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DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

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HYDROLOGY OF NEW ZEALAND COASTAL WATERS, 1955

by

D. M. GARNER

New Zealand Oceanographic Institute
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Memoir No. 8

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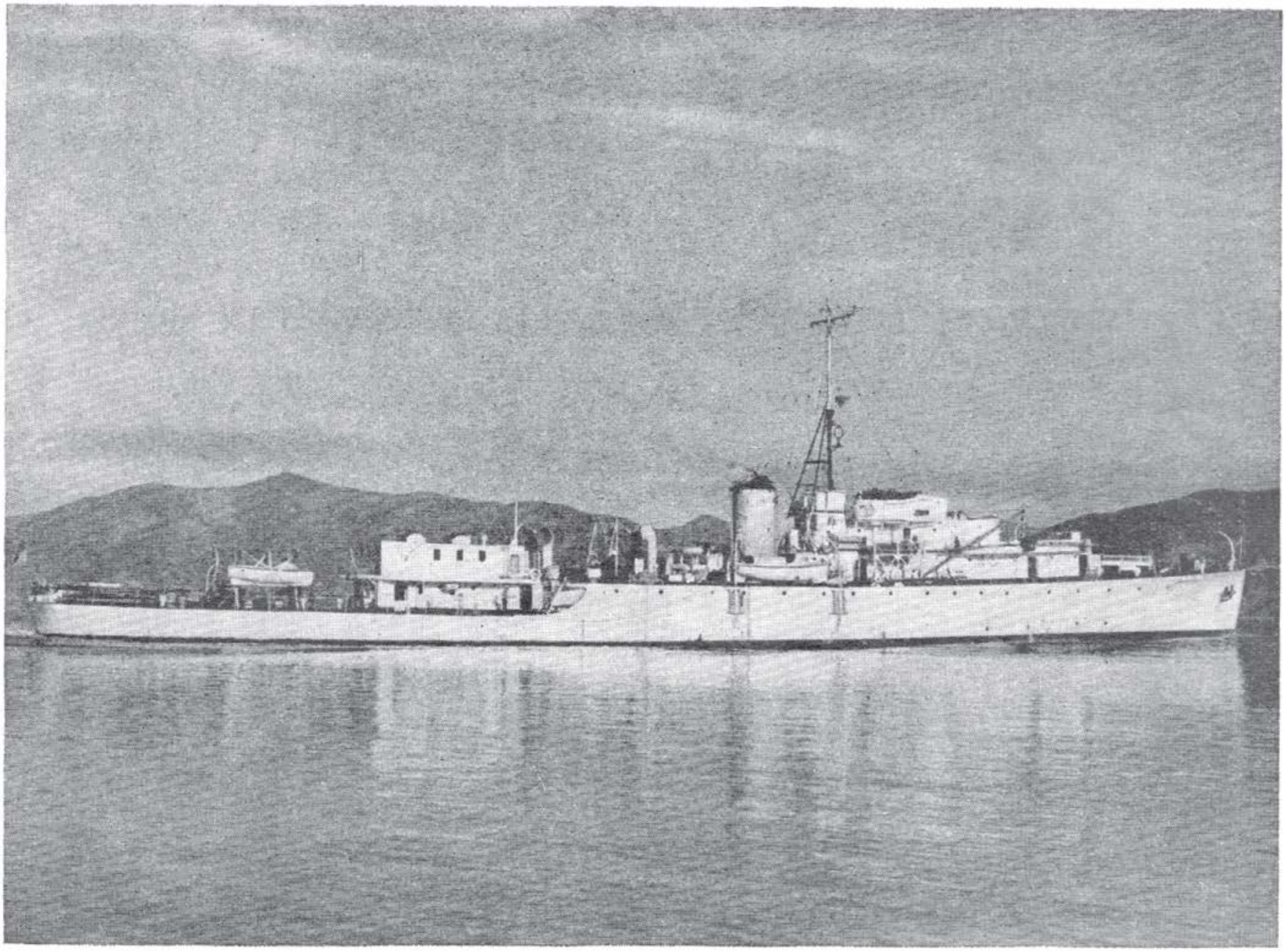

Frontispiece: The Survey Ship HMNZS *Lachlan* Photograph courtesy Royal New Zealand Navy·

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FOREWORD

THE results reported in this Memoir are those derived from the first of the regional hydrological investigations carried out by the New Zealand Oceanographic Institute. Of the problems demanding attention when the Institute commenced operations, study of the coastal area was selected for a number of reasons: principally that the results would have readily applicable local significance and that the extent of the survey was within the range of seagoing facilities likely to be available.

Final editing of the material for publication has been carried out by Mr M. O'Connor, Information Bureau, D.S.I.R.

J. W. BRODIE, Director,
New Zealand Oceanographic Institute.

CONTENTS

HYDROLOGY OF NEW ZEALAND COASTAL WATERS, 1955

INTRODUCTION

DURING 1955 the New Zealand Oceanographic Institute carried out a survey of the hydrological characteristics of New Zealand coastal waters. The term *hydrology* here represents the distribution of physical and chemical properties of ocean waters, temperature and salinity in particular, and their relation to the identification, origin, and history of ocean water types. This publication presents the results of the 1955 work with a general discussion of the situation revealed.

BACKGROUND WORK

NEW ZEALAND REGIONAL HYDROLOGY

There is available in the literature virtually no information geographically or seasonally systematic in character on the hydrology of waters over and immediately off shore from the New Zealand shelf. A general discussion of the hydrology of the New Zealand region using the miscellaneous information available up to the time of the present survey has recently been presented (Garner, 1959a) and the reader is referred to this for a summary of existing knowledge in this field.

GENERAL SHELF HYDROLOGY

Waters over the edge of the shelf are often found to contain a boundary between characteristic "coastal" water and "oceanic" water offshore. The formation of coastal water is commonly due to two processes. Firstly, drainage from the land tends to lower salinity at the surface near the coast and exchange between coastal and oceanic water tends to maintain a net movement of relatively fresh water seawards in surface layers, with a compensating deep shorewards movement of oceanic water. With the average density of the water column increasing seawards, the resultant pressure gradient tends to maintain a long-shore flow of water with a Southern Hemisphere coast on the left looking down stream. Such a density current is often strongest over, or just offshore from the shelf edge where bottom friction is abruptly reduced, and where large density gradients between coastal and oceanic waters are likely to be found. Secondly, the maximum development in depth of vertical mixing in summer and convective overturn in winter may be inhibited in shallow coastal waters. This often results in high summer maximum temperatures and lower values during the winter minimum period, relative to oceanic waters. In relatively sheltered areas, this effect may outweigh the influence of salinity on the horizontal pressure gradient. Vertical turbulence is often increased in shelf waters due to the action of tidal streams and winds, while the adjacent land mass, forming a barrier to water movement normal to the coast, often leads to sinking or upwelling, and channelling of currents in a long-shore direction.

An account of the relation of shelf circulation characteristics to problems of ecology and productivity has been given by Iselin (1939).

The transition between coastal and oceanic water off the east coast of North America was found by Miller (1950) to be accompanied by an apparent upwelling on to the shelf from deeper waters over the slope, this exchange being most pronounced with large density contrast between the two. A subsurface tongue of a mixture of coastal, surface slope, and mid-depth slope waters was also defined extending seawards from the main mixing region over the slope. It was suggested that this resulted from dissipation of internal wave energy propagated along the boundaries of water layers converging on the edge of the shelf.

Cooper (1952) has put forward interesting suggestions concerning mass movements of shelf waters through climatic effects; these include "cascading" over the shelf edge of waters whose density has been increased by winter cooling to a value greater than that of deeper slope waters, and the "capsizing" of water with an unstable density stratification produced by strong winds driving oceanic water on to the shelf.

The form of the seasonal variation in the temperature and salinity structure of the water column over the shelf off the east coast of North America has been established by Bigelow and Sears (1933, 1935) and this detailed work forms a useful model for coastal studies.

PHYSIOGRAPHY OF THE NEW ZEALAND COASTAL REGION

Bathymetry

Fig. 1 shows the major bathymetric features around New Zealand.

A 50-mile zone extending seawards from the New Zealand coast covers a varied bottom topography. Oceanic basins and troughs are found close to the coast at many points and extensive shelf areas do not form a notable feature of New Zealand coastal bathymetry. The *Hikurangi Trench* extends south-westwards close to the south-east coast of North Island, depths of 2,000 to 3,000 metres being found only 50 to 100 miles off shore. The shelf between East Cape and Cape Palliser is very narrow with a well defined edge. Canyons are cut into the slope in the vicinity of Cape Palliser, a notable one extending into southern Cook Strait.

The western margin of the *Bounty Trough* brings deep water towards the south-east coast of South Island, while between this feature and the southern end of the Hikurangi Trench lies the *Chatham Rise*, a relatively shallow ridge extending past the Chatham Islands from Banks Peninsula.

Lying parallel with the Hikurangi Trench is the *Havre Trough*, which reaches in towards the Bay of Plenty, while to the north of North Island is the relatively deep water of the *Norfolk* and *South Fiji Basins*.

West of New Zealand is the *Lord Howe Rise*, an extensive ridge extending north-westwards from northern Cook Strait, and separating the *New Caledonia Basin* to the north and the *Tasman Basin* to the south. The *Fiordland* and *Solander Troughs* bring deep water close to the south-west coast of South Island. South of the country an extensive area of relatively shallow water lies over the *Campbell Plateau.*

Topographic "highs" may form both barriers to the horizontal movement of bottom water and a controlling factor in vertical water movement. Proximity to the coast of oceanic "deeps", on the other hand, permits the deep water masses to play a part in the formation of coastal water.

Coastal Configuration

The long axis of New Zealand lies approximately in a north-east – south-west direction for some 800 miles, providing a significant barrier to both zonal and meridional water movements in the south-west Pacific. The only opening lies through Cook Strait, between North and South Islands, and consists of a relatively narrow and shallow passage between two large embayments in the general coastal trend. Large promontories which may be significant in deflecting long-shore water movements are found, such as the Coromandel Peninsula, East Cape, Mahia Peninsula, Banks Peninsula, Stewart Island, and Cape Egmont. These features are often associated with large embayments in which the properties of coastal water may be modified by isolation from oceanic influence, the accumulation of land-water drainage, or the effects of insolation, and often contain strong local eddies. Among such features are the Hauraki Gulf, the Bay of Plenty, Hawke Bay, Pegasus Bay, the South Canterbury Bight, Foveaux Strait, Cook Strait, and the North Taranaki Bight

FIELD OPERATIONS

General Plan

The original survey plan for the work described here established a series of lines around the country about 250 miles apart and extending seawards 50 miles from the coast. The collection of data was planned towards the construction of quarterly profiles of temperature and salinity in vertical section from surface to bottom along each line, to define the regional and seasonal variation in these basic hydrological elements. Seasonal work was to be concentrated in the months of February, May, August, and November to sample the four main oceanic climatic periods of the year.

Since no full-time sea-going facilities for oceanographic work were available to the New Zealand Oceanographic Institute when this survey was planned, it was expected that objectives would be only partially realised, and the work accomplished during the year was indeed governed almost entirely by the shipping which could be made available. Bad weather, too, placed a limit on working from the smaller craft available in some instances. Much useful work was completed, however, largely through the generous cooperation of the Royal New Zealand Navy. The Marine Department also gave assistance and commercial vessels were hired as opportunity permitted. Lines worked in whole or in part at some time during the year are shown in relation to the main features of bathymetry of New Zealand waters in fig. 1. Lines have been named from prominent associated geographic features.

Field activities during 1955 are summarized as follows:

Cruise I (Summer)

Work in summer was centred around a cruise by HMNZS *Lachlan* from February 7 to 17, during which full temperature and salinity sections were obtained along each of the North Island lines, except Barrier, which had been worked previously from RNZFA *Endeavour* (now *Hauraki*) on January 29. Equipment troubles during an earlier attempt on January 25 at North resulted in a few inshore observations only. Surface information from Plenty was obtained by the Marine Department Fisheries Research Laboratory from FRV *Ikatere* on February 16. An attempt to work lines around the southern part of South Island early in March from m.v. *Alert* (Mr A. J. Black, Dunedin) was severely curtailed by weather and inshore data only were collected between Jacksons Head, South Westland, and the Otago Peninsula, through Foveaux Strait. Surface temperature and salinity data were collected along the lines Kaikoura (February 3), Timaru (February 21), Taiaroa (February 12), and Long (February 7), off the east coast of South Island from HMNZS *Kiwi.*

Cruise II (Autumn)

The main autumn contribution was a further circumnavigation of North Island by *Lachlan* from May 9 to 16, during which full temperature and salinity sections were worked along all North Island lines. *Kiwi* again provided surface data from the east coast South Island lines Kaikoura (May 19), Banks, and Timaru (May 16).

Cruise III (Winter)

Work accomplished during the planned winter period was confined to a collection of surface data from South Island east coast waters by *Alert* between August 20 and 23. The Naval Research Laboratory worked a section along Barrier with bathythermograph and sea sampler from HMNZS *Hawea* on September 22 and, somewhat later in the year, similar sections were worked from HMNZS *Kaniere* by the Institute (October 2 to 3) at Foulwind and Hokitika, and from m.v. *Holmwood* (Holm Shipping Co.) at Raglan and Egmont (October 9).

Cruise IV (Spring)

The final series of observations was made as follows:

North was worked to 300 m from HMNZS *Takapu* on November 22 and bathythermograph sections with surface salinities were run along Palliser, Hawke, East, and Barrier between December 11 and 14 from *Hawea.*

Supplementary Data

Supplementary to the information obtained from movements outlined above, sea surface thermograph records were obtained during the year by several commercial vessels; these are acknowledged in the sections following.

Field Methods

Except where stated otherwise above, field work was under the direction of the writer, assisted at various times by A. E. Gilmour, P. E. Jones, N. M. Ridgway, P. C. Spence, and R. P. Willis of the New Zealand Oceanographic Institute and by members of the various ships' companies.

Temperature-depth profiles were measured by bathythermograph (Wallace and Tiernan) to the maximum depth of 275 m and by protected reversing thermometer (Negretti and Zambra) below this. A continuous measure of surface temperature was kept throughout each cruise by recording thermograph (Negretti and Zambra). Salinity samples were collected by Spilhaus-type sea sampler (S. G. Brown) sampling at depths of 10, 20, 30, 40, 55, 65, 75, 85, 95, 105, 115, and 125 m, and by Ekman-type reversing bottle (S. G. Brown) below this. In the latter case the depth of sampling was determined by metering the sounding wire and the use of unprotected thermometers (Negretti and Zambra).

Water samples collected were stored in 125-ml glass prescription bottles stopped with waxed bark corks. The density of samples was subsequently determined in the laboratory, using a sinker method set up by Gilmour (1958) who estimated that the method derived salinity within a range of $0{\cdot}03\,^0/_{00}$. Water samples collected during this project were analysed at various times up to 18 months following collection, and the precaution was taken of scattering throughout the collection 60 subsamples bottled from one bulk sample to check on the reliability of methods used, in particular storage of samples. The final analysis figures for these check samples were scattered over a range of $0{\cdot}04\,^0/_{00}$, with a standard deviation of $0{\cdot}02\,^0/_{00}$. No systematic change with time was evident. A careful analysis of a sample of Copenhagen "normal water", using the density method, reproduced the nominal salinity within $0{\cdot}01\,^0/_{00}$. Water analyses were made by Jones, Ridgway, and the writer.

A batch of five drift cards in plastic envelopes was released at each station.

In general, stations were occupied at intervals of 5 miles along each line and where full stations were worked an attempt was made to collect data at depths beyond the limits of bathythermograph and sea sampler, of 2, 3, 4, 5, 6, 8, 10, 12, 15, and 20 hundreds of metres.

Presentation of Data

Surface temperature and salinity have been plotted and contoured, and charts presented later show patterns of isotherms and isohalines so derived.

Drift card release and recovery data are tabulated, and where these may be usefully estimated, drift tracks are plotted.

Subsurface measurements of temperature and salinity are tabulated in the Appendix; in the text following, data have been worked up in the form of vertical cross sections of isothermal and isohaline surfaces below survey lines and are arranged together to enable ready intercomparison. Stations occupied are numbered consecutively along the lines, station 1 nearest the coast. Thus "II Barrier/3" represents the third station from the coast (about 15 miles seawards) along the line worked from Cape Barrier during the autumn (May) cruise. Inset maps on temperature sections show the geographical location of stations. Profiles of the sea bottom drawn in these sections, while based on recorded depths, are intended to show gross features of bathymetry only. It should be noted that slopes of both sea bottom and isolines indicated in the sections are greatly exaggerated, the ratio of vertical and horizontal scales in most cases being approximately 1 : 36. The vertical scale is further exaggerated by a factor of two in the relatively shallow sections Barrier, Egmont, Foulwind, and Hokitika.

In this work:

Distances are expressed in *nautical miles* (miles).

Depths are expressed in *metres* (m).

Temperatures are expressed in *degrees Centigrade* (°c).

Salinities are expressed in parts per thousand ($^0/_{00}$) and to a first approximation represent the total weight of solid matter dissolved in 1,000 units of weight of sea water. To be precise, values of salinity used in this work represent quantities *defined* in terms of measured temperature and density according to the relations given in Knudsen's Tables (1901). It is to be expected that small departures of this "salinity" from the total salt content will occur, especially in coastal waters subject to greater coastal dilution.

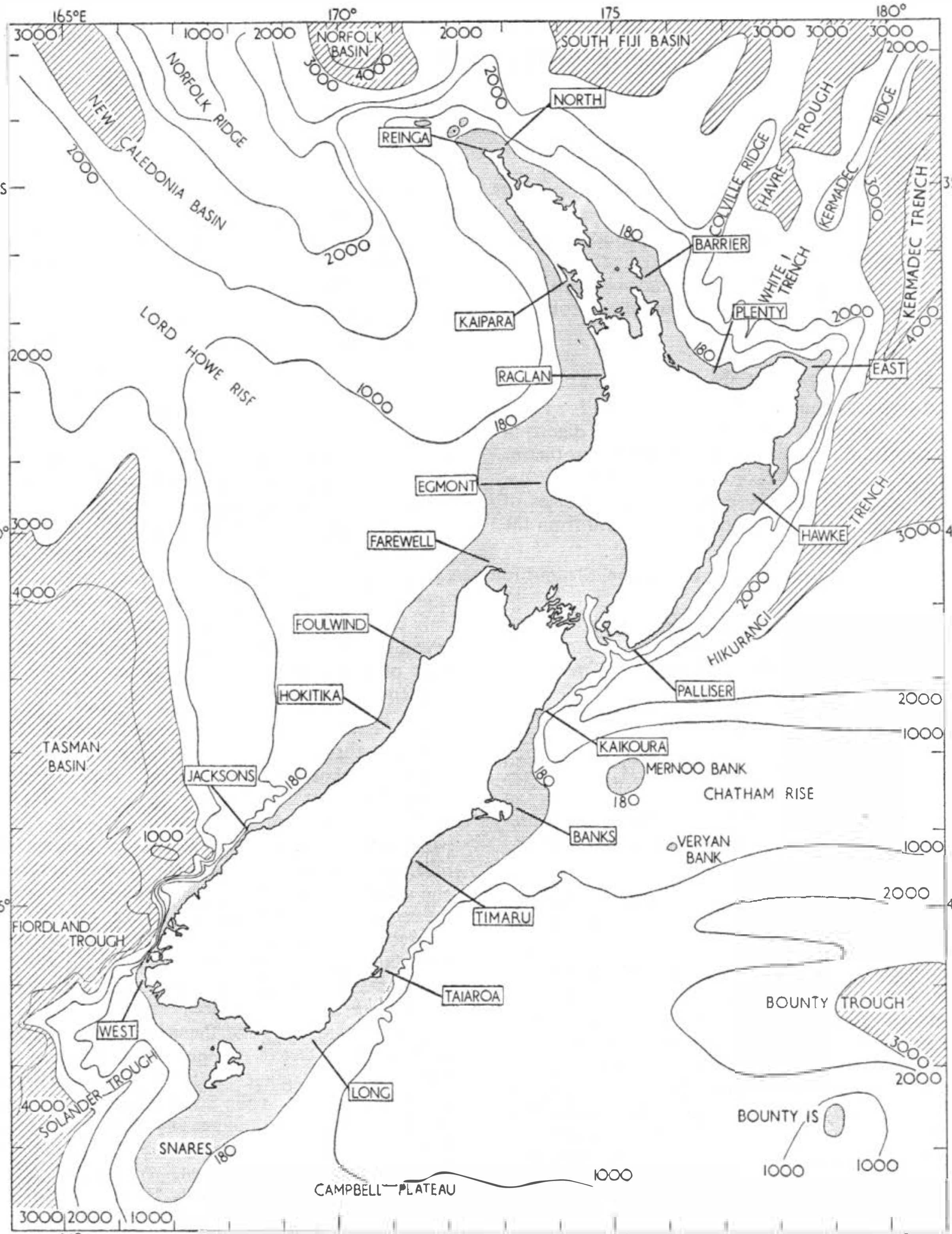

Fig. 1: Location of survey lines worked in whole or in part during 1955 in relation to a sketch of the main features of bathymetry. The general trend is shown of isobaths for 180 m, showing the extent of shelf waters (stippled), and for whole thousands of metres following. Areas deeper than 3000 m are shaded diagonally to show the main deeps around New Zealand.

THE SUMMER SITUATION

Results of the summer work will be discussed in some detail as the most comprehensive collection of data was made during this period. General concepts of New Zealand coastal hydrology will be derived from this phase of the work and used to guide the interpretation of data collected subsequently.

Surface Temperature and Salinity

All continuous thermograph records taken during February were plotted and a digest in terms of the regional pattern of surface isotherms appears as fig. 2. Records taken on the *Lachlan*, *Kiwi*, and *Alert* survey cruises form the basis of this chart; in addition, records were used from the following vessels—

- m.v. *Tofua*, Auckland-Suva (Union Steamship Co.);
- t.s.s. *Monowai*, Auckland-Sydney (Union Steamship Co.);
- m.v. *Tamaroa*, Auckland-Panama (Shaw, Savill, and Albion Co.);
- m.v. *Rangitoto*, Wellington-Panama (New Zealand Shipping Co.);
- m.v. *Port Waikato*, Lyttelton-Chatham Island (Holm Co.);

and surface temperature (and salinity) measurements by m.v. *Wanganella* (Rochford 1957a) were also used.

A good coverage of surface waters to the east of New Zealand resulted. Coastal waters off the west coast of the North Island were given fair coverage but data were very few from waters off the west coast of the South Island. The degree of synopticity of the pattern in fig. 2 must be kept in mind; while observations from any particular area were, in general, obtained within a period of a few days, this period altered progressively through the month as the survey proceeded. Little difficulty was experienced, however, in comparing observations made at the beginning and end of this interval, and indeed, with the temperature cycle at or near its annual maximum, the pattern might be expected to show relatively little change at this time of the year.

Most salinity data were obtained from the survey cruises, whereas temperature data were augmented by thermograms from commercial routes. The nature of the correlation between surface temperature and salinity has been used as an aid in filling out details of the regional pattern of surface isohalines, shown in fig. 3.

Clear of the local area of relatively cold water off Cape Reinga, surface temperatures of 23°C and salinity of $35{\cdot}9\,^0/_{00}$ were the highest values found. Tongues of warm water extended southwards east and west of the Northland peninsula, bringing the 22°C isotherm into coastal waters off Kaipara Harbour on the west and into the Bay of Plenty on the east coast. Offshore, this isotherm probably extended, off the east coast, as far south as Hawke Bay. The $35{\cdot}9\,^0/_{00}$ isohaline followed closely the trend of this isotherm in the north and off the east coast, but did not penetrate so far south off the west coast of the North Island. The only other area covered by the records used here revealing water as warm as 22°C lay in the southwest of the Hauraki Gulf in the approaches to Waitemata Harbour.

The coldest water encountered during the summer survey had a temperature of 12°C, located offshore from the south Otago coast, where the lowest salinity ($34{\cdot}4\,^0/_{00}$), apart from the result of coastal dilution, was also found. Cold patches of the same temperature were also found off Cape Campbell and the north Canterbury coast and these probably had a similar salinity. In inshore waters much lower salinities were evident in several places due to land-water drainage. While still standing at a relatively high value, salinity close inshore in the Bay of Plenty was significantly lower than might have been expected from the surrounding pattern, and there seems to be indicated here the effect of the spreading of fresh water from the Whakatane and Rangitaiki Rivers. Towards the coast in the South Canterbury Bight salinity decreased with increasing temperature to a minimum value measured of $34{\cdot}3\,^0/_{00}$. Many rivers, notably the Rakaia, Ashburton, and Rangitata, discharge into this Bight. A marked drop in salinity at the inshore end of the line Taiaroa is probably due to a northwards spread of the outflow of the Taieri River. The most pronounced instance recorded here of fresh-water dilution was off Jacksons Head, South Westland,

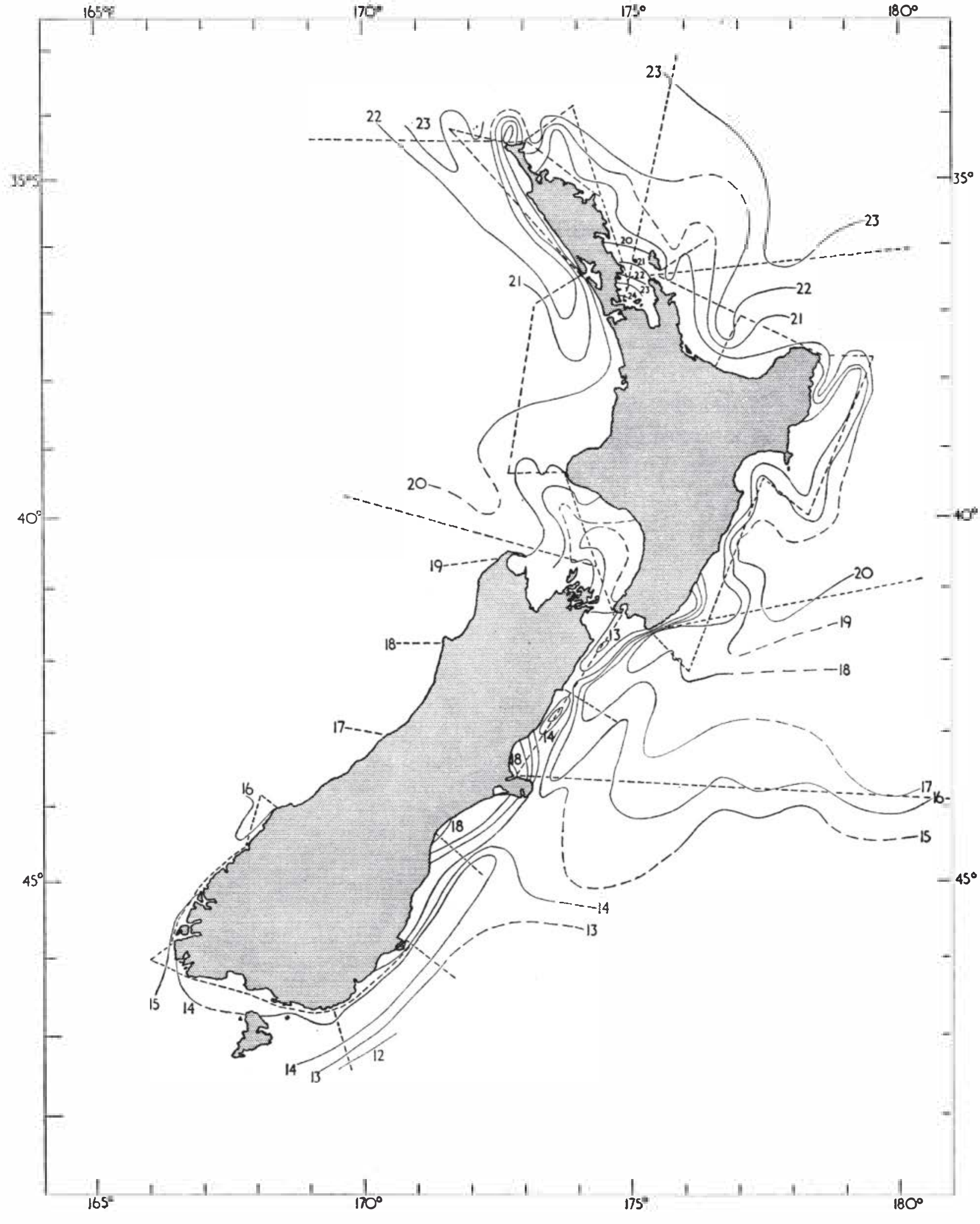

Fig. 2: Surface temperature pattern for February 1955 (°c) constructed from thermograph records obtained along the tracks shown as dotted lines

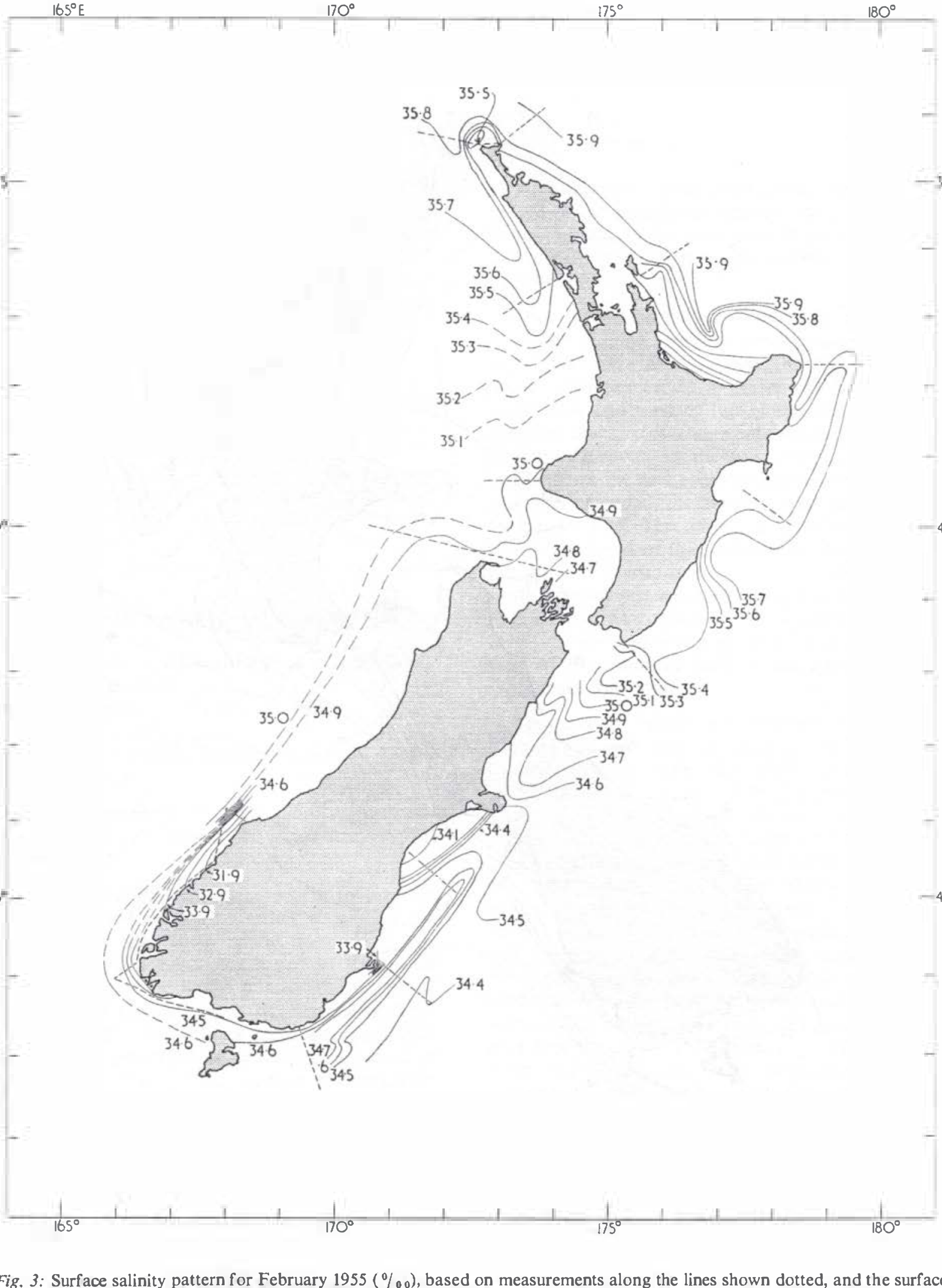

Fig. 3: Surface salinity pattern for February 1955 ($^0/_{00}$), based on measurements along the lines shown dotted, and the surface temperature – salinity correlation for the period

where a surface salinity of $32^0/_{00}$ was found several miles offshore. With the high rainfall characteristic of coastal Fiordland (about 250 in. a year) it is probable than an extensive band of relatively fresh water is often present off the south Westland coast, especially during the summer months with the higher frequency of north-west winds (Robertson, 1951). It seems that coastal dilution here had little effect on the surface temperature.

The localised low temperature anomalies off Cape Reinga and the north-east coast of South Island occurred in areas previously noted for this characteristic (Garner, 1953, 1954) and seem to mark the upwelling of subsurface waters against the shelf.

Areas anomalously warm with respect to local environment were found in such places as the Hauraki Gulf, Pegasus Bay, and the South Canterbury Bight, where the effects of semi-enclosing land and of shallow water were evident.

The outstanding feature of the oceanic surface temperature pattern to the east of New Zealand has been described (Garner, 1954) as a tongue of warm subtropical water extending southwards off the east coast of North Island into colder subantarctic waters. The tongue of warm water found approaching Cape Turnagain in the present study will be the inshore southern part of this system. The isotherm configuration of a broad subtropical tongue was recognisable offshore as far as the isolines of 15°C and $34{\cdot}5^0/_{00}$, beyond which surface water seemed to be wholly of subantarctic character.

Off the Otago and south Canterbury coast there is an intrusion of relatively warm and saline water from the south-east Tasman Sea.

In the eastern Tasman Sea, off the west coast of New Zealand, previous work has failed to define features in the surface temperature pattern as pronounced or as consistent in structure as those off the east coast. In this survey records supporting the main cruise data from west coast waters were few, and a skeleton coverage of inshore waters off the west coast of North Island only has been obtained. The temperature pattern of fig. 2 shows a narrow tongue of warm water extending southwards from Cape Reinga into the North Taranaki Bight. That this is not simply a repetition of the east coast pattern on a smaller scale, however, is evident from the low surface salinities in this region.

A cool tongue extends from northern Cook Strait past Cape Egmont, associated with an apparent indraught of warmer water into the southern part of this area from the west.

South of Cape Farewell the data collected were sufficient only to indicate the general temperature level near the coast, and no discussion can be undertaken of pattern details. It is apparent, however, that the general temperature level off the west coast of the South Island was significantly higher than that off its east coast, and the level of salinity offshore was higher than that near the coast because of coastal dilution off the south-west coast of South Island. The isohaline for $34{\cdot}9^0/_{00}$ followed the coastal trend in waters relatively close inshore.

Surface Water Movements

The recovery pattern of drift cards released at summer stations is shown in fig. 4. A batch of five cards was released at 5 mile intervals along all North Island lines except PLENTY, and of the 440 cards dropped, 21 have been returned, the particulars of which are summarised in table 1. A general drift southwards along the east coast is recorded between North Cape and the East Cape - Poverty Bay region. Cards from the middle of lines REINGA and NORTH were recovered in the vicinity of the Bay of Islands, with low indicated rates of drift. The record from the inshore end of NORTH was from an *Endeavour* release, some time before the main release in this area from *Lachlan.* Recovery was made near Coromandel in the Hauraki Gulf, also with a low rate of drift indicated at about $\frac{1}{5}$ knot. A release from the middle of BARRIER reached as far as Opotiki in the Bay of Plenty at, apparently, the rate of at least two knots. Released from a few miles closer inshore, however, a card found its way to an east coast beach of nearby Great Barrier Island. It was not found until some three months after release and had thus probably been lying stranded for some time, although this card may have shared in the general movement southwards and subsequently returned to the island in an inshore counter drift. The only recovery from releases in North Island east coast waters between East Cape and Cape Palliser was from the inshore end of EAST, a short drift down the coast being recorded. This portion of the east coast otherwise shows a notable absence of drift card recoveries.

Apart from the indication of drift from REINGA into east coast waters around the north of North Island, a general south-going movement was also recorded off the west coast. At KAIPARA two

Table 1. Drift-card Recoveries, Summer Release

Release Station	Cards Found	Place Found	Time to Recovery	Possible Drift (Miles)	Possible Rate (Knots)
I North/1	1	Coromandel	37 days	190	0·2
/6	1	Whangaruru South	20 days	100	0·2
I Barrier/5	1	Great Barrier Island	3 months	..	..
/7	1	Opotiki	29 days	135	1·9
I East/1	1	Tuparoa	6 days	50	0·4
I Egmont/1	2	Waikanae			
/2	2	Makara			
/3	2	Makara and Kapiti Island ..	(average)	200	1·7
/6	1	Otaki	5 days	120	1·0
/7	1	Waikanae	..	(direct)	
/8	1	,, ...			
/9	2	Foxton			
/10	1	Otaki			
I Kaipara/3	1	Manukau Harbour	..	..	..
/4	2	Port Waikato	15 days	70	0·2
I Reinga/6	1	Bay of Islands	12 months	165	..

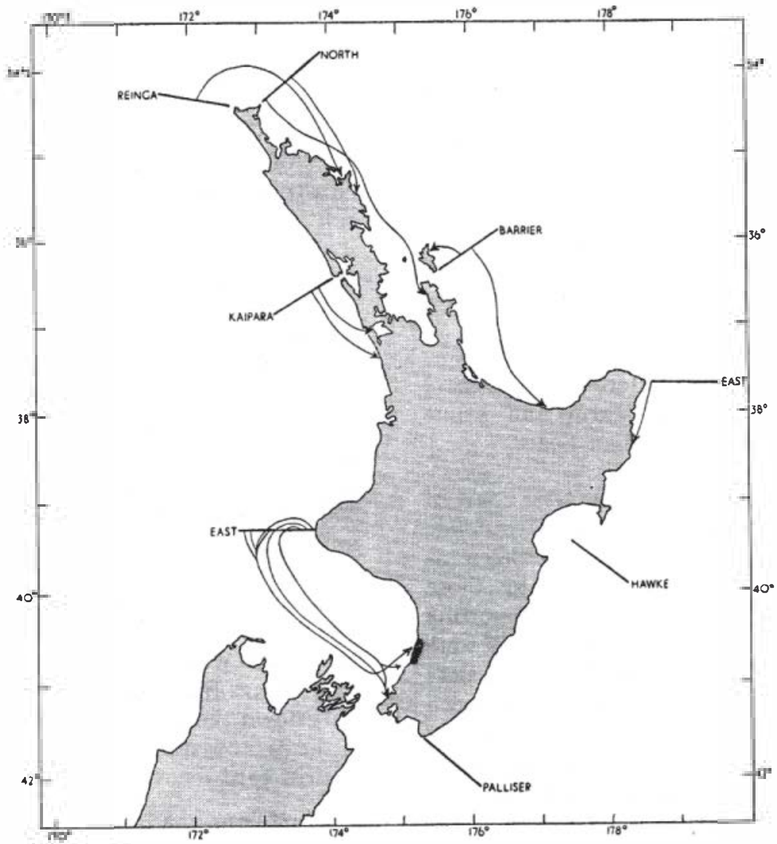

Fig. 4: Surface drift records, summer (see table 1), from cards released along the lines shown. Suggested tracks are shown of those cards recovered after on-shore stranding

cards from the one release about 20 miles off shore were found near the mouth of the Waikato River, while from the next station inshore one card found its way into the Manukau Harbour, presumably happening to be off the entrance during the flood tide. Relative to releases elsewhere, a very high recovery of cards was made from EGMONT. Stations 4 and 5 only were not represented in the recoveries and two cards were recovered from each of four drops. All recoveries were made from Wellington west coast beaches between Foxton and Makara (including one from the northern tip of Kapiti Island) but mostly from the northern part of this region. It is difficult to imagine the detail of the drift paths followed. Recoveries were made from well frequented beaches in March, April, and August following release, and after entering northern Cook Strait cards may have made several circuits before stranding. The first card was found only five days after release, and with a direct path between the end points, a drift of over 1 knot is implied.

The general movement in Subtropical Water to the east of North Island is south-going with an east-going (offshore) component which becomes predominant near the boundary region between subtropical water and the colder, less saline water of subantarctic origin.

An east-going component off the east coast North Island probably accounts for the remarkable lack of drift-card recoveries (fig. 4) from releases between East Cape and Cape Palliser. Well south of this boundary, north-east-going sets will probably be found in the Subantarctic Surface Water. Into coastal waters east of Otago flows water with relatively high temperature and salinity apparently derived from the south-east Tasman Sea where, from the general level of temperature and salinity, it would appear that surface water was of subtropical origin, probably derived from the East Australian Current. Data are still lacking, however, to enable the origin and behaviour of subtropical water off the west coast of the South Island to

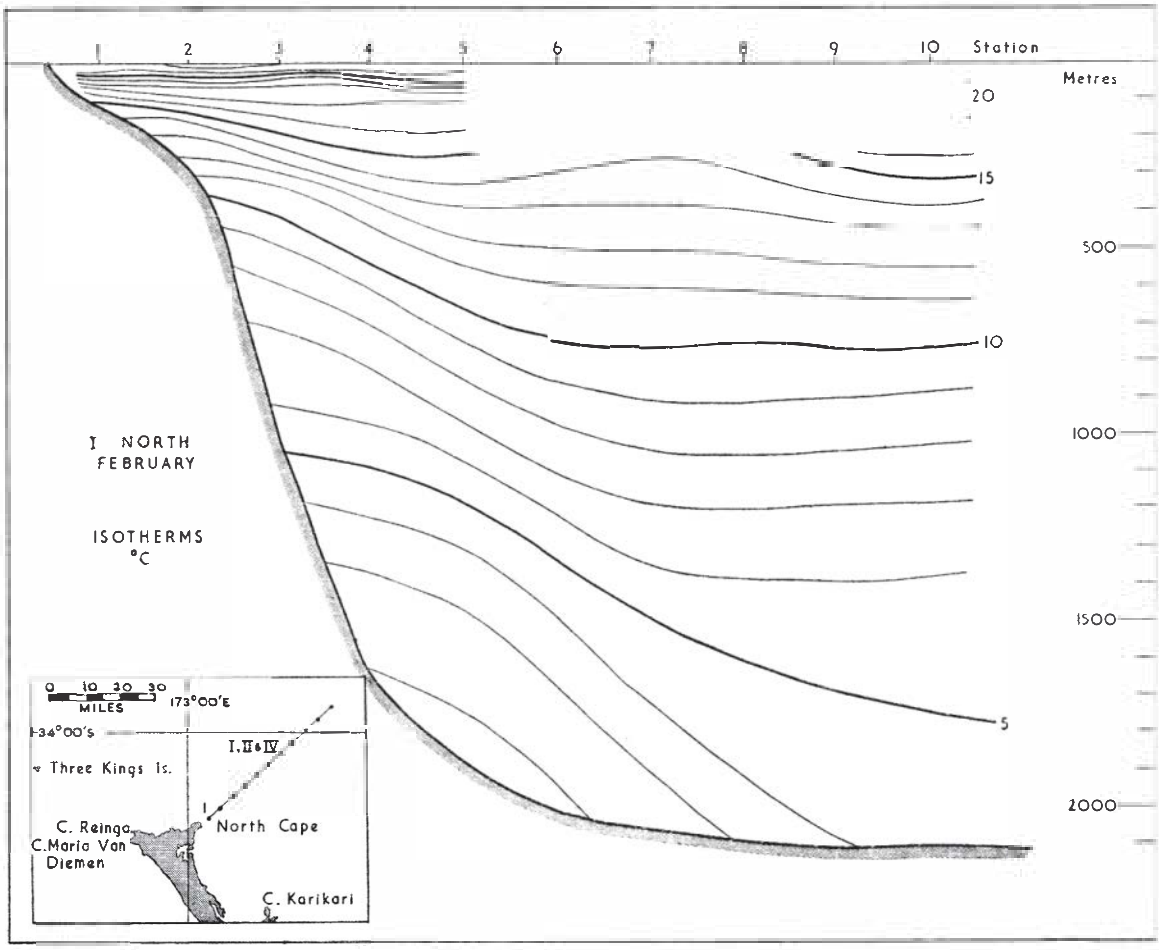

Fig. 5: Vertical section of temperature off North Cape, summer

be discussed. The low salinity off the west coast of North Island is difficult to account for here. If a southward movement of Subtropical Water similar to that attributed to the east coast region occurs, a considerable degree of mixing with water of similar temperature but lower salinity appears to be taking place. Whether this influence comes from surface waters further west, from coastal dilution, or from subsurface waters remains to be seen.

Vertical Temperature and Salinity Sections

Cross sections of temperature and salinity were obtained along all North Island lines except Plenty during the summer period.

The section I North (figs. 5 and 6) extended over the south-west slopes of the South Fiji Basin. The shelf is very narrow and station 2 lay over the upper part of the steep slope; at station 6 depths in excess of 2,000 m were attained. Temperature and salinity follow similar patterns. A relatively steep slope of isolines downwards from the coast was evident in deeper layers over the slope with the result that water properties at the 2,000 m level near the bottom varied from just under 2°C; 34·7‰ to over 4°C; 34·75‰ in some 20 miles only (between stations 6 and 10). The top of the thermocline lay at a depth of 50–100 m, a marked deepening occurring between stations 7 and 9. A fairly strong southward pressure gradient was thus evident in this section, over the slope in deep water and in surface layers at the seaward end of this line.

The section I Barrier (figs. 9 and 10) was relatively shallow, lying over the inshore end of the Colville Ridge between the deeps of the South Fiji Basin and the Havre Trough. Shelf waters extended as far as station 8, stations 9 and 10 lying over deeper slope waters. Deep isolines over the shelf tended to parallel the sea bottom, bottom conditions being around 14°C and just over

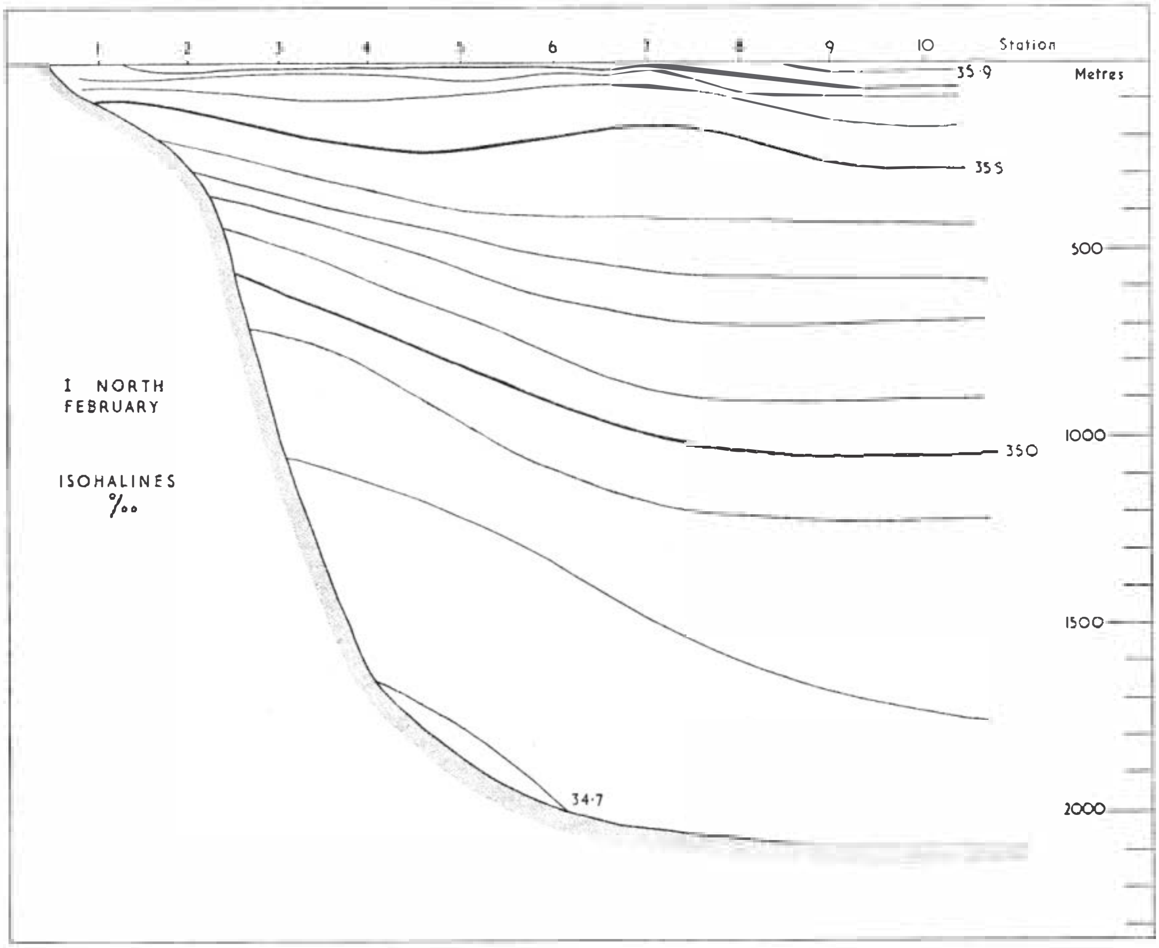

Fig. 6: Vertical section of salinity off North Cape, summer

$35 \cdot 2^{0}/_{00}$. Over the edge of the shelf the isolines were substantially horizontal. The top of the thermocline was at a depth of 30–40 m, with a marked shallow "dome" centred on station 6. Salinity decreased with depth, the pattern following closely that of temperature except at stations 2 and 3 where a shallow subsurface salinity maximum was recorded. In general, water to the north of the Colville Ridge is warmer than that on the south side, except for the cooler bottom water found closer inshore at I NORTH, The "doming" of isolines over the ridge seems to indicate that water at intermediate depth flowed over the ridge; the high stability of the sharp thermocline formed at BARRIER prevented an "upwelling" movement breaking through to the surface.

The section I EAST (figs. 11 and 12) was over the western slope of the Hikurangi Trench. In the upper layers, below about 20 m, isotherms had a moderate slope downwards away from the coast. The temperature on the shelf bottom was around 12°C and the isothermal slope resulted in a thermocline increasing in intensity shorewards so that at station 1 the temperature fell by nearly 7°C in the 80 or so metres of total depth. At station 9 this temperature range occupied over 300 m of the water column. The distribution of isohalines paralleled that of isotherms, bottom salinity on the shelf being about $35 \cdot 35^{0}/_{00}$. No sign of the upwelling of cold water off East Cape as noted in previous observations (Garner, 1959a) was present here.

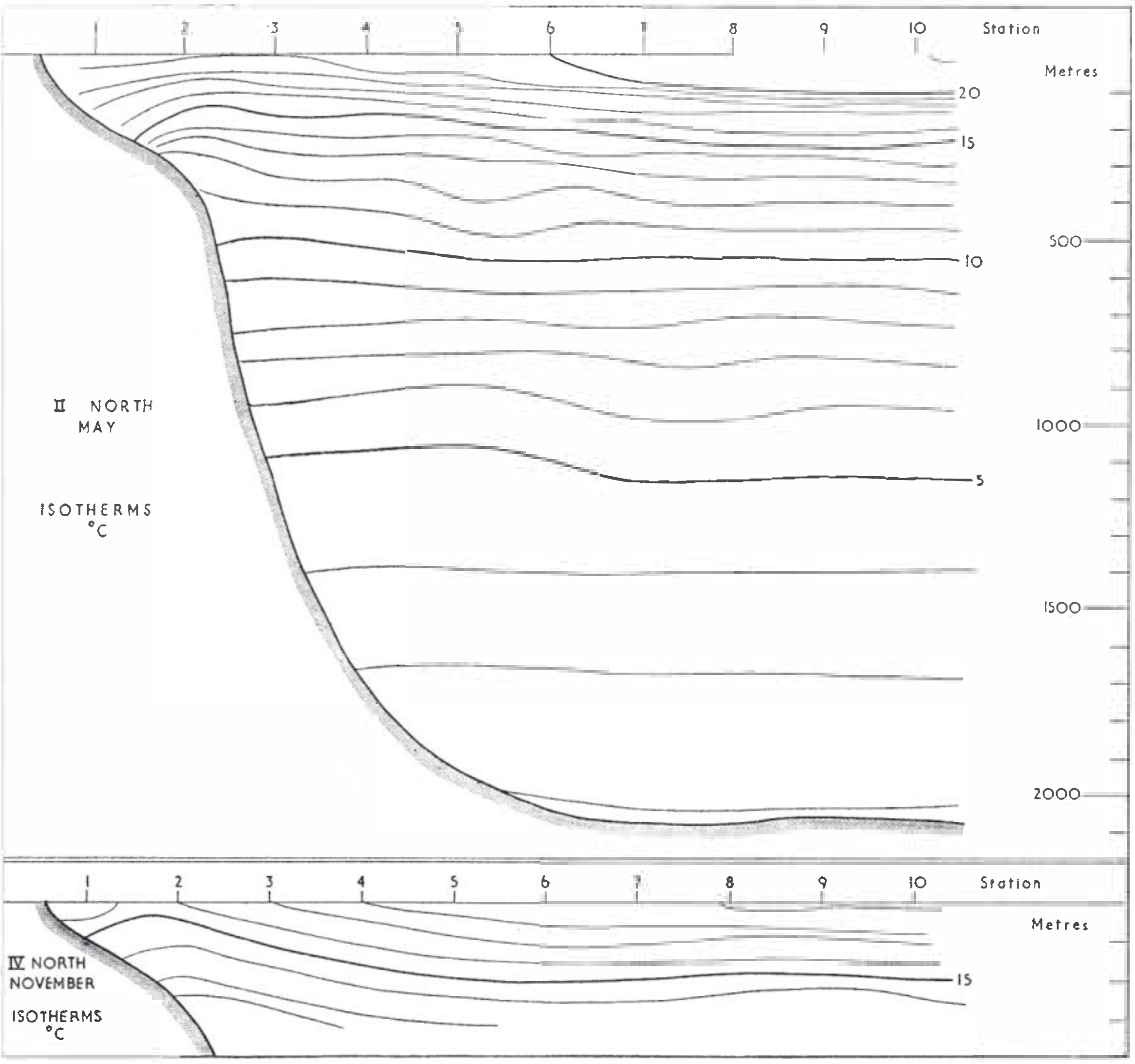

Fig. 7: Vertical section of temperature off North Cape, autumn and spring

In I HAWKE (figs. 13 and 14) the section was located over the shelf from the outer part of Hawke Bay across the slope to the Hikurangi Trench. Isoline configuration remained generally horizontal. Over the step-like feature in the slope a deflection of bottom waters appeared, while over the shelf itself a small temperature inversion was recorded on bathythermograph traces extending from the inshore end of the line, offshore nearly to station 4. With the data available it is difficult to assess the significance of this feature. If the cold tongue responsible for the inversion was hydrostatically stable, the salinity must have been proportionately low to maintain the necessary density relations with the water surrounding. In this case the inversion would represent a product of mixing between the oceanic water described in the profile and cold diluted water formed in inner Hawke Bay.

Off Cape Palliser the shelf is very narrow indeed, and the section I PALLISER (figs. 15 and 16) was almost wholly over the deep water of the southern part of the Hikurangi Trench. A moderate downward slope of isotherms away from the coast was evident out to station 7 and to a depth of 600–700 m. Below about 1,000 m a band of relatively warm water appeared against the slope. In the deeper layers isohalines paralleled the isotherms and conditions at the bottom of the

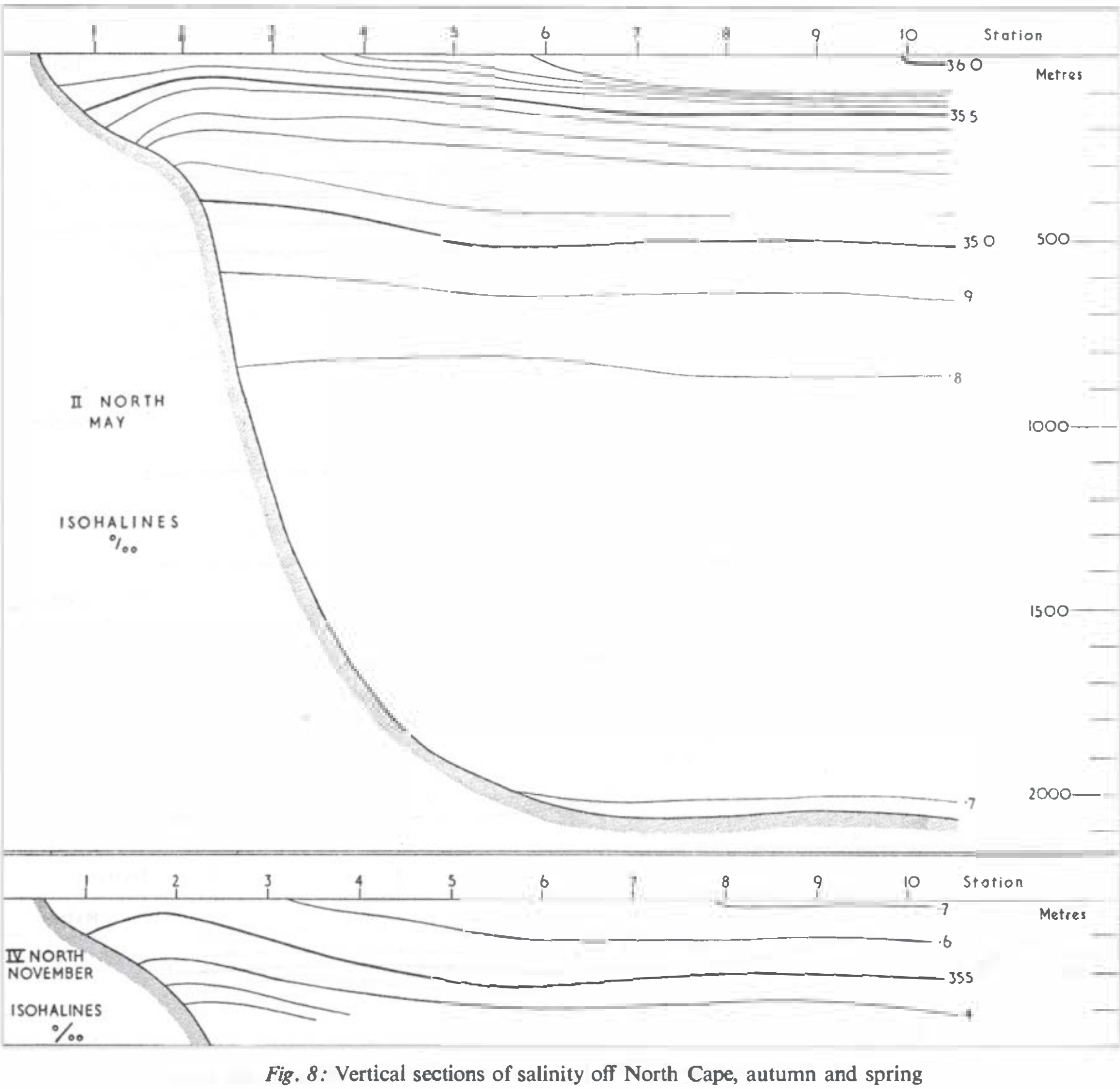

Fig. 8: Vertical sections of salinity off North Cape, autumn and spring

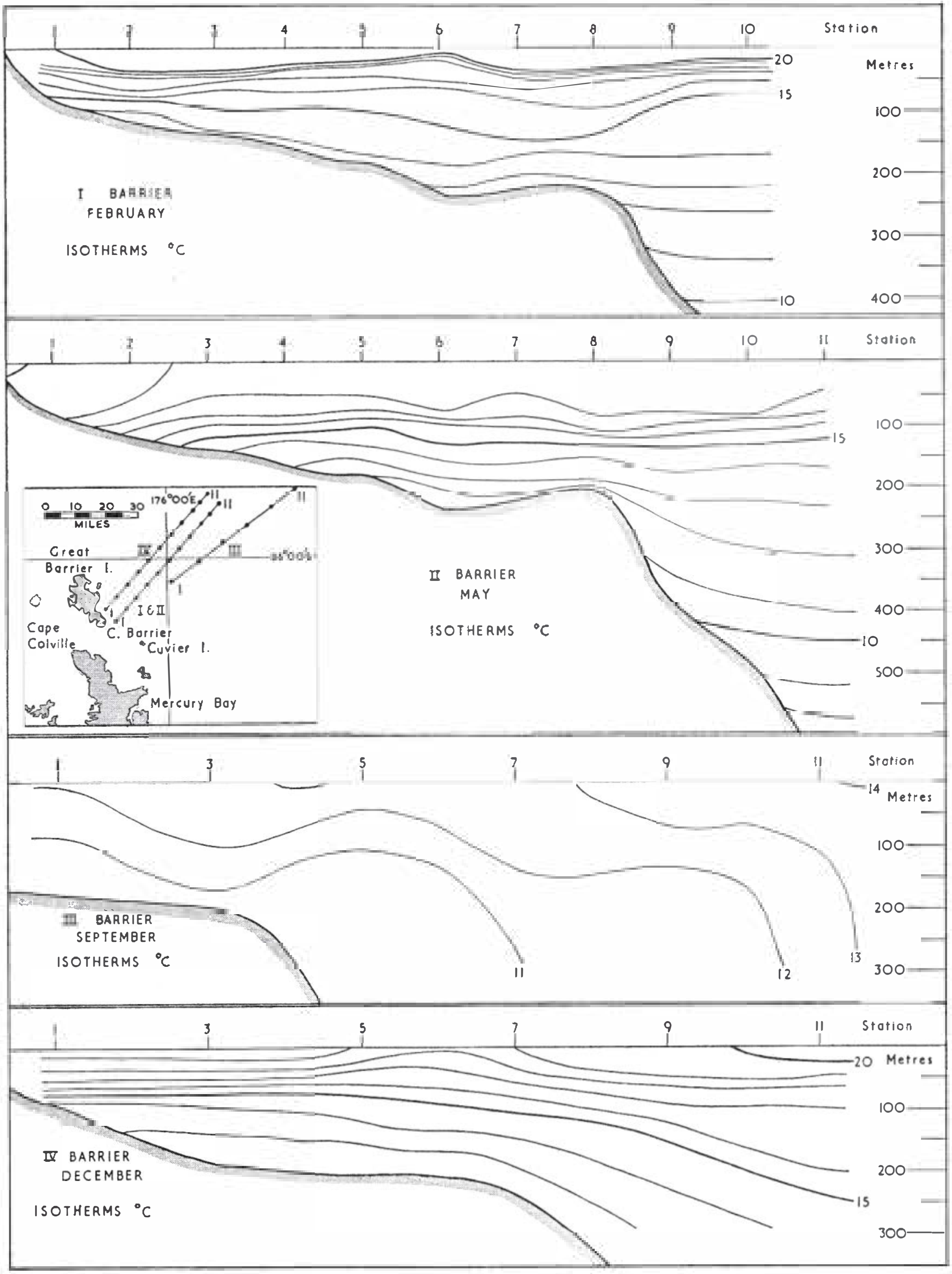

Fig. 9: Vertical sections of temperature off Great Barrier Island

trench were around 1·6°C and 34·68‰. Above 100 m a subsurface salinity maximum was evident, increasing seawards in intensity, a characteristic of the region near the Subtropical Convergence.

Turning now to the west coast, in the relatively shallow section I REINGA (figs. 25 and 26) the first indication was found of a marked change in the temperature structure over the shelf. Centred on station 2, an apparent upwelling of water on to the shelf from a depth of 100–150 m seemed to take place. A pronounced subsurface salinity maximum reaching a value of 36·0‰ at the off-shore end of the section reached in towards the shelf edge. The axis of this tongue followed closely the trend of the 20°C isotherm near the top of the thermocline.

I KAIPARA (figs. 23 and 24) extended into waters over the New Caledonia Basin and was characterised by a very sharp thermocline at a depth of some 50 m, the vertical temperature gradient increasing rapidly towards the seaward end of the line. No trace of the REINGA subsurface salinity maximum was evident in this section, isotherms and isohalines following similar trends.

I EGMONT (figs. 19 and 20) was worked entirely on the extensive shelf at the Cook Strait end of the Lord Howe Rise. Little temperature detail was evident in this section, while the salinity distribution appeared to be rather complex, in general increasing slightly with depth, the lowest values being concentrated in a shallow subsurface minimum around station 4.

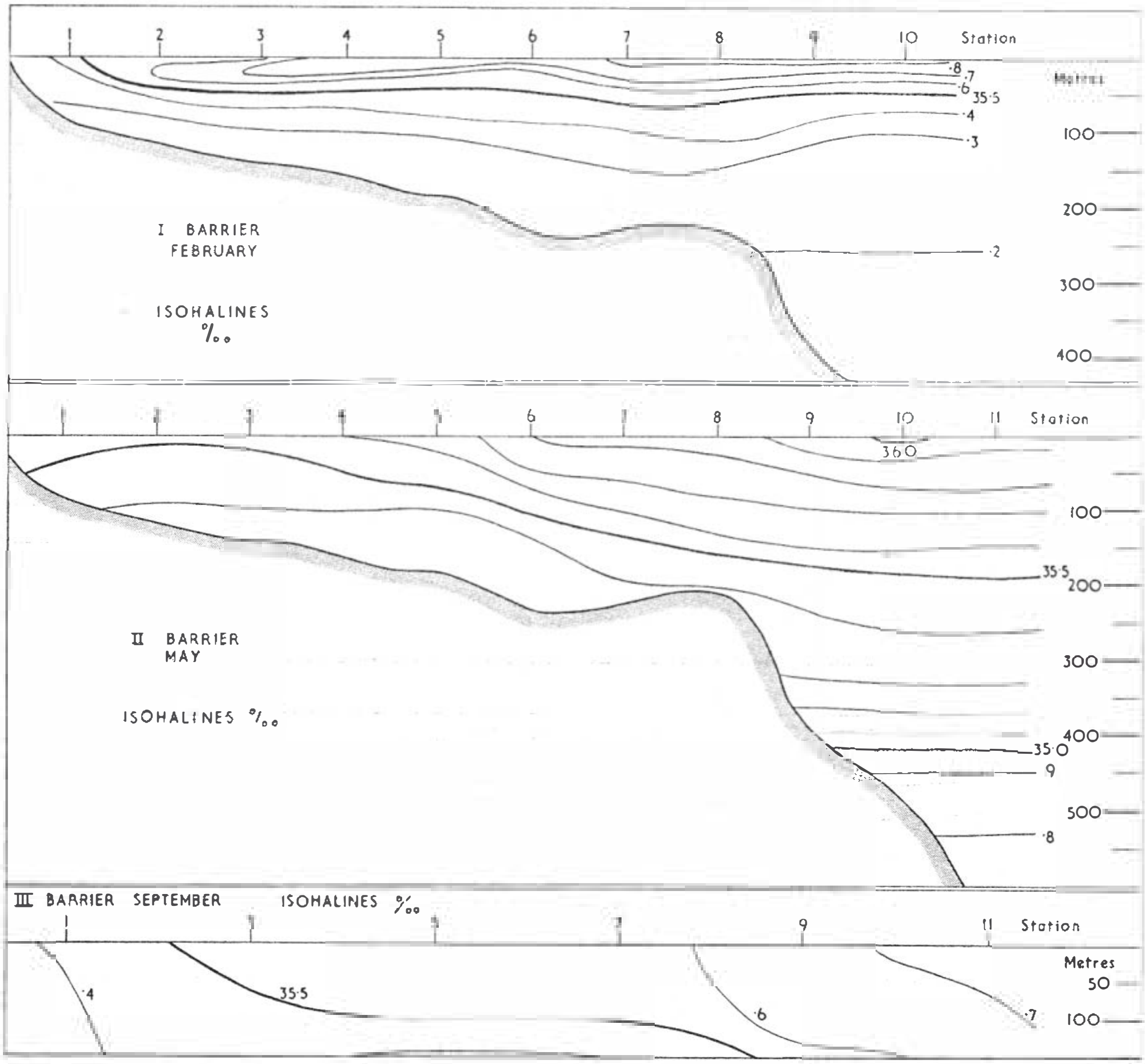

Fig. 10: Vertical sections of salinity off Great Barrier Island

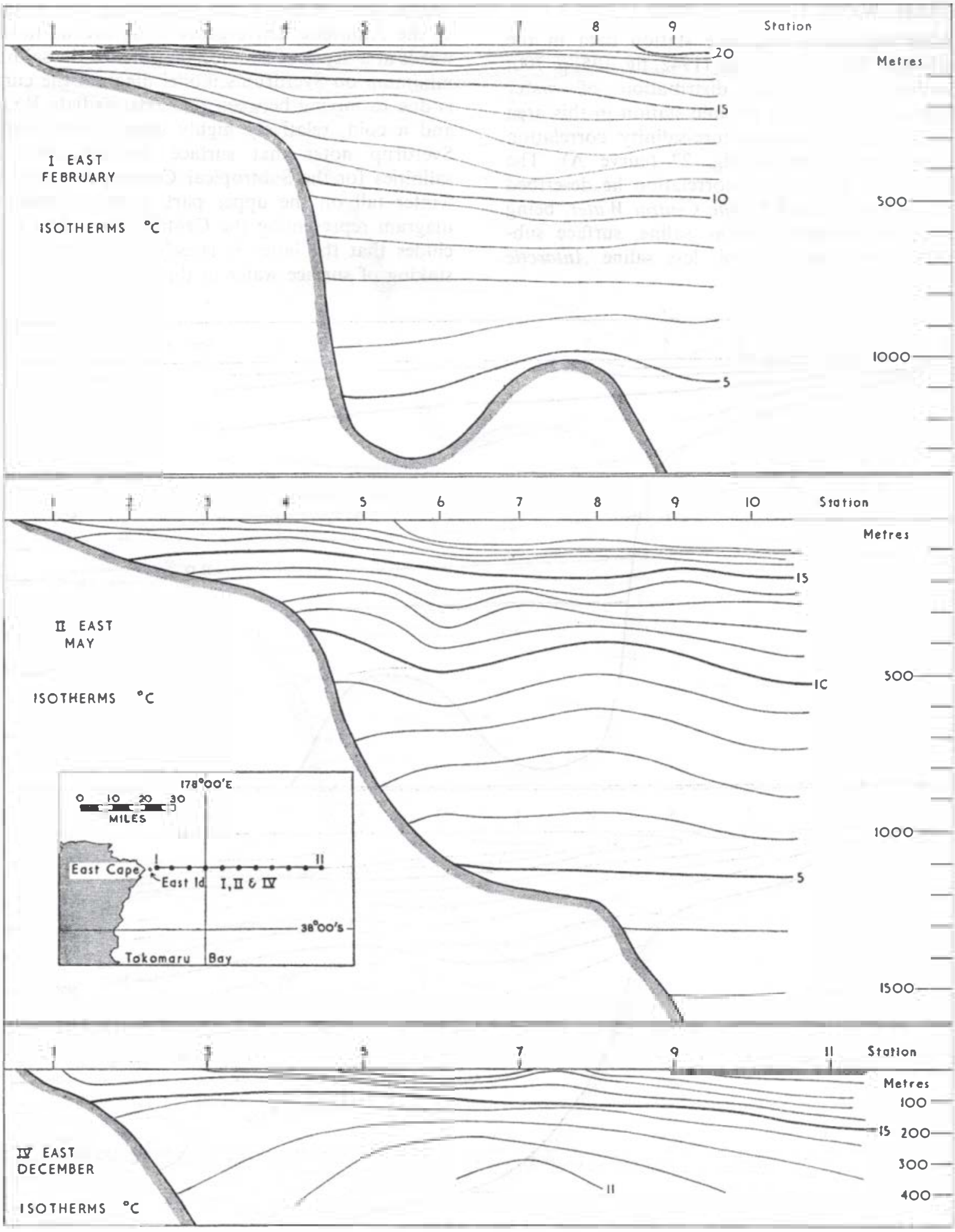

Fig. 11: Vertical sections of temperature off East Cape

General Water Characteristics

After examining available station data in the south-west Pacific, Sverdrup (1942, fig. 195, p. 700) described the vertical distribution of water properties at a typical oceanic station in this area in terms of the temperature-salinity correlation diagram reproduced in fig. 27 (curve A). The upper linear part of the correlation he described as the *Western South Pacific Central Water*, being a mixture between a warm, saline, surface subtropical water and a cool, less saline *Antarctic Intermediate Water* which sinks from the surface at the Antarctic convergence and spreads northwards at a depth of 800–1,000 m. Below the salinity minimum on Sverdrup's model diagram the curve is due to mixing between this Intermediate Water and a cold, relatively highly saline *Deep Water*. Sverdrup notes that surface temperatures and salinities for the Subtropical Convergence zone in winter fall on the upper part of the correlation diagram representing the Central Water and concludes that the latter is largely derived from the sinking of surface water in this area.

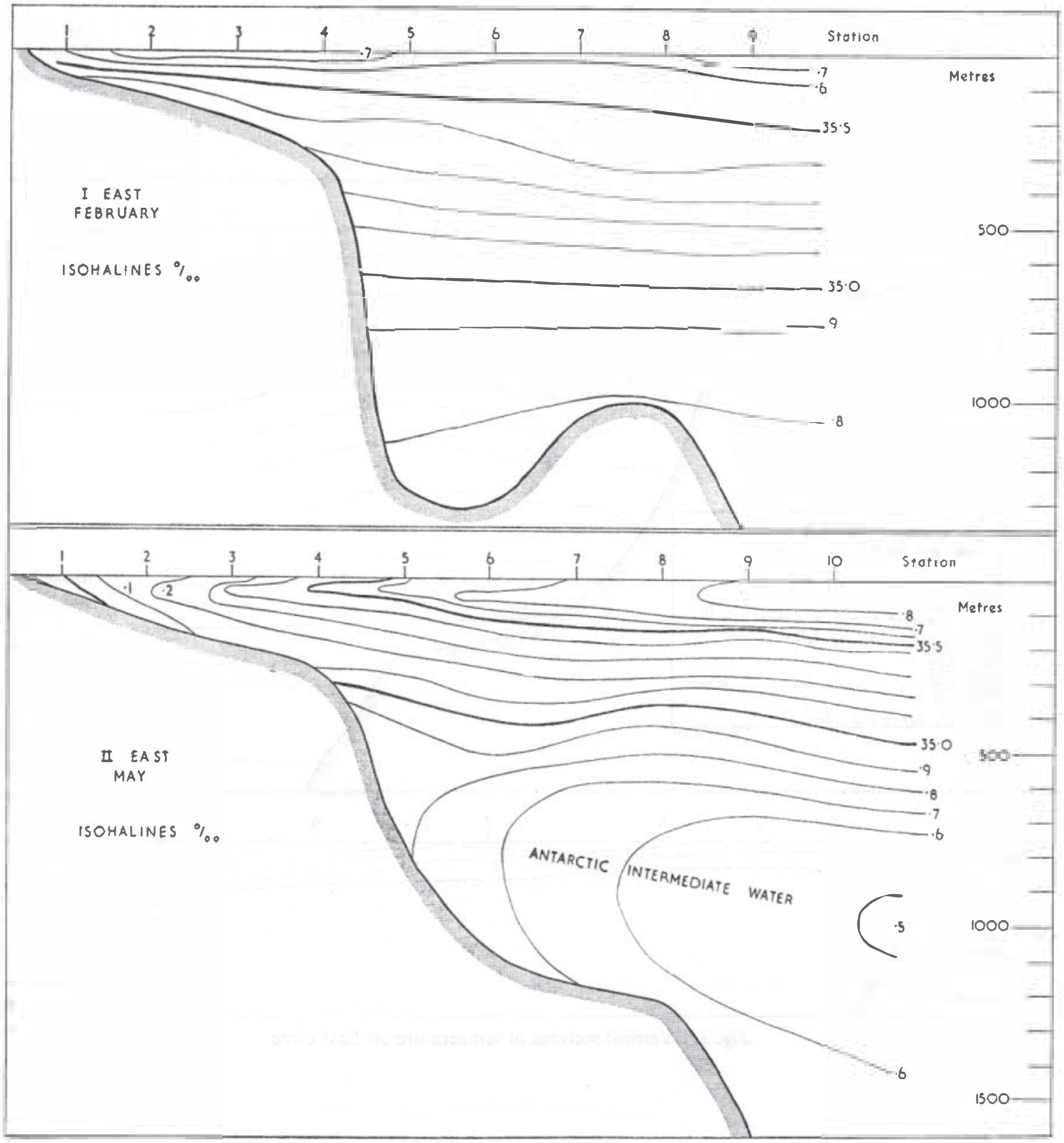

Fig. 12: Vertical sections of salinity off East Cape

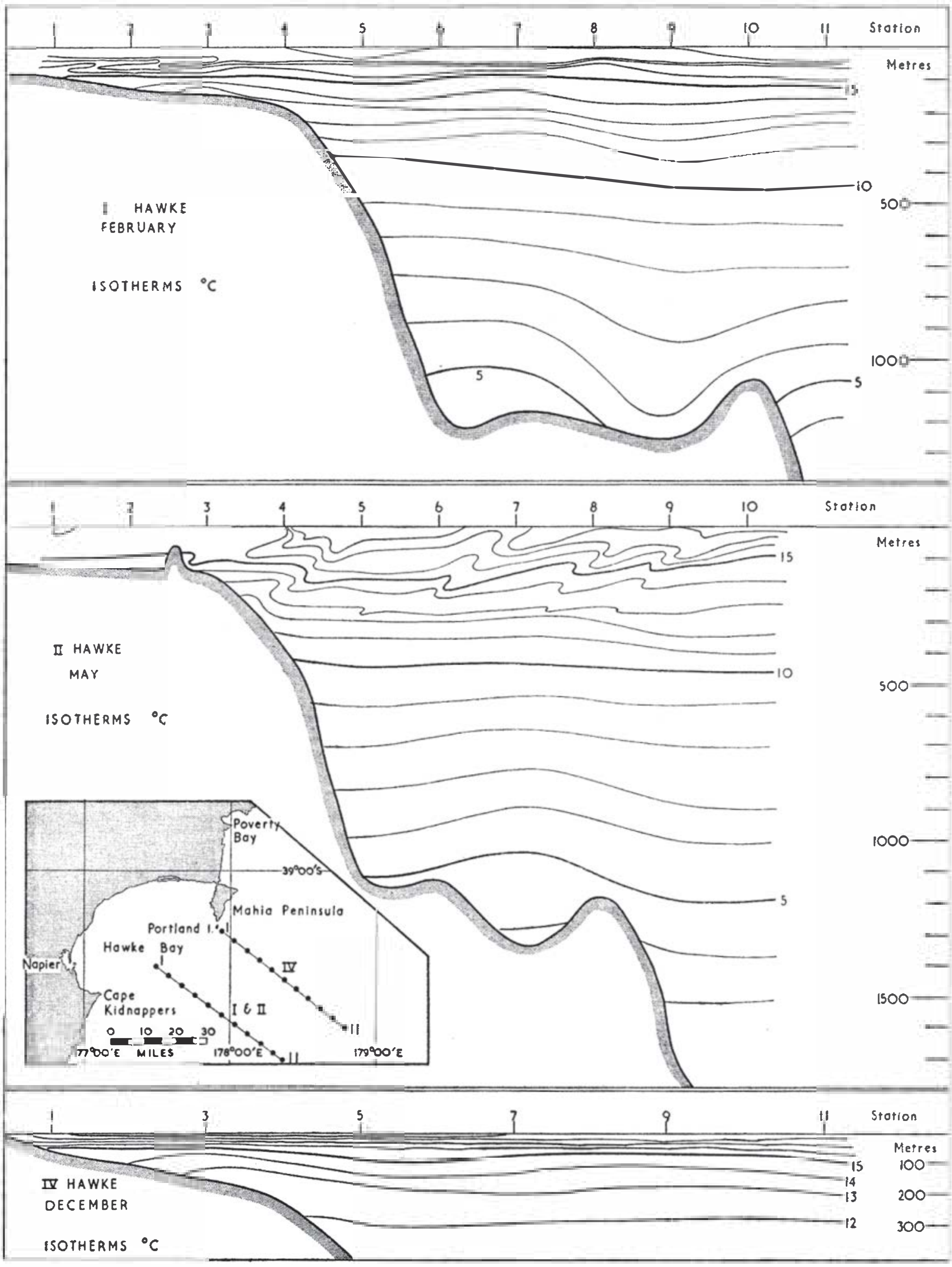

Fig. 13: Vertical sections of temperature off Hawke Bay

The temperature-salinity relations at the seaward ends of the profiles EAST, HAWKE, and PALLISER are shown in fig. 27 (curves E, H, and P). A notable feature is the virtual absence of any Antarctic Intermediate influence resulting in relatively high salinity at intermediate depth. The water column off the east coast, North Island, appears to be composed primarily of a mixture between surface subtropical water and Deep Water. With salinity decreasing rapidly southwards at any given temperature level, the curves bend more and more to the left on the T-S diagram, lateral mixing becoming more vigorous towards the Chatham Rise and the Convergence.

Notable off the west coast was the subsurface, subtropical water of very high salinity at REINGA, the shallow salinity maximum being due to the relatively low salinity surface water formed off

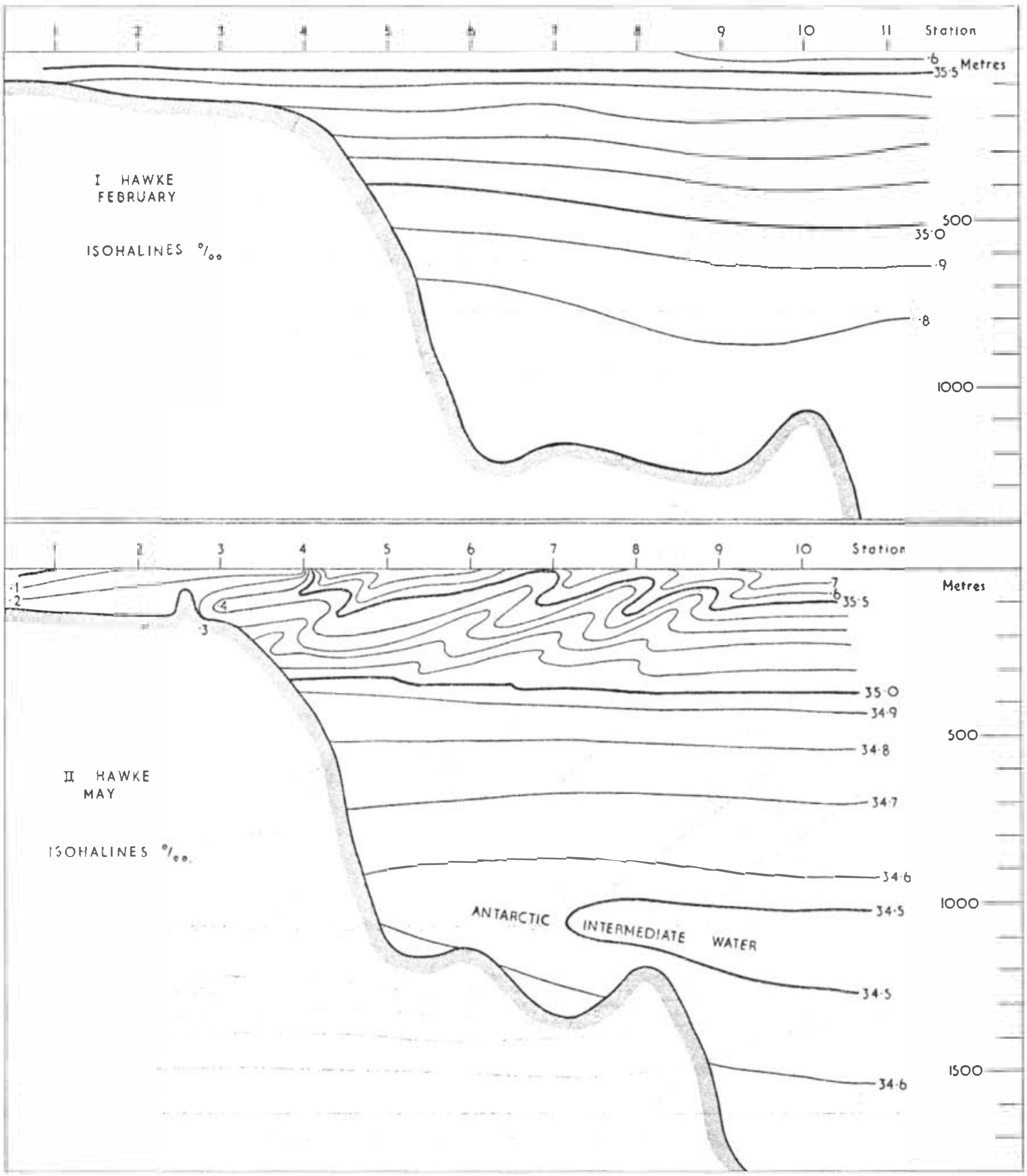

Fig. 14: Vertical sections of salinity off Hawke Bay

this coast. The deeper water at KAIPARA was similar in properties to that in the Hikurangi Trench off Hawke Bay, as may be seen from curves K and H, fig. 27. Near the steeply sloping shelf at the base of the Lord Howe Rise isohalines rose steeply across the isotherms (and surfaces of constant density), indicating lateral exchange in the top 400 m or so of depth between water with similar temperature characteristics but with a lower salinity, presumably over the Lord Howe Rise. In the shallow water at EGMONT the salinity increased with depth, and water characteristics were clearly different here from those encountered elsewhere. Remembering the cool tongue of relatively low salinity shown in the northern part of the approaches to Cook Strait in figs. 2 and 3, it may be that a dilution of northern Strait waters by river discharge was here being flushed out past Cape Egmont by a movement past Cape Farewell from the eastern central Tasman Sea. This influence probably accounts for the lower salinity near the surface at EGMONT as well as adding its contribution to the peculiar surface salinity relations west of North Island generally, a feature already noted by Rochford (1957b) from data in the western approaches to Cook Strait. His term "East Central New Zealand water" to describe these characteristics has been found unacceptable to the writer for reasons already stated (Garner 1959b): see also section, p. 52 in the present work.

THE AUTUMN SITUATION

Surface Temperature and Salinity

In figs. 28 and 29 are drawn the patterns of surface temperature and salinity based on the survey data supplemented by *Wanganella* material (Rochford 1957a) westwards from Cape Farewell, and by *Port Waikato* material eastwards from Banks Peninsula. Data cover North Island coastal waters as before, but South Island waters only between Cook Strait and the South Canterbury Bight.

Compared with the February pattern, a general cooling of surface water was apparent. The highest temperature found was 21°c north-east of North Cape, and this temperature was maintained in the south-west Hauraki Gulf. Warm, highly saline tongues were again evident on both sides of North Island; off the west coast reaching into northern Cook Strait past Cape Egmont, and to the east, extending south of Banks Peninsula with warm water trending inshore towards Hawke Bay and into southern Cook Strait. No indraught of warmer water into the Bay of Plenty was this time apparent. Subtropical influence was noticeable as far as the 12°c isotherm and the isohaline of 34·6‰. Subantarctic influence was represented by a cold core of water south-east of Banks Peninsula containing the coolest and least saline offshore waters (10°c; 34·5‰) found during this phase of the work. Warm, relatively fresh water was still present in the South Canterbury Bight, and between this coastal water and the cold water further off shore was recognised the core of relatively high salinity (34·7‰) water associated earlier with south-east Tasman influence. No areas of coastal upwelling were defined during this period.

The level of surface salinity was similar to that mapped in February. The highest value found was 36·0‰ paralleling the north-east coast of North Island. A slightly lower salinity characterised inshore waters between Capes Kidnappers and Palliser on the east coast, and it appeared that a larger proportion of subantarctic influence was evident off this coast inshore of the subtropical tongue. While higher salinities were found further south off the west coast than in February (due presumably to the disappearance of the outflow of cool water from northern Cook Strait), west coast salinities remained lower than those off the east coast at a comparable temperature level.

Surface Water Movements

About 600 drift cards were released in May and covered North Island and east coast South Island waters between Cook Strait and Kaikoura. Twenty-five cards were recovered, the details being shown in fig. 30 and table 2.

The recovery pattern for May practically duplicated that for February except for the pronounced coastal drift southwards between North Cape and the Bay of Plenty. As in February, one card found its way from the middle of Reinga on to the east Northland coast, several cards from the inner end of Barrier were found on the east coast of nearby Great Barrier Island, a local recovery was made from East, no other strandings being reported between East Cape and Cape Palliser. Recoveries from Kaipara to the south of the line were also duplicated, even to the entry of one card into the Manukau Harbour. Egmont releases again showed a very high rate of recovery, this time over a much greater length of coast, being found from the North Taranaki Bight through Cook Strait (the North Island coast) to the east coast north of Cape Palliser. Cards from the outer end of Egmont were recovered between Cape Egmont and the Mokau River, with a resultant drift northwards from the point of release. Remaining releases entered northern Cook Strait, some from the centre of the line being found at Opunake and Wanganui, while recoveries from releases nearer the coast travelled to the Wellington area before stranding, one passing right through the Strait and reaching the Wairarapa coast. Here is an example of a drifting card being exchanged between the west coast subtropical circulation system to an inshore east coast system with subantarctic character, the exchange being facilitated probably by the vigorous tidal streams oscillating through the narrows of the strait. The time to recovery of these North Island releases were all measured in terms of several weeks, even for the Egmont pattern, where relatively high rates of drift were recorded in February, and it was felt that the completion of table 2 in terms of drift rates was unprofitable. From releases off the north-east coast of South Island, recoveries were made in the Wellington area from the inshore sections of TIMARU and KAIKOURA, nothing being recovered from BANKS. A large number of cards released in Pegasus Bay during this month (E. W. Dawson, pers. comm.) revealed a wind-controlled circulation system within the confines of the bay, resulting in a high rate of recovery along the coast centred on New Brighton, while cards dropped in the outer part of the bay were carried northwards to the Wellington area following the drift pattern revealed here. The four weeks' passage from TIMARU to the Wellington coast implies a drift rate of at least 10 miles a day or nearly 0·5 knot.

VERTICAL TEMPERATURE AND SALINITY SECTIONS

The May survey again completed full temperature and salinity measurements along all North Island lines except PLENTY.

II NORTH (figs. 7 and 8) duplicated the position of the summer section and, as before, temperature and salinity decreased steadily with increasing depth, the structure of the two patterns being similar. To intermediate depth, a moderate south-

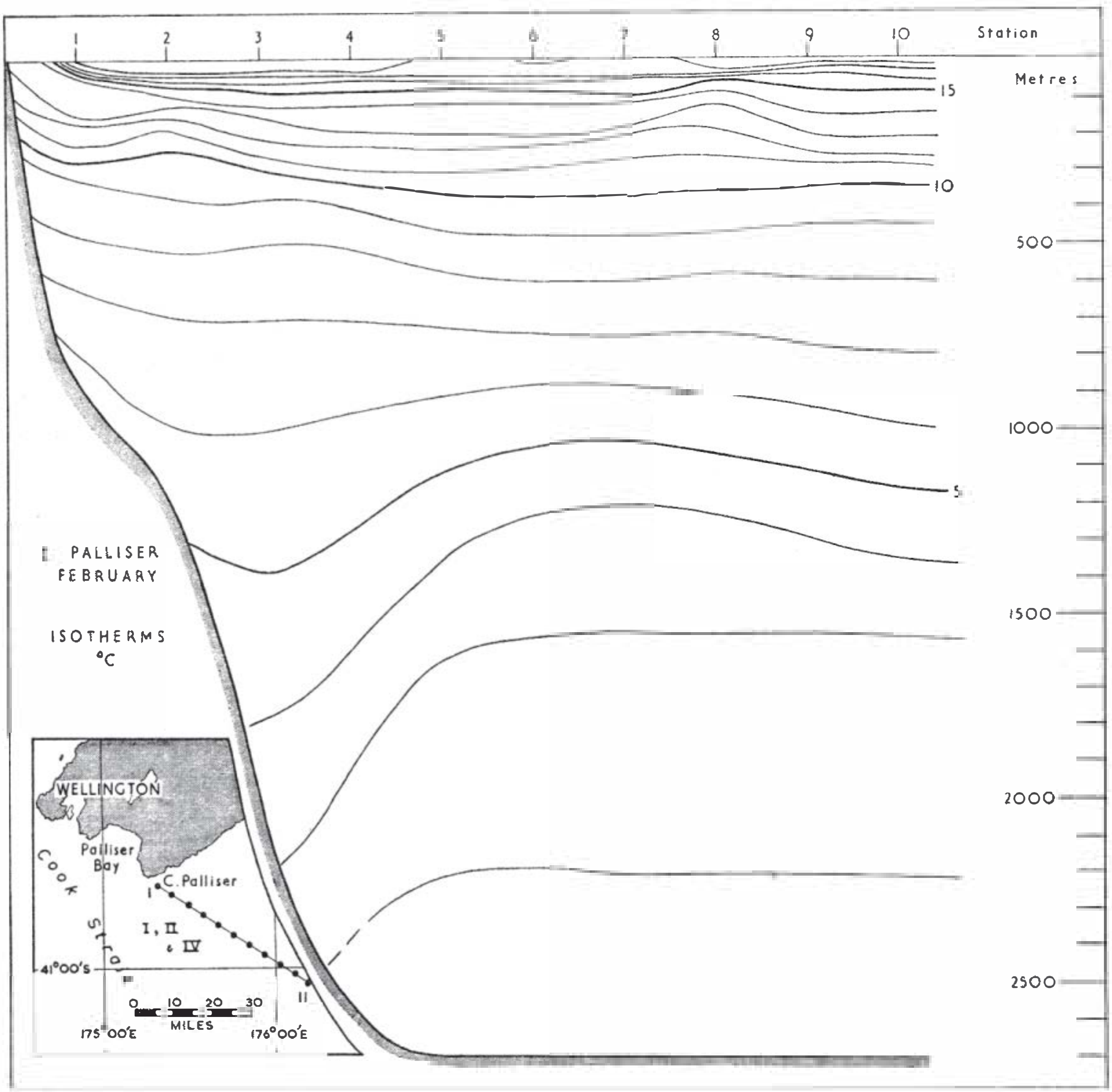

Fig. 15: Vertical section of temperature off Cape Palliser, summer

ward pressure gradient was evident over most of the section, with a counter gradient over the shelf between the first two stations. The relatively warm and highly saline bottom water evident in the offshore part of the line as worked in summer was absent in this section.

II Barrier (figs. 9 and 10) followed its summer counterpart geographically. As in the offshore section of II North, a deeper surface isothermal layer was evident compared with the summer section, the top of the thermocline lying between 50 and 100 m. throughout. The vertical salinity distribution differed considerably from the temperature section in the upper 200 m however, with a fairly steep slope downwards of isohalines over the shelf, high values to seawards, and a relatively steep vertical salinity gradient at about 400 m over the slope. These features appear to be associated with the lateral diffusion into slope waters of high salinity water from offshore, giving a marked increase since summer in the average salinity of the top 400 m of the water column at the seaward end of the profile.

The temperature pattern of II East (fig. 11) did not greatly differ from that described for summer but once more nonconforming features were found in the salinity distribution (fig. 12). A shallow maximum had developed at 50–60 m, a tongue of

Fig. 16: Vertical section of salinity off Cape Palliser, summer

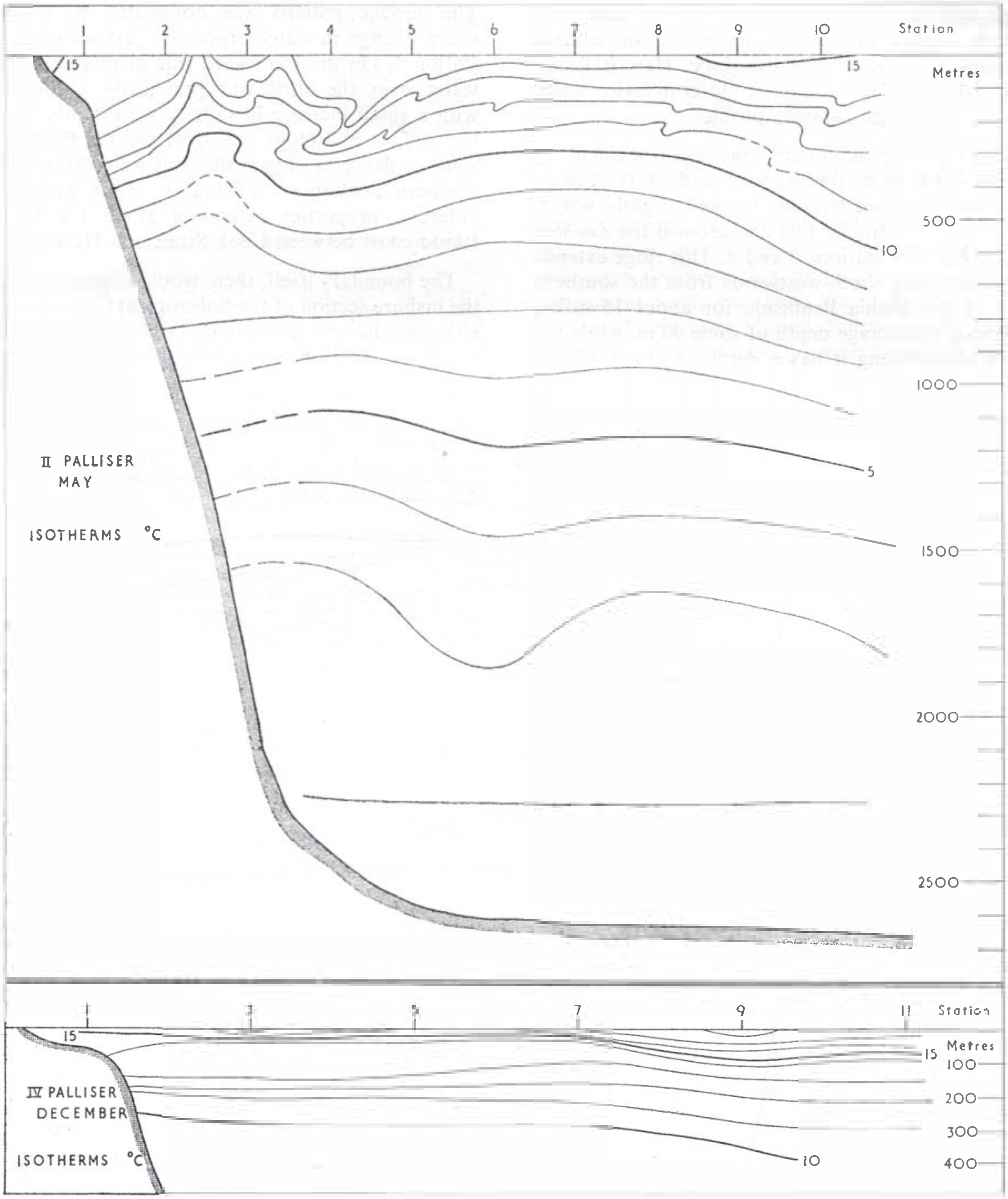

Fig. 17: Vertical sections of temperature off Cape Palliser, autumn and spring

high salinity reaching in over the shelf from seawards, while a pronounced minimum was evident centred at 1,000 m over the slope. Here is found the influence of Antarctic Intermediate water missing from the summer profiles.

This salinity minimum was again evident at about 1,100 m in the seaward end of II HAWKE (fig. 14). This section was worked slightly northwards of the summer line and crossed the *Lachlan Ridge* between stations 3 and 4. This ridge extends approximately south-westwards from the southern end of the Mahia Peninsula for about 15 miles, reaching an average depth of some 90 m, while the shelf surrounding it has a depth of about 130 m. The surface pattern was dominated by a very sharp change in water properties just seawards of station 4. On the shoreward side of this boundary water over the shelf was practically isothermal, with a small increase in salinity with depth. From the surface hydrology and drift records there was some evidence to suggest that this water formed the northern portion of a band of water with subantarctic properties extending along the North Island coast between Cook Strait and Hawke Bay.

The boundary itself, then, would appear to mark the inshore section of the Subtropical Convergence, although the very low salinity in Hawke Bay points to coastal dilution which intensifies the horizontal

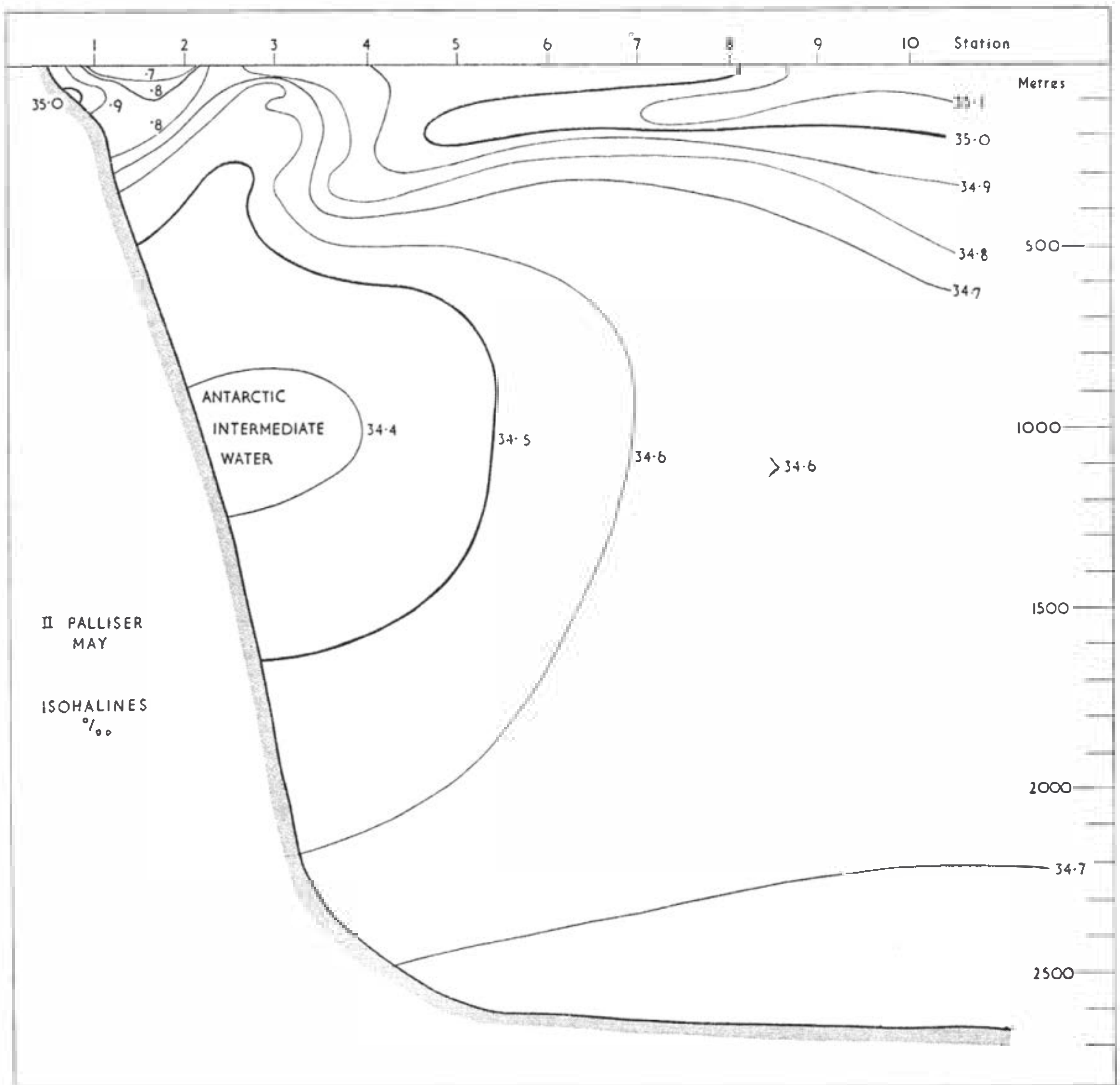

Fig. 18: Vertical section of salinity off Cape Palliser, autumn

gradient of temperature and salinity. It is apparent from the surface patterns of figs. 28 and 29 that this boundary trended fairly sharply eastwards to the south of this section. The tongue of sub-tropical water identified here off Hawke Bay was probably the remnant of the similar but more extensive feature mapped off Cape Turnagain during the summer survey, which had since retreated northwards.

Since the whole of the section II HAWKE between stations 4 and 10 lay close to the convergence, the complex temperature and salinity features shown in this part of the section were probably boundary phenomena, in the form of the interfingering of water layers from each side of the convergence. A complex series of temperature inversions was recorded on station bathythermograph traces, and their adequate representation in the cross-sections would have required a much closer spaced set of soundings than time in the field permitted. The structure of inversions at successive stations suggested, however, that this interfingering resulted in an "echelon" of cold layers sloping downwards towards the coast, probably projected laterally into the warm mass through the development of eddies and waves in the boundary surface between warm and cold water. The inversion structure could not be followed below the bathythermograph limit (275 m) but it seems unlikely that the feature was pronounced below this depth. The salinity profile could not be measured with the same detail as that of temperature with the equipment used, but from the T-S relation isohalines have been drawn following the same, probably rather idealised, isotherm pattern shown in figs. 13 and 14.

The section II PALLISER (figs. 17 and 18) also revealed a salinity minimum centred at a depth of about 1,000 m, but the lowest salinities were here found localised against the slope at stations 2

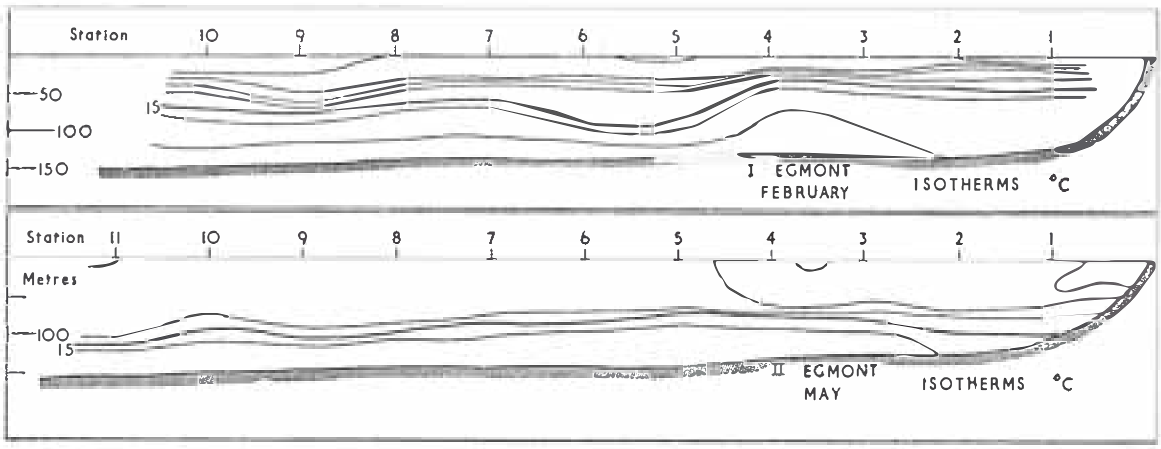

Fig. 19: Vertical sections of temperature off Cape Egmont, summer and autumn

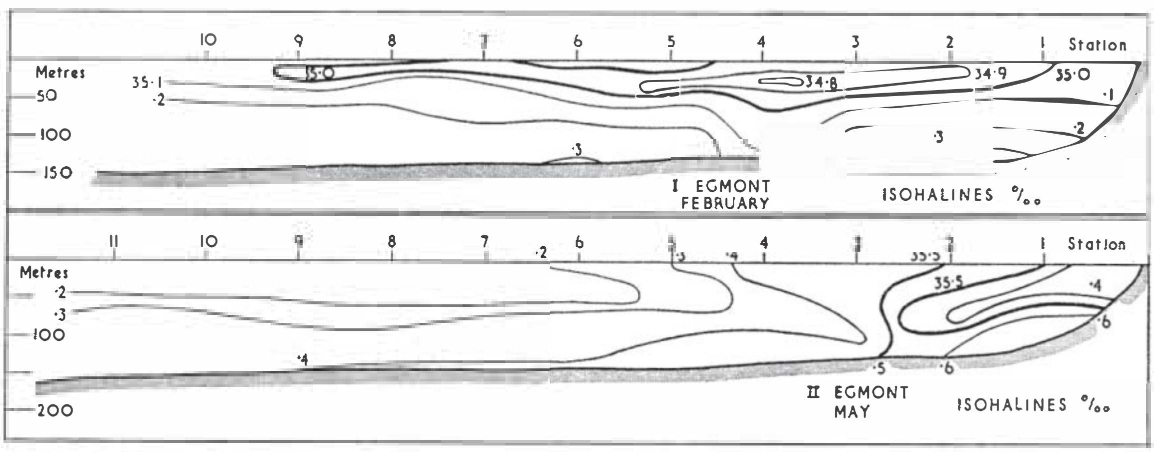

Fig. 20: Vertical sections of salinity off Cape Egmont, summer and autumn

and 3. Water from this core of, presumably, Antarctic Intermediate water, was upwelling over the slope, giving a column of low salinity around station 3. This probably contributed to the formation of the inshore band of water between Cape Palliser and Cape Kidnappers which, as was earlier noted, had subantarctic properties. This upwelling movement had broken through a salinity maximum in the upper layers at a depth of 150–200 m. Within this region a series of small temperature inversions were again recorded on bathythermograph traces; these have been represented on the temperature section of fig. 17 by the "kinks" in isotherms in upper layers.

Similarities and contrasts were found between the sections I and II REINGA (figs. 25 and 26). The cold, low salinity water raised to the surface over the shelf off Cape Reinga in summer was absent in May although surface temperature was lowered slightly over the shelf edge around station 5. The subsurface maximum in salinity, still tongues across the shelf reaching almost to station 1. In summer the axis of the high salinity tongue followed closely an isopycnal surface near the top of the thermocline. In the autumn section, however, the axis of the tongue of maximum salinity crossed several isotherms without any apparent modification.

The section II KAIPARA (figs. 23 and 24) was worked a little to the south of its summer counterpart. Little detail was evident in the temperature section except that the thermocline was again very sharply developed, especially in the seaward end of the section. The subsurface salinity maximum had here moved south and was strongly apparent in the seaward end of the section with the $35 \cdot 9^{0}/_{00}$ isohaline tonguing inwards over the thermocline. Below this, salinity decreased steadily to a bottom value of some $34 \cdot 7^{0}/_{00}$ at about 1,500 m with no trace of the Antarctic Intermediate influence that was found between East Cape and Cape Palliser on the east coast.

EGMONT sections for autumn (figs. 19 and 20) showed the thermocline lying between 70 and 100 m and surface temperatures increasing slightly towards the coast. As in summer, salinity in general increased with depth but much higher values were present in the eastern end of the section in the form of a subsurface maximum. The vertical salinity gradient observed in this section during both cruises I and II seems to indicate the admixture of diluted coastal water.

GENERAL WATER CHARACTERISTICS

Fig. 31 represents graphically the temperature-salinity correlation at various points in the May sections. The curves in both figs. 27 and 31 are displaced to the high-salinity side of the Sverdrup south-west Pacific model. The difference at intermediate depths, however, was reduced in May by the introduction of a relatively low salinity mass into the mixing diagram as noted earlier in the description of the vertical salinity sections. The

TABLE 2. DRIFT-CARD RECOVERIES, AUTUMN RELEASE

Release Station	Number of Cards Recovered	Place of Recovery	Time to Recovery (Weeks)
II REINGA/8	1	Mangonui	3
II KAIPARA/4	1	Manukau Harbour ..	2
/5	1	Manukau Heads ..	2
II EGMONT/1	1	Kapiti Island	2
/3	1	Martinborough	4
/5	1	Wanganui	3
/7	2	Opunake	2
/8	1	Mokau	4
/11	1	Cape Egmont	8
II BARRIER/2	1	Great Barrier Island ..	3
/3	3	,, ..	to
/4	2	,, ..	50
II EAST/7	1	East Cape	12
II KAIKOURA/2	1	Wellington	8
/4	2	Palliser Bay	20
/5	1	,, ...	3
/8	1	Wellington	19½
II TIMARU/2	1	Plimmerton	12
/3	1	Wellington	4
/4	2	Otaki/Titahi Bay ..	4

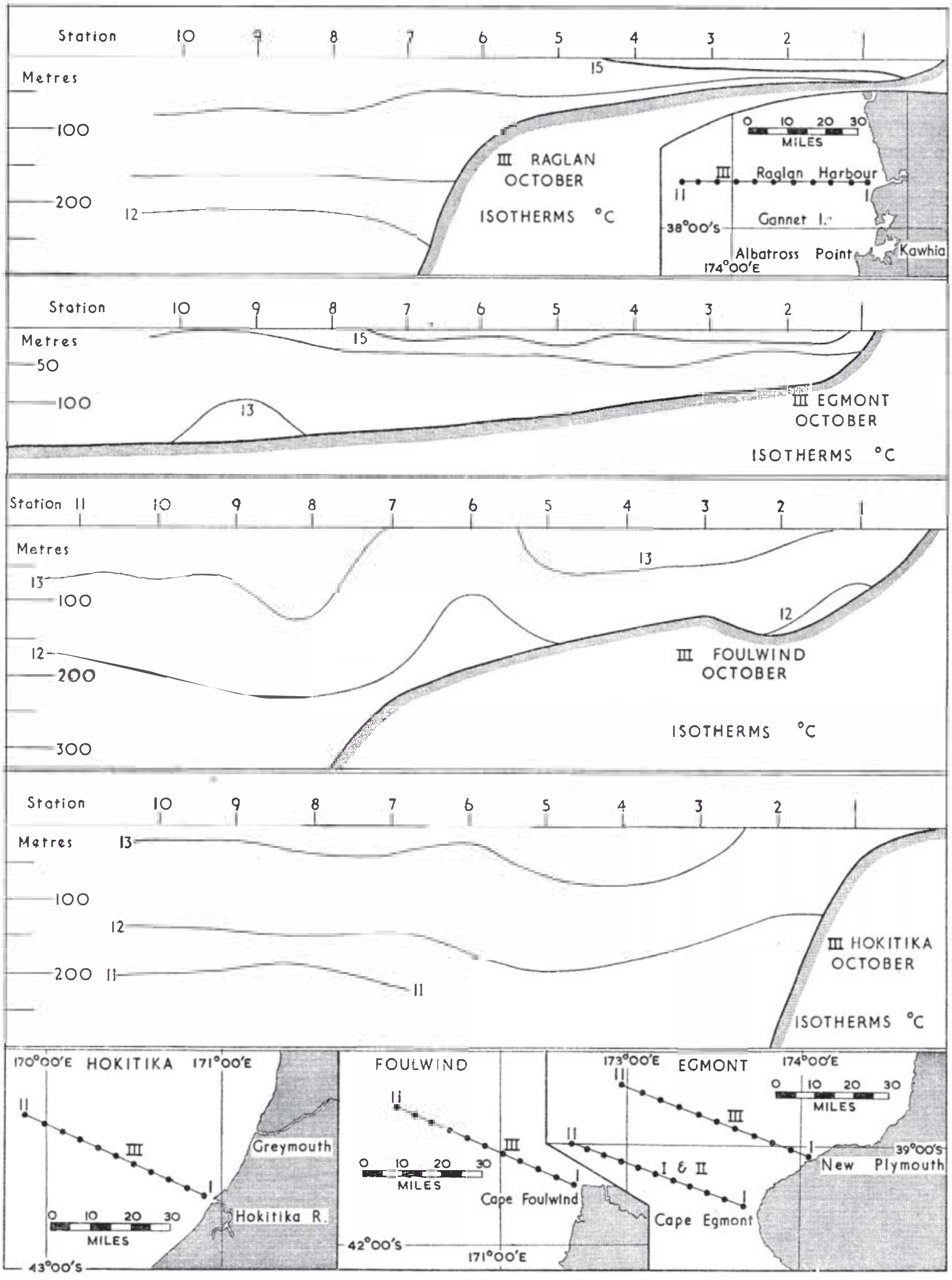

Fig. 21: Vertical sections of temperature in west coast waters between Raglan and Hokitika, winter

salinity minimum at EAST, HAWKE, and PALLISER in fig. 31 was developed at the same temperature level as appeared in the Sverdrup model, and, while at a higher level of salinity, was similar in shape; from this an Antarctic Intermediate influence has been deduced. The change in temperature-salinity relationships observed in summer between EAST and PALLISER due to the Subtropical Convergence was even more marked in May between HAWKE and PALLISER above the salinity minimum.

The west coast curves for REINGA and KAIPARA were dominated by the shallow salinity maximum which had developed along an isopycnal surface. The characteristics of this maximum at REINGA had been altered between February and May only through the cooling of near surface waters.

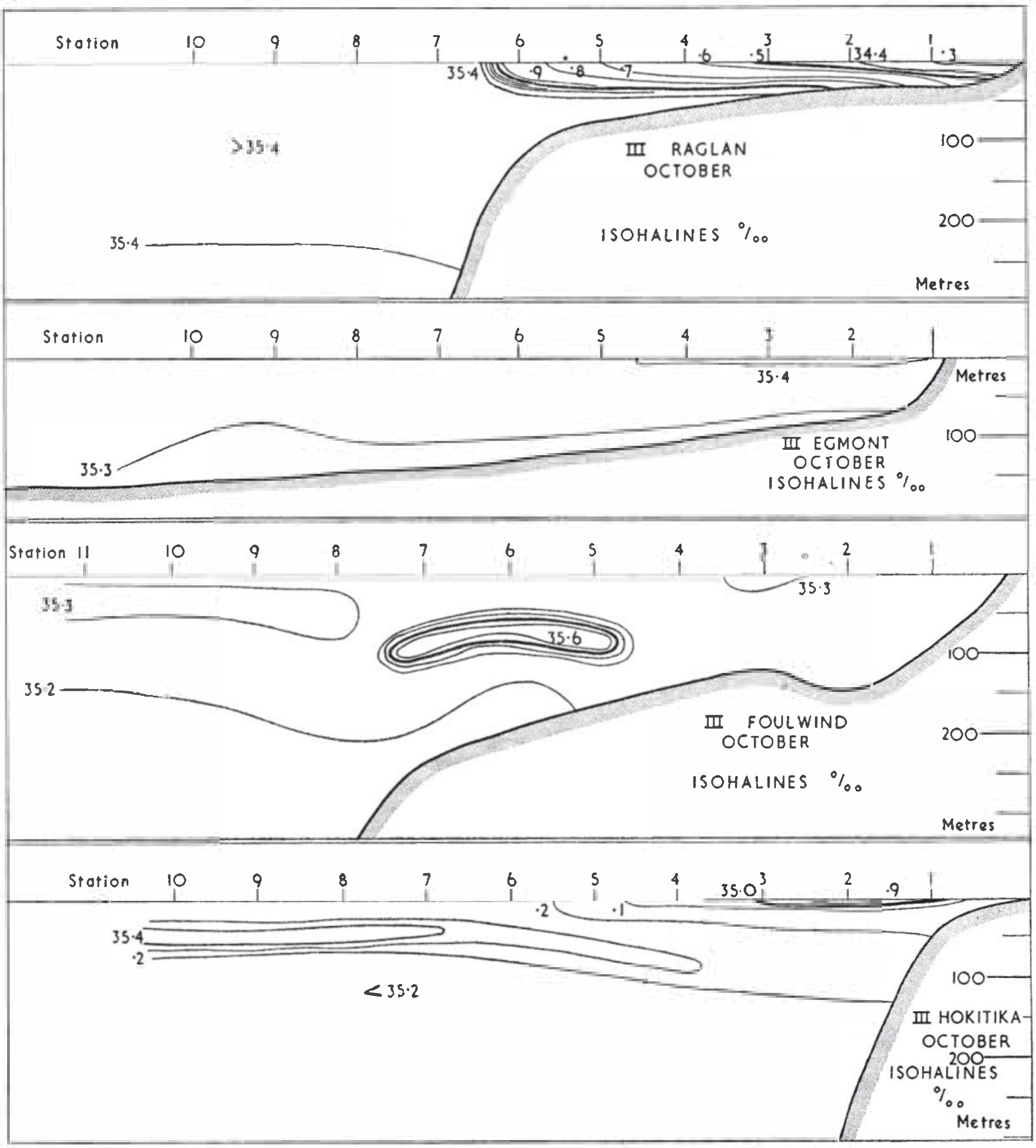

Fig. 22: Vertical sections of salinity in west coast waters between Raglan and Hokitika, winter

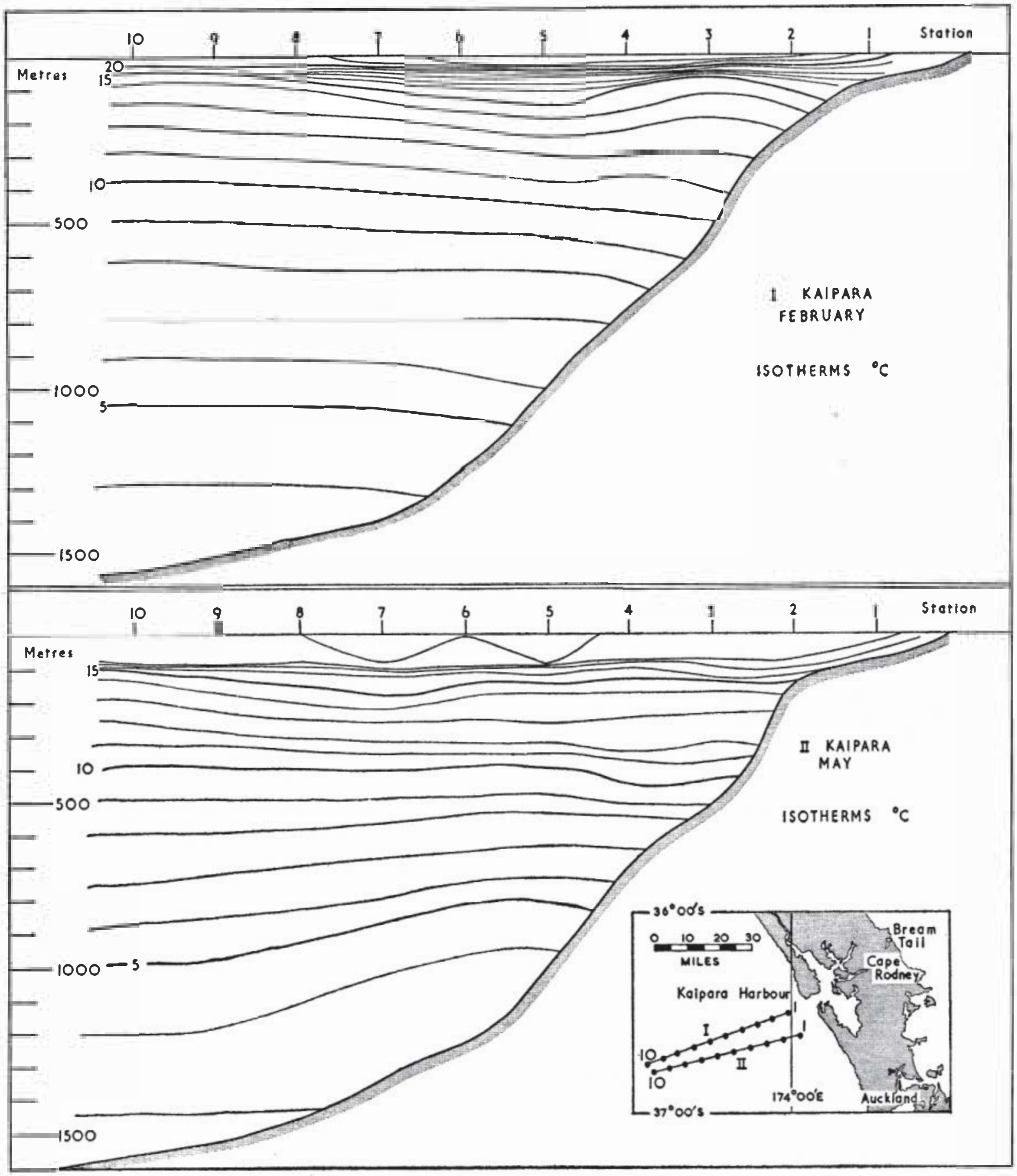

Fig. 23: Vertical sections of temperature off the Kaipara Heads

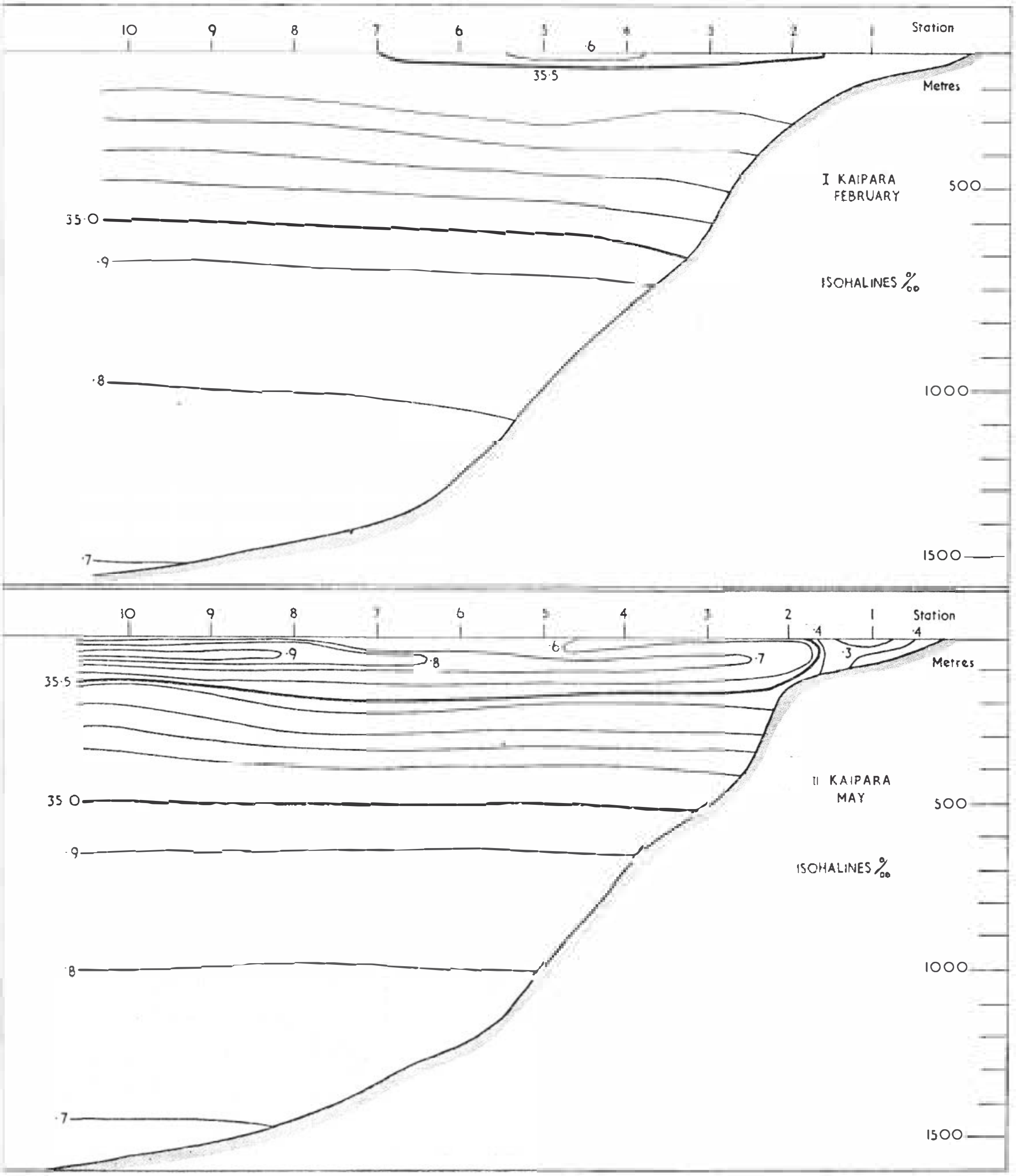

Fig. 24: Vertical sections of salinity off the Kaipara Heads

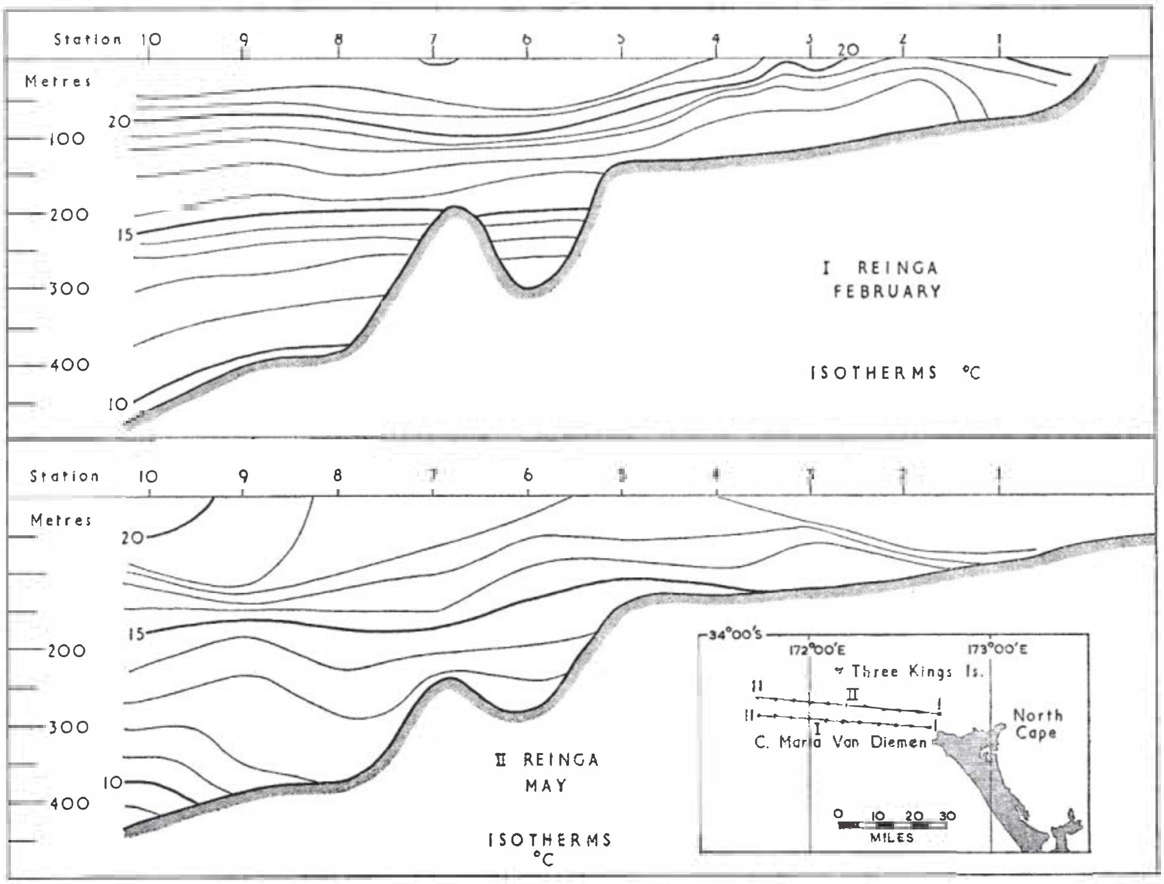

Fig. 25: Vertical sections of temperature off Cape Reinga

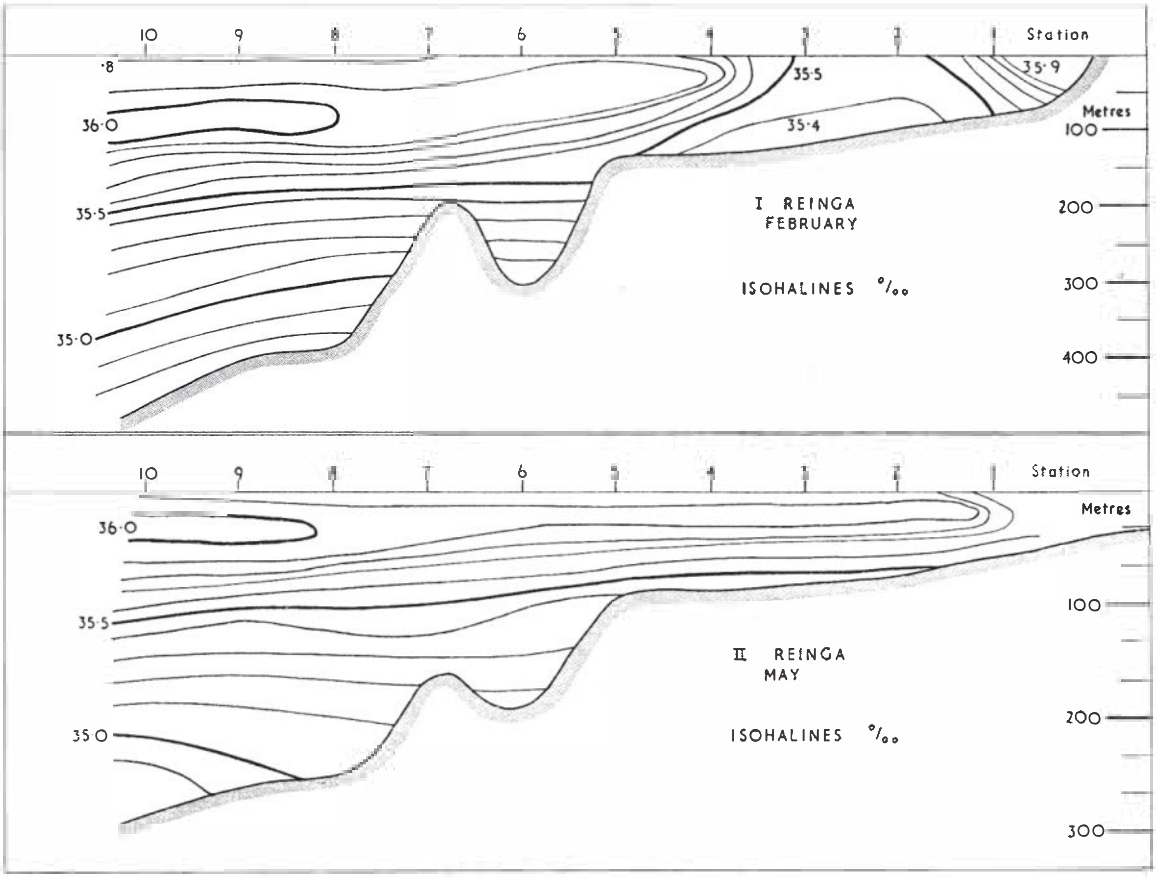

Fig. 26: Vertical sections of salinity off Cape Reinga

THE WINTER SITUATION

It was anticipated that this section would lack data through bad weather making working conditions impossible at sea. The difficulty finally become one of obtaining seagoing facilities at all, however, and it was found impossible to cover much ground systematically for the remainder of the year.

East Coast, South Island – August

The chart of surface isotherms and isohalines off the east coast of the South Island in fig. 32 defined the relative disposition in winter of the four surface water types which have been shown as characteristic of this area in both the earlier surveys, i.e., the tongue of warm water of high salinity north-east of Banks Peninsula, associated with the movement of subtropical water south along the east coast of North Island, a similar tongue off the North Otago coast marking the entry into east coast waters of subtropical water from the south-east Tasman Sea, the low salinity coastal water accumulating in the South Canterbury Bight, and to the south-west of these, the cold, low salinity subantarctic water. In addition, the *Port Waikato* record east bound out of Lyttelton showed Pegasus Bay surface water to be at a very low temperature, clearly a result of winter cooling in near-shore waters rather than subantarctic influence.

Drift cards were released at 5-mile intervals along the *Alert* track between Dunedin and Wellington. Recoveries were few. One card dropped about 12 miles off Timaru travelled northwards around Banks Peninsula and stranded in Pegasus Bay, being found three months after release on a well frequented beach (New Brighton), indicating a very slow drift northwards in the boundary zone between South Canterbury Bight coastal water and the Tasman water off shore. Two cards released a few miles off Kaikoura reached the shore in Cook Strait, one at the entrance to Tory Channel, with two months between release and recovery, and the other on Makara Beach after a period of one month, indicating a north-going (subantarctic) drift between the offshore subtropical tongue and the coast between Banks Peninsula and Cook Strait. A further recovery was made at Makara from a release in southern Cook Strait, a few miles north-east of Cape Campbell.

Barrier Section – September

The Section III Barrier was worked to a depth of some 300 m (temperature) and 100 m (salinity) only and along a line further off shore from the previous sections worked in this locality (figs. 9 and 10). Sections were relatively featureless, winter cooling and vertical mixing having advanced sufficiently to break down the shallow thermocline shown in earlier sections. The temperature and salinity of the water column increased slowly away from the coast. Of drift cards dropped at stations along this line, only those from station 1 were recovered, three of the release of five being found along the East Coast of the Coromandel Peninsula between Whangapara and Waihi after about a month adrift.

West Coast – October

These observations off the west coast between Raglan Harbour and the mouth of the Hokitika River have been arranged somewhat arbitrarily with the "series III" (winter) observations, chiefly because, as the vertical temperature sections show (fig. 21), vernal warming had not advanced to the development of a thermocline in surface layers. Because of the shallow gradients in temperature, both horizontally and vertically, it was difficult usefully to estimate horizontal patterns of isotherms, the range in surface temperature over the 5 degrees of latitude covered by these observations being only 2°C (13°–15°C). Gradients of salinity, too, were shallow (fig. 22), values lying around $35{\cdot}2$–$35{\cdot}4\,^0/_{00}$ in general, well within the characteristics of water with subtropical origin. Features of salinity structure peculiar to each section are to be noted, however. In III Raglan practically isohaline water was found seawards from the shelf to the depth examined. Over the shelf, however, water with much lower salinity lay near the surface, and a fairly sharp boundary separating these water masses existed between $35{\cdot}4$ and $34{\cdot}9\,^0/_{00}$, inshore of which the salinity dropped steadily to the relatively low value of $34{\cdot}3\,^0/_{00}$; the temperature of this water was slightly higher than that off shore. This will probably be the result of land-water drainage off this coast, to which the Waikato River north of the section makes a major contribution.

III EGMONT was almost isohaline, except for an intrusion, at a depth of about 100 m, of relatively high-salinity water between stations 5 and 7. The level of salinity at the core of this feature was not reached in other sections of this series and thus would seem to have had its origin well off shore.

The southernmost section extended seawards from the mouth of the Hokitika River, the outflow of which was probably responsible for the shallow inshore layer of lower salinity. Off shore, a weak salinity maximum had developed in near-surface layers, below which salinity varied little. Rochford (1957a, p. 59) reported surface temperatures and salinities along FAREWELL on 2 October 1955. The temperature was around 13°C, similar to that shown in the nearby sections, but salinities around 34·9‰ were reported, considerably lower

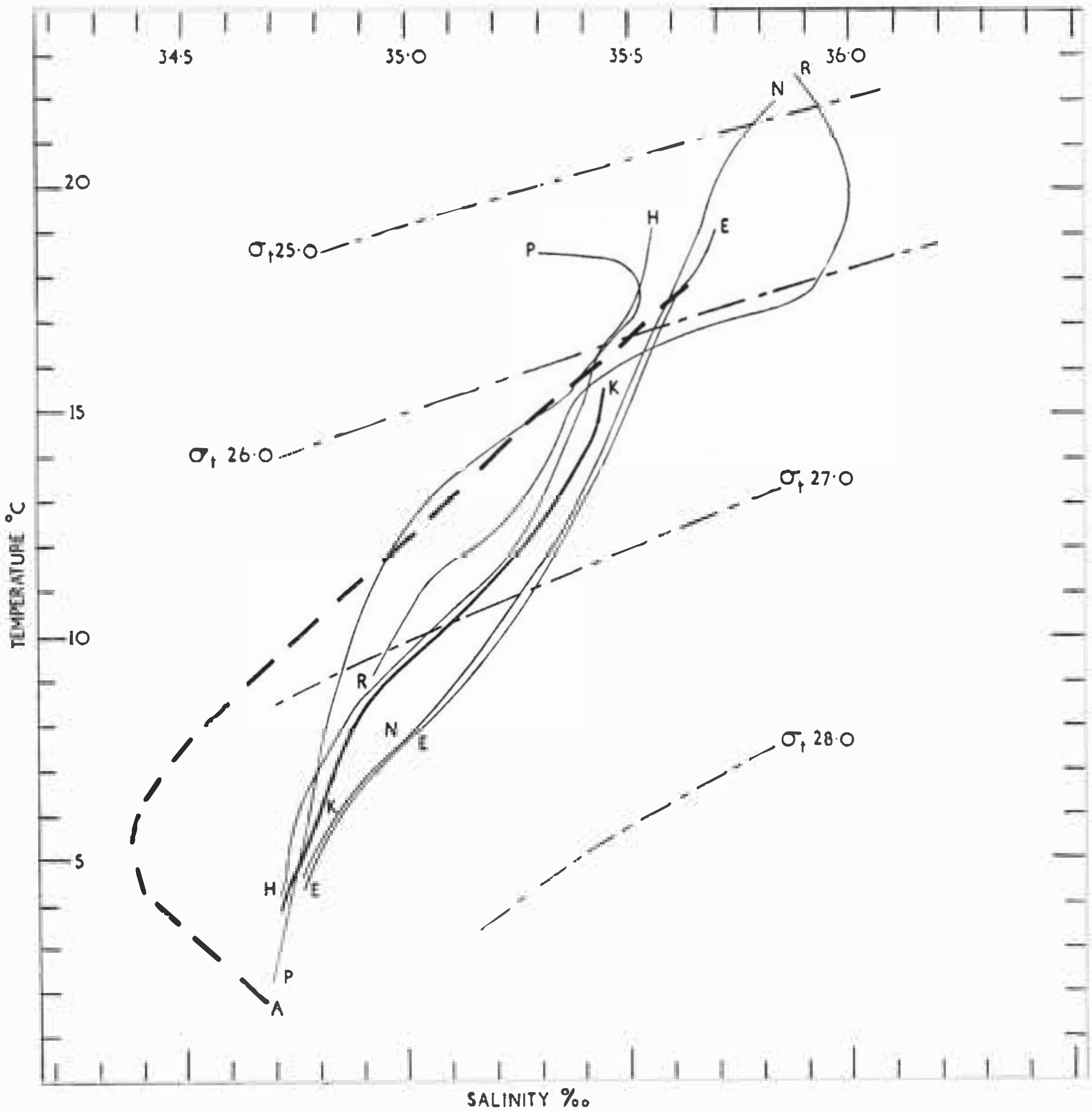

Fig. 27: Vertical temperature – salinity relations for a selection of summer stations: A – Sverdrup's (1942) *Western South Pacific Central Water;* N – station I NORTH/10, E – I EAST/9, H – I HAWKE/11, P – I PALLISER/9, R – I REINGA/10, K – I KAIPARA/9, E – I EGMONT/10. Isopleths of constant potential density (σ_t) are shown as broken lines

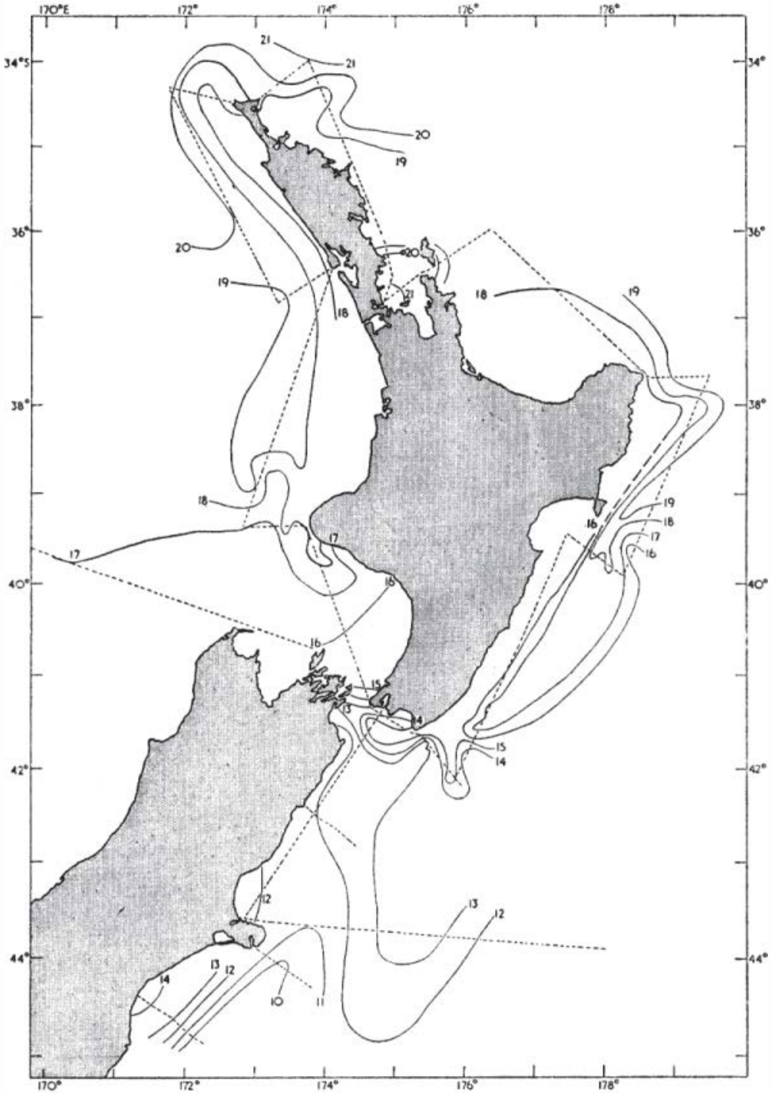

Fig. 28: Surface temperature pattern for May 1955 (°c) constructed from thermograph records obtained along the tracks shown as dotted lines

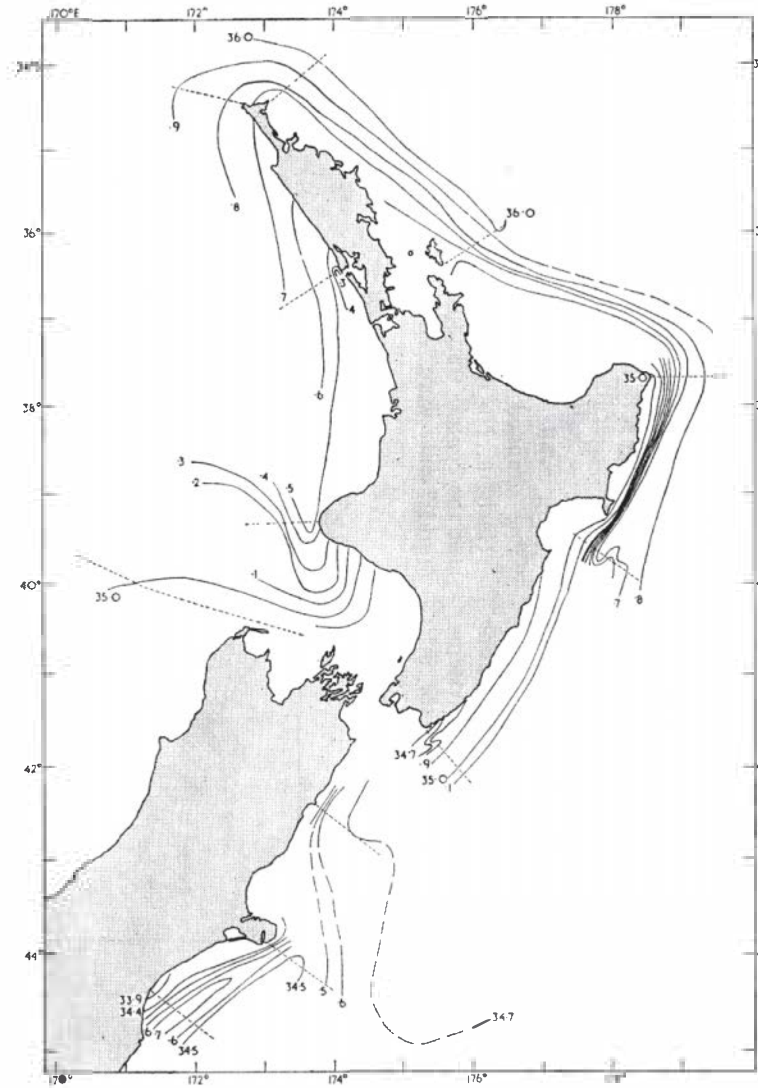

Fig. 29: Surface salinity pattern for May 1955 (°/₀₀) based on measurements along the lines shown dotted

than those measured here. From fig. 39, however, it seems that the period of low salinities was of short duration in this area.

The region west of Cook Strait appeared to be one of convergence between two components of subtropical origin, one probably derived from the East Australian region moving northwards along the west coast of South Island, the other moving southwards down the west coast of North Island, their convergence being accompanied by a strong in-draught into Cook Strait from both systems. This is shown by the recovery pattern of drift cards released along the five lines, details of which are given in table 3. Twenty-nine cards were recovered from the release of 260.

With so little detail evident in the associated hydrology it is difficult to assess the paths followed by these drifts. Cards from the *inshore* end of RAGLAN reached well into the North Taranaki Bight, while one card from the *outer* end of the line stranded only a few miles south of Raglan Harbour. No recoveries were made from releases at the central stations of this line. Stations 2, 5, and 7 only were represented in recoveries (off the

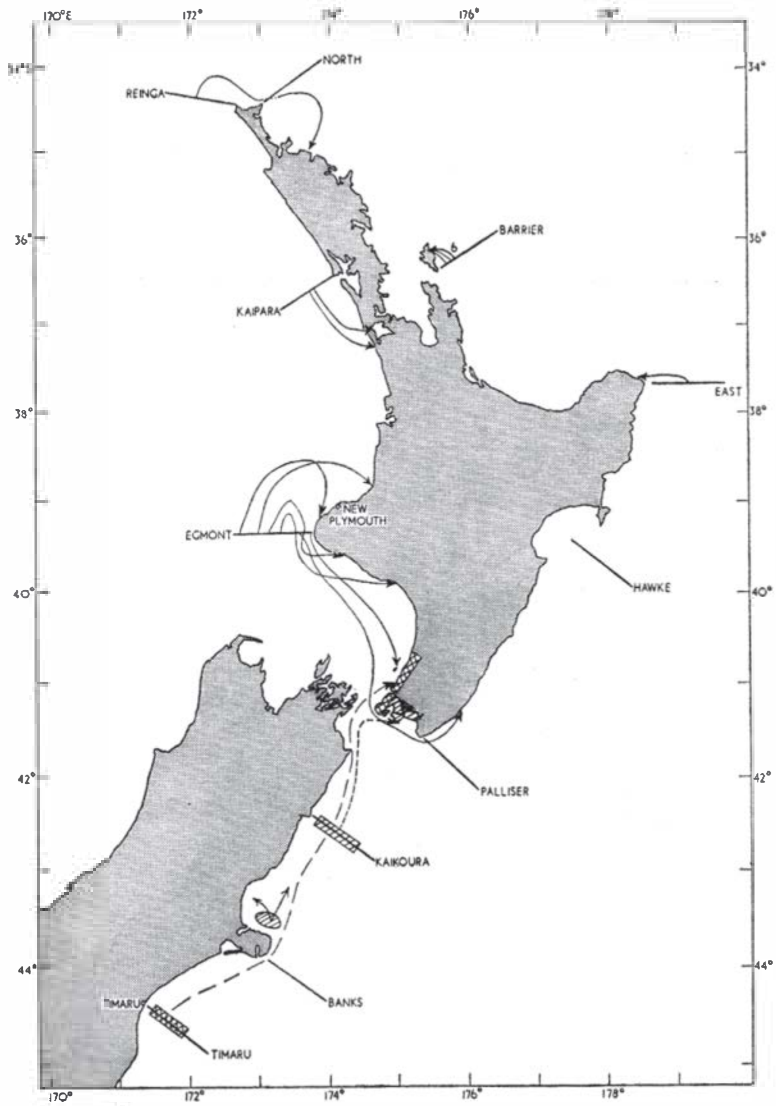

Fig. 30: Surface drift records, autumn (see table 2) from cards released along the lines shown dotted. Suggested tracks are shown of those cards recovered after on-shore stranding

Rangitikei coast) from EGMONT, from which a very high recovery rate was noted earlier in the year. From FAREWELL (*Wanganella*, 7 October) only stations 2 and 9 were not represented among the recoveries, which ranged from Mokau in the North Taranaki Bight, around Cape Egmont, and south to Himitangi Beach on the west Wellington coast, releases at increasing distances from the coast tending to strand further northwards in this range, as was noted in May. No recoveries were made from the central stations of F●ULWIND but cards from each end of the line were found on the Wellington west coast beaches (in addition to one stranding a few miles north of the release line). Cards from the offshore end only of HOKITIKA were recovered, two near the mouth of the Manawatu River and one a few miles north of the release line.

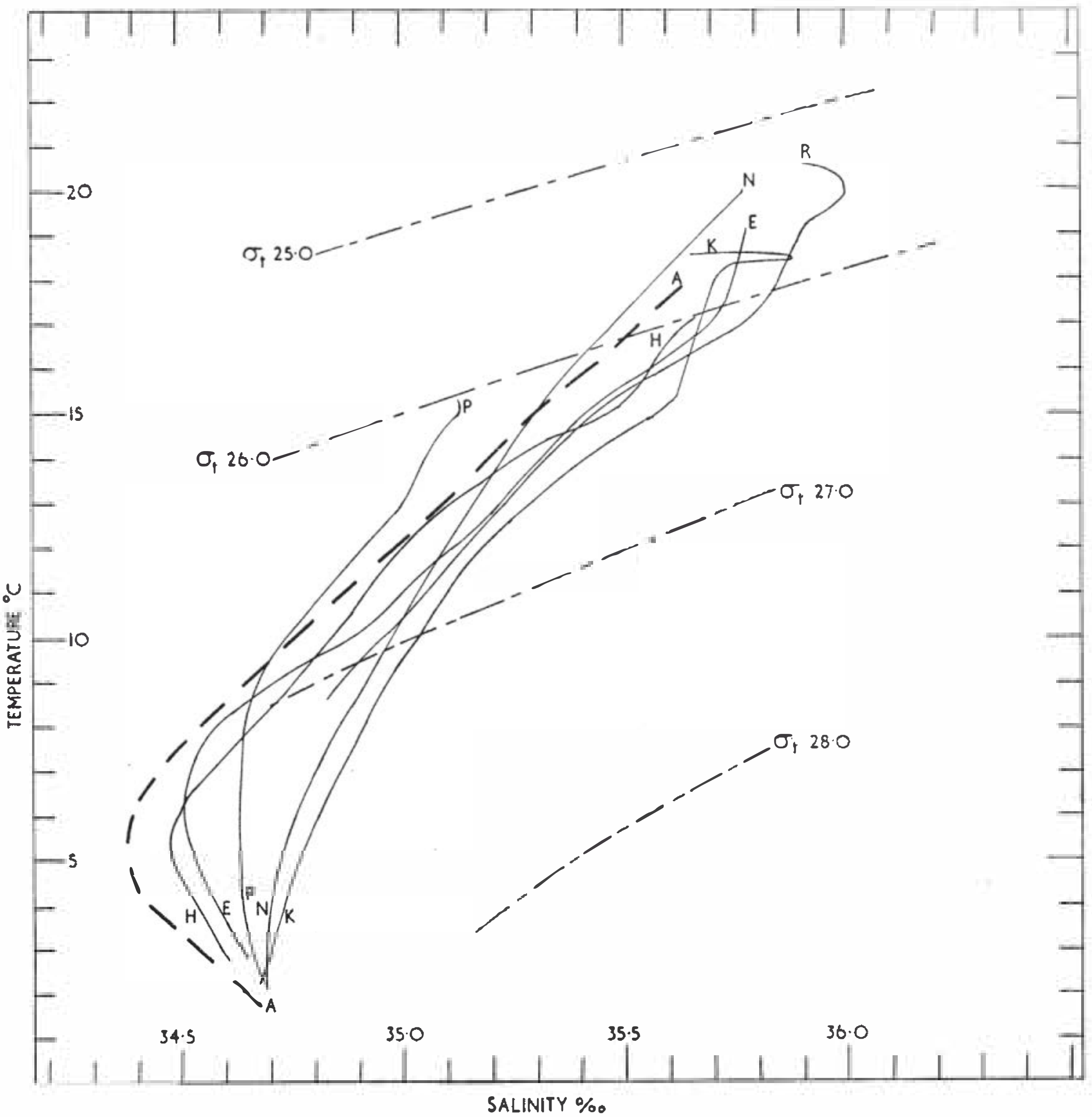

Fig. 31: Vertical temperature - salinity relations for a number of autumn stations: A – Sverdrup's (1942) *Western South Pacific Central Water;* N – station II NORTH/10, E – station II EAST/10; H – station II HAWKE/9; P – station II PALLISER/10; R – station II REINGA/10; K – station II KAIPARA/10; E – station II EGMONT/11. Isopleths of constant potential density (σ_t) are shown as broken lines

TABLE 3. DRIFT-CARD RECOVERIES, WINTER RELEASE

Release Station	Number of Cards Recovered	Place of Recovery	Time to Recovery
III RAGLAN/2	2	Awakino River mouth ..	4 months
		Mokau River mouth ..	7 days
/9	1	8 m S. of Raglan ..	3 months
III EGMONT/2	1	Wanganui	4 months
/5	1	Te Horo	3 months
/7	2	Turakina River	3 months
		Waimahara River ..	9 months
III FAREWELL/1 ..	1	Himitangi Beach ..	4 months
/3 ..	1	Moanaroa Beach ..	21 days
/4 ..	2	Otakeho River	13 days
/5 ..	2	5 m N. of Opunake ..	20 days
/6 ..	1	Mokau	22 days
/7 ..	2	Katikara River	21 days
/8 ..	4	Oakura River	26 days
		Waitara River	32 days
		Okato	2 months
		New Plymouth	24 days
/10 ..	1	,, ...	27 days
III FOULWIND/1 ..	1	Te Horo	35 days
/2 ..	1	Pukerua Bay	35 days
/8 ..	1	Makara	2 months
/9 ..	1	Charleston	9 months
/11 ..	1	Makara	3 months
III HOKITIKA/7	1	Greymouth	34 days
/8	1	Manawatu River	3 months
/9	1	Foxton	4 months

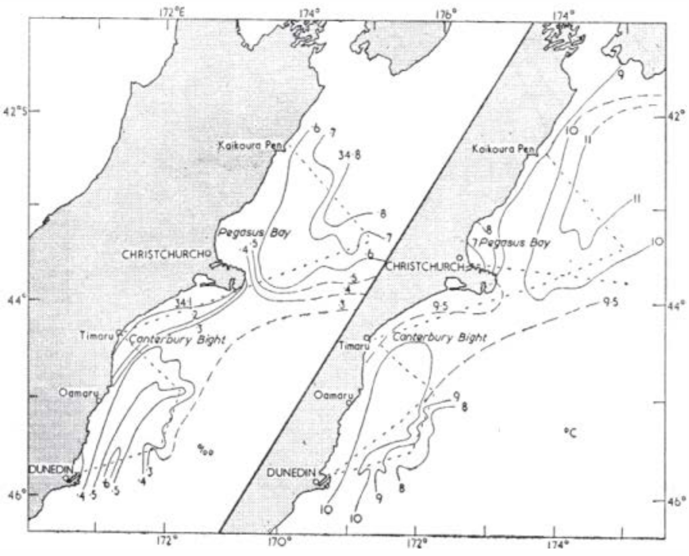

Fig. 32: Surface temperature (°c) and salinity (‰) patterns for August 1955

THE SPRING SITUATION

EAST COAST, NORTH ISLAND, NOVEMBER-DECEMBER

The work off the North Island east coast in November-December represents the nearest approach to the Spring (series IV) observations which could be arranged with available facilities. Fig. 33 shows the distribution at the surface of temperature and salinity. The line NORTH was worked about three weeks earlier than the BARRIER-PALLISER series to the south.

Rapidly falling surface temperature and salinity at the inshore end of NORTH indicated the presence of the "upwelling" area north of Cape Reinga – central characteristics less than 15°C and 35·4°/₀₀ were indicated. In general, isotherms paralleled the coast from North Cape to the south of East Cape, temperature increasing away from the coast. Offshore from Poverty Bay isotherms began to show an eastward trend outlining a tongue of warm

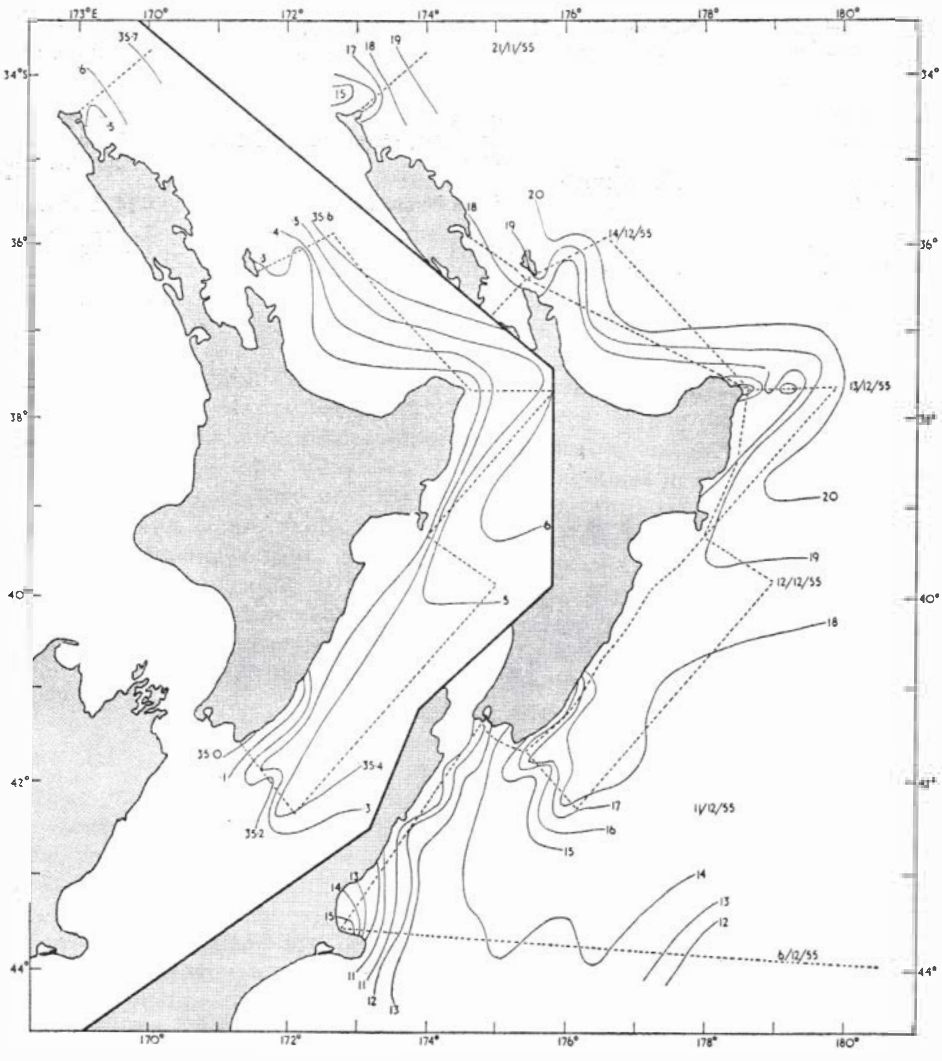

Fig. 33: Surface temperature (°C) and salinity (°/₀₀) patterns for November (NORTH) and December (remaining lines) 1955

water east of North Island as before. A steep temperature gradient was measured off Castlepoint (16°–18°c) and this seems to be traced east of Cape Palliser as the southern limit of this relatively narrow tongue. The general configuration of a broad tongue of warm, subtropical water was recognisable probably as far as the 12°c isotherm as indicated by the surface thermograph records between Wellington and Lyttelton and from Lyttelton towards the Chatham Islands. No salinities were available south from PALLISER. The subsurface sections of this series had no prominent feature. In IV NORTH, the only section for which deep salinities were available, there was, once again, no indication of a shallow salinity maximum of the subsurface subtropical water, or of the deeper salinity minimum of the Antarctic Intermediate water. In the remaining east coast bathythermograph sections features of interest were deep isotherms in IV BARRIER tending to parallel, bottom contours, and in IV EAST the "dome" of cold water below 200 m in the central part of the section.

Surface drifts during the November-December series of observations are recorded by the card recoveries listed in table 4. Of 275 releases, seven cards were recovered to a pattern very similar to the results for February and May.

TABLE 4. DRIFT-CARD RECOVERIES, SPRING RELEASE

Release Station	Number of Cards Recovered	Place of Recovery	Time to Recovery
IV NORTH/5 ..	1	Opotiki	48 days
IV BARRIER/7 ..	1	East coast, Great Barrier Island ..	17 days
/10 ..	1	Waihi	5 months
IV EAST	No recoveries	..	..
IV HAWKE/1 ..	2	Mahia Peninsula	14 days and 5 months
/3 ..	1	Napier	22 days
IV PALLISER ..	No recoveries	..	..

SEASONAL VARIATIONS

General

Available resources did not permit a complete description of the detail of seasonal variation in New Zealand coastal waters, but in this section supplementary data are used to extend the coverage of survey material.

The course of the seasonal cycle in surface temperature for several areas around the New Zealand coast has been reported recently (Skerman, 1958; Garner, 1959a). The annual temperature range in open water tends to lie between 4·5° and 5·0°C. Higher annual ranges were found in such enclosed areas as the Hauraki Gulf, Pegasus Bay, and the South Canterbury Bight, while relatively small annual ranges characterised southern Cook Strait, the regions off Kaikoura, the Otago Coast and Cape Farewell, and in Foveaux Strait, this being variously ascribed to the effects of vertical mixing and advection. Maximum mean monthly temperatures occurred in January or February and minimum values generally in August. The limits of water with a dominant subtropical character were marked, in this 1955 study, approximately by the isotherms of 15°C in summer and 10°C in winter, and a salinity of about 34·6–34·7‰ throughout the year. Oceanic water characterised by smaller values was dominantly subantarctic. Except in near-shore regions of very heavy run-off of fresh water it seems likely that any major changes in surface salinity at any point in New Zealand waters will, in general, be due to advection and probably confined to the vicinity of the Subtropical Convergence where both subtropical and subantarctic water may be present at different times of the year. This applies particularly to east coast waters between Cook and Foveaux Straits.

Pegasus Bay to Chatham Islands

From thermograph records taken between Lyttelton and Waitangi during 1955 (fig. 34) a marked seasonal change in the structure of the temperature pattern was evident in this region. During the period April-June a well defined "block" of warm water was found east of Banks Peninsula between, approximately, longitudes 174°E and 176°E. This feature resembles the temperature structure across the East Australian Current off Sydney (Garner, 1954, figs. 6 and 7) and gives the impression of a relatively fast-moving narrow current of similar nature. A mass of warm water with a fairly well defined western edge was also found east of the 180th meridian during this period – April to June. During the remainder of the year a broad diffuse mass of warm water lay between New Zealand and the Chatham Islands, with cooler water at each end of this line.

Cook Strait to Pegasus Bay

It has been noted that the warm water of the subtropical tongue east of New Zealand often appears close inshore in southern Cook Strait and off Kaikoura. Assuming that the mid temperature of the Subtropical Convergence follows a sinusoidal seasonal variation with a maximum of 15°C in February and a minimum of 10°C in August, the stippled areas in fig. 35 were drawn to represent the occurrence of water above a subtropical temperature level. Some of the temperature variations shown in this diagram will be due to coastal effects; these are evident chiefly in Wellington and Lyttelton Harbours and in Pegasus Bay, where shallow water and coastal sheltering give rise to very warm summer temperatures, and in the Lyttelton Harbour - Pegasus Bay area, which have very low surface temperatures over the winter months. It may be seen from table 5 that subtropical salinities were associated with warmer temperatures in Cook Strait and off the Kaikoura coast, while very low salinities, indicating freshwater dilution were found in Pegasus Bay, whether warm or cold conditions prevailed, However, in April 1952 surface salinity in Pegasus Bay was greater than 35‰, even in waters close inshore (Garner, 1953, fig. 7), so evidently very large fluctuations of salinity may be expected in this area, as coastal dilution, subtropical, or subantarctic influence prevails. Without supporting salinity data it is thus not possible to detect in fig. 35 the southern limits, if any, of the Kaikoura tongue of subtropical water during the November to March period of summer warming in Pegasus Bay. Subtropical water appeared off the Kaikoura coast in a series of incursions at intervals of approximately two months. The subtropical water in southern Cook Strait could be traced throughout the seasonal period and had a particularly well defined southern boundary north-east of Cape Campbell from the summer months through to June, except where it was displaced by pulses of particularly cold water which appeared to be associated with the periods of strong flow of subtropical water off Kaikoura. This cold water will represent an unusually strong subantarctic flow and, since water of the same or lower temperatures was not found south of Kaikoura on these occasions, this cold water was, presumably, upwelling from below.

North Cape to Hauraki Gulf

The seasonal temperature cycle in coastal waters between North Cape and the Hauraki Gulf, as shown in fig. 36, appears to be a relatively simple climatically controlled process. The summer maximum, in February, was of relatively short duration, with the warmest water in the lower Hauraki Gulf. During the period April-May a steady fall of temperature occurred, with almost isothermal water along the ship's coastal track. The winter minimum occurred in mid August south of North Cape and appeared progressively earlier to the southward, occurring in late July in the lower Hauraki Gulf. At the same time the value of the minimum temperature decreased as the depth of the water shallowed.

North-east Tasman Sea

Westwards from Cape Reinga the seasonal surface temperature pattern lost the simple character shown between Hauraki Gulf and North Cape. The outstanding advective feature was the band of colder water which may be traced on fig. 36 throughout the year to the west of Cape Reinga and which was particularly pronounced through the summer and autumn months (January to May) as a sharply defined "trough" in the isotherm pattern, the temperature contrast with the surrounding surface water reaching 4°c. The lowest salinities, about $35{\cdot}2^{0}/_{00}$ (fig. 37) were found in this area during January and June-July. This "trough" was associated with very high surface temperatures east and west of the northern tip of the North Island (although somewhat cooler inshore conditions prevailed off the east coast south of North Cape during *Lachlan's* summer cruise; fig. 2), the 23°c isotherm matching the temperature found in the shallow, sheltered Hauraki Gulf. This seems to indicate a pronounced flow of subtropical water, predominantly off the west coast, North Island, as is also suggested by the very high salinity found between longitudes 170° and 171°E in February (fig. 37). Because of this the summer period of highest temperatures was unusually prolonged off the west coast, and the withdrawal of this warm weather resulted in a very rapid fall of surface temperature, from 19°c to 16°c in about 10 days during May. The upwelling region off Cape Reinga may become particularly pronounced during the summer months due to a divergence of flow in a surface subtropical current at the northern end of the Northland peninsula. The winter-spring period was rather featureless, west of Cape Reinga, as far as the temperature pattern was concerned.

Westwards From Cook Strait

Seasonal surface temperature and salinity diagrams for northern Cook Strait and its western approaches are shown in figs. 38 and 39. As in the section west from Cape Reinga, the period of highest surface temperature west of Cape Farewell was prolonged well into autumn, a secondary maximum in mid April reaching the same temperature level as the usual climatic peak in January-February. This resulted in a marked fall of temperature from late April to early May, although the gradient was not so steep as was its counterpart in fig. 36. There is little in the salinity pattern of fig. 39 to suggest a more pronounced subtropical inflow in this case, there being little seasonal variation of salinity at any particular point along the track chosen except for a short period in November when relatively high salinity prevailed. In general, salinity fell towards the east, and in fig. 39 the isohaline for $34{\cdot}8^{0}/_{00}$ has been drawn in greater weight to delineate, approximately, subtropical water from water with components with either subantarctic or coastal dilution characteristics. From points raised in previous sections, coastal dilution would seem to be the most likely cause of the lower salinity observed in northern Cook Strait during the summer and autumn months, with maximum development in March and September-October. Minimum temperatures observed were in the Cook Strait narrows, apparently in June-July; data were lacking during this period but the shape of the winter minimum in the northern Cook Strait region was probably similar to that shown in fig. 38 judging by the comparable shallow water patterns for Pegasus Bay and the Hauraki Gulf. No pronounced period of maximum summer temperature appeared in the Cook Strait narrows. The relatively low temperature level (while still close to the value expected at the Subtropical Convergence) and the complex pattern of isotherms inshore from Cape Farewell during the summer months will presumably be due to the same process that gave rise to the lower salinity in this area, namely, river outflow. There is no trace, in fig. 38, of the area of very cold surface water off Cape Farewell, similar to that off Cape Reinga, which has been previously observed (Garner, 1954, fig. 7) as a summer feature in this region.

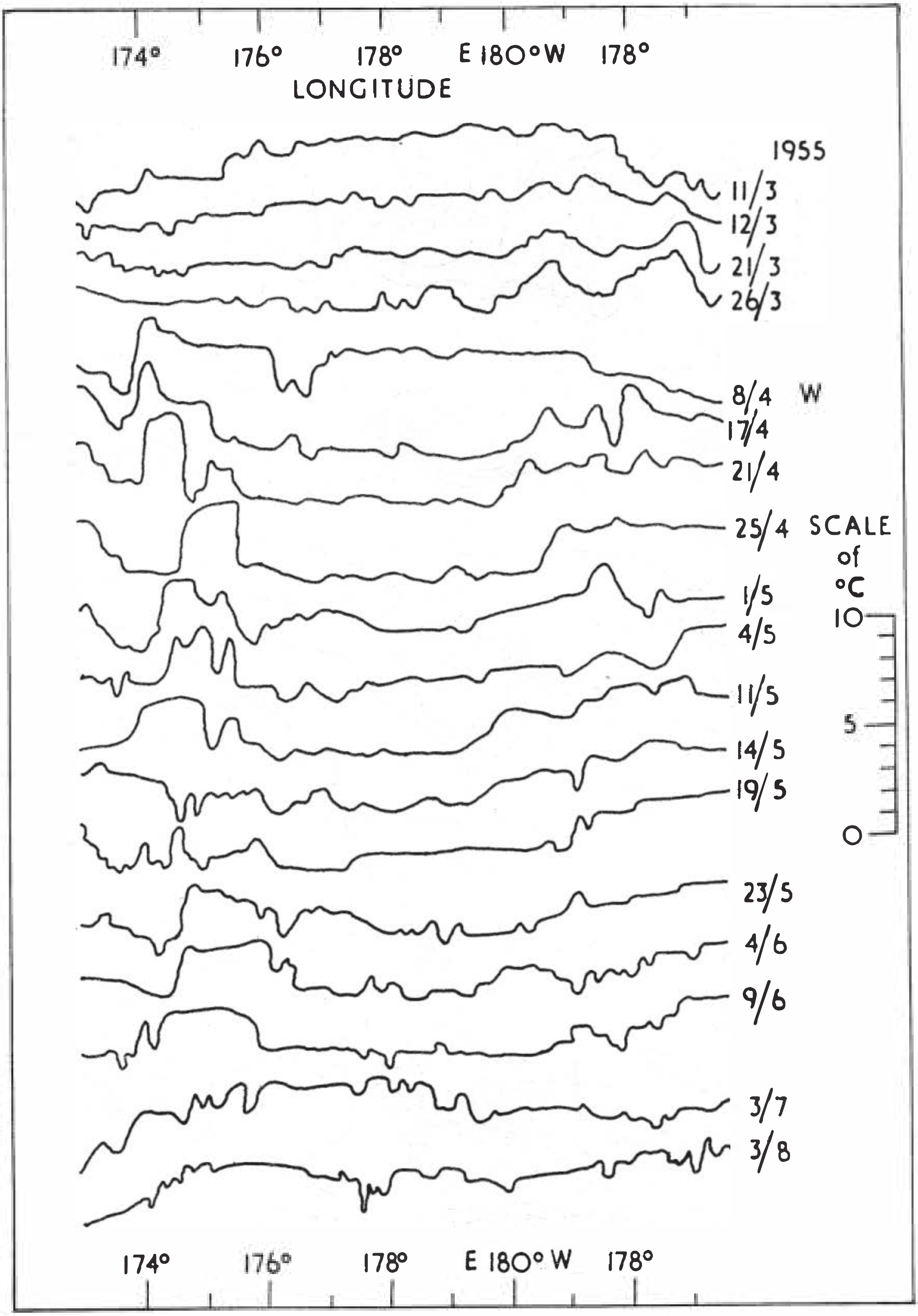

Fig. 34: Thermograph records of sea surface temperature taken by m.v. *Port Waikato* between Lyttelton and the Chatham Islands (except the record for 8/4/58—marked W—where Wellington was the western terminal). Positions are given in terms of longitude, only; the date at the mid-point of each run is given at the right.

A relative temperature scale is given on the right-hand side of the diagram. Isotherms are parallel with the upper and lower frames of the diagram. The calibration of the thermograph used is in doubt and absolute temperatures cannot be given

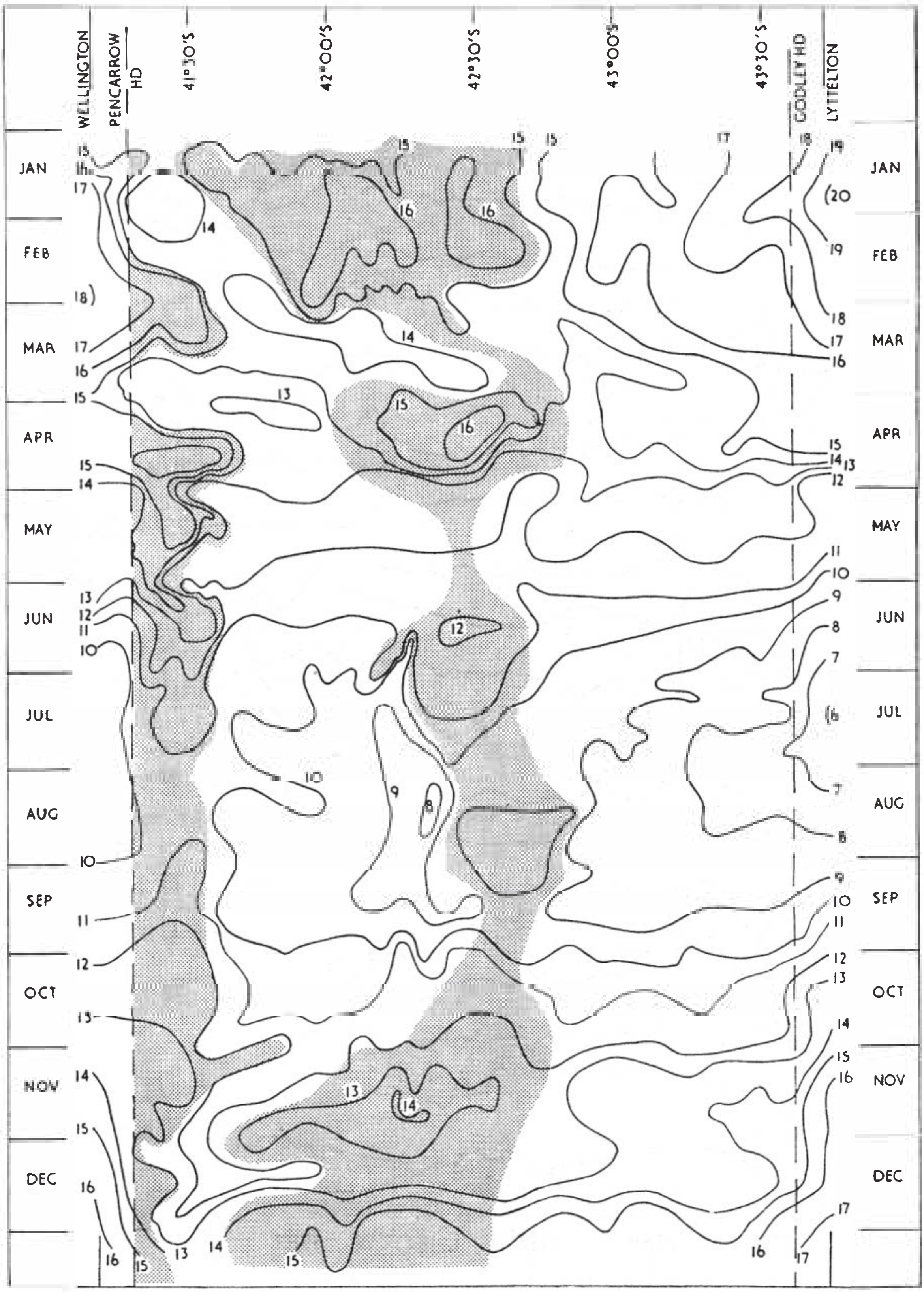

Fig. 35: Surface temperature (°C) between Wellington and Lyttelton plotted as a function of position (abscissae show latitudes along a direct line between the entrances to Wellington and Lyttelton Harbours, marked as "Pencarrow Head" and "Godley Head" respectively) and of time (ordinates show months, January to December, all referring to 1955 except from mid July to mid September where data for 1954 were used to bridge a gap in the sequence). Data from thermograph records taken by the inter-Island ferry steamer t.e.v. *Hinemoa* (Union Steamship Co. of New Zealand).

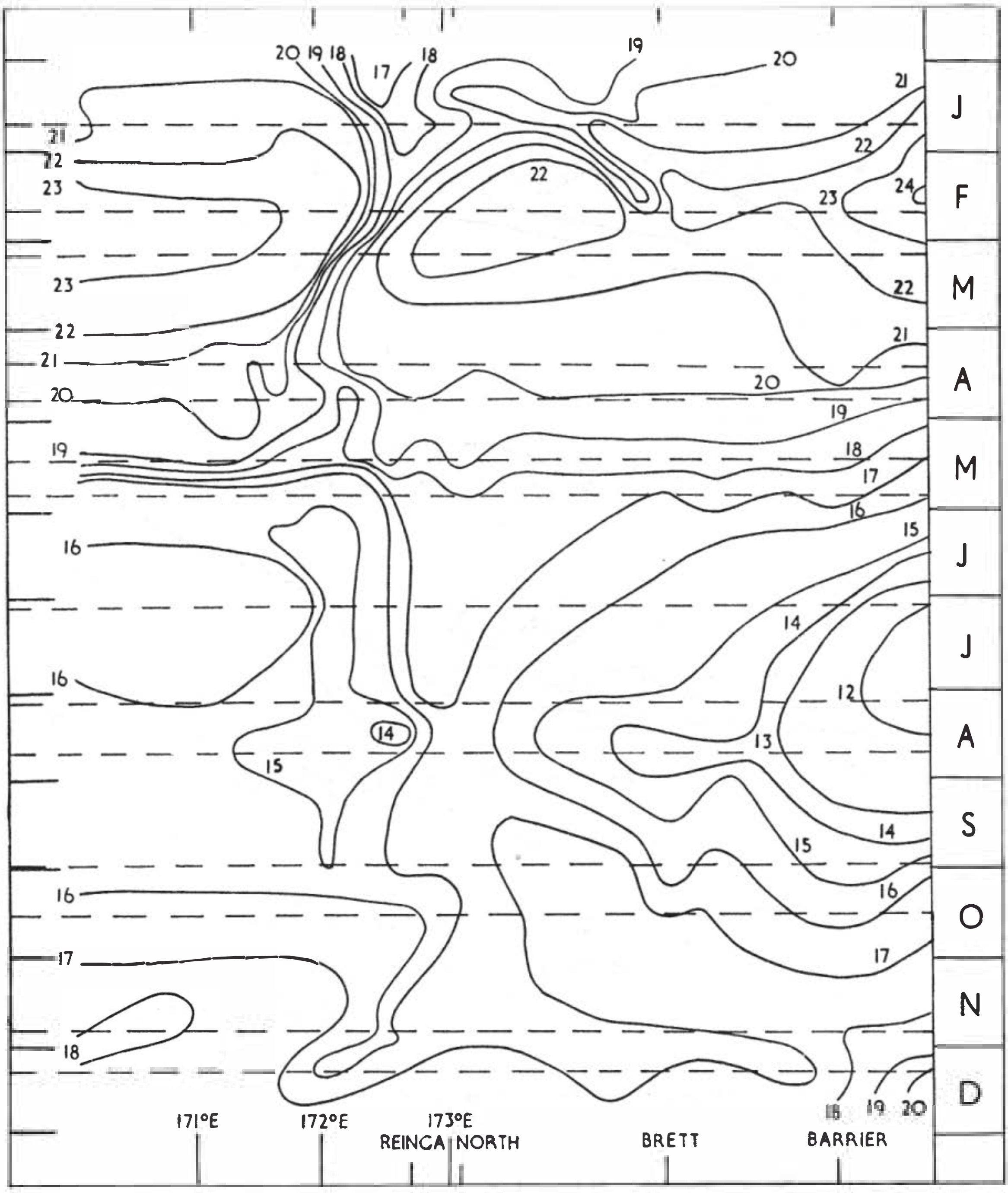

Fig. 36: Surface temperature (°c) plotted as a function of position and of time along the commercial coastal passage from Auckland northwards through the Hauraki Gulf to North Cape, thence westwards towards Sydney. The points where measurements are made off prominent geographical features are shown as abscissae and months of the year as ordinates. Horizontal broken lines show the position of thermograph records used to construct this diagram, taken by t.s.s. *Monowai*

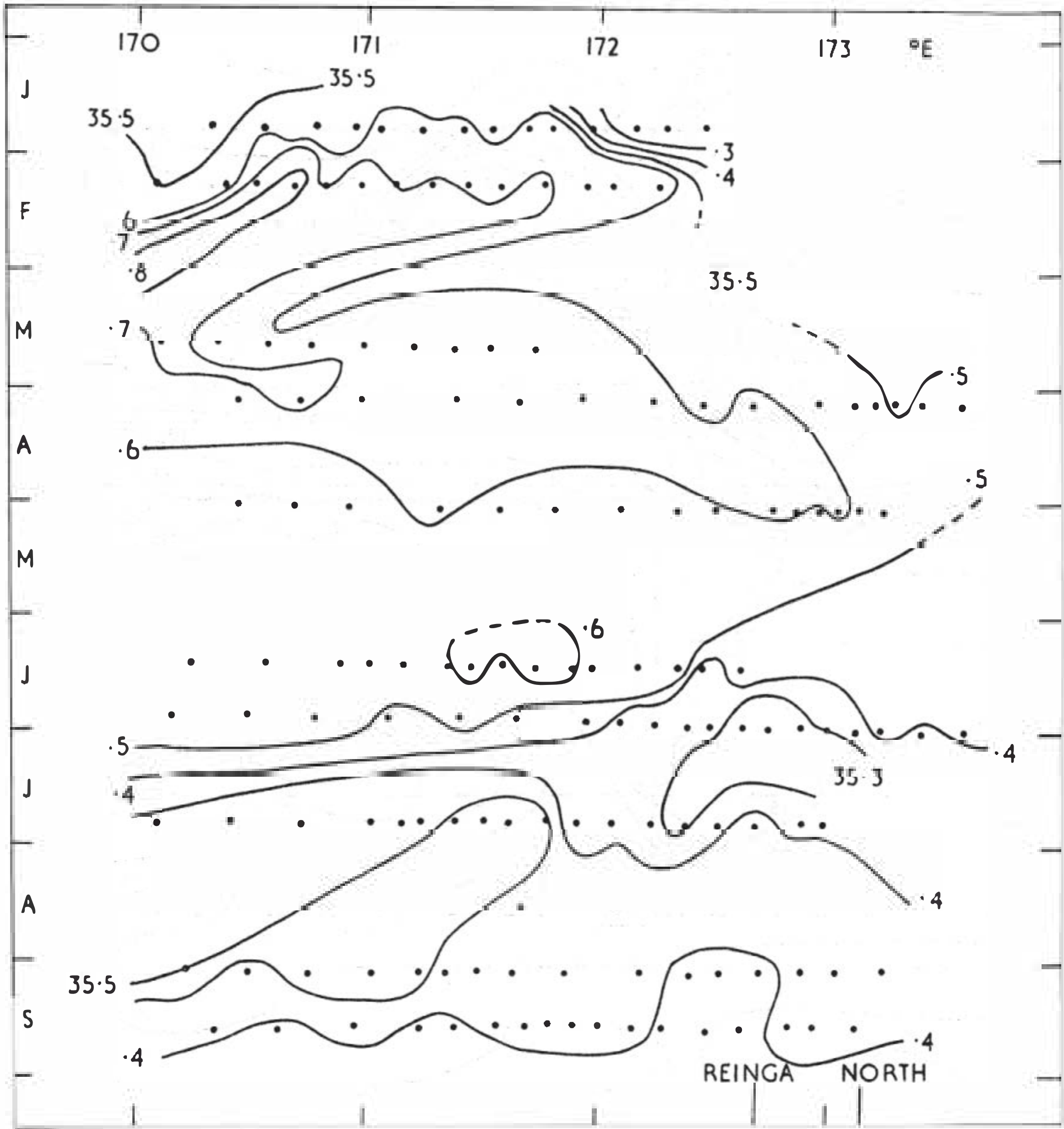

Fig. 37: Surface salinity westwards from North Cape plotted as a function of position (longitudes shown as abscissae) and time. Data taken from Rochford (1957a); sampling positions shown as dots

TABLE 5. SURFACE TEMPERATURES AND SALINITIES ON A DIRECT LINE BETWEEN WELLINGTON AND LYTTELTON

Latitude	25/10/51		11/12/51		10/1/52		12/2/52		6/6/52	
41° 32′ S	12·0	35·12	11·0	34·81	13·	34·79	13·5	34·96	13·5	34·99
41° 46′	10·5	34·76	10·5	34·69	11·5	34·58	13·0	34·72	13·0	34·83
42° 00′	9·5	34·60	11·0	34·42	11·5	34·63	12·0	34·52	10·5	34·52
42° 14′	9·0	34·59	11·0	34·36	12·0	34·90	12·0	34·67	10·5	34·49
42° 28′	10·0	34·74	10·5	34·72	11·0	34·70	13·5	34·85	10·5	34·40
42° 43′	11·0	34·94	11·0	34·74	11·0	34·56	13·0	34·61	11·0	34·63
42° 53′	10·0	34·56	11·0	34·76	11·0	34·60	13·5	34·69	10·0	34·69
43° 10′	10·0	34·42	11·5	34·73	11·5	34·85	13·0	34·69	10·5	34·54
43° 20′	9·5	34·05	12·0	33·98	13·0	34·40	13·5	34·54	10·0	34·05
43° 34′	10·5	33·80	13·5	33·89	13·5	34·18	14·5	33·89	10·0	33·96

Data provided by t.e.v. *Hinemoa* (Union Steam Ship Co.). Temperatures were read to the nearest half degree (Centigrade) from the engine-room injection thermometer, and are approximate only. Salinities were determined by the Dominion Laboratory, Wellington.

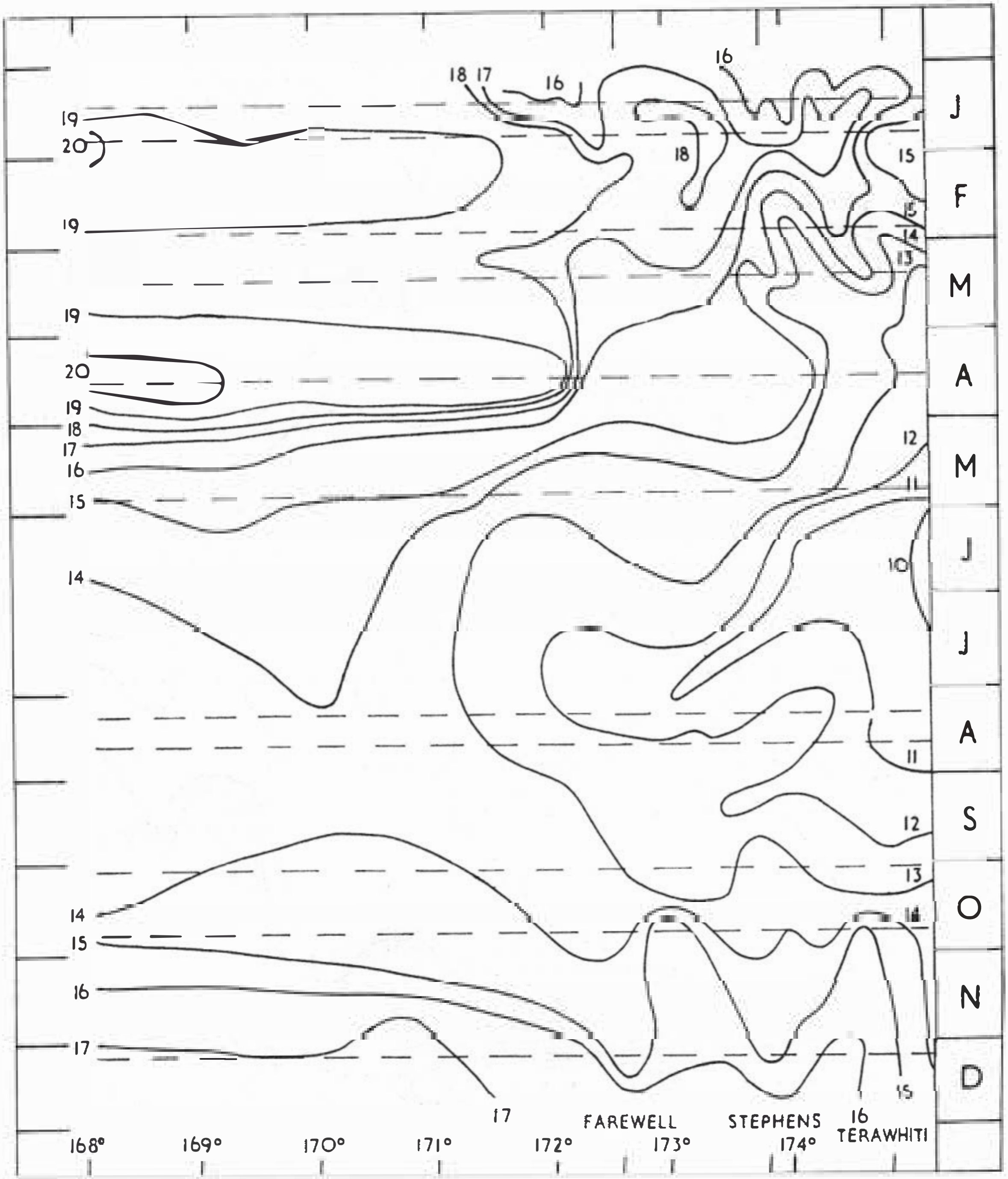

Fig. 38: Surface temperature (°c) plotted as a function of position and time along the passage from Wellington westbound through northern Cook Strait towards Sydney. Longitudes are shown as abscissae and the points of measurement off Cape Farewell, Stephens Island, and Cape Terawhiti are also marked. Data are from *Monowai* thermograph records indicated by the horizontal broken lines

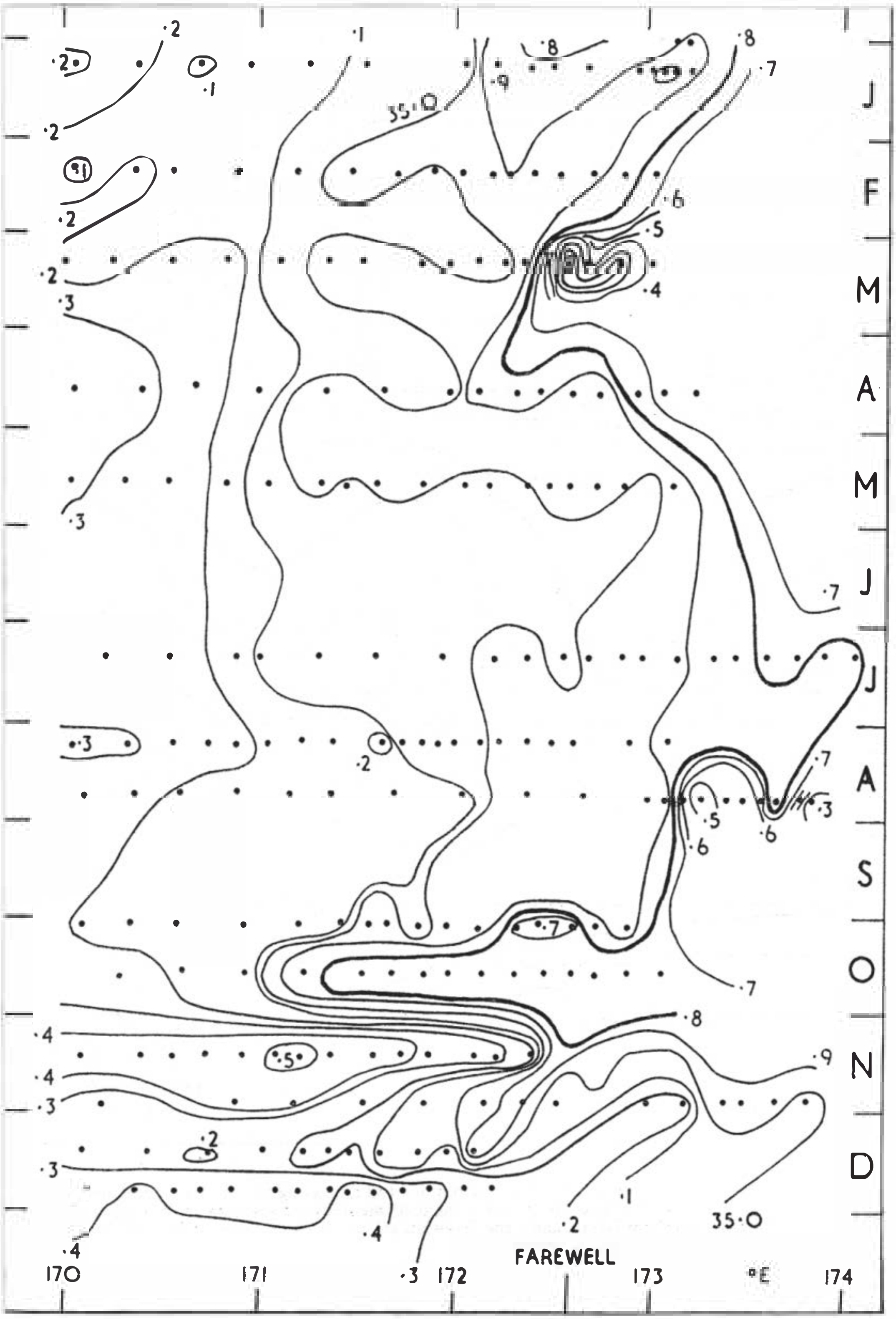

Fig. 39: Surface salinity westwards out of Cook Strait towards Sydney plotted as a function of position (longitudes shown as abscissae) and time. Data from Rochford (1957a): sampling positions shown as dots

CONCLUSIONS

General Range of Temperature and Salinity

Surface Temperature and Salinity

Sea surface temperature in the New Zealand coastal region investigated in this project ranged from 23°C in summer in waters off shore from the Northland peninsula and the Hauraki Gulf to 8°C off the South Otago Coast in winter. The associated range of surface salinity in oceanic water, unmodified by coastal effects, was from 36·0‰ to 34·3‰. In near-shore waters river outflow may be entrained sufficiently in a region giving rise to extensive areas of much lower surface salinity. Such areas were noted during this survey, particularly off the south Westland coast, in the South Canterbury Bight, Pegasus Bay, and off the west coast of North Island between the North Taranaki Bight and Cook Strait.

Subsurface Temperature and Salinity

In general, bottom water at the edge of the North Island shelf has a temperature of 12–15°C and a salinity of 34·9–35·4‰. In the deeper water offshore from the shelf the 10°C isotherm is found in general at a depth of 400–500 m, 5°C, 1,000–1,200 m, and the temperature at the bottom in the deepest water worked, over the Hikurangi Trench east of Cape Palliser, was just under 2°C at a depth of about 2,600 m.

Subsurface salinities took various patterns. A pronounced intermediate maximum was found off the north-west coast of North Island reaching a salinity of 36·0‰ at a depth of 70–400 m. Less marked shallow salinity maxima were found off the east coast of North Island. Below these maxima salinity generally decreased with depth, except in the extensive shelf waters off Cape Egmont where a small increase with depth, probably due to an admixture of fresh river water, was evident.

An intermediate salinity minimum reaching some 34·5‰ at a depth of about 1,000 m was observed in May off the east coast of North Island between East Cape and Cape Palliser. In the deep water, below 2,000 m, bottom salinities varied between 34·6 and 34·7‰.

Seasonal Variations

Seasonal variations due to external climatic effects will, in general, be confined to the upper 200–300 m of depth. The detail of the seasonal pattern of surface temperature and salinity for several coastal areas has been described in a previous section.

There appears to be little seasonal variation in surface salinity due to evaporation/precipitation differences in the open ocean around New Zealand, and any large changes during the year seem to be related to the movement of water from different sources. In those near-shore regions where the run-off of land water determines the salinity structure, doubtless large-scale changes in surface salinity may be found, depending on the seasonal pattern of precipitation over the associated watershed (Cowie and Attwood, 1957; figs. 35 and 36), but on the scale of the investigation reported here areas of pronounced coastal dilution form a minor proportion of New Zealand's coastal waters. It is interesting to note that in the one coastal area with water of this type sampled both summer and winter – the South Canterbury Bight – surface salinity varied little.

Seasonal ranges in surface temperature were around 5°C generally in open water. Semi-enclosed and relatively shallow waters have been noted, such as the Hauraki Gulf and approaches, northern Cook Strait, and Pegasus Bay, where convective cooling in autumn and winter depletes the reserve of heat available in subsurface waters relatively early in the season, resulting in a winter minimum temperature depressed below that obtaining in the deeper waters close by. The reverse effect was noted in very shallow and sheltered waters such as the lower Hauraki Gulf, Pegasus Bay off Lyttelton Harbour, and the South Canterbury Bight, where the depth of water would be less than that of the summer thermocline off shore.

Hydrology and Circulation

General

Care must be taken not to push the qualitative interpretation of hydrological data in terms of circulation patterns too far, especially with surface data, where it is often difficult to sort out the effects of purely external causes, such as climate.

No attempt has been made here to compute gradient currents from the vertical temperature and salinity cross-sections worked in this project, both because of the difficulty in selecting a suitable reference level in a section crossing the shelf and because the attainment of steady-state conditions seemed unlikely in many cases.

More direct measurements of water movements around New Zealand, will, then, be of interest. The nearest approach to such measurements possible during the work reported here involved the use of drift cards, the interpretation of whose behaviour presents many problems. A positive record is available only of the place and time of release. Details for recovery are more indefinite, the time of pick-up after stranding, in particular, depending on the extent to which the coast is frequented. Rate of drift is uncertain both because of this and the unknown path by which the card has travelled between its points of release and recovery. Drift tracks sketched in fig. 4 and in similar figures following are schematic only, although an attempt has been made to fit them rationally to the hydrological pattern. Of course if the time to recovery is long, the average hydrological influence on a card may well differ markedly from that at the time of release. In most cases here, cards recovered were found either within a week or two following release or were returned several months (up to a year) later – mostly from lonely beaches.

Used supplementary to an investigation of more precisely determinable factors, however, the results of drift card releases can provide useful information. In particular, it is valuable to have positive indications of direction of movement to compare with deductions from the hydrological pattern, while drift rates computed give at least a lower limit to likely velocities.

Several points of interest arise in assessing the significance of recovery or non-recovery. Since cards float on the sea surface they will be subject to the effects of local wind drift superimposed on prevailing gradient currents. The surface hydrology will be similarly affected by local wind patterns, whereas the total mass distribution as measured by subsurface density profiles will not have time, in many cases, to adjust to the more rapid wind changes. The combined effect of high winds and steep or breaking seas may also result in cards travelling considerable distances airborne. Cards have been found, on occasion, blown inland after initial stranding and the reverse process must occur at times.

An inquiry into the means of stranding of drifting material would be of interest. Returns of cards are usually from well known beaches, and doubtless a proportion of strandings remain unrecorded through cards lying in unfrequented areas. Remote locations are by no means unrepresented in recovery records, however, and it is felt that this neglected proportion probably remains small. In New Zealand extensive beach systems are usually associated with centres of population, and since processes which tend to maintain beach formation are probably those contributing to the stranding of material floating off shore, the pattern of return points is logical. A proportion of cards may be found but not reported, but it is felt that data lost in this way are few, and acknowledgment must be made to the interest shown by some threescore people who returned cards, dropped during the present survey, with the details requested. Cards were occasionally returned in damaged condition, and it is possible that some cards sink at sea and are lost.

The percentage return of cards dropped in coastal waters is very low, and presumably the great majority of releases remain in circulation, strandings representing accidental events. Since coastal currents in general will have a predominantly long-shore movement, a shorewards drift of floating material is probably induced by waves and swell and the onshore component of flooding tidal streams. Strandings are thus probably strongly controlled by wind systems in and near the area of drift. It would be of interest to learn why only one, or occasionally two, cards from each release of five were recovered, even from lines with a relatively high recovery rate such as EGMONT, and why on an open coast, recovery will be made from a release well off shore while nothing more will be heard of cards dropped closer inshore. Presumably large scale dispersion of cards follows release under the action of wind, waves, and eddy motions in the sea. Under the influence of these same effects floating material can probably be transported across water mass boundaries, especially in zones of strong convergence, and continuity of a circulation system will not necessarily be implied between points of release and recovery.

Surface Circulation

Keeping in mind the cautions expressed in the previous section concerning the interpretation of hydrological data, it will be useful to summarise

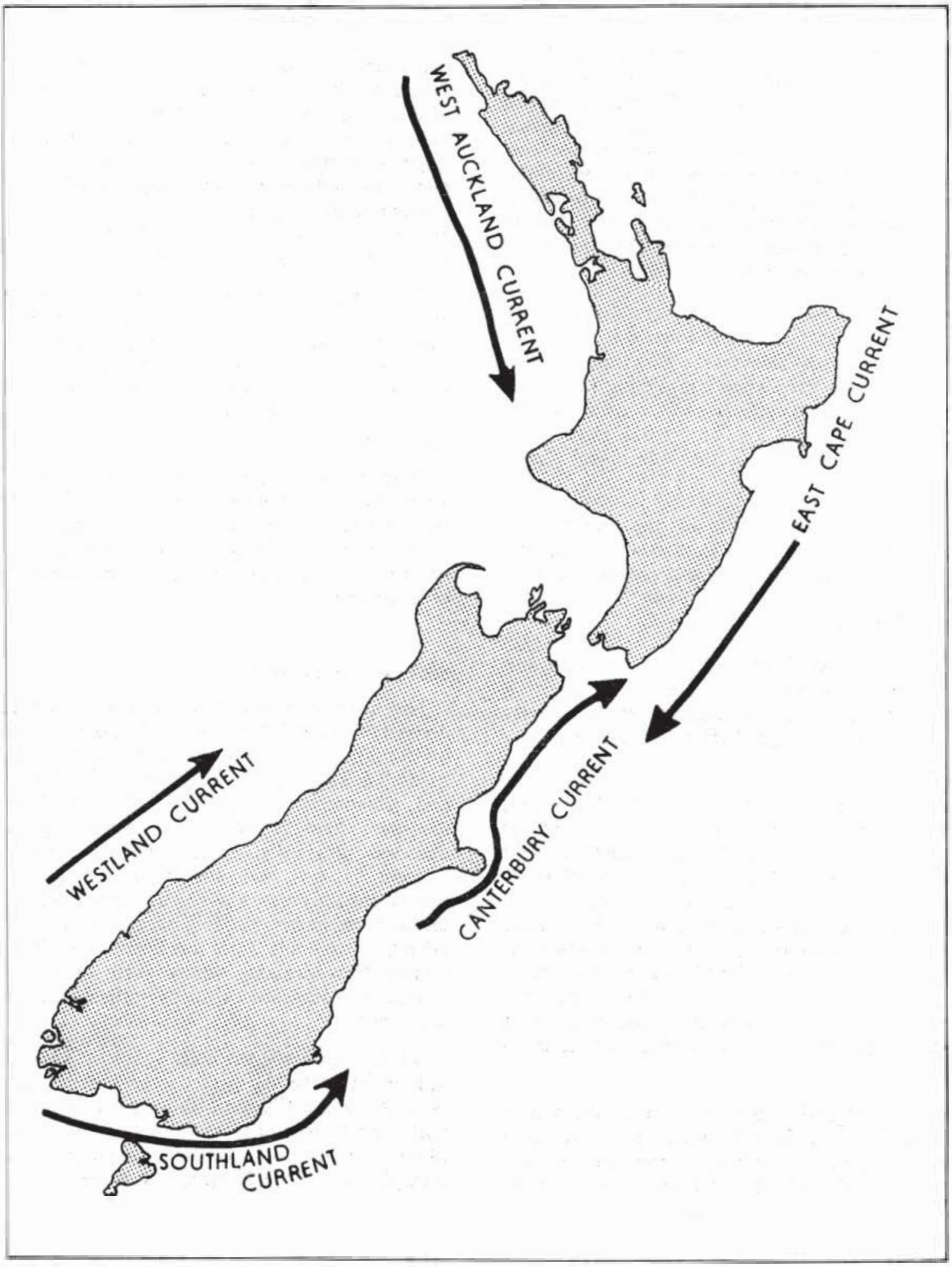

Fig. 40: Schematic description of the main New Zealand coastal water movements.

here the general pattern of circulation which has been derived from work to date. As always with investigations of this nature, the future results of observations may lead to a radical change in the concept of ocean circulation. Confidence gained through the consistency of results obtained during various investigations, however, warrants making a summary in terms of a generalised pattern of circulation, which then provides a useful frame on which to base future work. Fig. 40 illustrates the names proposed for the main coastal water movements.

A warm current east of New Zealand was first recognised from the temperature distribution by Fleming (1950) who called it the *East Cape Current*. This is a useful term when considering the region where this current affects near coastal waters, i.e., between East Cape and Cook Strait, the movement originating in the subtropical Trade Wind Drift.

A north-flowing branch of the subantarctic West Wind Drift is found in coastal waters, predominantly off the Canterbury coast and reaching the vicinity of southern Cook Strait. This is therefore called the *Canterbury Current*.

Flowing eastwards through Foveaux Strait and entering surface waters off the Otago coast, a branch of the Tasman Current, predominantly subtropical in nature, is here called the *Southland Current*.

The south-flowing tongue of subtropical water, derived from the Trade Wind Drift, found off the west coast of North Island, is called the *West Auckland Current*. This meets the northward-moving section of the Tasman Current in the eastern Tasman Sea – in coastal waters here called the *Westland Current* – in the *East Tasman Convergence*. This is a boundary between two currents with differing but mainly subtropical characteristics, and probably varies its position in west coast waters between Cape Reinga and northern Cook Strait.

The Subtropical Convergence in coastal waters is thus the boundary between the East Cape Current and the Canterbury Current in the east; between the Southland and Canterbury Currents in the south-east; and between the Tasman or Westland Currents and the West Wind Drift in the south-west.

Drift-card recoveries from releases made in 1953 and 1954 define a similar surface-current pattern (Brodie, 1960).

Intermediate and Deep Circulation

The localised occurrence of the shallow salinity maximum in coastal waters north-west of North Island was due to the local formation in this area of a diluted surface water. Whether the very high salinity found here and at the surface east of North Cape is continuous with the intermediate salinity maximum widespread over lower latitudes of the western south Pacific (Garner, 1959b) and called by Wyrtki (1956) the "Southern Subtropical Lower Water", remains to be seen.

The complete absence of Antarctic Intermediate water in New Zealand coastal waters during the summer survey and its appearance in slope waters between East Cape and Cape Palliser only three months later is another interesting feature of the intermediate circulation which will be worth further study.

Deep water salinity approached a value of about $34 \cdot 68\,^0/_{00}$ between 1,500 and 2,000 m at a temperature of about 2°C. This is nearly $0 \cdot 1\,^0/_{00}$ higher than the salinity at this temperature noted on the Sverdrup mean curve, and the significance of this higher value should be investigated further.

Secular Variations

The question arises to what extent the results derived from this 1955 work may be taken as typical of conditions in New Zealand coastal waters generally. The general distribution of subtropical and subantarctic water east of New Zealand described here is typical of general patterns observed previously, except that the Southland Current has not been shown so well developed before. Possibly this water is at times confined to the western approaches to Foveaux Strait and, at others, it may mix with the East Cape Current, putting New Zealand wholly north of the Subtropical Convergence as far as surface waters are concerned.

Off the west coast the chief source of variability will probably be the presence or absence of the West Auckland Current, subtropical flow sometimes being confined to east coast waters (Garner, 1954). The regions of coastal upwelling noted in such places as Cape Reinga, East Cape, and Cape Farewell are very variable in their behaviour, and it may be expected that the various manifestations of coastal water types will also reflect local climatological fluctuations. Climatologically, 1955 was one of the warmest years on record in New Zealand (Department of Statistics, 1956, p. 11), the average departure from normal air temperatures being about 0·9°C over the whole country. However, sunshine was mainly below normal, departures being greatest over the North Island. In the North Island in February the mean air temperatures were about 2·8°C above normal, and approximately equal to the temperature of the warmest months on record. However, as February was also unusually cloudy, the absorption of solar radiation directly in surface waters may not have been unusually great. Rainfall was well above average in many coastal areas, notably Northland, Gisborne to Castlepoint, south-west Wellington Province, and the coasts of the south-western Cook Strait area. May was generally mild over the country, the winter months were unusually dull and the spring season unusually warm.

Rodewald (1957) has noted that so far as temperature was concerned the year 1955 began normally and then grew increasingly colder than normal over a large area of the Pacific Ocean, mainly in the eastern and equatorial regions. In the north-west and south-west regions positive temperature anomalies were noted and it was suggested that the distribution of temperature anomalies were related to changes in the general anticlockwise gyrals of wind and surface water in the two hemispheres. Little systematic secular variation in sea temperatures in coastal waters of northern Cook Strait and off the east coast north of Auckland is evident from *Monowai* thermograph records on file from 1949.

It can reasonably be assumed that in general terms the hydrological situation in New Zealand coastal waters as revealed by the present survey is typical of the range of values of temperature and salinity that may be encountered in any year. At particular localities results show that local sources of variation, such as shallow water, summer warming, and the drainage of land water can produce dominant changes of temperature and salinity values, especially in surface waters.

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The large number of figures was prepared for publication by Mr C. T. Webb and staff of the Draughting Section, Geological Survey, DSIR.

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APPENDIX A—STATION CIRCUMSTANCES

The *project station numbers* are given in the code explained on page 00 and are shown in geographical sequence in this table. In the second table of station data, figures are listed in numerical order according to the relevant New Zealand Oceanographic Institute *serial station number* (Register A). *Dates* are listed as day and month only (all refer to 1955), while New Zealand standard *times* of station commencement are given. *Depths* listed are uncorrected sonic soundings, in *fathoms* at the completion of each station. *Latitudes* are all south and *longitudes* east. *Wind direction* is the true bearing of the direction from which the wind is blowing and its *force* represents estimates on the Beaufort scale.

Station No.		Date	Time	Depth	Latitude	Longitude	Wind	
Project	Serial						Direction	Force
I North/1A	4	25/1	1330	. .	34° 23′	173° 05′	272°	4
1	73	17/2	1225	55	34° 24′	173° 06′	360°	2
2	74	,,	1312	145	34° 21′	173° 11′	,,	3
3	75	,,	1347	496	34° 17′	173° 16′	,,	3
4	76	,,	1503	865	34° 14′	173° 21′	,,	3
5	77	,,	1546	1,040	34° 11′	173° 25′	,,	3
6	78	,,	1736	1,100	34° 07′	173° 30′	010°	3
7	79	,,	1822	1,120	34° 04′	173° 35′	005°	3
8	80	,,	2004	1,100	34° 00′	173° 40′	360°	3
9	81	,,	2045	1,115	33° 57′	173° 46′	,,	3
I Barrier/1	7	29/1	0932	. .	36° 17′	175° 36′	. .	0
2	8	,,	1115	. .	36° 14′	175° 40′	. .	0
3	9	,,	1245	. .	36° 10′	175° 43′	. .	0
4	10	,,	1414	. .	36° 07′	175° 50′	. .	0
5	11	,,	1556	. .	36° 04′	175° 55′	. .	0
6	12	,,	1736	. .	36° 00′	176° 00′	. .	0
7	13	,,	1911	. .	35° 59′	176° 07′	. .	0
8	14	,,	2055	. .	35° 56′	176° 12′	270°	2
9	15	,,	2240	. .	35° 53′	176° 16′	,,	2
I East/1	16	7/2	1735	50	37° 42′	178° 38′	040°	3
2	17	,,	1845	79	37° 42′	178° 45′	070°	2
3	18	,,	2000	115	37° 42′	178° 51′	070°	2
4	19	,,	2140	170	37° 42′	178° 57′	080°	4
5	20	,,	2330	720	37° 42′	179° 03′	020°	1
6	21	8/2	0216	720	37° 43′	179° 09′	,,	2
7	22	,,	0259	580	37° 42′	179° 15′	010°	3
8	23	,,	0437	555	37° 42′	179° 20′	,,	3
9	24	,,	0518	780	37° 42′	179° 25′	,,	3
I Hawke/1	35	9/2	0628	50	39° 29′	177° 27′	020°	1
2	34	,,	0530	71	39° 32′	177° 32′	030°	1
3	33	,,	0430	78	39° 35′	177° 37′	045°	2
4	32	,,	0334	105	39° 38′	177° 43′	015°	2
5	31	9/2	0200	280	39° 41′	177° 48′	020°	3
6	30	,,	0110	650	39° 44′	177° 53′	,,	3
7	29	8/2	2315	640	39° 48′	177° 60′	010°	4
8	28	,,	2230	670	39° 51′	178° 05′	360°	4
9	27	,,	2055	710	39° 54′	178° 10′	010°	4
10	26	,,	2012	580	39° 57′	178° 15′	030°	4
11	25	,,	1743	1,000	40° 00′	178° 21′	010°	4

Station No.		Date	Time	Depth	Latitude	Longitude	Wind	
Project	Serial						Direction	Force
I PALLISER/1	44	10/2	1740	480	41° 41′	175° 24′	115°	1
2	43	,,	1606	650	41° 44′	175° 31′	090°	1
3	42	,,	1411	1,210	41° 47′	175° 38′	120°	1
4	41	,,	1336	1,350	41° 49′	175° 44′	,,	2
5	40	,,	1142	1,445	41° 51′	175° 51′	,,	1
6	39	,,	1103	1,475	41° 55′	175° 54′	080°	2
7	38	,,	0908	1,480	41° 58′	176° 03′	,,	2
8	37	,,	0827	1,480	42° 01′	176° 10′	,,	2
9	36	,,	0605	1,480	42° 05′	176° 16′	060°	4
I EGMONT/1	45	15/2	0150	61	39° 15′	173° 38′	320°	3
2	46	,,	0258	69	39° 13′	173° 32′	,,	2
3	47	,,	0410	71	39° 11′	173° 26′	340°	1
4	48	,,	0510	70	39° 10′	173° 20′	330°	2
5	49	,,	0609	71	39° 08′	173° 14′	320°	2
6	50	,,	0710	73	39° 06′	173° 08′	330°	2
7	51	,,	0815	75	39° 04′	173° 02′	,,	3
8	52	,,	0920	76	39° 02′	172° 56′	,,	3
9	53	,,	1010	78	39° 00′	172° 50′	320°	3
10	54	,,	1100	82	38° 59′	172° 44′	,,	3
I KAIPARA/1	63	16/2	0909	42	36° 32′	173° 59′	020°	2
2	62	,,	0731	95	36° 34′	173° 52′	330°	3
3	61	,,	0651	290	36° 36′	173° 45′	,,	3
4	60	,,	0612	420	36° 37′	173° 39′	,,	3
5	59	,,	0430	540	36° 39′	173° 32′	,,	2
6	58	,,	0345	680	36° 41′	173° 26′	020°	2
7	57	,,	0205	767	36° 43′	173° 20′	,,	2
8	56	,,	0120	792	36° 45′	173° 13′	000°	2
9	55	15/2	2310	826	36° 46′	173° 06′	030°	2
I REINGA/1	73	17/2	1008	46	34° 22′	172° 37′	010°	3
2	72	,,	0918	53	34° 21′	172° 30′	,,	3
3	71	,,	0828	64	34° 21′	172° 24′	000°	3
4	70	,,	0728	73	34° 20′	172° 17′	350°	4
5	69	,,	0640	73	34° 19′	172° 11′	,,	4
6	68	,,	0541	167	34° 18′	172° 05′	340°	3
7	67	,,	0446	114	34° 18′	171° 59′	320°	3
8	66	,,	0330	205	34° 17′	171° 53′	330°	3
9	65	,,	0108	213	34° 15′	171° 45′	360°	4
10	64	,,	0035	230	34° 14′	171° 40′	,,	4
II NORTH/1	172	16/5	1005	67	34° 25′	173° 07′	210°	2
2	173	,,	1042	170	34° 20′	173° 10′	220°	2
3	174	,,	1125	640	34° 17′	173° 15′	,,	2
4	175	,,	1255	960	34° 13′	173° 20′	240°	3
5	176	,,	1446	1,050	34° 10′	173° 26′	,,	3
6	177	,,	1527	1,120	34° 07′	173° 31′	,,	3
7	178	,,	1612	1,115	34° 03′	173° 36′	230°	2
8	179	,,	1806	1,150	34° 00′	173° 41′	240°	2
9	180	,,	1904	1,120	33° 57′	173° 46′	230°	3
10	181	,,	1958	1,050	33° 53′	173° 50′	,,	3
II BARRIER/1	101	9/5	1345	46	36° 18′	175° 37′	200°	3
2	102	,,	1415	65	36° 14′	175° 42′	,,	3
3	103	,,	1503	75	36° 11′	175° 46′	,,	3
4	104	,,	1536	90	36° 08′	175° 51′	215°	3
5	105	,,	1630	98	36° 05′	175° 55′	218°	3
6	106	,,	1721	130	36° 02′	176° 00′	180°	2
7	107	,,	1814	124	35° 58′	176° 05′	,,	2
8	108	,,	1904	132	35° 55′	176° 09′	,,	2
9	109	,,	1954	210	35° 52′	176° 14′	200°	2
10	110	,,	2050	260	35° 49′	176° 19′	220°	3
11	111	,,	2212	370	35° 45′	176° 24′	,,	3

Station No.		Date	Time	Depth	Latitude	Longitude	Wind	
Project	Serial						Direction	Force
II East/1	112	10/5	1222	20	37° 42′	178° 37′	195°	3
2	113	"	1304	72	37° 41′	178° 43′	185°	3
3	114	"	1353	102	37° 41′	178° 49′	185°	3
4	115	"	1453	140	37° 41′	178° 55′	110°	3
5	116	"	1618	435	37° 42′	179° 00′	165°	2
6	117	"	1745	590	37° 42′	179° 05′	190°	2
7	118	"	1934	650	37° 42′	179° 12′	100°	2
8	119	"	2028	660	37° 42′	179° 19′	080°	3
9	120	"	2235	850	37° 42′	179° 25′	100°	3
10	121	"	2228	1,870	37° 42′	179° 31′	"	3
II Hawke/1	130	11/5	2345	68	39° 30′	177° 30′	240°	2
2	129	"	2300	76	39° 33′	177° 37′	"	2
3	128	"	2215	82	39° 36′	177° 43′	"	1
4	127	"	2121	202	39° 40′	177° 49′	220°	1
5	126	"	1943	615	39° 43′	177° 56′	200°	1
6	125	"	1847	620	39° 47′	178° 02′	190°	1
7	124	"	1634	730	39° 51′	178° 07′	310°	2
8	123	"	1515	650	39° 55′	178° 12′	330°	3
9	122	"	1305	870	39° 59′	178° 17′	320°	3
II Palliser/1	140	13/5	0520	70	41° 38′	175° 21′	060°	1
2	139	"	0353	470	41° 42′	175° 28′	020°	4
3	138	"	0302	1,000	41° 45′	175° 34′	030°	4
4	137	"	0000	1,360	41° 50′	175° 38′	020°	3
5	136	12/5	2308	1,420	41° 53′	175° 43′	045°	3
6	135	"	2050	1,430	41° 56′	175° 49′	"	3
7	134	"	1952	1,460	41° 59′	175° 57′	050°	2
8	133	"	1736	1,450	42° 03′	176° 02′	"	3
9	132	"	1636	1,450	42° 05′	176° 08′	055°	3
10	131	"	1353	1,455	42° 06′	176° 14′	050°	3
II Egmont/1	141	13/5	2107	55	39° 15′	173° 40′	090°	1
2	142	"	2142	66	39° 13′	173° 34′	"	1
3	143	"	2218	70	39° 12′	173° 27′	070°	1
4	144	"	2300	69	39° 10′	173° 21′	050°	2
5	145	"	2338	71	39° 08′	173° 15′	050°	2
6	146	14/5	0017	73	39° 07′	173° 09′	080°	2
7	147	"	0059	75	39° 05′	173° 03′	"	2
8	148	"	0139	76	39° 03′	172° 57′	085°	2
9	149	"	0219	78	39° 01′	172° 52′	060°	2
10	150	"	0303	82	39° 00′	172° 45′	080°	2
11	151	"	0346	86	38° 58′	172° 40′	"	3
II Kaipara/1	152	14/5	1923	38	36° 37′	174° 03′	070°	4
2	153	"	2002	69	36° 38′	173° 57′	080°	4
3	154	"	2041	280	36° 39′	173° 51′	075°	4
4	155	"	2146	370	36° 41′	173° 45′	080°	4
5	156	"	2257	540	36° 42′	173° 39′	"	5
6	157	15/5	0027	670	36° 44′	173° 31′	075°	5
7	158	"	0159	720	36° 45′	173° 24′	"	5
8	159	"	0335	790	36° 47′	173° 16′	"	5
9	160	"	0435	825	36° 48′	173° 09′	080°	6
10	161	"	0527	850	36° 50′	173° 01′	"	6
II Reinga/1	171	16/5	0750	48	34° 22′	172° 35′	235°	3
2	170	"	0717	57	34° 22′	172° 29′	235°	3
3	169	"	0634	65	34° 21′	172° 23′	230°	2
4	168	"	0552	70	34° 20′	172° 17′	240°	3
5	167	"	0508	73	34° 20′	172° 11′	230°	3
6	166	"	0420	141	34° 18′	172° 05′	"	4
7	165	"	0315	130	34° 18′	171° 59′	250°	4
8	164	"	0210	205	34° 17′	171° 52′	220°	4
9	163	"	0100	210	34° 15′	171° 46′	180°	4
10	162	15/5	2333	230	34° 15′	171° 42′	150°	5

Station No.		Date	Time	Depth	Latitude	Longitude	Wind	
Project	Serial						Direction	Force
III Barrier/1	195	22/9	2400	>1,000	35° 37′	176° 52′	270°	3
3	194	,,	2304	,, 1,000	35° 44′	176° 42′	,,	3
5	193	,,	2213	,, 1,000	35° 50′	176° 32′	,,	3
7	192	,,	2118	,, 1,000	35° 55′	176° 23′	,,	3
9	191	,,	2025	,, 1,000	36° 02′	176° 14′	,,	2
11	190	,,	1930	,, 1,000	36° 08′	176° 02′	,,	2
III Raglan/1	230	9/10	0313	20	37° 47′	174° 44′	..	0
2	231	,,	0412	27	37° 47′	174° 38′	..	0
3	232	,,	0450	34	37° 47′	174° 32′	..	0
4	233	,,	0528	40	37° 47′	174° 26′	..	0
5	234	,,	0607	46	37° 47′	174° 19′	..	0
6	235	,,	0645	65	37° 47′	174° 13′	..	0
7	236	,,	0728	140	37° 47′	174° 07′	..	0
8	237	,,	0815	500	37° 47′	174° 00′	..	0
9	238	,,	0900	500	37° 47′	173° 54′	..	0
10	239	,,	0945	500	37° 47′	173° 47′	..	0
III Egmont/2	241	9/10	2215	50	39° 02′	173° 58′	..	0
3	242	,,	2120	59	39° 00′	173° 52′	..	0
4	243	,,	2105	66	38° 59′	173° 44′	..	0
5	244	,,	2025	69	38° 57′	173° 37′	..	0
6	245	,,	1935	72	38° 54′	173° 26′	..	0
7	246	,,	1855	72	38° 52′	173° 19′	..	0
8	247	,,	1815	73	38° 50′	173° 13′	..	0
9	248	,,	1730	75	38° 48′	173° 07′	..	0
10	249	,,	1650	75	38° 47′	173° 01′	..	0
III Foulwind/1	210	2/10	1225	56	41° 43′	171° 20′	340°	2
2	211	,,	1310	81	41° 42′	171° 16′	350°	2
3	212	,,	1350	75	41° 41′	171° 10′	350°	2
4	213	,,	1440	87	41° 39′	171° 04′	010°	4
5	214	,,	1518	100	41° 37′	170° 58′	025°	4
6	215	,,	1555	122	41° 35′	170° 52′	045°	4
7	216	,,	1638	148	41° 33′	170° 43′	,,	4
8	217	,,	1722	242	41° 32′	170° 38′	,,	4
9	218	,,	1804	..	41° 30′	170° 31′	,,	4
10	219	,,	1845	..	41° 28′	170° 25′	,,	4
11	220	,,	1932	..	41° 25′	170° 17′	,,	4
III Hokitika/1	229	3/10	0648	33	42° 37′	170° 40′	080°	1
2	228	,,	0611	151	42° 34′	170° 31′	,,	1
3	227	,,	0535	..	42° 33′	170° 25′	,,	2
4	226	,,	0452	..	42° 31′	170° 19′	,,	2
5	225	,,	0410	..	42° 30′	170° 12′	,,	2
6	224	,,	0325	..	42° 28′	170° 07′	,,	3
7	223	,,	0240	..	42° 26′	170° 00′	060°	3
8	222	,,	0150	..	42° 24′	169° 49′	080°	5
9	221	,,	0100	..	42° 21′	169° 42′	,,	5
IV North/1	253	21/11	0935	55	34° 24′	173° 06′	135	2
2	254	,,	1014	152	34° 21′	173° 10′	115	2
3	255	,,	1105	541	34° 17′	173° 16′	135	2
4	256	,,	1240	..	34° 14′	173° 21′	,,	1
5	257	,,	1330	..	34° 11′	173° 25′	,,	1
6	258	,,	1423	..	34° 07′	173° 30′	,,	1
7	259	21/11	1505	..	34° 04′	173° 35′	180°	1
8	260	,,	1555	..	34° 00′	173° 40′	,,	1
9	261	,,	1640	..	33° 57′	173° 46′	,,	1
10	262	,,	1724	..	33° 54′	173° 51′	,,	1
IV Barrier/1	291	14/12	0445	50	36° 12′	175° 33′	260°	1
3	290	,,	0350	100	36° 07′	175° 45′	,,	1
5	289	,,	0255	110	36° 04′	175° 55′	,,	1
7	288	,,	0150	135	36° 08′	176° 02′	,,	2
9	287	,,	0055	..	36° 00′	176° 12′	,,	2
11	286	13/12	2350	..	35° 55′	176° 28′	240°	3

Station No.		Date	Time	Depth	Latitude	Longitude	Wind	
Project	Serial						Direction	Force
IV EAST/1	280	13/12	0050	30	37° 42′	178° 37′	335°	2
3	281	,,	0146	..	37° 42′	178° 50′	,,	2
5	282	,,	0245	..	37° 42′	179° 02′	290°	3
7	283	,,	0345	..	37° 42′	179° 14′	270°	3
9	284	,,	0443	..	37° 42′	179° 26′	,,	3
11	285	,,	0545	..	37° 42′	179° 39′	,,	3
IV HAWKE/1	279	12/12	1605	29	39° 20′	177° 55′	025°	2
3	278	,,	1514	80	39° 23′	178° 05′	335°	1
5	277	,,	1428	..	39° 26′	178° 15′	,,	1
7	276	,,	1330	..	39° 32′	178° 26′	,,	1
9	275	,,	1228	..	39° 38′	178° 38′	,,	1
11	274	,,	1138	..	39° 43′	178° 49′	,,	1
IV PALLISER/1	268	11/12	1625	29	41° 38′	175° 20′	250°	2
3	269	,,	1718	..	41° 43′	175° 31′	,,	2
5	270	,,	1813	..	41° 48′	175° 43′	205°	2
7	271	,,	1905	..	41° 53′	175° 55′	,,	2
9	272	,,	1955	..	41° 58′	176° 06′	,,	2
11	273	,,	2055	..	42° 03′	176° 17′	,,	2

APPENDIX B—STATION DATA

The following table summarises the numerical station data in numerical order of the N.Z.O.I. Serial Station Number (Register A). For each station, columns show (from left to right) depths in metres, temperatures in degrees Centigrade, and salinities in parts per thousand. Where temperatures are listed to 0·1°c, either the accuracy of depth determination did not permit a greater accuracy to be given in regions of steep gradient or else temperature was measured by bathythermograph only without reversing-thermometer check. Values are listed at International Standard Depths to which the actual sampling depths approximated. Within the range of the continuous bathythermograph record, maximum and/or minimum values are also listed where temperature inversion structures occurred.

A 7

0	20·0	35·45
10	19·9	·42
20	·6	·39
30	17·4	·34
50	16·5	·32
75	15·1	·28

A 8

0	20·3	35·57
10	·3	·59
20	·2	·62
30	19·2	·53
50	17·8	·44
75	15·8	·31
100	14·0	·24

A 9

0	20·2	35·59
10	·2	·66
20	·2	·72
30	19·2	·61
50	17·5	·50
75	15·7	·38
100	14·9	·29

A 10

0	20·1	35·72
10	·1	·72
20	·0	·68
30	18·0	·53
50	16·8	·47
75	15·8	·37
100	14·9	·30
150	·0	·24

A 11

0	20·09	35·71
10	·09	·71
20	·04	·62
30	17·55	·51
50	16·80	·48
75	15·89	·41
100	·08	·31
150	14·27	·26

A 12

0	20·02	35·71
10	·01	·66
20	18·25	·59
30	17·52	·52
50	·28	·48
75	16·83	·42
100	·42	·36
150	15·62	·28
200	14·54	·24

A 13

0	20·14	35·82
10	·14	·80
20	·12	·77
30	19·82	·62
50	18·08	·55
75	16·62	·45
100	15·76	·39
150	14·98	·30
200	13·22	·26

A 14

0	20·13	35·81
10	·13	·79
20	·13	·74
30	19·51	·63
50	16·40	·54
100	15·90	·42
150	14·54	·30
200	13·36	·24

A 15

0	20·12	35·81
10	·12	·76
20	·07	·70
30	18·22	·58
50	16·90	·49
75	15·60	·42
100	14·89	·33
150	·28	·26
200	13·52	·22
300	11·50	·19

A 16

0	19·2	35·60
10	·2	·59
20	·0	·57
30	18·1	·54
50	15·8	·48
75	13·0	·42

A 17

0	20·1	35·73
10	19·6	·72
20	18·2	·71
30	16·6	·70
50	14·4	·57
75	13·4	·46
100	12·8	·38

A 18

0	20·16	35·72
10	·03	·72
20	19·01	·70
30	17·48	·65
50	16·00	·56
75	14·60	·50
100	13·68	·46
150	13·00	·38
200	11·76	·33

A 19

0	20·32	35·73
10	·32	·73
20	·30	·73
30	19·52	·70
50	17·11	·61
75	15·84	·55
100	15·00	·51
150	14·09	·45
200	13·20	·40
300	11·59	·29

A 20

0	19·78	35·69
10	·78	·68
20	·61	·66
30	17·72	·64
50	16·60	·59
75	·12	·56
100	15·40	·53
150	14·18	·45
200	12·88	·40
300	·09	·33
400	10·59	·25
500	9·04	·13
600	8·13	·05
800	6·70	34·89
1000	5·82	·83
1200	4·69	·79

A 21

0	19·77	35·62
10	·77	·61
20	·32	·61
30	18·72	·60
50	17·80	·58
75	16·41	·55
100	15·57	·53
150	14·50	·49
200	13·81	·44
300	·38	·35

A 22

0	19·78	35·62
10	·78	·62
20	·13	·60
30	17·83	·60
50	·00	·58
75	15·94	·56
100	·52	·54
150	14·77	·50
200	·20	·47
300	13·19	·41
400	12·33	·30
500	10·00	·17
600	8·44	·06
800	6·69	34·89
1000	5·12	·80

A 23

0	19·82	35·68
10	·82	·68
20	·20	·62
30	18·72	·61
50	·00	·59
75	16·91	·57
100	15·79	·55
150	·19	·51
200	14·50	·48
300	13·48	·42

A 24

0	20·30	35·73
10	·30	·73
20	·29	·73
30	·00	·72
50	18·28	·66
75	17·51	·60
100	·09	·57
150	16·00	·53
200	15·01	·50
300	13·24	·41
400	11·66	·33
500	9·79	·20
600	8·41	·08
800	6·79	34·90
1000	5·31	·82
1200	4·44	·77

A 25

0	19·28	35·61
10	·28	·61
20	·28	·61
30	·28	·59
50	·21	·53
75	16·80	·50
100	·22	·41
150	14·39	·32
200	13·30	·30
300	11·27	·20
400	10·44	·11
500	9·61	·03
600	8·82	34·93
800	7·20	·81
1000	5·67	·75
1200	4·00	·73

A 26

0	19·18	35·62
10	·18	·62
20	·18	·62
30	·15	·58
50	18·00	·54
75	16·49	·47
100	15·81	·43
150	14·44	·36
200	13·49	·30
300	11·58	·21

A 27

0	19·02	35·61
10	18·90	·61
20	·89	·61
30	·88	·60
50	17·75	·53
75	16·24	·47
100	15·53	·42
150	14·47	·36
200	13·72	·31
300	12·97	·22
400	11·11	·11
500	9·59	·01
600	8·78	34·93
800	7·66	·82
1000	6·77	·78
1200	5·98	·76

A 28

0	19·01	35·59
10	18·50	·59
20	·47	·59
30	·34	·59
50	16·18	·52
75	15·41	·46
100	·00	·41
200	13·68	·31
300	11·30	·18

A 29

0	18·83	35·52
10	·83	·52
20	·83	·52
30	·83	·52
50	·35	·51
75	15·94	·46
100	14·76	·40
200	12·97	·26
300	10·80	·15
400	9·99	·04
500	·20	34·95
600	8·23	·88
800	6·68	·78
1000	5·21	·75
1150	4·38	·74

A 30

0	18·92	35·54
10	·82	·52
20	·82	·52
30	·82	·52
50	18·00	·51
75	16·26	·46
100	14·98	·40
150	·19	·33
200	13·00	·27
300	10·69	·14

A 31

0	19·40	35·58
10	·40	·58
20	·40	·58
30	·31	·57
50	17·30	·50
75	16·44	·43
100	15·92	·41
150	14·31	·34
200	12·78	·27
300	11·00	·14
400	9·51	·00
500	9·00	34·92

A 32

0	18·9	35·56
10	·9	·56
20	·8	·56
30	·8	·55
50	17·0	·52
75	15·5	·47
100	14·9	·40
150	·2	·32

A 33

0	18·2	35·54
10	·2	·54
20	·2	·54
30	·1	·52
40	17·7	..
50	18·0	·49
53	·1	..
75	16·3	·46
100	14·5	·40
140	12·6	·33

A 34

0	18·2	35·53
10	·2	·53
20	·2	·53
30	·1	·52
45	16·7	..
50	·6	·50
62	17·1	..
75	16·5	·41
100	14·7	·37

A 35

0	18·2	35·53
10	·2	·53
20	·2	·53
30	·0	·52
50	16·6	·50
75	15·6	·44

A 36

0	18·09	35·38
10	·08	·40
20	17·70	·41
30	16·00	·42
50	15·83	·40
75	·25	·35
100	14·79	·26
150	·00	·15
200	13·20	·06
300	10·78	34·91
400	9·51	·87
500	8·70	·85
600	·00	·83
800	6·91	·80
1000	5·70	·78
1200	4·60	·77
1500	3·22	·75
2000	2·24	·71
2500	1·79	·68

A 37

0	18·13	35·35
10	·13	·40
20	·13	·41
30	·10	·42
50	16·00	·40
75	14·43	·34
100	13·80	·26
150	12·61	·14
200	11·90	·05
300	10·62	34·91

A 38

0	17·85	35·28
10	·85	·28
20	·85	·40
30	·85	·42
50	·01	·33
75	15·50	·26
100	·00	·24
150	13·38	·19
200	12·36	·13
300	10·79	34·95
400	9·97	·87
500	8·86	·84
600	·08	·82
800	6·71	·80
1000	5·32	·78
1200	4·10	·77
1500	3·10	·75
2000	2·33	·71
2500	1·78	·68

A 39

0	18·10	35·27
10	·10	·27
20	17·78	·27
30	·50	·30
50	16·41	·40
75	15·60	·41
100	14·56	·38
150	13·70	·28
200	·17	·19
300	11·01	34·98

A 40

0	17·87	35·22
10	·87	·22
20	·87	·25
30	·81	·31
50	16·47	·35
75	15·41	·38
100	14·52	·38
150	13·62	·34
200	·03	·25
300	11·06	·00
400	9·70	34·96
500	8·78	·92
600	7·89	·91
800	6·40	·79
1000	5·58	·78
1200	4·60	·77
1500	3·41	·75
2000	2·25	·71
2500	1·79	·68

A 41

0	18·13	35·28
10	·13	·28
20	·13	·28
30	·07	·29
50	16·45	·32
75	15·30	·33
100	14·62	·33
150	13·62	·30
200	12·91	·20
300	11·00	34·94

A 42

0	18·18	35·18
10	·18	·18
20	·18	·18
30	·10	·20
50	17·02	·31
75	15·60	·32
100	14·67	·28
150	13·64	·16
200	12·30	·04
300	10·00	34·89
400	8·88	·86
500	·08	·83
600	7·52	·82
800	6·71	·80
1000	·07	·78
1200	5·42	·77
1500	4·72	·75
2000	3·53	·72
2200	3·08	·71

A 43

0	18·16	35·27
10	·16	·27
20	·16	·28
30	·08	·28
50	17·46	·21
75	15·00	·12
100	13·89	·05
150	12·18	34·97
200	10·84	·92
300	9·59	·88
400	8·77	·85
500	·15	·83
600	7·51	·82
800	6·61	·79
1000	5·98	·78

A 44

0	18·00	35·26
10	17·52	·26
20	16·53	·29
30	15·34	·30
50	14·01	·35
75	13·68	·32
100	·42	·28
150	·00	·08
200	11·53	34·89
300	9·38	·86
400	8·46	·85
500	7·88	·83
600	·15	·82
800	6·00	·80

A 45

0	19·1	34·99
10	·1	·99
20	17·0	35·04
30	15·9	·06
50	14·2	·11
75	13·6	·18
100	·3	·22

A 46

0	19·0	34·92
10	18·2	·89
20	16·7	·89
30	·0	·95
50	14·4	35·07
75	13·6	·18
100	·4	·26
120	·3	·33

A 47

0	18·4	34·92
10	·4	·90
20	·0	·88
30	15·9	·88
50	14·6	35·04
75	·1	·15
100	13·9	·24
120	·8	·30

A 48

0	18·5	34·92
10	·5	·90
20	15·9	·81
30	·2	·79
50	13·8	·95
75	·1	35·02
100	12·8	·07
120	·6	·10

A 49

0	19·0	35·02
10	·0	·02
20	18·8	34·95
30	·1	·88
50	15·9	35·04
75	·2	·16
100	14·5	·22
120	·0	·25

A 50

0	18·8	35·02
10	·8	·00
20	·8	34·98
30	17·5	·99
50	15·7	35·08
75	·2	·18
100	13·8	·24
120	12·8	·29

A 51

0	18·8	34·99
10	·8	·99
20	·8	35·00
30	·6	·10
50	15·4	·15
75	13·7	·19
100	·1	·22
120	12·8	·24

A 52

0	18·9	35·01
10	·9	34·99
20	·9	35·04
30	·2	·12
50	15·9	·17
75	14·0	·21
100	13·2	·23
130	12·8	·25

A 53

0	19·2	35·01
10	·2	·00
20	·2	34·99
30	18·8	35·01
50	·0	·15
75	15·2	·22
100	13·5	·24
130	12·8	·25

A 54

0	19·2	35·05
10	·2	·05
20	·2	·05
30	18·3	·08
50	16·0	·17
75	14·8	·22
100	13·6	·23
150	12·5	·24

A 55

0	20·68	35·44
10	·68	·44
20	·68	·44
30	·04	·44
50	14·84	·43
75	·03	·42
100	13·61	·41
150	12·95	·37
200	·31	·31
300	11·04	·19
400	9·88	·09
500	·01	·00
600	8·21	34·92
800	6·94	·84
1000	5·39	·80
1200	3·97	·77
1500	·22	·71

A 56

0	20·82	35·47
10	·82	·47
20	·82	·47
30	19·69	·47
50	17·58	·46
75	14·99	·44
100	13·90	·43
150	·26	·38
200	12·60	·32
300	11·21	·21

A 57

0	21·42	35·50
10	·42	·50
20	·42	·50
30	·24	·49
50	18·10	·48
75	16·11	·47
100	15·16	·45
150	13·78	·42
200	12·81	·36
300	11·38	·23
400	10·21	·12
500	9·24	·03
600	8·39	34·94
800	7·04	·85
1000	5·48	·81
1200	4·39	·78

A 58

0	22·13	35·56
10	·13	·56
20	21·65	·55
30	20·89	·51
50	18·94	·49
75	17·12	·47
100	15·80	·45
150	14·48	·43
200	13·33	·39
300	11·60	·26

A 59

0	22·32	35·61
10	·32	·61
20	·32	·60
30	21·95	·54
50	19·67	·50
75	17·65	·48
100	16·36	·47
150	15·00	·44
200	13·84	·41
300	12·07	·27
400	10·72	·15
500	9·48	·04
600	8·49	34·94
800	7·01	·85
950	6·27	·82

A 60

0	22·27	35·61
10	·27	·61
20	·01	·59
30	21·39	·54
50	19·24	·50
75	17·02	·48
100	15·06	·47
150	14·22	·44
200	13·53	·38
300	12·00	·29

A 61

0	22·20	35·56
10	·20	·56
20	21·98	·53
30	20·94	·50
50	18·09	·49
75	14·89	·47
100	·38	·45
150	·49	·42
200	12·93	·37
300	·00	·29
400	10·99	·29
500	·00	·10

A 62

0	22·0	35·51
10	·0	·51
20	·0	·50
30	20·3	·49
50	18·5	·47
75	16·7	·45
100	15·3	·44
150	14·2	·42
200	13·4	·40

A 63

0	20·5	35·47
10	·5	·47
20	·0	·46
30	19·5	·45
50	18·5	·43
75	17·6	·41

A 64

0	22·7	35·79
10	·7	·81
20	·7	·84
30	·7	·86
50	·0	·91
75	20·4	36·00
100	19·1	·02
150	17·2	35·73
200	16·11	·50
300	12·00	·14
400	10·54	34·86

A 65

0	22·7	35·79
10	·7	·80
20	·7	·83
30	·7	·85
50	21·6	·94
75	20·0	36·02
100	18·5	·01
150	16·7	35·67
200	15·32	35·41
300	11·73	·09
375	10·29	34·84

A 66

0	22·7	35·78
10	·7	·81
20	·7	·84
30	·5	·87
50	21·6	·92
75	20·4	36·00
100	18·6	35·99
150	17·0	·66
200	15·03	·37
300	11·47	·00
375	10·19	34·88

A 67

0	23·0	35·79
10	·0	·81
20	22·8	·84
30	·8	·86
50	·3	·92
75	21·0	·96
100	20·0	·95
150	16·9	·60
200	15·0	·35

A 68

0	22·8	35·87
10	·8	·87
20	·8	·89
30	·8	·92
50	·8	·94
75	21·0	·93
100	19·9	·80
150	16·2	·56
200	15·0	·38
300	11·2	·03

A 69

0	22·8	35·87
10	·8	·90
20	·8	·91
30	·8	·92
50	21·4	·92
75	19·7	·86
100	18·1	·70
125	17·0	·55

A 70

0	21·9	35·74
10	·9	·80
20	·5	·87
30	20·8	·88
50	18·5	·72
75	17·2	·55
100	16·8	·43
125	·5	·36

A 71

0	20·4	35·49
10	·4	·49
20	19·8	·48
30	18·7	·46
50	17·7	·43
75	16·9	·40
100	·4	·38

A 71a

0	18·6	35·48
10	·5	·48
20	17·7	·44
30	·3	·42
50	16·7	·40
75	·5	·38

A 72

0	19·8	35·84
10	·7	·77
20	·0	·70
30	18·8	·66
50	·5	·59
75	·2	·52

A 73

0	21·7	35·75
10	·7	·75
20	·5	·75
30	·4	·73
50	18·4	·65
75	16·4	·56
100	15·0	·50

A 74

0	22·2	35·82
10	·0	·81
20	21·0	·80
30	19·8	·72
50	18·5	·66
75	17·3	·59
100	16·2	·54
150	14·1	·48
200	12·9	·42
250	11·9	·38

A 75

0	22·00	35·82
10	21·68	·81
20	20·92	·74
30	·05	·70
50	18·68	·67
75	17·80	·63
100	·26	·60
150	15·94	·55
200	14·63	·49
300	11·82	·38
400	10·00	·22
500	8·91	·10
600	7·97	·02
800	6·62	34·87
1000	5·31	·74

A 76

0	21·32	35·81
10	·30	·80
20	20·77	·76
30	·00	·71
50	18·68	·67
75	17·59	·62
100	·08	·60
150	16·38	·55
200	15·59	
300	13·90	

A 77

0	21·30	35·81
10	·25	·80
20	20·98	·78
30	·69	·76
50	·00	·70
75	18·15	·61
100	17·00	·59
150	16·20	·55
200	15·51	·52
300	14·20	·46
400	12·72	·40
500	11·37	·26
600	10·38	·17
800	8·33	·01
1000	6·51	34·88
1500	2·81	·74
1800	1·90	·70

A 78

0	21·24	35·81
10	20·99	·80
20	·49	·75
30	·20	·70
50	18·94	·64
75	17·50	·58
100	16·88	·56
150	16·00	·52
200	15·11	
300	13·93	

A 79

0	21·22	35·80
10	·00	·80
20	20·09	·70
30	19·52	·67
50	18·67	·62
75	16·86	·58
100	·26	·56
150	15·42	·50
200	14·70	·48
300	13·61	·44
400	12·80	·40
500	·01	·34
600	11·01	·26
800	9·67	·14
1000	8·19	34·99
1200	6·83	·89
1500	4·92	·80
2000	2·86	·76

A 80

0	22·12	35·85
10	·10	·85
20	·10	·85
30	·05	·84
50	21·24	·79
75	20·00	·72
100	19·17	·61
150	16·07	·55
200	15·01	
300	13·82	

A 81

0	22·21	36·02
10	·21	·01
20	·20	·00
30	·20	35·90
50	·00	·85
75	20·72	·74
100	19·23	·68
150	17·91	·61
200	16·90	·56
300	14·72	·48
400	13·28	·42
500	12·30	·36
600	11·20	·29
800	9·69	·16
1000	8·33	·04
1200	6·88	34·90
1500	5·49	·90
2000	4·14	·90

A 101

0	19·72	35·53
10	·63	·52
20	·62	·52
30	·49	·49
50	·40	·47
75	·20	·44

A 102

0	19·29	35·52
10	·29	·51
20	·29	·50
30	·27	·47
50	·11	·45
75	18·56	·42
100	17·53	·38

A 103

0	18·68	35·52
10	·68	·51
20	·68	·50
30	·48	·48
50	·16	·47
75	17·35	·44
100	16·02	·40

A 104

0	18·52	35·60
10	·52	·59
20	·52	·56
30	·28	·53
50	·01	·50
75	17·44	·44
100	16·12	·40

A 105

0	18·48	35·65
10	·48	·62
20	·48	·60
30	·43	·57
50	·12	·54
75	17·24	·47
100	15·45	·39
150	13·42	·36

A 106

0	18·51	35·79
10	·50	·78
20	·50	·46
30	·49	·72
50	·47	·69
75	·08	·59
100	15·99	·51
150	14·25	·38
200	12·26	·34

A 107

0	18·32	35·83
10	·32	·81
20	·31	·79
30	·20	·76
50	18·00	·73
75	17·31	·67
100	16·40	·60
150	14·35	·41
200	12·56	·39

A 108

0	18·59	35·87
10	·59	·84
20	·59	·81
30	·59	·78
50	·59	·75
75	·26	·71
100	17·47	·66
150	14·24	·53
200	12·00	·40

A 109

0	18·59	35·93
10	·59	·91
20	·59	·89
30	·59	·84
50	·59	·80
75	17·31	·74
100	17·00	·69
150	14·66	·60
200	13·41	·45
300	11·36	·32

A 110

0	18·57	36·00
10	·57	·00
20	·57	35·94
30	·57	·88
50	·57	·85
75	·51	·78
100	17·53	·71
150	15·41	·61
200	14·38	·48
300	13·02	·35
400	11·77	·10

A 111

0	18·20	35·93
10	·20	·92
20	·20	·89
30	·17	·86
50	17·90	·84
75	·25	·78
100	16·00	·70
150	14·40	·59
200	13·55	·49
300	12·20	·34
400	11·04	·09
500	9·38	34·83

A 112

0	16·8	34·99
10	·8	·99
20	·7	·94
30	·5	·90

A 113

0	17·3	35·17
10	·3	·18
20	·3	·18
30	16·8	·18
50	15·7	·16
75	·4	·12
100	·2	·08

A 114

0	17·8	35·27
10	·8	·28
20	·6	·30
30	·0	·40
50	16·4	·40
75	15·7	·33
100	·1	·36
150	14·2	·18

A 115

0	18·08	35·43
10	18·00	·46
20	17·63	·50
30	·24	·51
50	16·36	·50
75	15·59	·48
100	·00	·36
150	14·13	·25
200	12·79	·17
250	12·12	·11

A 116

0	18·68	35·57
10	·67	·58
20	·60	·62
30	·00	·63
50	17·18	·57
75	16·41	·47
100	15·78	·41
150	14·56	·32
200	12·89	·25
300	11·07	·08
400	10·00	34·93
500	9·19	·87
600	8·61	·84
750	7·78	·82

A 117

0	19·43	35·67
10	·43	·67
20	·43	·67
30	·43	·68
50	·43	·72
75	·62	·65
100	17·21	·58
150	15·21	·40
200	14·26	·31
300	12·61	·15
400	11·16	·02
500	9·82	34·91
600	8·92	·79
800	6·91	·73
1000	5·64	·76

A 118

0	19·44	35·72
10	·44	·72
20	·44	·73
30	·44	·75
50	·44	·76
75	·02	·71
100	17·68	·61
150	15·48	·47
200	14·52	·35
300	12·79	·19

A 119

0	19·43	35·77
10	·43	·78
20	·43	·79
30	·43	·79
50	·43	·78
75	18·69	·77
100	17·24	·72
150	15·43	·50
200	14·79	·37
300	12·19	·16
400	9·91	34·94
500	8·97	·81
600	·06	·68
800	6·69	·58
1000	5·70	·57
1200	4·64	·64

A 120

0	19·45	35·82
10	·45	·85
20	·45	·87
30	·45	·87
50	·45	·86
75	·45	·81
100	18·00	·74
150	15·23	·48
200	14·00	·35
300	12·50	·15

A 121

0	19·46	35·82
10	·46	·82
20	·46	·82
30	·46	·83
50	·46	·83
75	·46	·82
100	18·33	·76
150	15·72	·58
200	14·61	·40
300	12·52	·22
400	11·26	·05
500	10·00	34·93
600	9·07	·78
800	7·54	·62
1000	6·08	·52
1200	4·68	·55
1500	2·50	·63

A 122

0	18·0	35·63
10	·0	·63
20	17·8	·62
30	·7	·60
50	·2	·54
75	16·2	·51
100	·3	·53
150	14·7	·43
200	·0	·26
300	12·77	·11
400	10·92	34·93
500	9·61	·83
600	8·84	·76
800	7·42	·65
1000	6·03	·51
1200	4·97	·50
1500	3·15	·60

A 123

0	18·1	35·59
10	·0	·58
20	17·8	·56
30	·6	·50
50	·0	·46
75	16·1	·42
90	15·7	..
100	·8	·53
120	16·3	..
150	15·2	·41
200	14·0	·32
300	12·0	·17

A 124

0	17·8	35·54
10	·7	·54
20	·8	·48
30	18·0	·48
50	·1	·50
75	·0	·54
100	16·7	·52
150	15·0	·34
200	14·0	·18
300	11·82	·08
400	10·49	34·92
500	9·42	·81
600	8·48	·74
800	6·83	·64
1000	5·28	·53
1200	4·28	·57
1300	4·00	·63

A 125

0	18·2	35·71
10	·2	·70
20	·2	·66
30	·1	·63
50	17·5	·55
75	16·9	·47
100	·5	·42
150	15·6	·28
175	14·8	..
195	·9	..
200	·9	·31
300	12·9	·07

A 126

0	18·3	35·72
10	·3	·73
20	·4	·74
30	·3	·72
50	·0	·67
75	17·3	·60
100	16·8	·50
150	·0	·43
200	14·2	·36
265	13·0	..
280	·1	..
300	12·25	·07
400	10·61	34·88
500	9·61	·81
600	8·86	·76
800	7·30	·65
1000	6·00	·57
1100	5·23	·61

A 127

0	15·0	35·30
10	·0	·32
20	·0	·35
30	·0	·37
60	17·1	..
75	16·7	·51
100	15·9	·38
150	14·1	·30
180	13·8	..
200	·9	·32
215	14·1	..
300	12·0	·10

A 128

0	15·7	35·18
10	·7	·19
20	·7	·20
30	·7	·22
50	·7	·31
75	·7	·35
90	·6	..
100	·7	·43
150	13·7	·35

A 129

0	15·8	35·14
10	·8	·14
20	·8	·16
30	·7	·18
50	·5	·20
75	·3	·22
100	·0	·25

A 130

0	15·9	35·00
10	·9	·02
20	16·0	·05
30	15·9	·09
50	·6	·13
75	·3	·19
100	·1	·23

A 131

0	15·0	35·13
10	·0	·13
20	·0	·13
30	14·9	·13
50	·9	·13
75	·6	·11
100	·2	·08
150	13·1	·03
175	12·7	..
200	·91	34·99
300	11·90	·91
400	10·94	·84
500	·10	·77
600	9·40	·70
800	7·83	·67
1000	6·48	·65
1200	5·25	·65
1500	3·74	·66
2000	2·55	·68
2500	1·81	·71

A 132

0	15·1	35·12
10	·1	·11
20	·1	·11
30	·0	·11
50	14·8	·13
75	·4	·12
100	13·9	·09
150	·0	·03
200	12·5	34·97
300	11·5	·84

A 133

0	14·2	34·99
10	·2	·99
20	·2	·99
30	·2	35·00
50	13·9	·03
75	·5	·10
100	·0	·13
150	11·9	·10
200	·0	34·94
210	10·8	..
220	·9	..
300	·06	·76
400	9·23	·69
500	8·53	·66
600	·00	·65
800	6·90	·63
1000	5·76	·63
1200	4·89	·64
1500	3·57	·66
2000	2·29	·68
2500	1·90	·71

A 134

0	14·2	34·98
10	·2	·98
20	·2	·98
30	·2	·98
50	13·8	·98
75	·4	35·04
100	12·7	·09
150	11·9	·06
200	·1	34·90
300	10·0	·74

A 135

0	14·3	34·95
10	·3	·95
20	·3	·95
30	13·9	·95
50	·3	·95
75	12·9	·99
100	·5	35·03
140	11·9	..
150	12·0	·05
160	·1	..
200	11·5	34·93
300	10·00	·74
400	9·20	·66
500	8·49	·62
600	7·79	·59
800	6·88	·57
1000	5·91	·56
1200	4·93	·56
1500	3·88	·58
2000	2·65	·65
2500	1·80	·71

A 136

0	14·2	34·93
10	·2	·93
20	·2	·93
30	·2	·93
40	·2	·93
50	·2	·93
75	·0	·93
100	13·4	·95
130	12·8	..
150	·9	35·02
200	·1	·02
300	10·7	34·82

A 137

0	14·4	34·90
10	·4	·90
20	·4	·89
30	·4	·89
50	·4	·88
75	·4	·87
100	·4	·87
150	13·5	·87
200	12·6	·88
260	13·1	..
300	12·0	·82
400	10·16	·75
500	9·31	·60
600	8·50	·51
800	6·98	·44
1000	5·41	·42
1200	4·42	·44
1500	3·29	·49
2000	2·13	·58
2400	1·92	·66

A 138

0	14·1	34·82
10	·1	·82
20	·1	·82
30	·0	·80
50	13·6	·60
75	·0	·56
100	·1	·61
150	12·3	·58
200	11·2	·57
300	10·2	·59

A 139

0	14·2	34·68
10	·2	·68
20	·2	·70
30	·2	·75
50	·2	·82
75	·0	·83
100	13·6	·82
150	12·9	·73
200	·2	·62
300	10·51	·54
400	9·42	·48
500	8·30	·46
600	7·66	·43
800	7·10	·40

A 140

0	14·8	34·68
10	·8	·68
20	·8	·70
30	·8	·80
50	·7	·87
75	·6	·93
100	·5	·95

A 141

0	17·7	35·50
10	·8	·45
20	·9	·39
30	·9	·38
50	·3	·48
75	16·0	·62
100	14·9	·64

A 142

0	17·6	35·51
10	·6	·51
20	·6	·51
30	·6	·51
50	·4	·44
75	16·0	·40
100	14·9	·54

A 143

0	17·7	35·47
10	·7	·47
20	·7	·47
30	·7	·47
50	·2	·45
75	15·4	·41
100	13·9	·40

A 144

0	17·7	35·42
10	·7	·42
20	·7	·42
30	·7	·40
50	·5	·34
75	·1	·34
100	13·7	·42

A 145

0	16·8	35·30
10	·8	·28
20	·8	·26
30	·8	·25
50	·8	·26
75	14·9	·33
100	13·8	·40

A 146

0	16·8	35·22
10	·8	·21
20	·8	·19
30	·8	·18
50	·8	·16
75	15·6	·32
100	13·9	·36

A 147

0	16·8	35·18
10	·8	·18
20	·8	·18
30	·8	·18
50	·8	·18
75	15·8	·31
100	14·2	·36
120	13·7	·39

A 148

0	16·8	35·18
10	·8	·18
20	·8	·18
30	·8	·18
50	·8	·18
75	·8	·26
100	14·9	·33
120	13·6	·37

A 149

0	16·7	35·17
10	·7	·17
20	·7	·17
30	·7	·17
50	·7	·17
75	·5	·26
100	15·4	·33
130	13·5	·38

A 150

0	16·7	35·17
10	·7	·17
20	·7	·17
30	·7	·17
50	·6	·20
75	15·9	·32
100	14·7	·34
150	13·5	·37

A 151

0	17·0	35·15
10	·0	·15
20	16·8	·16
30	·7	·17
50	·6	·22
75	·4	·32
100	·1	·34
150	13·5	·36

A 152

0	18·2	35·29
10	·2	·29
20	·2	·29
30	17·6	·30
50	·0	·40

A 153

0	18·3	35·59
10	·3	·60
20	·3	·61
30	·3	·62
50	·3	·63
75	17·9	·62
100	16·8	·60

A 154

0	18·63	35·54
10	·63	·56
20	·63	·61
30	·63	·65
50	·63	·70
75	·02	·71
100	16·98	·66
150	14·80	·55
200	13·53	·41
300	12·30	·26
400	11·31	·10
500	10·31	·01

A 155

0	18·82	35·58
10	·82	·58
20	·82	·58
30	·82	·60
50	·82	·67
75	·03	·73
100	16·15	·68
150	14·56	·54
200	13·60	·39
300	12·59	·27
400	10·89	·09
500	9·28	·01
600	7·48	34·94

A 156

0	19·27	35·63
10	·27	·63
20	·27	·62
30	·27	·61
50	·27	·68
75	·27	·76
100	17·90	·70
150	15·00	·56
200	13·77	·45
300	12·56	·25
400	10·12	·08
500	8·90	·01
600	7·49	34·93
800	5·14	·86
950	4·00	·82

A 157

0	19·04	35·64
10	·00	·64
20	18·90	·64
30	·82	·63
50	·82	·73
75	·82	·78
100	17·26	·70
150	15·00	·58
200	13·77	·47
300	12·39	·27
400	10·29	·09
500	8·80	·00
600	7·64	34·92
800	5·10	·86
1000	3·81	·80
1200	·29	·78

A 158

0	19·26	35·68
10	·26	·68
20	·26	·68
30	·26	·68
50	·26	·78
75	·26	·83
100	18·04	·70
150	15·47	·58
200	14·58	·48
300	12·40	·29
400	10·21	·10
500	9·04	·00
600	7·71	34·93
800	5·93	·85
1000	4·17	·80
1200	·59	·77

A 159

0	19·0	35·69
10	18·9	·70
20	·8	·79
30	·8	·84
50	·8	·88
75	·8	·83
100	17·1	·70
150	15·2	·56
200	14·2	·44
300	12·3	·27

A 160

0	18·8	35·69
10	·8	·70
20	·8	·79
30	·8	·55
50	·8	·91
75	·8	·86
100	16·4	·69
150	14·5	·51
200	13·5	·36
300	11·8	·21

A 161

0	18·67	35·69
10	·67	·70
20	·67	·75
30	·67	·84
50	·67	·92
75	·67	·80
100	16·49	·64
150	13·81	·39
200	12·98	·31
300	11·61	·16
400	9·98	·05
500	·06	34·99
600	8·08	·92
800	6·60	·84
1000	4·97	·80
1200	·02	·75
1500	2·84	·69

A 162

0	20·2	35·88
10	·2	·90
20	·2	·96
30	·2	36·00
50	·1	·01
75	19·7	35·97
100	18·5	·87
150	15·9	·59
200	14·42	·36
300	12·14	·05
400	9·62	34·84

A 163

0	19·7	35·89
10	·7	·89
20	·7	·93
30	·7	·99
50	·7	36·02
75	·7	35·97
100	·7	·84
150	16·1	·52
200	13·67	·33
300	12·41	·07
375	11·89	34·98

A 164

0	18·8	35·87
10	·8	·88
20	·8	·90
30	·8	·95
50	·8	·97
75	·8	·94
100	·3	·75
150	16·0	·51
200	14·46	·35
300	12·87	·10
350	·45	·05

A 165

0	18·4	35·85
10	·4	·85
20	·4	·90
30	·4	·92
50	·4	·93
75	17·7	·85
100	·1	·68
150	16·0	·51
200	14·2	·37

A 166

0	18·2	35·84
10	·2	·86
20	·2	·90
30	17·8	·92
50	·1	·90
75	16·4	·77
100	15·8	·66
150	14·8	·43
200	13·9	·32

A 167

0	17·7	35·83
10	·7	·85
20	·7	·91
30	·7	·92
50	·4	·86
75	16·3	·71
100	15·3	·58

A 168

0	18·0	35·84
10	17·9	·86
20	·8	·91
30	·6	·93
50	·0	·87
75	16·4	·68
100	15·8	·54

A 169

0	18·3	35·85
10	·3	·88
20	·3	·91
30	·3	·92
50	16·7	·88
75	15·8	·65
100	15·4	·54

A 170

0	18·4	35·85
10	·4	·88
20	·4	·91
30	·4	·91
50	·4	·83
75	17·4	·63
100	15·4	·50

A 171

0	18·4	35·68
10	·4	·68
20	·4	·75
30	·4	·76
50	·4	·70
75	·0	·56

A 172

0	19·24	35·64
10	·23	·64
20	·20	·64
30	·06	·63
50	18·81	·61
75	·35	·59
100	17·74	·55

A 173

0	19·08	35·66
10	·00	·66
20	18·62	·65
30	·43	·65
50	17·95	·58
75	16·80	·49
100	·14	·41
150	15·00	·33
200	13·99	·24
300	11·47	·10

A 174

0	19·02	35·67
10	18·91	·67
20	·64	·66
30	·43	·63
50	17·98	·57
75	·30	·51
100	16·21	·40
150	15·30	·34
200	14·20	·23
300	12·44	·13
400	11·10	·02
500	9·97	34·96
600	·00	·91
800	7·24	·81
1000	5·60	·75

A 175

0	19·21	35·81
10	·20	·80
20	·20	·75
30	·17	·71
50	18·84	·64
75	17·88	·57
100	16·86	·47
150	15·30	·34
200	14·38	·25
300	12·58	·14

A 176

0	19·51	35·84
10	·50	·84
20	·50	·81
30	·46	·76
50	·00	·70
75	18·30	·62
100	17·50	·54
150	15·91	·38
200	14·60	·30
300	12·88	·17
400	11·87	·11
500	10·66	·00
600	9·50	34·94
800	7·03	·81
1000	5·36	·78
1200	4·47	·76
1500	3·49	·75
1900	2·28	·72

A 177

0	20·00	35·92
10	19·90	·92
20	·90	·91
30	·90	·90
50	·90	·84
75	·82	·75
100	18·00	·60
150	16·68	·43
200	15·50	·33
300	12·96	·17

A 178

0	20·22	35·92
10	·22	·92
20	·20	·92
30	·01	·91
50	19·56	·91
75	·10	·88
100	18·30	·65
150	16·86	·52
200	15·49	·38
300	13·23	·19
400	11·77	·13
500	10·50	·01
600	9·32	34·93
800	7·20	·81
1000	5·81	·79
1200	4·79	·77
1500	3·59	·75
2000	2·07	·70

A 179

0	20·38	35·94
10	·38	·94
20	·38	·94
30	·38	·94
50	·38	·94
75	·30	·93
100	19·93	·81
150	17·78	·52
200	·16	·40
300	14·57	·20

A 180

0	20·62	35·96
10	·62	·96
20	·62	·96
30	·62	·96
50	·62	·96
75	·49	·95
100	·00	·90
150	16·76	·52
200	·17	·40
300	14·41	·22

A 181

0	20·87	36·00
10	·86	·00
20	·82	·00
30	·82	35·99
50	·81	·98
75	·80	·98
100	·33	·95
150	17·28	·55
200	16·06	·40
300	14·00	·24
400	12·13	·14
500	10·52	·02
600	9·34	34·93
800	7·29	·84
1000	5·71	·79
1200	4·76	·78
1500	3·59	·75
1900	2·11	·70

A 190

0	13·88	35·73
10	·88	·73
20	·71	·73
30	·63	·72
50	·51	·71
75	·34	·69
100	·12	·68
150	12·90	
200	·72	
300	·52	

A 191

0	13·33	35·66
10	·33	·66
20	·31	·65
30	·30	·65
50	·20	·63
75	12·91	·62
100	·49	·60
150	11·90	
200	·68	
300	·43	

A 192

0	12·81	35·58
10	·81	·58
20	·80	·57
30	·76	·57
50	·66	·56
75	·48	·53
100	·31	·50
150	11·89	
200	·49	
300	10·91	

A 193

0	12·82	35·55
10	·68	·55
20	·43	·55
30	·25	·54
50	11·91	·53
75	·45	·52
100	·16	·50
150	10·63	
200	·31	
300	·18	

A 194

0	12·59	35·52
10	·59	·52
20	·59	·51
30	·57	·51
50	·42	·51
75	·21	·50
100	·01	·50
150	11·40	
200	10·44	

A 195

0	12·08	35·42
10	·01	·42
20	11·80	·41
30	·66	·41
50	·39	·40
75	·17	·39
100	10·90	·39
150	·59	

A 210

0	12·8	35·27
10	·8	·27
20	·7	·26
30	·5	·26
50	·2	·25
75	·0	·23
100	11·8	·22

A 211

0	13·2	35·28
10	·1	·28
20	·0	·28
30	·0	·27
50	12·7	·27
75	·5	·26
100	·3	·25
150	11·9	·22

A 212

0	13·2	35·31
10	·2	·31
20	·2	·30
30	·1	·29
50	·0	·27
75	12·8	·25
100	·6	·23

A 213

0	13·2	35·28
10	·2	·28
20	·2	·28
30	·2	·28
50	·1	·27
75	12·9	·27
100	·6	·26
150	·1	·24

A 214

0	13·2	35·28
10	·2	·28
20	·2	·28
30	·2	·28
50	·1	·30
75	12·9	·62
100	·6	·51
150	·1	·25

A 215

0	12·6	35·28
10	·6	·28
20	·5	·28
30	·5	·29
50	·4	·40
75	·2	·61
100	11·9	·30
150	·7	·29
200	·6	·28

A 216

0	12·9	35·28
10	·9	·28
20	·8	·28
30	·8	·28
50	·7	·29
75	·6	·57
100	·4	·60
150	·2	·24
200	·0	·19

A 217

0	13·5	35·28
10	·5	·29
20	·5	·30
30	·5	·31
50	·5	·32
75	·4	·31
100	·2	·28
150	12·8	·24
200	·2	·20
300	11·7	·17

A 218

0	13·3	35·28
10	·3	·29
20	·3	·31
30	·3	·31
50	·3	·31
75	·1	·29
100	12·9	·27
150	·5	·23
200	·2	·19
300	11·2	·15

A 219

0	13·3	35·29
10	·3	·30
20	·3	·32
30	·3	·32
50	·3	·30
75	·0	·27
100	12·8	·24
150	·4	·20
200	·1	·18
300	11·5	·15

A 220

0	13·3	35·29
10	·3	·30
20	·3	·31
30	·3	·31
50	·2	·31
75	12·9	·27
100	·7	·25
150	·2	·20
200	11·8	·17
300	·4	·14

A 221

0	13·2	35·28
10	·2	·28
20	·0	·29
30	12·9	·35
50	·7	·41
75	·5	·18
100	·3	·16
150	11·9	·14
200	10·9	·13
300	·4	·12

A 222

0	13·3	35·49
10	·3	·29
20	·3	·29
30	·2	·31
50	12·9	·41
75	·5	·18
100	·4	·16
150	·0	·14
200	10·9	·13
300	·4	·12

A 223

0	13·3	35·29
10	·3	·29
20	·3	·29
30	·2	·34
50	12·9	·31
75	·7	·18
100	·5	·16
150	·0	·14
200	11·2	·13
300	10·5	·12

A 224

0	13·2	35·28
10	·2	·28
20	·1	·29
30	12·9	·29
50	·8	·32
75	·6	·23
100	·5	·16
150	·2	·15
200	11·8	·14
300	·0	·13

A 225

0	13·3	35·14
10	·3	·14
20	·3	·14
30	·3	·21
50	·2	·30
75	12·9	·29
100	·7	·18
150	·3	·15
200	·0	·14
300	11·3	·13

A 226

0	13·4	35·07
10	·4	·11
20	·4	·16
30	·4	·21
50	·2	·26
75	·0	·31
100	12·8	·24
150	·3	·17
200	11·9	·14
300	·4	·13

A 227

0	13·2	34·99
10	·2	35·10
20	·2	·14
30	·1	·18
50	·0	·21
75	12·8	·22
100	·6	·22
150	·1	·15
200	11·7	·14
300	·2	·13

A 228

0	12·8	34·89
10	·8	·94
20	·8	35·12
30	·8	·17
50	·7	·21
75	·4	·22
100	·2	·22
150	11·8	·15
200	·6	·14
300	·4	·13

A 229

0	12·3	34·98
10	·3	35·11
20	·3	·13
30	·3	·16
50	·2	·21

A 230

0	15·4	34·31
10	·3	·42
20	14·3	·58
30	·0	·64

A 231

0	15·4	34·40
10	·2	·55
20	14·4	·70
30	13·8	·83

A 232

0	15·3	34·49
10	·1	·61
20	14·7	·71
30	·0	·86
50	13·5	35·46

A 233

0	15·1	34·62
10	14·9	·62
20	·6	·73
30	·4	·85
50	13·8	35·41
75	·4	·42

A 234

0	14·8	34·70
10	·8	·70
20	·7	·81
30	·6	·94
50	·1	35·42
75	13·5	·43

A 235

0	14·7	34·87
10	·7	·87
20	·5	·94
30	·4	35·35
50	·0	·44
75	13·7	·45
100	·6	·46

A 236

0	14·4	35·49
10	·4	·49
20	·4	·49
30	·4	·49
50	·0	·49
75	13·7	·49
100	·5	·47
150	·1	·44
200	12·5	·42

A 237

0	14·3	35·61
10	·3	·61
20	·3	·61
30	·3	·61
50	·3	·61
75	·1	·60
100	13·7	·67
150	·2	·50
200	12·2	·44
300	11·1	·38

A 238

0	14·3	35·63
10	·3	·63
20	·3	·63
30	·3	·63
50	·3	·63
75	·0	·62
100	13·7	·60
150	·1	·54
200	12·3	·46
300	11·1	·32

A 239

0	14·3	35·65
10	·3	·65
20	·3	·65
30	·3	·65
50	·3	·65
75	·0	·58
100	13·8	·54
150	·2	·49
200	12·2	·43
300	11·2	·35

A 241

0	15·2	35·40
10	·2	·40
20	14·7	·36
30	·0	·33
50	13·8	·31
75	·7	·30

A 242

0	15·2	35·40
10	·2	·40
20	14·8	·37
30	·3	·35
50	13·8	·31
75	·6	·30
100	·5	·28

A 243

0	15·1	35·40
10	·0	·40
20	14·5	·36
30	·2	·34
50	·0	·32
75	13·8	·31
100	·7	·30

A 244

0	15·2	35·38
10	·2	·38
20	·1	·38
30	14·5	·37
50	13·8	·33
75	·5	·31
100	·3	·29

A 245

0	15·1	35·38
10	·1	·38
20	14·5	·37
30	·1	·36
50	13·7	·32
75	·5	·31
100	·3	·30

A 246

0	15·1	35·38
10	·1	·38
20	14·5	·37
30	·1	·35
50	13·7	·33
75	·5	·31
100	·3	·31

A 247

0	14·8	35·37
10	·8	·37
20	·2	·36
30	·0	·34
50	13·7	·33
75	·4	·31
100	·2	·31

A 248

0	14·1	35·36
10	13·9	·35
20	·7	·33
30	·5	·32
50	·3	·31
75	·2	·31
100	·0	·28

A 249

0	14·1	35·36
10	·0	·35
20	13·8	·34
30	·7	·33
50	·5	·32
75	·4	·32
100	·2	·31

A 253

0	16·2	35·55
10	·2	·55
20	·2	·55
30	·2	·54
50	15·9	·52
75	·3	·51
100	·0	·50

A 254

0	15·9	35·52
10	·8	·52
20	·6	·51
30	·4	·50
50	14·9	·49
75	·5	·47
100	·2	·45
150	13·8	·41
200	·5	·35
250	·0	·27

A 255

0	17·0	35·58
10	16·7	·57
20	·6	·56
30	·4	·56
50	·1	·54
75	15·6	·52
100	·2	·50
150	14·2	·46
200	13·6	·41
300	11·7	·20

A 256

0	18·0	35·61
10	17·8	·61
20	·6	·60
30	·4	·60
50	·0	·59
75	16·6	·57
100	·2	·56
150	15·4	·52
200	14·4	·47
300	13·0	·33

A 257

0	18·4	35·63
10	·4	·63
20	·3	·63
30	·1	·62
50	17·7	·62
75	·3	·60
100	16·8	·59
150	·0	·56
200	15·0	·52
300	13·3	·38

A 258

0	18·4	35·65
10	·4	·65
20	·4	·65
30	·4	·65
50	·0	·64
75	17·7	·63
100	·2	·61
150	16·2	·57
200	15·2	·53
300	13·5	·38

A 259

0	18·7	35·67
10	·7	·67
20	·7	·67
30	·5	·66
50	·3	·64
75	17·8	·63
100	·3	·50
150	16·2	·60
200	15·2	·52
300	12·6	·38

A 260

0	19·0	35·71
10	·0	·70
20	18·9	·69
30	·7	·68
50	·3	·65
75	17·4	·63
100	16·9	·60
150	·0	·55
200	14·8	·50
300	13·4	·38

A 261

0	19·1	35·71
10	·0	·70
20	·0	·69
30	18·81	·67
50	·7	·66
75	17·7	·63
100	16·8	·60
150	·0	·56
200	14·9	·50
300	12·4	·38

A 262

0	19·1	35·71
10	·0	·71
20	18·9	·70
30	·8	·68
50	·5	·66
75	·1	·63
100	17·2	·61
150	16·0	·56
200	15·0	·51
300	13·1	·39

A 268

0	15·1	35·00
10	·1	″
20	·0	″
30	·0	″
50	14·8	″

A 269

0	17·1	35·29
10	·0	″
20	16·4	″
30	15·3	″
50	14·0	″
75	13·7	″
100	·5	″
150	·0	″
200	11·5	″
300	9·8	″

A 270

0	15·1	35·18
10	·1	″
20	·0	″
30	14·7	″
50	13·8	″
75	·6	″
100	·4	″
150	12·6	″
200	11·2	″
300	9·9	″

A 271

0	16·7	35·25
10	·7	″
20	15·5	″
30	14·6	″
50	13·7	″
75	·4	″
100	·0	″
150	12·3	″
200	11·5	″
300	9·9	″

A 272

0	18·2	35·41
10	·2	″
20	·2	″
30	17·6	″
50	16·8	″
75	15·6	″
100	14·7	″
150	13·0	″
200	12·1	″
300	10·8	″

A 273

0	17·5	35·40
10	·5	″
20	16·9	″
30	·6	″
50	·0	″
75	14·5	″
100	13·8	″
150	·0	″
200	12·2	″
300	10·9	″

A 274

0	18·5	35·53
10	·5	″
20	·2	″
30	17·3	″
50	16·6	″
75	15·4	″
100	14·7	″
150	13·8	″
200	12·9	″
300	11·8	″

A 275

0	18·7	35·54
10	·7	″
20	·7	″
30	17·5	″
50	16·0	″
75	14·7	″
100	·1	″
150	13·2	″
200	12·7	″
300	11·8	″

A 276

0	18·8	35·55
10	·8	″
20	·8	″
30	16·9	″
50	15·8	″
75	14·9	″
100	·4	″
150	13·6	″
200	12·9	″
300	11·8	″

A 277

0	19·1	35·54
10	·1	″
20	17·5	″
30	16·9	″
50	15·8	″
75	·1	″
100	14·6	″
150	13·5	″
200	12·6	″
300	11·9	″

A 278

0	19·1	35·51
10	18·9	″
20	17·7	″
30	16·4	″
50	14·7	″
75	13·7	″
100	·2	″
140	12·6	″

A 279

0	18·4	35·30
10	·4	″
20	·0	″
30	17·0	″
50	15·2	″

A 280

0	15·8	35·28
10	·8	″
20	·7	″
30	·5	″
50	·3	″

A 281

0	17·0	35·35
10	·0	″
20	16·5	″
30	15·9	″
50	·5	″
75	·1	″
100	14·0	″
150	·6	″
200	·3	″
300	·1	″

A 282

0	18·1	35·43
10	·1	″
20	17·5	″
30	·0	″
50	15·2	″
75	·0	″
100	14·3	″
150	·3	″
200	12·7	″
300	11·8	″

A 283

0	18·0	35·46
10	·0	″
20	17·5	″
30	16·8	″
50	·1	″
75	15·6	″
100	·1	″
150	13·4	″
200	12·4	″
300	10·9	″

A 284

0	18·8	35·49
10	·8	″
20	·7	″
30	·1	″
50	17·3	″
75	16·5	″
100	15·7	″
150	14·2	″
200	13·3	″
300	12·2	″

A 285

0	19·2	35·60
10	·2	″
20	·2	″
30	·2	″
50	18·7	″
75	·2	″
100	17·5	″
150	15·9	″
200	14·5	″
300	13·2	″

A 286

0	20·2	35·62
10	·2	″
20	·1	″
30	19·7	″
50	18·4	″
75	17·6	″
100	·0	″
150	16·4	″
200	15·9	″
300	14·1	″

A 287

0	19·6	35·50
10	·6	″
20	·6	″
30	·5	″
50	18·8	″
75	17·6	″
100	16·8	″
150	15·9	″
200	14·3	″
300	13·2	″

A 288

0	19·0	35·30
10	18·9	″
20	·8	″
30	·2	″
50	17·3	″
75	16·2	″
100	15·1	″
150	13·9	″
200	12·8	″

A 289

0	18·8	35·29
10	·8	″
20	·1	″
30	17·4	″
50	16·5	″
75	15·0	″
100	14·5	″
150	13·1	″
200	12·3	″

A 290

0	19·2	35·34
10	·2	″
20	·1	″
30	18·1	″
50	17·0	″
75	15·0	″
100	13·8	″
150	12·6	″

A 291

0	19·2	35·30
10	·2	″
20	18·7	″
30	·2	″
50	17·0	″
75	15·0	″

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