed thermocline existed at depths between 50 and 100 m except in the region of Sta. D 420, where the thermocline deepened. With this exception the isotherms within the thermocline were almost horizontal.

Below the thermocline and down to a depth of 1,600 m, where the temperature was approximately 3°C, the intermediate isotherms showed marked departures from the horizontal. Since the density of sea water is mainly a function of temperature, the slope of isotherms will approximate that of isopycnals and will consequently give an indication of components of geostrophic flow normal to the section. Between Sta. D 416 and D 419 in the north the isotherm slope indicates an east-going component in the geostrophic flow between approximately 100 and 1,500 m. South of Sta. D 419 the mean isotherm slope indicates a west-going component

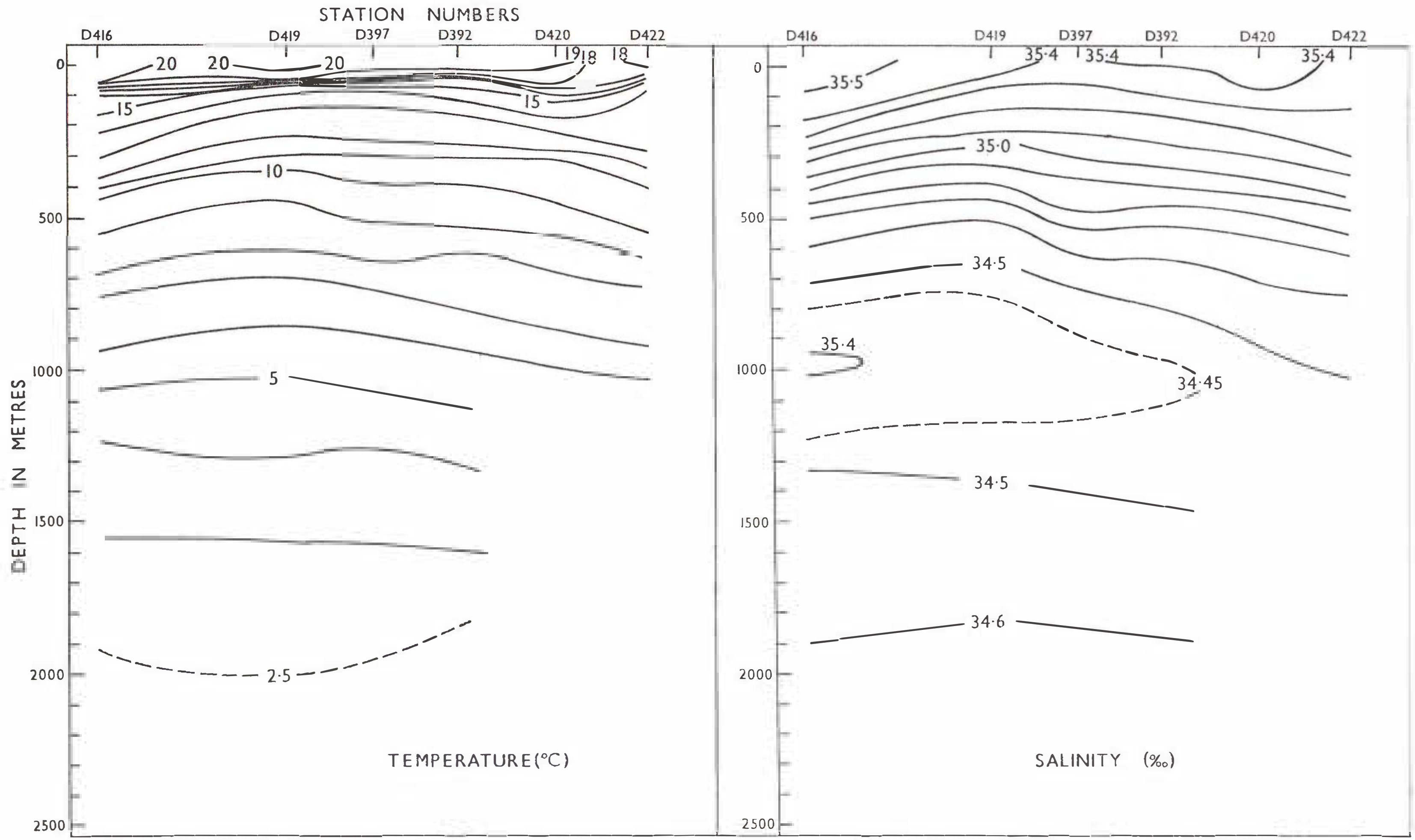

FIG. 6. Vertical meridional cross sections of temperature (°C) and salinity (‰).

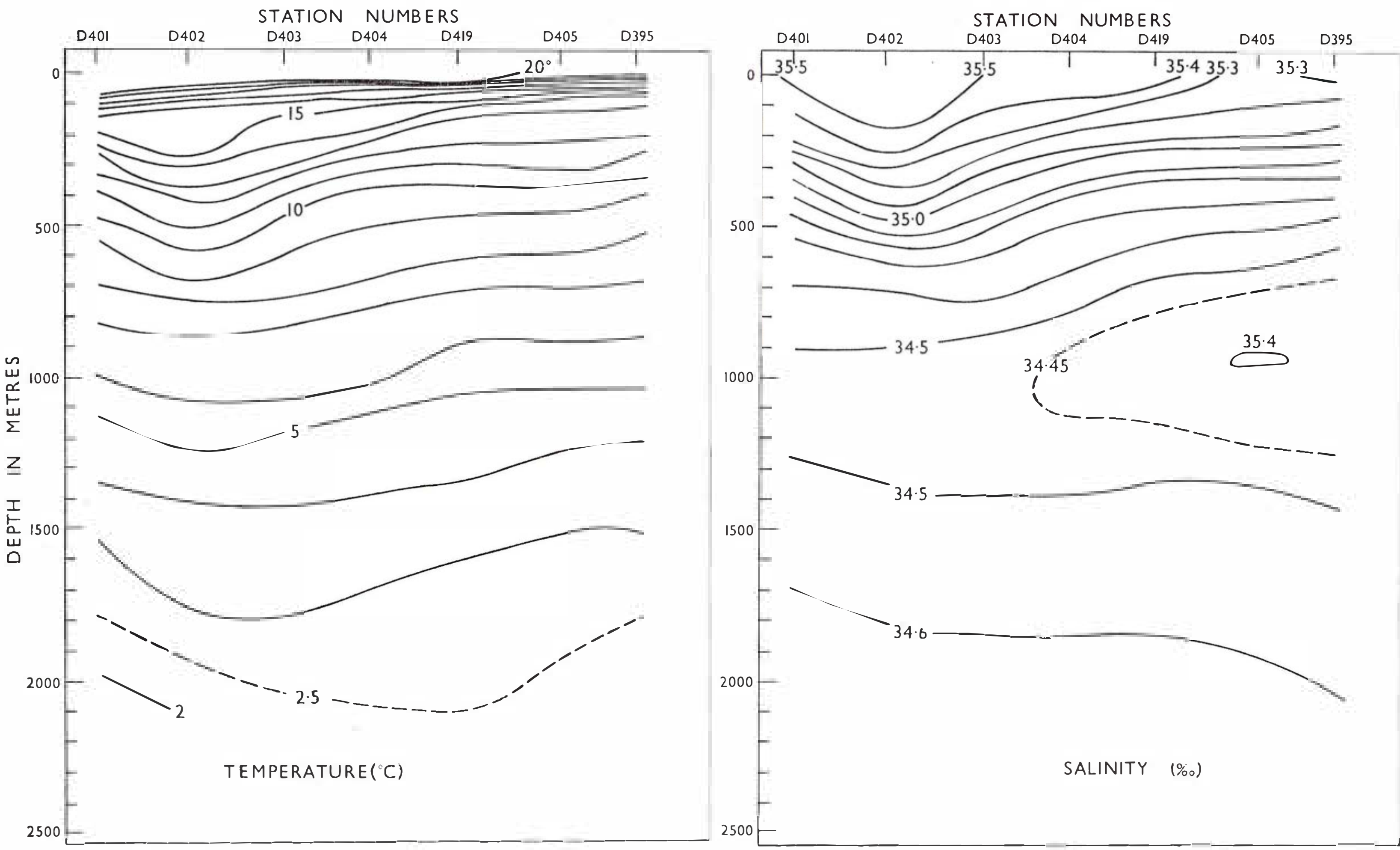

FIG. 7. Vertical zonal cross sections of temperature (°C) and salinity (‰).

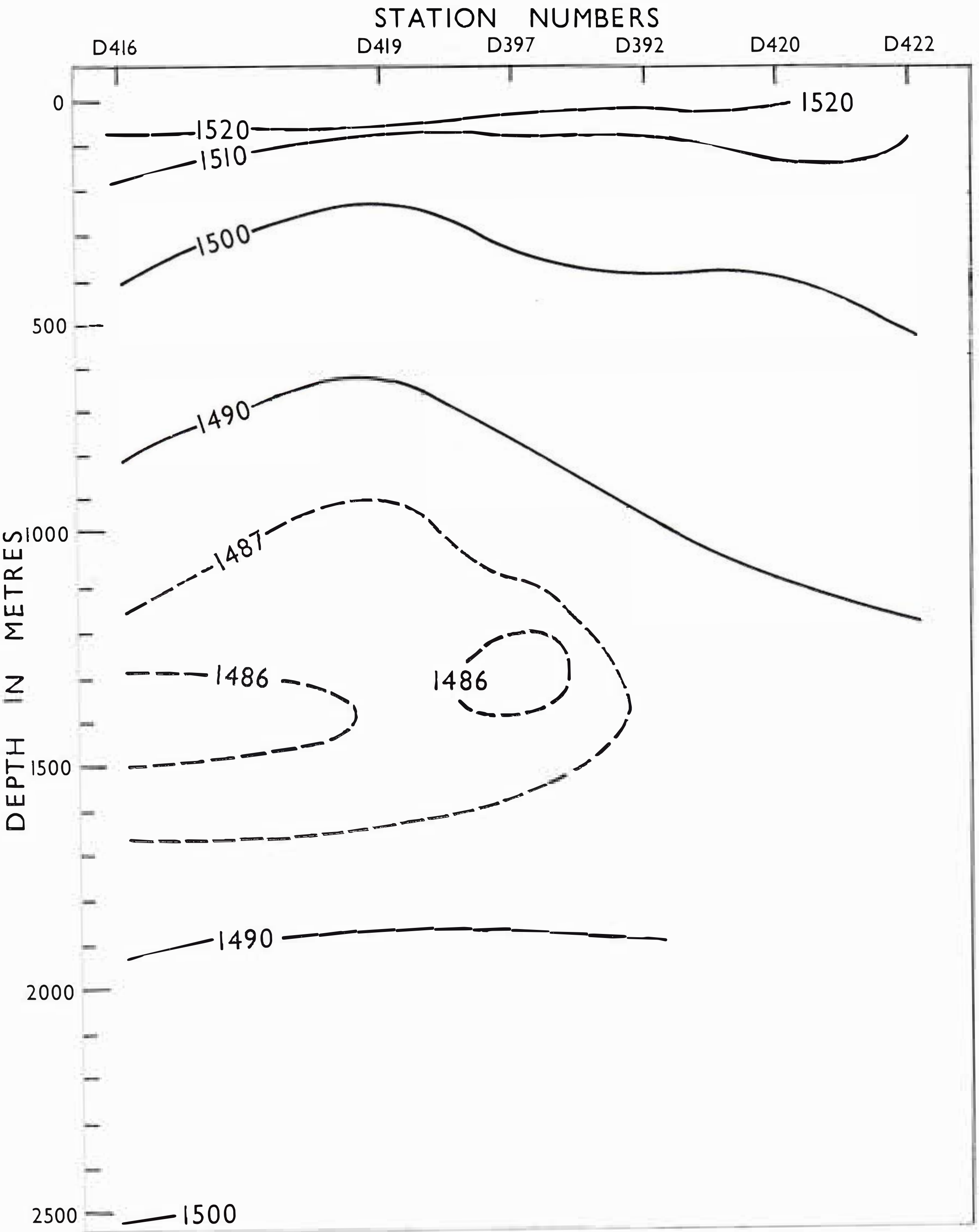

FIG. 8. Vertical meridional cross section of sound velocity. Contour values expressed in metres per second.

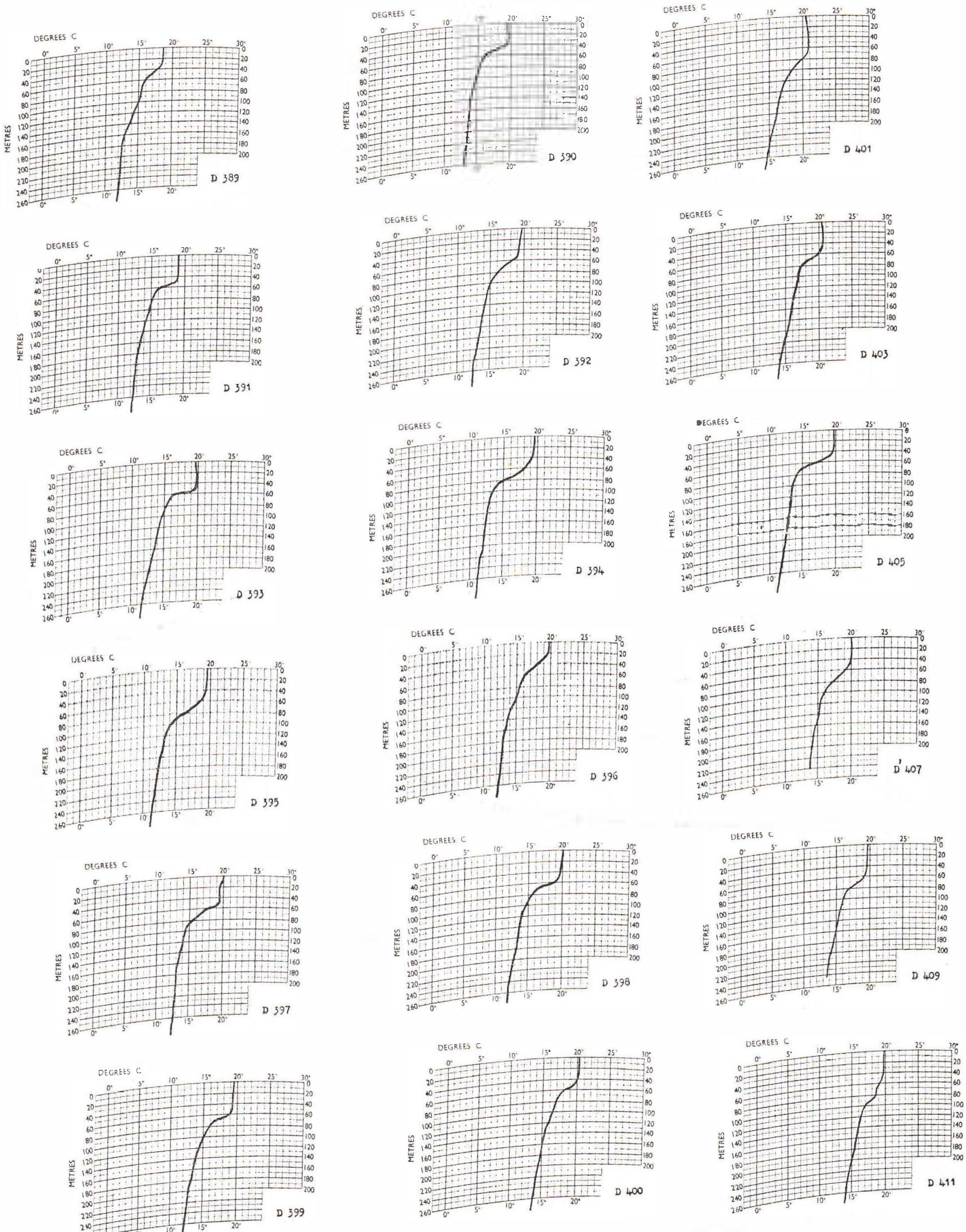

FIG. 9. Bathythermograph traces from the stations indicated.

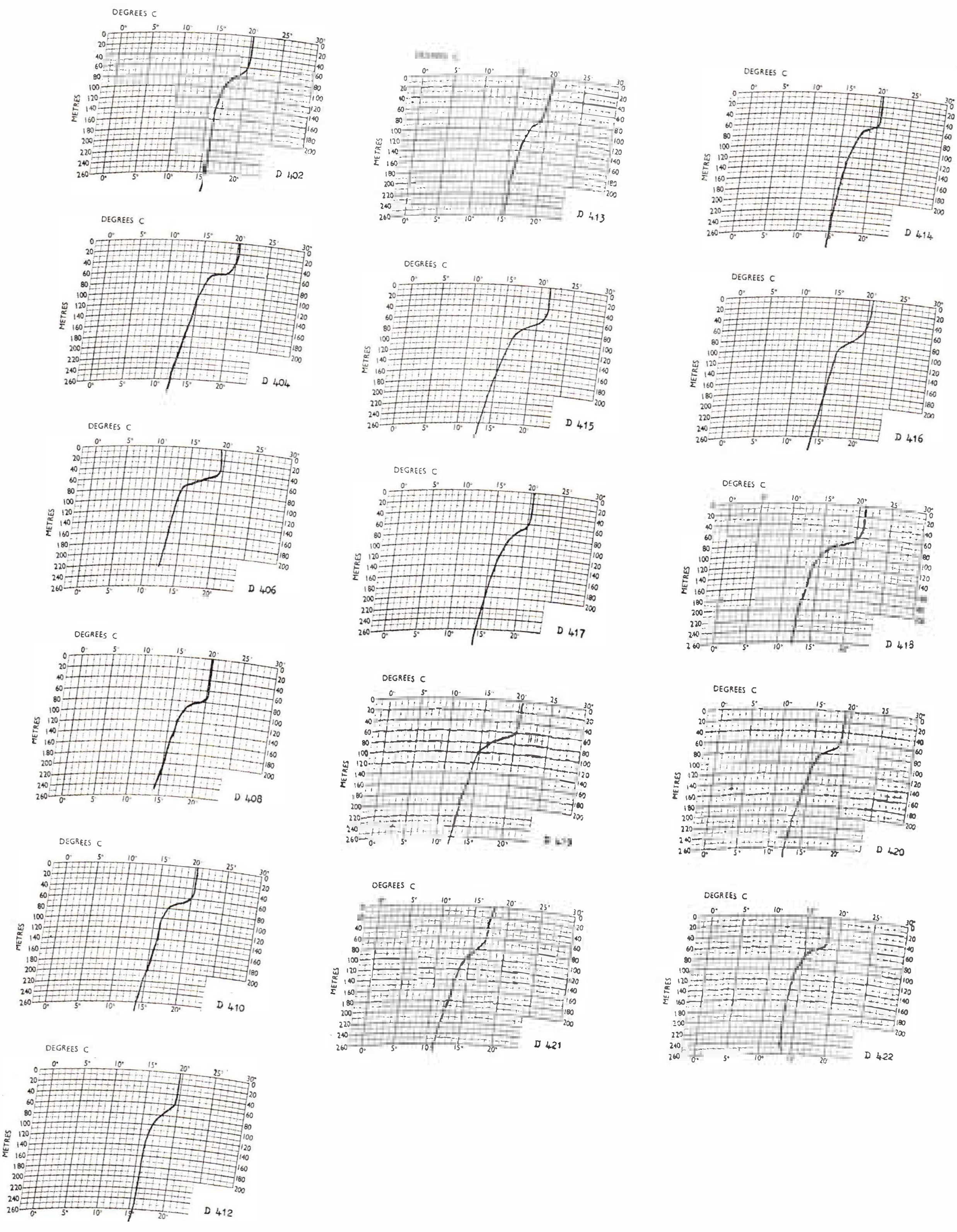

FIG. 9.—*continued.*

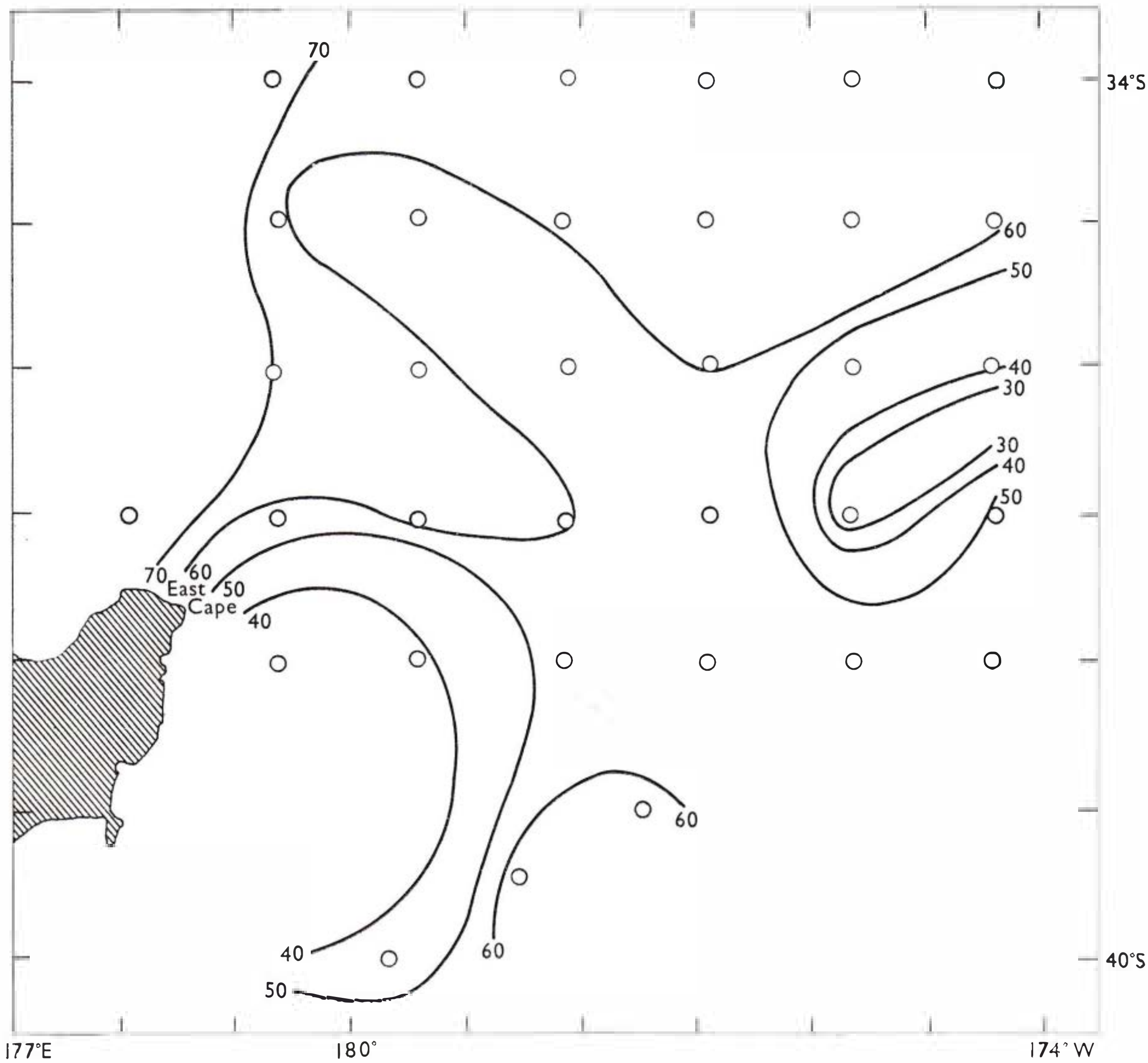

FIG. 10. Contours of the depth of the mixed layer. Values expressed in metres.

of the geostrophic flow below the thermocline extending to a depth of 1,600 m. Since the surface-water temperature falls towards the south the isotherms will reverse their slope eventually and lead towards the surface south of the survey area.

The east-west temperature section (Fig. 7) also shows a well developed thermocline between 50 and 100 m. Isotherms below the thermocline all show significant departures from the horizontal. Between Sta. D 401 and D 402, at the western end of the section, the slope of the isotherms indicates a relative south-going component in the geostrophic flow below 200 m and extending at least to 2,000 m. To the east of Sta. D 402 the isotherm slope is reversed and a relative north-going component in the geostrophic flow is indicated. This component is present below about 100 m and extends to a depth of 1,700 m or more.

SUBSURFACE SALINITY

The salinity structure in both cross sections (Figs 6, 7) was governed by the temperature structure. This is shown by the manner in which isohalines follow the isotherms in the corresponding temperature cross sections. No subsurface salinity maximum existed, the salinity decreasing uniformly from the surface to a salinity minimum which represents the core of Antarctic Intermediate Water at depths of 900 to 1,100 m. Below this core layer salinity gradually increased.

Within the core layer, salinity increased from north to south in the meridional cross section

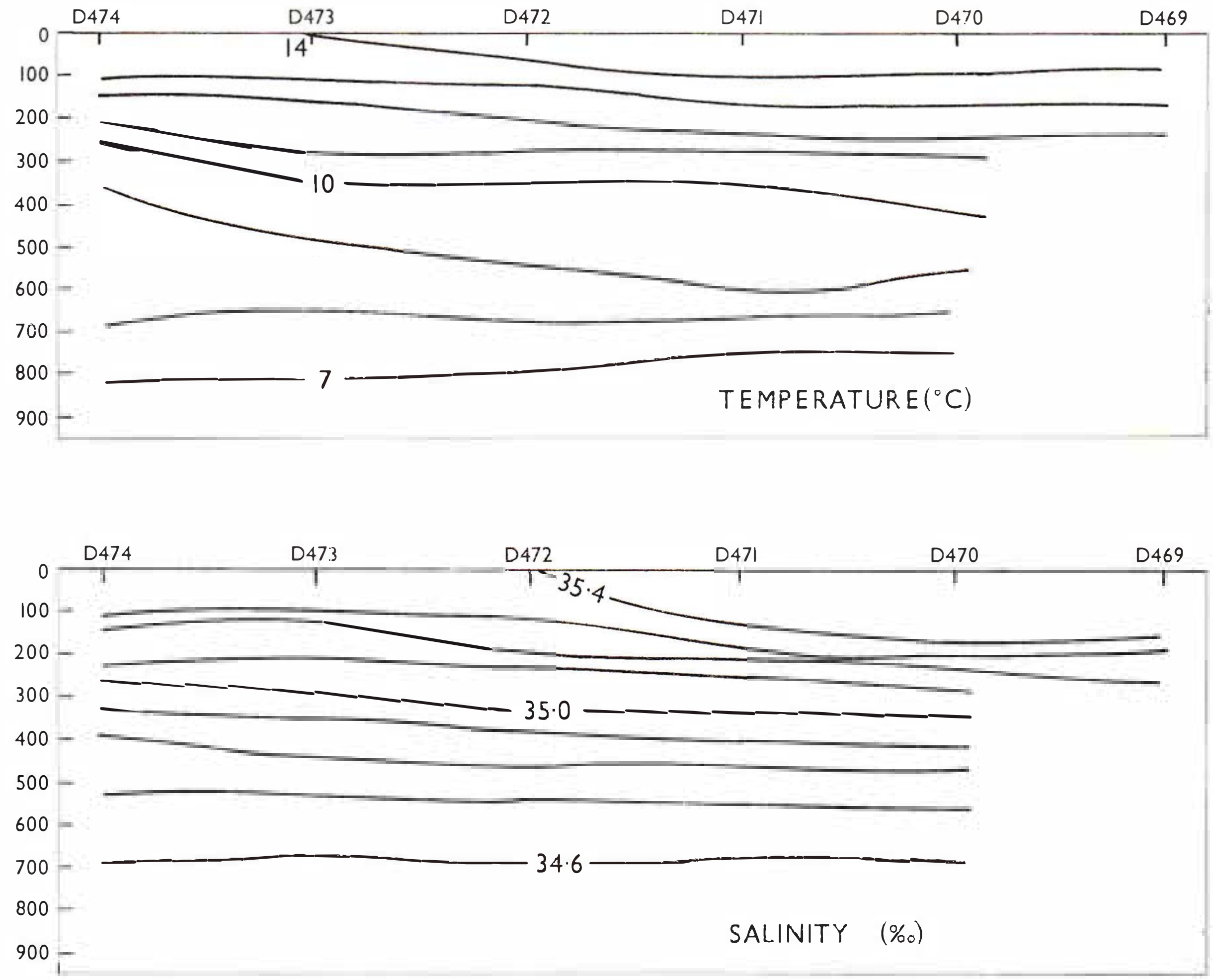

FIG. 11. Vertical meridional cross section of temperature (°c) and salinity (‰). Data obtained from stations occupied on 5–6 November 1965.

TABLE 2. Mean Vertical Sounding Velocity

Corrections (m) to be added algebraically to echo soundings from machines calibrated at 1,500 m sec^{-1} derived from data given in Appendix. Corrections are shown for two stations together with appropriate area corrections from Matthews' Tables.

Depth (m)	Station D 392		Station D 416		Matthews (Area 41)	
	MVSV m sec^{-1}	Correction for Sounder Set at 1,500 m sec^{-1}	MVSV m sec^{-1}	Correction for Sounder Set at 1,500 m sec^{-1}	MVSV m sec^{-1}	Correction for Sounder Set at 1,500 m sec^{-1}
200	1,511	+ 1	1,516	+ 2	1,530	+ 4
400	1,507	+ 2	1,510	+ 3	1,514	+ 4
600	1,503	+ 1	1,506	+ 2	1,504	+ 2
800	1,500	0	1,503	+ 2	1,499	− 1
1,000	1,498	− 1	1,500	0	1,496	− 3
1,200	1,496	− 3	1,498	− 2	1,494	− 5
1,400	1,495	− 5	1,496	− 4	1,493	− 7
1,600	1,495	− 5	1,495	− 5	1,492	− 9
1,800	1,494	− 7	1,494	− 7	1,491	−11
2,000	1,493	− 9	1,494	− 8	1,491	−12
2,200	1,493	−10	1,494	− 9	1,492	−12
2,400	1,494	−10	1,494	−10	1,492	−13

(Fig. 6) and from east to west in the zonal cross section (Fig. 7). This increase in salinity was accompanied by an increase in the depth of the layer from 1,000 m to an estimated 1,120 m in the meridional section and from 900 m to 1,100 m in the zonal section.

ANTARCTIC INTERMEDIATE WATER

The areal distribution of the core layer of Antarctic Intermediate Water is shown in Fig. 5. A well defined tongue of low salinity water (> 34.4‰) is located in the north-east of the survey area. Antarctic Intermediate Water with salinity less than 34.4‰ was shown to exist north of New Zealand by Wyrtki (1962b) who postulated that this water comes from a strong northward flow of Antarctic Intermediate Water around the eastern end of Chatham Rise. Garner (1962) has discussed the predominant effect of bottom topography in controlling the circulation of Antarctic Intermediate Water and has described a tongue of such water (34.5‰) extending southwards off the east coast of North Island.

The tongue of Antarctic Intermediate Water extending south-eastwards in the present survey shows that the flow of this water, after being deflected by the Chatham Rise, is directed towards the south.

SOUND VELOCITY

A meridional cross section showing the vertical distribution of sound velocity is featured in Fig. 8. No subsurface maximum in the sound velocity was present, the sound velocities decreasing with depth until minimum values, representing the SOFAR channel, were reached. The axis of the channel lay at a depth of approximately 1,400 m. The minimum sound velocity increases from north to south along the section.

Throughout the survey area in general, sound velocity in the SOFAR minimum layer was highest in the west and decreased towards the east. Sound velocities within this layer ranged from 1,484.8 m sec^{-1} at Sta. D 405 to 1,488.9 m sec^{-1} at Sta. D 402.

The configuration of the SOFAR channel around New Zealand has been described by Garner (1967c), but for the area covered by this survey few data were available. Sound velocities determined here supplement Garner's work and define the detail of the SOFAR channel configuration within the survey area.

ECHO SOUNDER CORRECTIONS

Echo sounders are usually calibrated for an assumed velocity of sound in sea water of 1,500 m sec^{-1}. Errors in depth resulting from this assumption are compensated by applying corrections according to Matthews' tables (Matthews, 1939). The sound velocities shown here allow the velocity correction of echo soundings to be computed directly for comparison with those obtained by Matthews' tables.

Such computations have been made for two stations (Sta. D 416 and D 392) located in the north and south respectively of the survey area (Table 2). Corrections according to Matthews' tables are also shown. The corrections derived from the survey data are slightly smaller than those given by Matthews, confirming a trend found in the two previous surveys of this series (Garner, 1967a, b). This suggests that the redetermination of sound velocity corrections applicable to the New Zealand region as a whole may be desirable.

ACKNOWLEDGMENTS

The writer appreciates the assistance given in the field by Th. J. Houtman, E. J. Barnes, W. Main, and I. D. Slater of the New Zealand Oceanographic Institute and by the officers and crew of m.v. *Taranui* commanded by Captain R. D. Matheson. Drawings were prepared for publication under the supervision of Mr C. T. T. Webb, Chief Cartographer, Information Service. Temperature and depth calculations were made on the Treasury IBM 650 computer through the Applied Mathematics Division, DSIR.

Particular thanks are expressed to the writer's colleague, Dr D. M. Garner, for his assistance with the manuscript.

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APPENDIX

STATION DATA

Observed and computed station data are listed on the following pages. Station circumstances are shown in Table 1. The abbreviations used as table headings are:

D	sampling depth in metres.
WAD	wire angle depth in metres. These are shown for stations D 417, D 418, and D 421 (see text under "Data Collection").
T	temperature in °C.
S	salinity in ‰.
σ_t	density reduced to surface pressure isothermally.
$\Sigma\Delta D$	anomaly of the geopotential distance from the sea surface to the sample depth in dynamic metres.
C	*in situ* sound velocity in m sec^{-1}.

D389

D	T	S	σ_t	ΣΔD	C
0	18.68	35.39	25.42	.00	1518.6
49	15.31	35.32	26.17	.11	1509.0
129	13.56	35.21	26.46	.25	1504.6
178	12.56	35.11	26.58	.32	1502.0
225	11.85	35.02	26.65	.39	1500.0
290	11.12	34.94	26.73	.49	1498.2
365	10.45	34.87	26.79	.59	1497.2
397	9.92	34.81	26.84	.63	1495.7
532	8.71	34.65	26.91	.81	1493.0
665	7.84	34.58	26.99	.97	1492.0
730	7.06	34.52	27.05	1.04	1490.1
809	6.61	34.50	27.10	1.13	1489.6
918	5.89	34.47	27.17	1.24	1488.4
1010	5.43	34.46	27.22	1.34	1487.9
1120	4.92	34.47	27.29	1.44	1487.6
1248	4.35	34.48	27.36	1.56	1487.3
1476	3.36	34.55	27.51	1.73	1486.9
1693	2.79	34.60	27.61	1.87	1488.1

D390

D	T	S	σ_t	ΣΔD	C
0	19.65	35.47	25.23	.00	1521.4
12	19.43	35.47	25.29	.03	1521.0
31	16.90	35.41	25.87	.08	1513.7
67	15.11	35.39	26.27	.15	1508.7
89	14.66	35.37	26.35	.19	1507.6
147	13.61	35.29	26.51	.28	1505.0
188	13.43	35.27	26.53	.35	1505.2
247	13.01	35.22	26.58	.44	1504.5
328	12.31	35.12	26.64	.56	1503.3
501	10.44	34.84	26.77	.81	1499.1
690	8.56	34.63	26.92	1.06	1495.1
789	7.66	34.54	26.98	1.19	1493.1
857	7.15	34.50	27.02	1.27	1492.3
953	6.33	34.46	27.11	1.38	1490.6
1131	5.18	34.45	27.24	1.56	1488.9
1185	4.90	34.46	27.28	1.61	1488.6
1238	4.67	34.46	27.31	1.66	1488.5
1395	3.80	34.49	27.42	1.79	1487.4
1453	3.56	34.51	27.46	1.84	1487.6
1695	2.85	34.57	27.58	2.01	1488.4
1846	2.63	34.60	27.62	2.10	1489.9

D391

D	T	S	σ_t	ΣΔD	C
0	18.97	35.44	25.38	.00	1519.4
24	19.30	35.44	25.30	.06	1520.7
49	16.98	35.44	25.88	.12	1514.4
73	15.43	35.43	26.23	.17	1509.9
98	14.90	35.39	26.31	.22	1508.6
147	13.64	35.29	26.50	.30	1505.2
196	13.09	35.24	26.58	.37	1504.1
245	12.36	35.14	26.65	.45	1502.2
343	10.44	34.86	26.79	.58	1496.8
490	8.73	34.65	26.91	.78	1492.6
637	7.64	34.56	27.00	.96	1490.8
784	6.72	34.51	27.09	1.13	1489.5
882	5.96	34.48	27.17	1.23	1487.9
980	5.31	34.46	27.23	1.33	1486.8
1078	4.75	34.47	27.31	1.43	1486.3
1176	4.30	34.49	27.37	1.52	1485.9
1274	3.92	34.51	27.43	1.60	1486.0
1378	3.51	34.52	27.48	1.68	1485.9
1470	3.16	34.55	27.53	1.75	1486.0
1715	2.75	34.60	27.61	1.[illegible]3	1488.3
2450	2.12	34.66	27.61	2.42	1497.8

D392

D	T	S	σ_t	ΣΔD	C
0	19.67	35.42	25.20	.00	1521.4
25	19.16	35.39	25.30	.07	1520.3
50	18.64	35.35	25.40	.13	1519.2
75	15.66	35.40	26.15	.19	1510.6
100	14.79	35.37	26.32	.24	1508.3
150	13.71	35.25	26.46	.32	1505.4
200	12.99	35.19	26.56	.40	1503.7
250	12.62	35.14	26.60	.48	1503.2
350	11.41	34.98	26.71	.62	1500.4

D392 (cont'd)

D	T	S	σ_t	ΣΔD	C
500	9.28	34.71	26.76	.83	1495.0
650	7.80	34.58	26.99	1.01	1491.6
800	7.08	34.50	27.04	1.19	1491.1
900	6.57	34.47	27.11	1.30	1490.7
1000	5.75	34.45	27.17	1.41	1489.1
1100	5.12	34.45	27.25	1.51	1488.3
1200	4.78	34.46	27.30	1.60	1488.5
1300	4.24	34.47	27.36	1.69	1487.8
1400	3.72	34.49	27.43	1.77	1487.2
1500	3.37	34.52	27.49	1.85	1487.3
1750	2.77	34.58	27.59	1.98	1488.1
2000	2.34	34.62	27.66	2.15	1491.2
2500	2.06	34.65	27.71	2.42	1498.3

D393

D	T	S	σ_t	ΣΔD	C
0	19.76	35.47	25.20	.00	1521.7
23	19.77	35.47	25.20	.06	1522.1
46	19.66	35.45	25.21	.12	1522.1
75	15.48	35.38	26.18	.20	1510.0
91	14.67	35.36	26.34	.22	1507.8
195	12.71	35.17	26.60	.39	1502.7
278	11.54	35.00	26.70	.51	1499.8
415	9.80	34.76	26.81	.70	1495.5
511	8.95	34.67	26.89	.82	1493.8
629	7.98	34.56	26.95	.97	1492.0
742	7.21	34.51	27.02	1.10	1490.6
849	6.58	34.47	27.08	1.22	1490.0
906	6.12	34.45	27.12	1.29	1489.0
1024	5.38	34.43	27.20	1.41	1487.9
1104	4.96	34.44	27.26	1.49	1487.4
1173	4.66	34.44	27.29	1.55	1487.2
1278	4.09	34.46	27.37	1.64	1486.7
1550	3.13	34.52	27.51	1.85	1487.0
1803	2.64	34.58	27.60	2.01	1489.2
2139	2.33	34.62	27.66	2.21	1493.5

D394

D	T	S	σ_t	ΣΔD	C
0	19.58	35.21	25.05	.00	1520.9
22	19.05	35.21	25.19	.06	1519.8
44	18.51	35.21	25.32	.12	1518.5
66	16.85	35.18	25.71	.18	1514.0
78	13.06	35.08	26.46	.20	1501.9
135	12.09	35.04	26.62	.29	1502.7
158	11.81	35.02	26.66	.32	1498.7
308	10.21	34.79	26.77	.53	1495.3
441	8.93	34.64	26.87	.71	1492.6
569	7.91	34.55	26.95	.86	1490.6
687	7.33	34.50	27.00	1.01	1490.2
786	6.71	34.47	27.06	1.12	1489.4
871	6.28	34.46	27.11	1.22	1489.1
952	5.75	34.45	27.12	1.30	1488.2
1118	4.79	34.45	27.18	1.46	1487.1
1217	4.21	34.46	27.25	1.55	1486.2
1286	3.92	34.48	27.40	1.61	1486.1
1489	3.16	34.52	27.51	1.76	1486.2
1694	2.65	34.57	27.60	1.89	1487.5

D395

D	T	S	σ_t	ΣΔD	C
0	19.52	35.32	25.15	.00	1520.8
24	19.24	35.30	25.21	.07	1520.5
49	18.99	35.28	25.26	.14	1520.1
73	16.53	35.24	25.83	.19	1513.1
89	13.62	35.18	26.42	.22	1504.0
141	12.64	35.11	26.57	.31	1501.5
193	12.12	35.05	26.62	.38	1500.5
236	11.64	34.98	26.67	.45	1499.5
306	10.45	34.81	26.75	.55	1496.1
460	8.74	34.61	26.87	.75	1492.1
583	7.76	34.51	26.95	.90	1490.1
726	6.83	34.44	27.02	1.09	1488.9
828	6.58	34.42	27.07	1.20	1489.6
910	5.74	34.41	27.14	1.29	1487.5
991	5.38	34.42	27.19	1.38	1487.3
1080	4.78	34.42	27.26	1.46	1485.7

D395 (cont'd)

D	T	S	σ_t	$\Sigma\Delta D$	C
1166	4.45	34.43	27.31	1.54	1486.4
1269	3.92	34.45	27.38	1.63	1485.9
1346	3.56	34.47	27.43	1.69	1485.6
1565	2.99	34.53	27.53	1.84	1486.8
1790	2.50	34.58	27.62	1.99	1488.4
2245	2.32	34.61	27.66	2.25	1495.2

D396

D	T	S	σ_t	$\Sigma\Delta D$	C
0	19.74	35.44	25.19	.00	1521.6
20	19.74	35.44	25.19	.06	1521.9
39	17.91	35.44	25.33	.11	1516.9
59	16.90	35.45	25.90	.16	1514.2
79	15.31	35.43	26.25	.19	1509.6
118	14.14	35.30	26.41	.26	1506.3
147	13.49	35.22	26.48	.31	1507.8
168	12.97	35.16	26.54	.34	1503.1
270	12.12	35.07	26.64	.50	1501.7
430	10.06	34.77	26.78	.72	1496.6
586	8.35	34.57	26.91	.93	1492.6
685	7.38	34.48	26.98	1.05	1490.4
778	6.62	34.43	27.04	1.16	1488.9
952	5.50	34.40	27.16	1.34	1487.0

D397

D	T	S	σ_t	$\Sigma\Delta D$	C
0	19.96	35.39	25.09	.00	1522.2
22	19.58	35.39	25.19	.06	1521.6
45	18.74	35.39	25.40	.12	1519.4
67	15.32	35.35	26.19	.17	1509.4
90	14.05	35.30	26.42	.21	1505.5
135	13.18	35.23	26.55	.28	1503.3
181	12.69	35.16	26.60	.35	1502.4
227	12.38	35.14	26.65	.42	1502.0
460	10.44	34.89	26.81	.75	1498.7
602	8.88	34.69	26.92	.94	1495.1
745	7.41	34.52	27.00	1.11	1491.4
841	6.74	34.47	27.06	1.22	1480.5
938	5.94	34.45	27.15	1.33	1488.8
1034	5.28	34.44	27.22	1.43	1487.6
1130	4.64	34.44	27.19	1.52	1486.6
1226	4.07	34.46	27.37	1.60	1485.7
1323	3.76	34.47	27.41	1.68	1486.0
1421	3.41	34.49	27.46	1.76	1486.1
1662	2.86	34.55	27.56	1.92	1487.7
1907	2.53	34.60	27.63	2.07	1490.5
2393	2.18	34.66	27.71	2.34	1497.1

D398

D	T	S	σ_t	$\Sigma\Delta D$	C
0	19.95	35.46	25.15	.00	1522.3
21	20.02	35.46	25.13	.06	1522.8
42	19.79	35.46	25.19	.12	1522.5
64	19.40	35.45	25.28	.18	1521.7
85	15.66	35.29	26.07	.23	1509.6
127	13.94	35.22	26.38	.31	1505.7
168	13.35	35.20	26.50	.37	1504.4
194	12.90	35.16	26.56	.41	1503.3
297	11.89	35.03	26.65	.57	1501.3
424	10.23	34.92	26.87	.74	1500.9
512	8.77	34.65	26.90	.86	1493.1
628	7.87	34.54	26.95	1.00	1491.5
708	7.17	34.56	27.07	1.10	1490.1
791	6.75	34.48	27.07	1.19	1489.6
869	6.10	34.45	27.13	1.28	1488.3
949	5.43	34.45	27.21	1.36	1486.8
1069	5.05	34.45	27.25	1.48	1487.3
1133	4.69	34.46	27.30	1.55	1486.8
1302	3.98	34.49	27.40	1.70	1486.7
1473	3.24	34.53	27.51	1.83	1486.3
1703	2.53	34.58	27.61	2.00	1487.2

D399

D	T	S	σ_t	$\Sigma\Delta D$	C
0	19.54	35.40	25.21	.00	1521.0
22	19.62	35.40	25.19	.06	1521.6
43	19.12	35.40	25.31	.12	1520.5
65	16.25	35.38	26.00	.17	1512.2
87	15.16	35.33	26.21	.21	1508.9
130	13.76	35.23	26.43	.29	1505.1
177	13.08	35.15	26.51	.36	1503.6
218	12.54	35.09	26.57	.43	1502.4
286	11.54	34.99	26.76	.53	1499.9
353	10.75	34.91	26.77	.61	1498.0
442	9.69	34.80	26.87	.74	1495.6
536	8.74	34.68	26.93	.85	1493.4
670	7.68	34.57	27.00	1.01	1491.4
784	6.77	34.48	27.06	1.14	1489.6
1000	5.63	34.44	27.18	1.38	1488.5
1155	4.88	34.45	27.27	1.53	1488.0
1229	4.50	34.46	27.33	1.60	1487.6
1447	3.53	34.50	27.46	1.77	1487.1
1684	2.79	34.56	27.58	1.94	1487.8
2331	2.18	34.60	27.66	2.32	1495.9

D400

D	T	S	σ_t	$\Sigma\Delta D$	C
0	20.19	35.50	25.11	.00	1523.0
20	20.21	35.50	25.11	.06	1523.3
40	19.88	35.50	25.19	.11	1522.6
60	17.39	35.42	25.76	.16	1515.8
80	15.97	35.35	26.04	.21	1511.7
120	15.07	35.36	26.25	.28	1509.4
191	14.33	35.30	26.37	.41	1508.1
225	13.92	35.27	26.43	.47	1507.3
292	12.65	35.15	26.60	.57	1507.4
441	10.92	34.94	26.76	.79	1500.1
528	9.46	34.76	26.88	.91	1496.0
663	8.20	34.61	26.96	1.08	1493.3
746	7.75	34.56	26.98	1.18	1492.9
892	6.39	34.48	27.11	1.35	1489.9
970	5.83	34.47	27.18	1.43	1488.9
1177	5.02	34.47	27.28	1.63	1489.0
1240	4.55	34.48	27.34	1.69	1488.0
1429	3.74	34.52	27.45	1.84	1487.8
1613	3.09	34.57	27.56	1.97	1488.1
1989	2.29	34.64	27.68	2.19	1490.9

D401

D	T	S	σ_t	$\Sigma\Delta D$	C
0	20.45	35.50	25.04	.00	1523.7
20	20.59	35.50	25.00	.06	1524.4
40	20.38	35.50	25.06	.12	1524.0
61	20.15	35.52	25.14	.18	1523.8
81	18.11	35.49	25.64	.23	1520.3
121	16.21	35.43	26.05	.32	1513.1
172	15.32	35.38	26.21	.42	1511.0
224	14.51	35.31	26.34	.51	1509.2
278	12.47	35.09	26.61	.60	1503.1
444	10.47	34.88	26.80	.84	1498.5
596	8.92	34.67	26.89	1.04	1495.0
697	8.01	34.59	26.97	1.17	1493.0
895	6.53	34.51	27.12	1.39	1490.5
960	6.05	34.47	27.16	1.46	1489.6
1109	5.09	34.47	27.27	1.61	1488.2
1228	4.41	34.48	27.35	1.72	1487.2
1317	4.04	34.51	27.41	1.79	1487.2
1570	3.17	34.57	27.55	1.97	1487.7
1701	2.72	34.60	27.61	2.06	1487.9
2051	1.94	34.67	27.73	2.24	1490.4

D402

D	T	S	σ_t	$\Sigma\Delta D$	C
0	20.22	35.59	25.17	.00	1523.2
25	20.19	35.61	25.20	.07	1523.4

D	T	S	σ_t	$\Sigma\Delta D$	C
D402 (cont'd)					
49	19.97	35.61	25.25	.14	1523.3
74	17.17	35.55	25.91	.20	1515.6
98	16.32	35.53	26.10	.25	1513.3
147	15.69	35.51	26.23	.34	1516.1
196	15.52	35.50	26.26	.43	1512.4
246	15.34	35.49	26.29	.52	1512.5
344	13.87	35.28	26.48	.69	1509.1
492	11.23	34.96	26.72	.92	1502.1
640	9.20	34.72	26.90	1.12	1496.8
788	7.75	34.56	26.99	1.31	1493.6
886	6.97	34.51	27.06	1.42	1492.1
985	6.35	34.47	27.11	1.53	1491.2
1083	6.00	34.46	27.15	1.64	1491.4
1182	5.53	34.46	27.21	1.74	1491.0
1280	4.78	34.48	27.31	1.84	1489.6
1379	4.27	34.50	27.38	1.92	1489.3
1477	3.85	34.52	27.44	2.00	1488.9
1723	3.12	34.57	27.55	2.18	1490.0
1978	2.46	34.65	27.68	2.34	1491.4
D403					
0	20.38	35.51	25.07	.00	1523.5
24	20.38	35.52	25.08	.07	1523.9
49	19.55	35.47	25.26	.14	1524.5
73	16.88	35.47	25.92	.20	1514.4
97	15.97	35.45	26.12	.25	1512.1
146	14.89	35.39	26.32	.34	1509.4
195	14.29	35.34	26.41	.42	1508.2
244	13.70	35.27	26.48	.50	1506.9
341	12.00	35.07	26.66	.65	1502.5
502	9.94	34.82	26.84	.74	1497.5
707	8.33	34.62	26.95	1.00	1494.5
892	6.50	34.48	27.10	1.24	1490.4
D404					
0	20.07	35.48	25.13	.00	1522.6
17	20.11	35.48	25.12	.05	1523.0
35	19.94	35.47	25.15	.10	1522.9
48	19.63	35.46	25.23	.14	1522.2
63	16.58	35.41	25.95	.17	1513.3
343	10.27	34.89	26.85	.64	1496.2
382	9.82	34.82	26.86	.69	1495.0
420	9.42	34.77	26.89	.74	1494.2
480	9.06	34.71	26.90	.82	1493.6
502	8.60	34.66	26.93	.84	1492.3
540	8.26	34.62	26.96	.89	1491.5
580	8.12	34.61	26.97	.94	1491.6
970	7.47	34.57	27.04	1.40	1495.5
D405					
0	19.71	35.28	25.07	.00	1521.3
21	19.86	35.28	25.03	.06	1521.9
43	19.01	35.32	25.26	.12	1520.1
64	14.79	35.25	26.23	.17	1516.5
127	13.11	35.20	26.54	.28	1502.9
175	12.52	35.14	26.62	.35	1501.6
220	12.20	35.09	26.64	.42	1501.2
299	11.20	34.92	26.70	.53	1498.8
426	9.50	34.70	26.82	.70	1494.5
555	8.41	34.59	26.91	.87	1492.4
683	7.29	34.47	26.98	1.03	1490.0
768	6.78	34.44	27.03	1.13	1489.4
854	6.22	24.42	27.09	1.22	1488.6
940	5.66	34.40	27.14	1.32	1487.6
1027	5.07	34.41	27.21	1.40	1486.6
1111	4.53	34.42	27.29	1.48	1485.7
1196	4.05	34.44	27.36	1.56	1485.2
1282	3.66	34.46	27.41	1.63	1484.8
1492	3.11	34.51	27.51	1.78	1486.0
1710	2.66	34.57	27.59	1.92	1487.8
2202	2.30	34.63	27.67	2.20	1494.3

D	T	S	σ_t	$\Sigma\Delta D$	C
D407					
0	19.95	35.54	25.21	.00	1522.3
21	20.50	35.54	25.06	.06	1524.1
42	20.46	35.54	25.07	.12	1524.4
46	20.40	35.54	25.09	.13	1524.2
62	20.04	35.55	25.19	.18	1523.6
92	16.37	35.47	26.04	.25	1513.3
258	13.10	35.19	26.54	.46	1505.1
335	12.07	35.07	26.65	.58	1502.7
412	10.82	34.91	26.76	.69	1499.3
507	9.99	34.80	26.82	.82	1497.8
572	9.36	34.72	26.86	.91	1496.3
674	8.59	34.63	26.91	1.04	1495.1
702	8.10	34.57	26.94	1.07	1493.5
770	7.47	34.50	26.98	1.16	1492.1
810	7.05	34.48	27.02	1.21	1491.1
862	6.67	34.46	27.06	1.27	1490.5
979	5.65	34.46	27.19	1.39	1488.3
1048	5.04	34.47	27.29	1.46	1487.0
D408					
0	20.08	35.60	25.22	.00	1522.7
15	20.11	35.60	25.21	.04	1523.0
30	20.07	35.60	25.22	.08	1523.2
45	20.05	35.59	25.22	.12	1523.3
60	20.02	35.59	25.23	.17	1523.5
153	17.02	35.49	25.90	.40	1516.2
211	14.33	35.33	26.39	.51	1508.4
301	12.57	35.13	26.60	.65	1503.8
391	10.91	34.90	26.73	.79	1499.2
536	9.09	34.67	26.86	.98	1494.7
D410					
0	20.23	35.60	25.18	.00	1532.2
18	20.27	35.60	25.17	.05	1523.5
35	20.24	35.60	25.17	.10	1523.8
55	16.82	35.53	25.98	.20	1520.0
74	16.30	35.51	26.09	.23	1512.7
111	15.71	35.50	26.22	.30	1511.4
150	15.20	35.46	26.30	.37	1510.5
185	14.70	35.39	26.36	.44	1509.3
262	13.21	35.21	26.53	.56	1505.4
375	11.70	35.04	26.70	.73	1502.0
487	9.82	34.78	26.82	.89	1496.8
600	8.55	34.63	26.92	1.04	1493.7
675	7.77	34.55	26.98	1.13	1491.8
750	7.08	34.49	27.03	1.25	1490.3
825	6.52	34.45	27.07	1.34	1489.3
900	6.13	34.44	27.12	1.42	1488.8
976	5.54	34.43	27.18	1.50	1487.7
1051	5.15	34.43	27.23	1.57	1487.3
1127	4.79	34.44	27.28	1.64	1487.2
1315	3.89	34.47	27.40	1.81	1486.5
1500	3.29	34.53	27.50	1.94	1487.0
1880	2.56	34.59	27.62	2.19	1490.0
D411					
0	19.87	35.49	25.19	.00	1522.1
13	19.98	35.49	25.16	.04	1522.4
20	19.92	35.49	25.18	.06	1522.4
45	19.82	35.49	25.20	.13	1522.5
60	19.81	35.49	25.20	.17	1522.8
90	18.19	35.45	25.59	.25	1518.6
120	16.38	35.38	25.97	.31	1513.6
150	15.92	35.36	26.06	.38	1512.6
217	14.77	35.29	26.26	.50	1510.0
320	12.70	35.13	26.57	.65	1504.5
425	11.14	34.96	26.73	.81	1500.8
535	9.85	34.79	26.83	.96	1497.6
610	9.18	34.71	26.88	1.06	1496.2
690	8.43	34.63	26.94	1.16	1494.6
768	7.83	34.57	26.98	1.25	1493.6

D411 (cont'd)

D	T	S	σ_t	$\Sigma\Delta D$	C
848	7.36	34.53	27.02	1.35	1492.9
925	6.94	34.50	27.06	1.44	1492.6
1002	6.55	34.49	27.10	1.53	1492.3
1080	6.27	34.48	27.13	1.61	1492.5

D412

D	T	S	σ_t	$\Sigma\Delta D$	C
0	19.80	35.61	25.30	.00	1521.9
22	19.82	35.61	25.29	.06	1522.4
43	19.77	35.61	25.30	.12	1522.5
65	18.17	35.55	25.66	.17	1518.2
130	15.91	35.52	26.19	.31	1512.4
173	15.67	35.51	26.23	.39	1512.3
217	15.55	35.50	26.25	.47	1512.7
303	14.80	35.41	26.35	.63	1511.5

D413

D	T	S	σ_t	$\Sigma\Delta D$	C
0	20.07	35.55	25.19	.00	1522.6
21	19.76	35.55	25.26	.06	1522.0
40	19.65	35.55	25.29	.11	1522.0
62	19.41	35.55	25.35	.17	1521.7
83	17.57	35.53	25.80	.22	1516.7
125	16.36	35.51	26.08	.31	1513.8
166	15.66	35.50	26.23	.39	1512.2
208	15.40	35.49	26.28	.46	1512.1
291	14.25	35.32	26.40	.61	1509.5
416	12.44	35.11	26.61	.81	1505.1
540	10.74	34.89	26.76	1.00	1501.1
664	9.02	34.67	26.89	1.17	1496.5
747	8.33	34.61	26.94	1.28	1495.2
830	7.55	34.55	27.01	1.38	1493.4
913	6.90	34.51	27.07	1.47	1492.2
996	6.40	34.49	27.12	1.57	1491.6
1079	5.77	34.47	27.18	1.66	1490.5
1162	5.14	34.47	27.26	1.74	1489.2
1245	4.76	34.48	27.31	1.81	1489.0
1452	3.77	34.55	27.47	1.98	1488.2
1659	2.96	34.65	27.63	2.12	1488.3

D414

D	T	S	σ_t	$\Sigma\Delta D$	C
0	20.22	35.59	25.17	.00	1523.1
23	20.22	35.59	25.17	.06	1523.5
46	20.17	35.58	25.18	.13	1523.7
69	16.77	35.53	25.99	.19	1514.1
92	16.06	35.52	26.16	.23	1512.2
138	15.61	35.50	26.34	.32	1511.6
184	15.34	35.48	26.28	.40	1511.5
230	14.80	35.42	26.36	.48	1510.4
322	13.35	35.24	26.53	.64	1507.0
460	10.80	34.91	26.76	.84	1500.0
598	9.01	34.70	26.90	1.03	1495.5
736	7.81	34.58	26.99	1.20	1493.0
829	7.20	34.53	27.04	1.32	1492.1
937	6.53	34.49	27.10	1.44	1491.2
1013	6.08	34.48	27.15	1.52	1490.6
1105	5.45	34.46	27.22	1.61	1489.5
1197	5.02	34.46	27.27	1.70	1489.3
1289	4.43	34.48	27.35	1.79	1488.3
1385	4.08	34.50	27.40	1.87	1488.5
1611	3.28	34.55	27.52	2.04	1488.7
1841	2.65	34.61	27.63	2.18	1489.9
2302	2.14	34.65	27.70	2.44	1495.3

D415

D	T	S	σ_t	$\Sigma\Delta D$	C
0	21.13	35.53	24.90	.00	1525.5
26	21.13	35.55	24.90	.08	1525.9
52	20.93	35.54	24.94	.16	1525.8
77	17.90	35.50	25.70	.23	1517.6
148	15.92	35.49	26.16	.38	1512.7
210	14.81	35.41	26.35	.49	1510.1
264	14.00	35.31	26.44	.58	1508.2
298	13.60	35.25	26.48	.64	1507.4
437	11.35	34.95	26.69	.85	1501.6
616	8.94	34.66	26.88	1.10	1486.4
830	6.80	34.46	27.04	1.36	1490.5
917	6.02	34.42	27.11	1.46	1488.8

D416

D	T	S	σ_t	$\Sigma\Delta D$	C
0	20.70	35.58	25.03	.00	1524.4
25	20.22	35.57	25.16	.07	1523.6
50	20.20	35.57	25.16	.14	1523.9
75	17.54	35.53	25.82	.21	1516.5
100	15.94	35.49	26.16	.27	1512.0
150	15.16	35.45	26.31	.36	1512.0
200	14.45	35.37	26.40	.45	1508.7
250	13.47	35.25	26.51	.53	1504.1
350	12.14	35.07	26.69	.68	1503.1
500	9.63	34.75	26.84	.89	1496.2
650	8.08	34.58	26.95	1.08	1492.6
800	6.86	34.47	27.04	1.26	1490.1
900	6.21	34.42	27.09	1.38	1489.1
1000	5.51	34.40	27.16	1.48	1487.9
1100	4.94	34.41	27.24	1.58	1487.3
1200	4.40	34.43	27.31	1.67	1486.6
1300	3.83	34.47	27.41	1.76	1486.0
1400	3.37	34.51	27.48	1.83	1485.7
1500	3.19	34.53	27.52	1.90	1486.6
1750	2.76	34.58	27.59	2.07	1488.8
2000	2.46	34.61	27.64	2.21	1491.6
2500	2.27	34.64	27.68	2.49	1499.9

D417
WAD

D	T	S	σ_t	$\Sigma\Delta D$	C
0	20.42	35.54	25.08		
25	20.53	35.55	25.06		
49	20.53	35.54	25.05		
74	17.80	35.52	25.74		
98	16.19	35.51	26.11		
197	14.74	35.42	26.37		
492	13.27	35.24	26.54		
640	10.45	34.88	26.80		
788	8.48	34.63	26.93		
985	6.87	34.50	27.06		
1182	5.00	34.43	27.25		
1256	4.39	34.44	27.32		
1352	3.74	34.47	27.41		
1449	3.40	34.49	27.46		
1690	2.87	34.56	27.57		
1932	2.73	34.59	27.61		
2415	2.32	34.63	27.67		

D418
WAD

D	T	S	σ_t	$\Sigma\Delta D$	C
0	20.90	35.45	24.88		
17	20.82	35.44	24.90		
33	20.79	35.44	24.91		
52	20.75	35.44	24.92		
103	15.43	35.26	26.09		
140	13.74	35.20	26.41		
225	12.61	35.11	26.57		
321	11.34	34.95	26.69		
418	10.41	34.84	26.75		
514	9.40	34.72	26.80		
643	8.33	34.61	26.94		
771	7.54	34.53	26.99		
964	7.25	34.50	27.01		
1125	6.66	34.45	27.05		
1286	5.89	34.42	27.13		

D419

D	T	S	σ_t	$\Sigma\Delta D$	C
0	20.29	35.42	25.02	.00	1523.1
21	19.64	35.41	25.20	.06	1521.6
41	19.48	35.40	25.22	.12	1521.6
62	17.82	35.37	25.56	.17	1517.6
82	14.48	35.32	26.35	.21	1506.8
124	13.25	35.23	26.54	.28	1503.4
166	12.86	35.17	26.57	.34	1502.6
208	12.30	35.11	26.64	.41	1501.4
291	11.04	34.92	26.72	.53	1498.2
416	9.45	34.73	26.85	.69	1494.1
541	8.17	34.59	26.95	.85	1491.2
666	7.31	34.50	27.00	1.00	1489.7
749	6.71	34.46	27.06	1.09	1488.8
832	6.20	34.43	27.10	1.19	1488.0

D	T	S	σ_t	$\Sigma\Delta D$	C
D419 (contd)					
916	5.60	34.42	27.17	1.27	1486.9
999	5.22	34.42	27.21	1.36	1486.8
1082	4.96	34.43	27.25	1.44	1487.0
1165	4.54	34.45	27.31	1.51	1486.8
1249	4.22	34.48	27.37	1.59	1486.8
1408	3.56	34.52	27.47	1.71	1486.6
1665	2.71	34.59	27.61	1.88	1487.2
2080	2.51	34.62	27.65	2.12	1493.0
D420					
0	19.22	35.44	25.32	.00	1520.1
18	19.23	35.44	25.32	.05	1520.4
36	18.93	35.43	25.39	.10	1519.9
65	18.58	35.43	25.48	.17	1519.3
105	17.91	35.42	25.63	.27	1517.9
139	15.95	35.39	26.08	.34	1512.6
175	14.23	35.32	26.40	.41	1507.5
244	13.09	35.21	26.56	.52	1504.8
349	11.69	35.04	26.70	.68	1501.4
454	10.39	34.87	26.80	.82	1498.4
557	9.27	34.75	26.90	.96	1495.8
697	8.09	34.63	26.99	1.13	1493.5
766	7.65	34.59	27.02	1.21	1492.9
838	7.23	34.55	27.05	1.3[illegible]	1492.4
974	6.35	34.49	27.13	1.45	1491.0
D421					
WAD					
0	17.80	35.15	25.45		
20	17.89	35.16	25.44		
39	17.48	35.16	25.54		
59	17.30	35.17	25.59		
79	15.75	35.19	25.96		
118	13.47	35.14	26.43		
158	12.89	35.12	26.53		
197	12.31	35.08	26.61		
276	11.61	35.01	26.69		
394	9.46	34.77	26.88		
512	7.71	34.60	27.02		
630	7.00	34.52	27.06		
788	6.84	34.51	27.08		
867	6.60	34.49	27.09		
946	6.16	34.47	27.14		
1024	5.16	34.45	27.24		
1300	3.57	34.52	27.47		
1857	2.53	34.60	27.63		
D422					
0	18.19	35.37	25.53	.00	1517.1
23	18.11	35.37	25.55	.06	1517.2
46	17.61	35.38	25.68	.11	1516.1
91	14.32	35.34	26.40	.20	1506.5
182	13.16	35.26	26.58	.33	1504.0
273	13.10	35.26	26.59	.47	1504.5
465	11.43	35.00	26.72	.75	1502.4
546	10.10	34.80	26.80	.87	1498.7
637	9.09	34.67	26.87	.99	1496.4
728	8.37	34.61	26.93	1.11	1495.6
820	7.64	34.55	26.99	1.22	1493.6
910	7.23	34.53	27.04	1.33	1493.4
1002	6.65	34.51	27.10	1.43	1492.7
1092	5.78	34.48	27.19	1.53	1490.6

D	T	S	σ_t	$\Sigma\Delta D$
EAST CAPE STATIONS				
D469				
0	15.78	35.48	26.18	.00
18	15.29	35.47	26.29	.03
38	15.28	35.47	26.29	.07
57	15.20	35.47	26.31	.10
77	15.18	35.47	26.31	.13
115	14.81	35.42	26.36	.19
153	14.25	35.37	26.44	.26
229	13.13	35.22	26.56	.38
D470				
0	15.75	35.49	26.20	.00
37	15.49	35.50	26.27	.06
62	15.19	35.49	26.33	.11
135	14.69	35.43	26.39	.23
235	12.90	35.20	26.59	.40
363	11.48	34.98	26.69	.59
506	9.48	34.75	26.87	.77
675	7.67	34.58	27.01	.94
D471				
0	15.55	35.46	26.22	.00
38	15.33	35.48	26.29	.07
76	15.31	35.47	26.28	.13
152	14.05	35.31	26.43	.26
265	12.24	35.08	26.62	.44
379	10.85	34.92	26.76	.60
569	9.89	34.67	26.73	.87
758	6.96	34.52	27.07	1.11
D472				
0	15.24	35.39	26.24	.00
44	15.16	35.42	26.28	.08
86	14.85	35.39	26.32	.15
170	13.30	35.22	26.52	.29
295	11.60	35.01	26.69	.48
418	10.11	34.82	26.81	.65
622	8.23	34.64	26.98	.91
826	6.89	34.52	27.08	1.14
D473				
0	15.04	35.37	26.27	.00
36	14.93	35.39	26.31	.06
72	14.36	35.32	26.41	.10
145	13.36	35.11	26.62	.22
254	12.29	35.09	26.62	.38
363	10.50	34.87	26.78	.53
544	8.83	34.69	26.92	.77
727	7.59	34.57	27.02	.99
D474				
0	14.94	35.35	26.27	.00
43	14.77	35.38	26.33	.07
86	14.60	35.38	26.37	.15
170	12.88	35.17	26.44	.29
287	10.84	34.92	26.76	.46
420	9.71	34.78	26.85	.64
646	8.28	34.63	26.96	.93
852	6.95	34.53	27.08	1.41

MEMOIRS OF THE NEW ZEALAND OCEANOGRAPHIC INSTITUTE

Memoir No.	Year	Title
[1]	1955	Bibliography of New Zealand Oceanography, 1949–1953. By N.Z. Oceanographic Committee. *N.Z. Dep. scient. ind. Res. geophys. Mem. 4.*
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