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NO. 111

SURFACE WATER TEMPERATURES, TASMAN BAY AND MARLBOROUGH SOUNDS, NEW ZEALAND FROM AUGUST 1968 TO JUNE 1969

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WELLINGTON, NEW ZEALAND

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C O N T E N T S

ABSTRACT

Surface water temperatures (°C) have been plotted from August 1968 to June 1969, for Tasman Bay and the Marlborough Sounds. These records were taken from the r.v. "W.J. Scott" while bottom trawling and purse seining during the time period. Temperatures were found to be similar to 1955 and 1972, but cooler than in 1970. It is suggested that a possible 5-7 year temperature cycle of surface water may occur, thus affecting pelagic fish in the region.

INTRODUCTION

Surface water temperatures (°C) were recorded from the r.v. "W.J. Scott" during the period August 1968 to June 1969. These temperatures were noted as part of the bottom trawling project (Webb, 1972a) and purse seine experiments for pelagic kahawai, "English" mackeral, and horse mackeral (Webb, 1970). Temperatures were taken using a Murayama Electric Resistance Thermometer, type M-2 (dry cell batteries FM-4), having an accuracy of ± 0.1°C. Records were noted per 10 minute interval while cruising or searching for fish shoals and per 30 minute interval when intensively fishing an area. The objects of the temperature records were:

(a) to provide comparative surface temperature records for Tasman Bay and the Marlborough Sounds areas, and

(b) using temperatures, show the best areas for purse seining pelagic fish species.

Tasman Bay, situated to the north of the South Island, is a large indentation consisting of two main areas; the central area, from Nelson to Farewell Spit to D'Urville Island, of approximately 3,500km^2 in area, 18km wide at its lowest end and 66km wide between Farewell Spit and D'urville Island, and 85km in length (north-south line). This central area is entirely open to the

north and protected on the east and west by high ranges (900-1500m): sea bottom contours are regular and generally run east-west, from 5m off Nelson to 64m at the entrance. The second area is Golden Bay, situated to the north-west of Tasman Bay. It is roughly sickle-shaped, 88km^2 (29.6km x 29.6km) in area, and opened to the easterly quarter: bottom contours are regular and run north-south from 5m in the west to 36m at the entrance. Ranges (600m) extend around the coastline from south to west, while the north is bounded by a low sand spit 29.6km long and approximately 10m high. The pattern of surface currents in these two areas have been described by Brodie (1960), McKenzie (1964), Heath (1969) and Baker (1972).

The Marlborough Sounds were situated east of D'Urville Island and to the north-east of the South Island. They formed a complex, convoluted area 47km long by 56km wide (including land mass). The upland hills ranged from 450-1200m, with the sea bottom contours mainly between 18 to 100m. According to the New Zealand Tide Tables 1973 (pp. 14-16) and the New Zealand Marine Chart 615, tidal streams range from 1.8-5.4km/hour throughout most of the Sounds, culminating in 9.0-12.6km/hour through French Pass.

Air currents for the Tasman Bay area (Webb, 1972b) are mainly from the southerly and northerly quarters with a high proportion of calm and variable days, while in the Marlborough Sounds south-easterlies and westerlies are predominant. A larger proportion of wind speeds below 36km/hour were found for both areas (70-95%). The 36km/hour limit was set by the author as the maximum wind strength for safety and fishing practicability with purse seine plus dory, for a 27m vessel.

RESULTS

The surface water temperatures were plotted in 0.2°C divisions as isotherms or spot water temperatures, for Tasman Bay (Fig. 1a - 11) and the Marlborough Sounds

(Fig. 1b - 9b). Periods covered were from August 1968 to June 1969 (Tasman Bay) and August 1968 to April 1969 (Marlborough Sounds).

Tasman Bay

1. There averaged a fluctuation of 1-2°C each month over the whole bay area depending on rising temperatures (spring and summer) or falling temperatures (autumn and winter).

2. Variation in surface sea temperatures, however, occurred with passing storms, with a 1-5°C fall in temperatures above the 46m isobath. The degree of variation depended on wind speed and duration of storm, which caused mixing within the surface water and turbulence throughout the vertical water depths from wave action. Recovery time for the surface waters to regain their normal temperatures was 36-48 hours. Thus, the temperatures on Fig. 1a-11 represent the average for the month.

3. Tidal streams, upwelling and the D'Urville Current formed a complex temperature pattern around Stephens Island and along the west coast of D'Urville Island (e.g. Fig. 7a). It was possible to have a 2-3°C variation depending on the state of the tide and weather. For example, on February 20 1969, 5.4km west of the D'Urville coast, the surface sea temperatures ranged from 18.2-19.2°C, as distinct from the plotted range of 15.8-17.6°C: for the previous 5 days the weather had been fine and warm.

4. A further complication occurred during summer from the southern and westward influx of the cool D'Urville Current to lower Tasman Bay and Golden Bay, which mixed with the warmer inshore waters from these areas (Baker, 1972; Heath, 1969). These areas provided a system of surface water temperatures where the warm, shallow

inshore waters gave way to a belt of cooler water, followed by rising temperatures over the deeper water of central Tasman Bay. Isolated zones of upwelling and mixing of cool and warm water occurred in spring and autumn in central Tasman Bay. During winter isotherms generally were cooler in lower Tasman Bay, rising slightly (0.5-1°C) in central Tasman Bay and falling again at the Bay entrance.

5. As was expected the temperature of the shallow waters of lower Tasman Bay rose slightly (0.2-1.0°C) in periods of prolonged fine weather, e.g. during February 24 to 26 1969 the surface temperatures west of Pepin Island rose to 20.0°C and at the entrance to Port Nelson to 20.8°C, before falling to 19.6 and 19.8°C respectively.

Marlborough Sounds

1. Surface water temperature within the Sounds was generally more stable than Tasman Bay owing to the enclosed nature of the area. Strong winds caused little turbulence and only slight variations of 0.5-1.0°C, as distinct from the 1-5°C for the Bay. Generally, surface temperatures did not vary more than 2°C throughout the Marlborough Sounds in any one month.

2. Temperature rise in Cook Strait for the period August 1968 to April 1969, ranged from 9.0-9.8°C in August, 13.0-14.8°C in December 1968, to 12.8-15.4°C in April 1969. Temperatures were highest in all months in the inshore waters of Cloudy Bay and northern Cook Strait, and lowest in central and southern Cook Strait. Patches of upwelling occurred along the western coastline of Cook Strait during summer, although the principal isotherms showed:

(a) the gradation of temperature from shoreline to centre of Strait,

(b) the northern inflow of the cool Canterbury Current (Heath, 1971), and

(c) the southward encroachment of warmer water in the northern and eastern parts of Cook Strait (Heath, 1969).

3. Warmest areas of the Sounds for the spring and summer months were in Admiralty Bay, north of Pelorus Sound, and along the eastern coast of D'Urville Island. In these areas, surface water temperatures were 1-2°C higher than for the rest of the Sounds. Where sufficient isotherms were plotted there was generally found, to the area north of the Sounds, an even gradation of surface temperatures from west to east and from south to north, e.g. Fig. 1b and 9b. Within the lower reaches of the Marlborough Sounds (Queen Charlotte, Pelorus) surface sea temperatures were cooler in winter and warmer in summer, than for the outer Sounds areas.

4. There appeared to be in most months, an area of warm water north of the Chetwode Islands surrounded by a cooler (0.2-0.5°C) circular water current which dipped down from North of D'Urville Island towards the Brothers Island, with an off-branch westward to north of Titi Island. This current was probably an extension of the D'Urville current. Upwelling north of Queen Charlotte Sound, Port Gore, and Pelorus Sound was also noted in spring.

5. The warm northern Cook Strait current was again evident north of the Brothers Island were surface temperatures rose 1°C on a rising gradient of isotherms.

DISCUSSION

A comparison of surface sea temperatures between Tasman Bay and the Marlborough Sounds showed that:

(a) Tasman Bay had isotherms 2-3°C higher than the Sounds, and

(b) the surface water of the Sounds was generally 2-3°C higher than those in central and southern Cook Strait, and 1-2°C higher than northern and western Cook Strait.

The variation in water temperatures between the two areas during 1968 and 1969 has been suggested in previous papers as separating different populations and communities of demersal fish species (Webb, 1972a), and different populations of pelagic kahawai, "English" mackeral and horse mackeral (Webb, 1971).

The seasonal temperatures for 1968-1969 showed variation with other years. During the period September 1969 to May 1970 (Webb, 1972c), the surface water in Tasman Bay and the Sounds were 1-3°C and 0.5-1.0°C respectively higher than for the corresponding period for 1968-1969, while the 1968-1969 temperatures were similar to those for 1972 (Webb, in prep.). Garner (1961) gave isotherm patterns for 1955 which corresponded to those noted in 1968-1969. Confirmation of the March 1969 sea temperatures was given by Stanton (1971). Thus the fluctuations in surface water temperatures over the previous years suggested a possible 5-7 year cyclic pattern which probably reflected similar variations in weather conditions.

In pelagic fishing, using purse seine, trolling, pole-fishing, mid-water trawling, or gill netting, surface temperatures play an important role in concentrating, or otherwise, the fish shoals in areas or along inter-faces of varying water masses. The author has found for tuna, kahawai, mackerals, and pilchards around New Zealand that it is not just the large 1-3°C differences in surface water temperatures which attract the plankton and therefore the fish shoals, but rather the small, numerous 0.2°C variations that abound throughout the water column or mass. Although large temperature changes across a water front (refer York, 1969) are important for pelagic fishing (usually indicates upwelling or confluence of two large currents), they occur only in localized zones or sporadically over large ocean areas. Thus, the landings of kahawai and mackeral shoals for 1968-1969 (Webb, 1970)

were all in areas of small temperature variation, being from:

(a) west of Stephens Island,
(b) along the western coast of D'Urville Island and Pepin Island,
(c) 20km east of Farewell Spit,
(d) east of Rangitoto Island and north of Chetwode Island and Cape Lambert, and
(e) 10km offshore in Cloudy Bay (Cook Strait).

ACKNOWLEDGEMENTS

I wish to thank Captains D. Munro, T. Rowlings, and J. Brew and the crew of the "W.J. Scott" for helpful assistance during the 1968-1969 period; to Messrs A.R. Brown (until October 1968) and M. Baker (now Captain), mate of the "W.J. Scott" respectively, for assistance in temperature recordings and regular plotting of ship's location; and to Messrs S. Robertson, C. Alves, T. Ure and B. Ransby, Technicians, Marine Department, Wellington, for helping record temperature data. Thanks are also due to the Marine Department staff, Nelson, for maintaining the ship operational and to Mr D. Williamson for helping to draft the figures.

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YORK, A.G. 1969 — Tuna investigations - east coast of New Zealand 1965 - 1967. N.Z. Ministry of Agriculture and Fisheries Tech. Rept. 40: 80pp

LIST OF FISH SPECIES

Kahawai *Arripis trutta* (Forster)

"English" mackeral *Scomber australasicus* Cuv. & Val.

horse mackeral *Trachurus declivis* (Jenyns)

pilchards *Sardinops neopilchardus* (Steindachner)

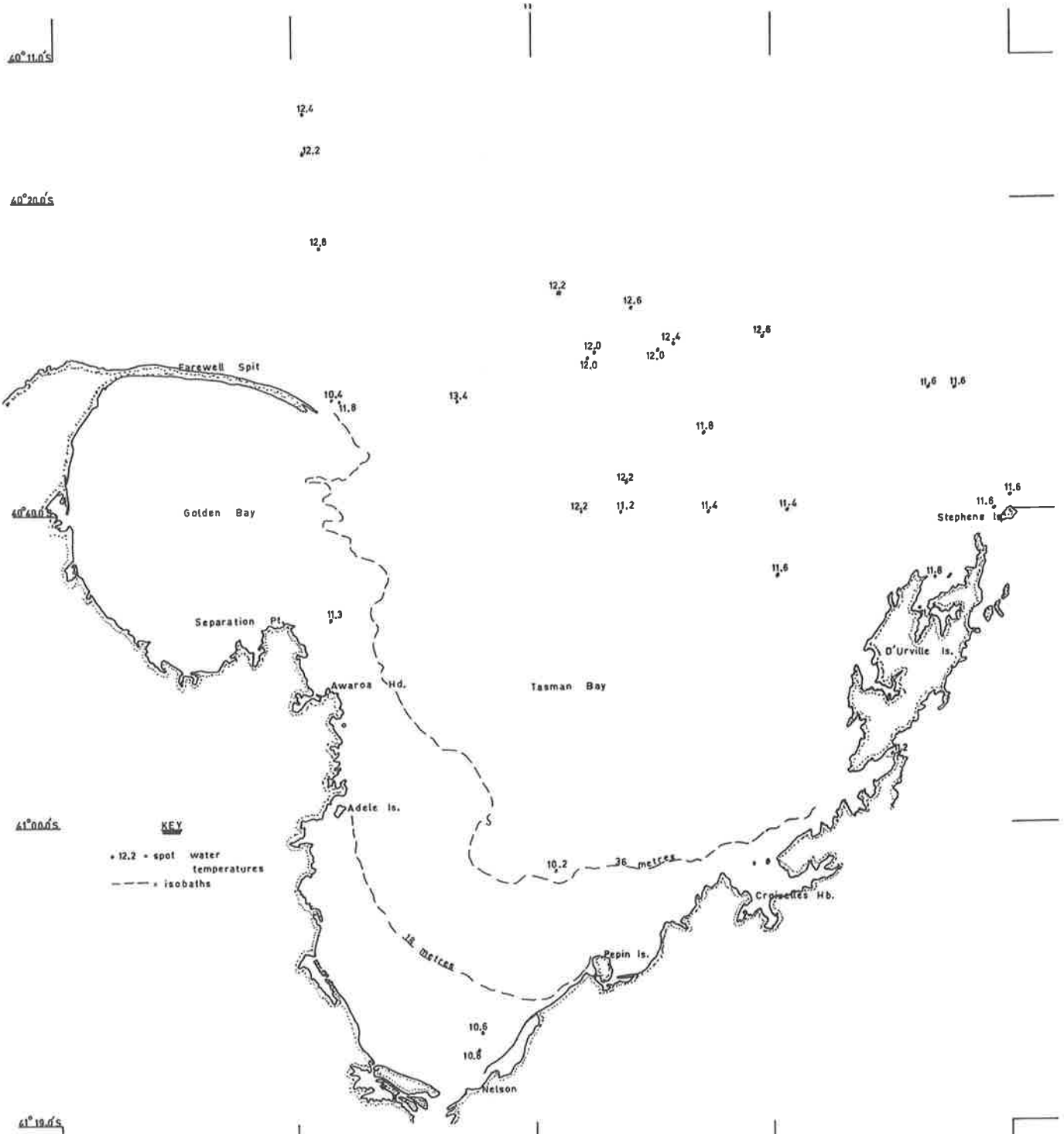

FIG. 1a Surface water temperatures (°C) plotted for August 1968, Tasman Bay area; recorded from "W. J. Scott."

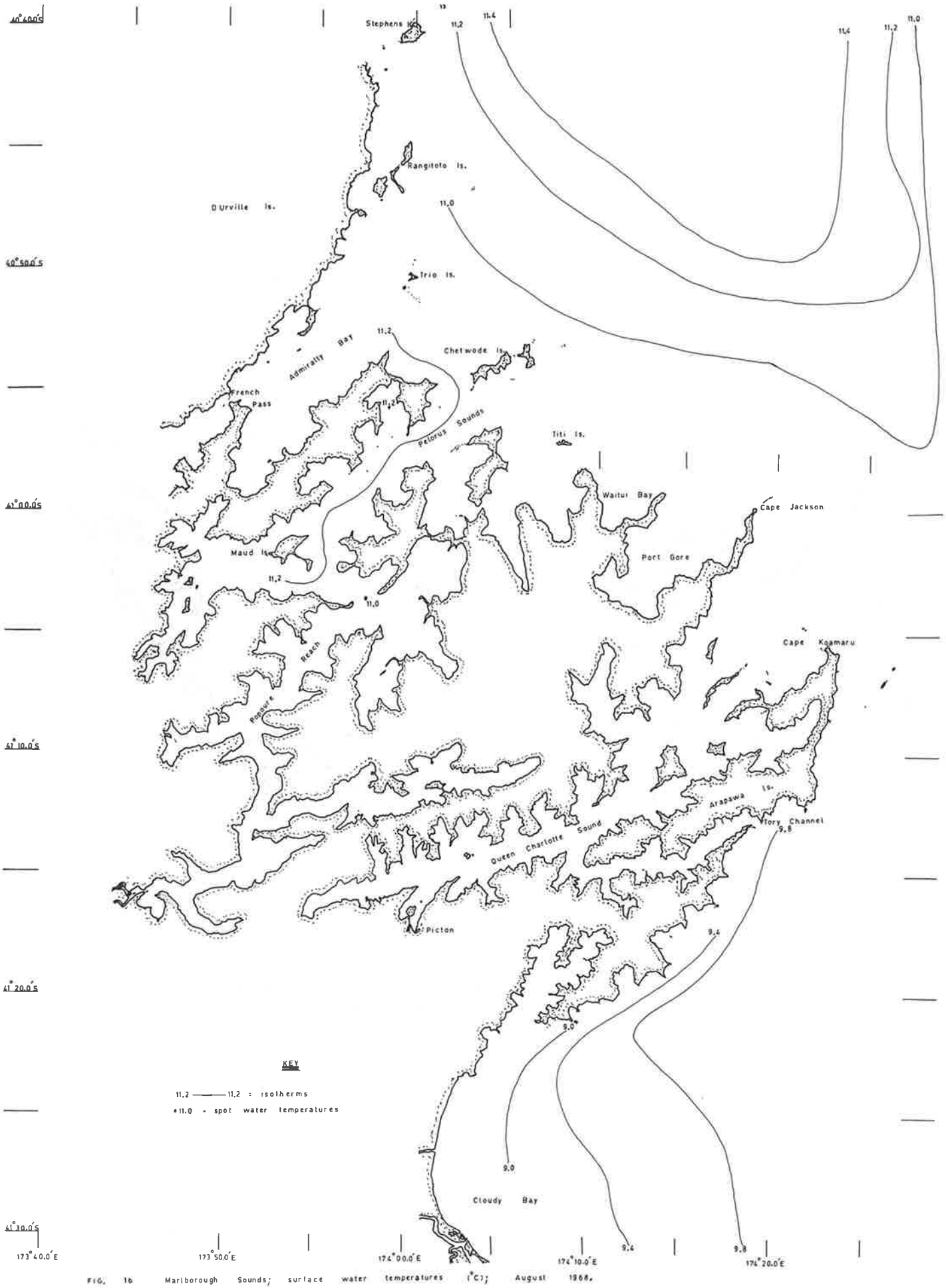

FIG. 16 Marlborough Sounds; surface water temperatures (°C); August 1968.

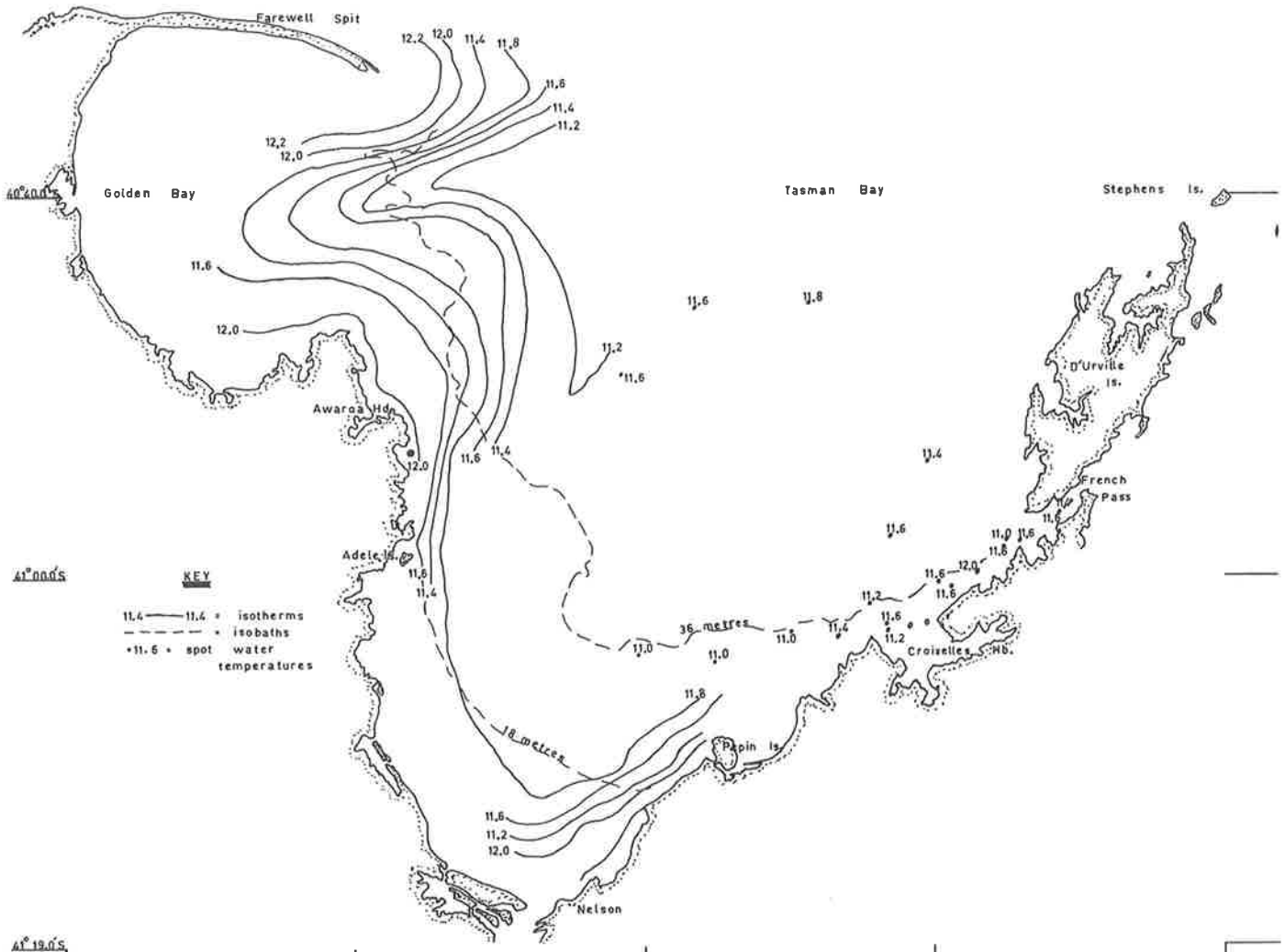

FIG. 2a Surface water temperatures and isotherms (°C) plotted for September 1968, Tasman Bay area, recorded from "W. J. Scott".

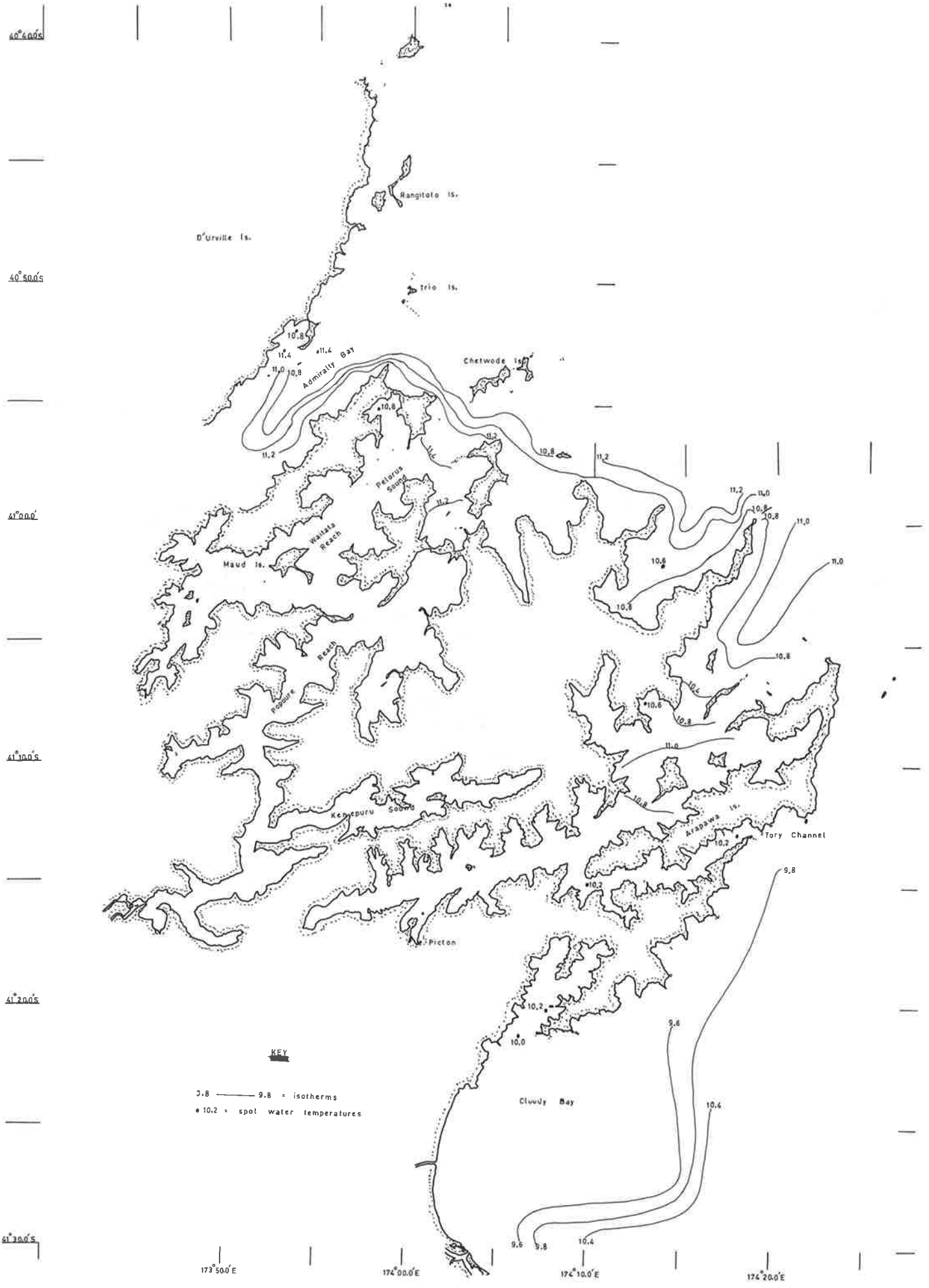

FIG. 26 Marlborough Sounds; surface water temperatures (°C); September 1968.

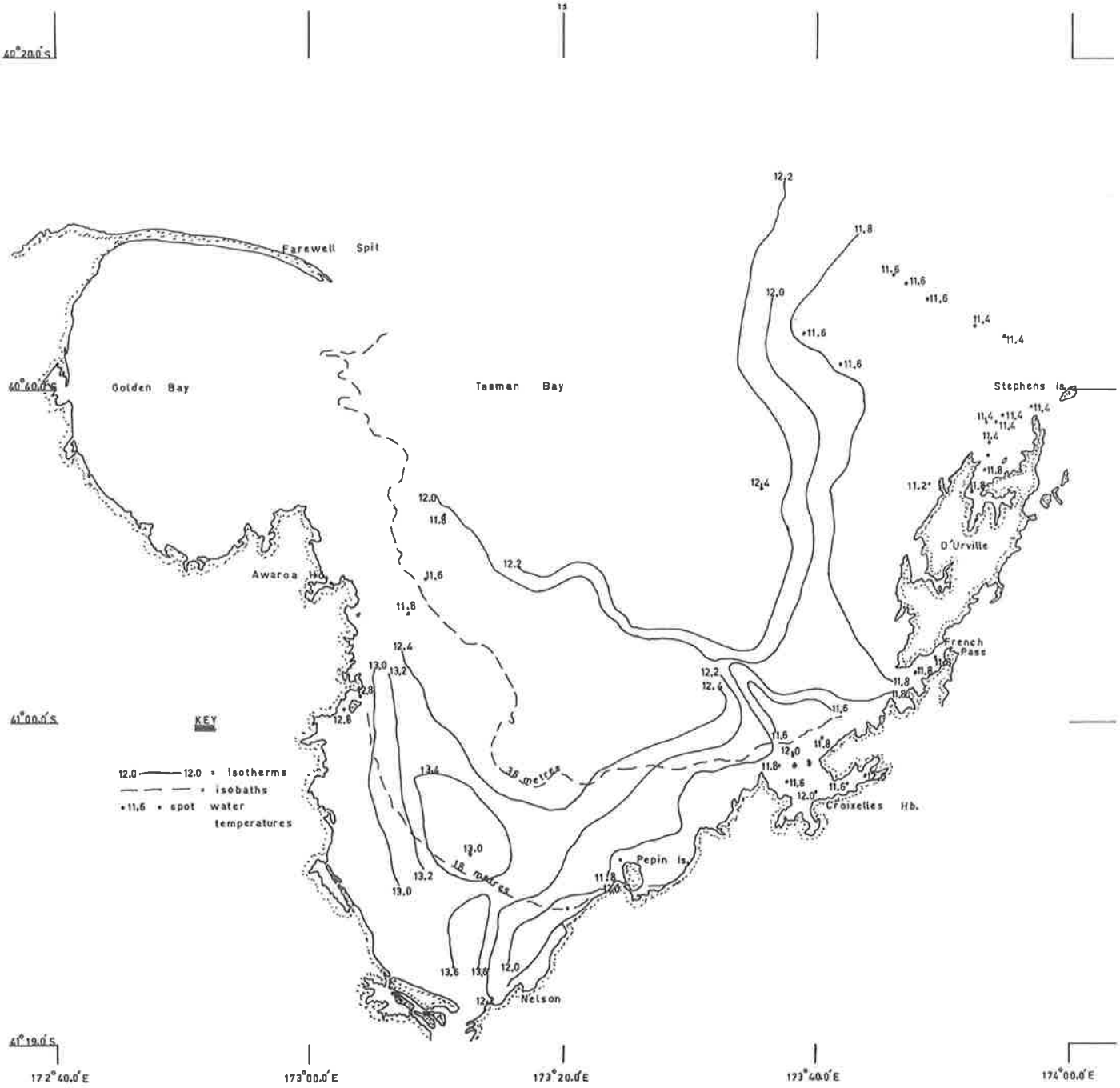

FIG. 3a Surface water temperatures and isotherms (°C) plotted for October 1968, Tasman Bay area, recorded from "W. J. Scott".

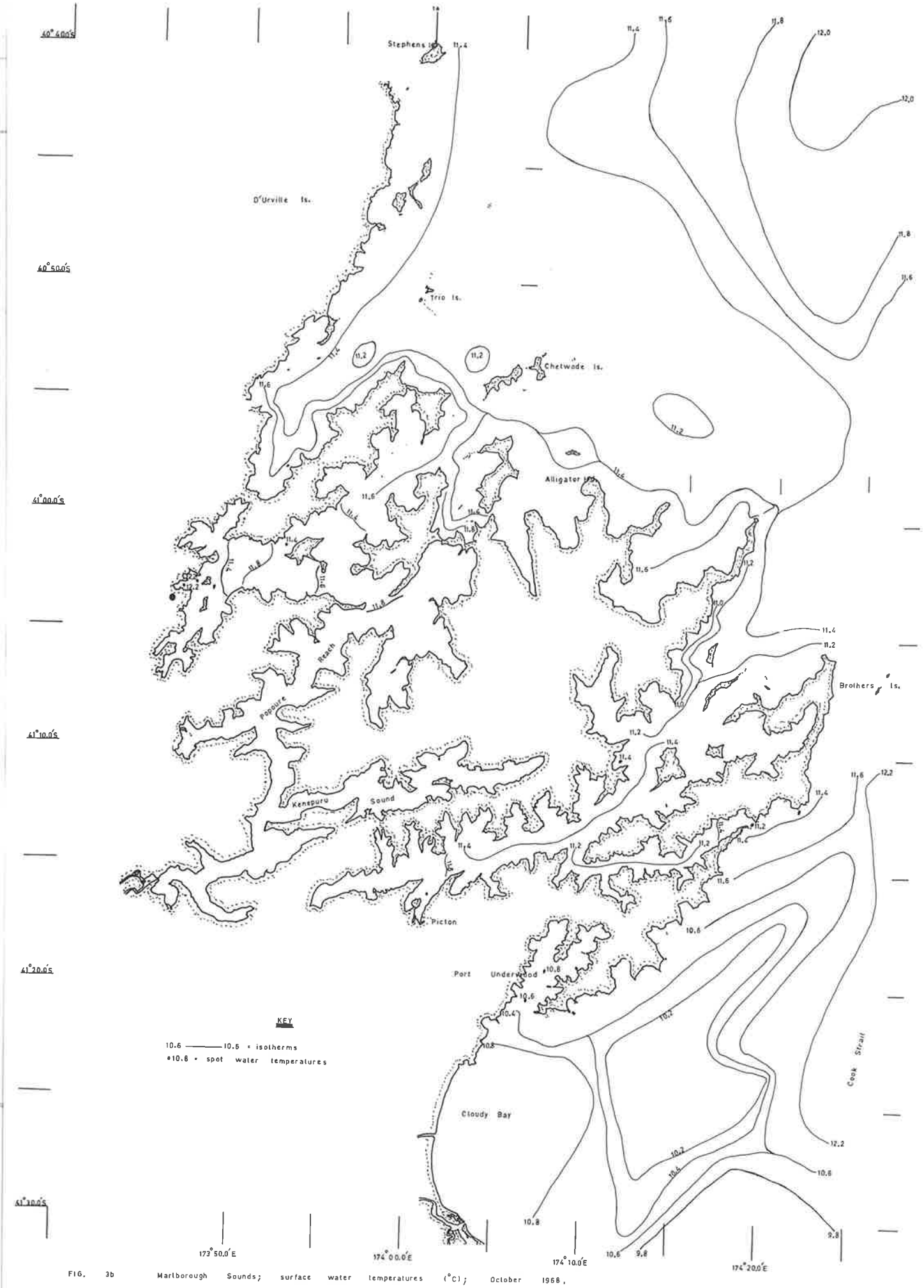

FIG. 3b Marlborough Sounds; surface water temperatures (°C); October 1968.

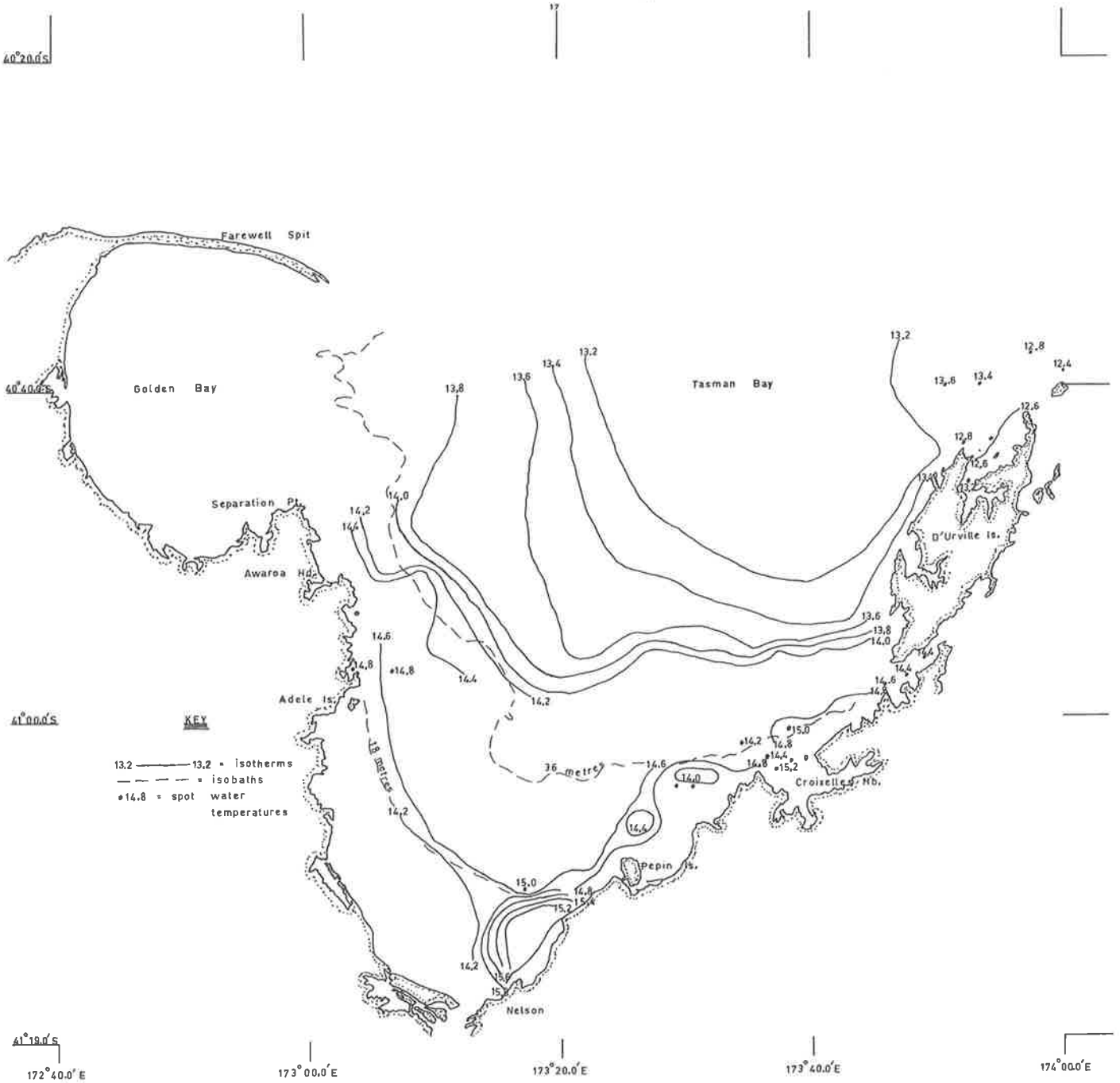

FIG. 4a Surface water temperatures and isotherms (°C) plotted for November 1968, Tasman Bay area, recorded from "W. J. Scott".

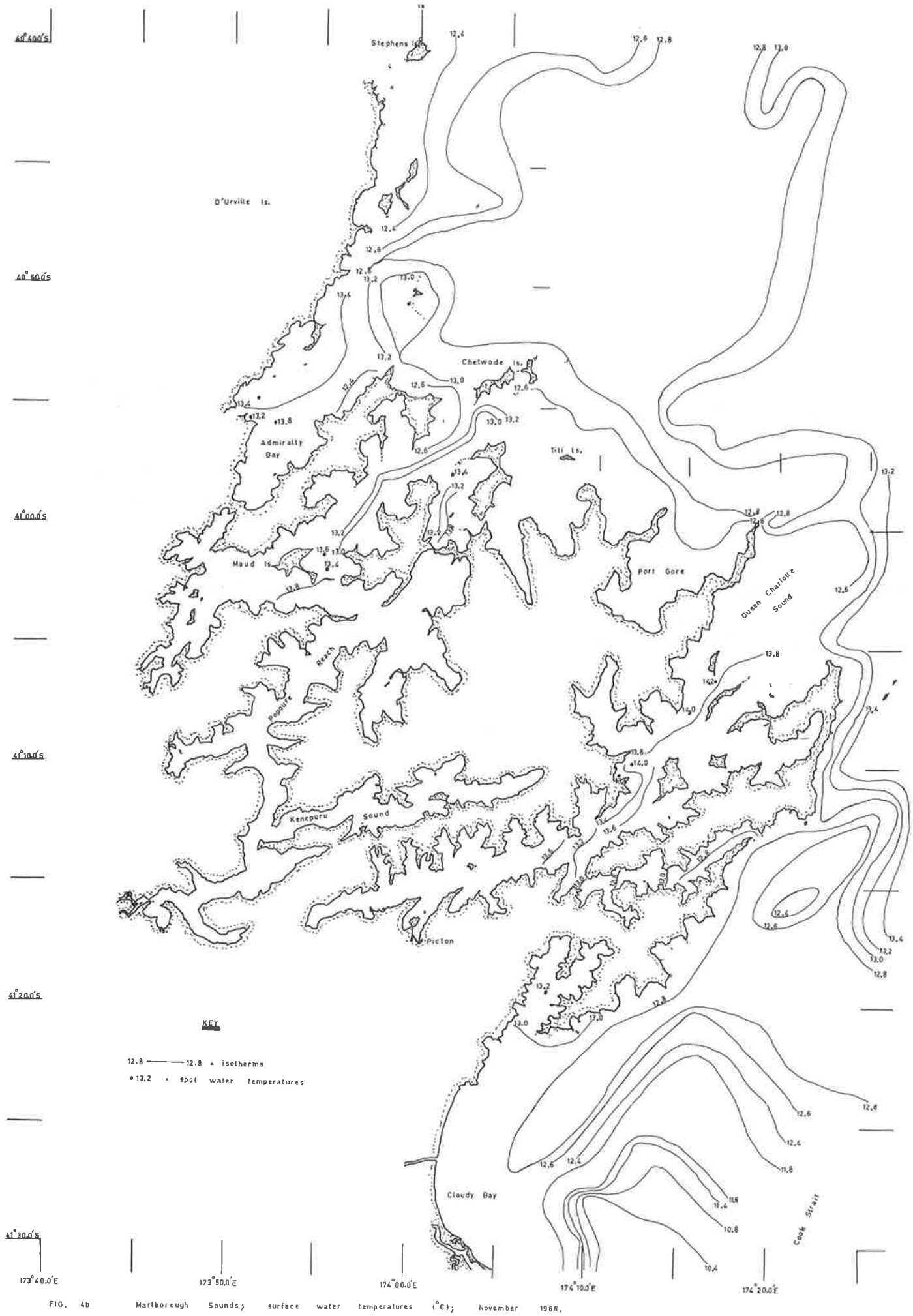

FIG. 4b Marlborough Sounds; surface water temperatures (°C); November 1968.

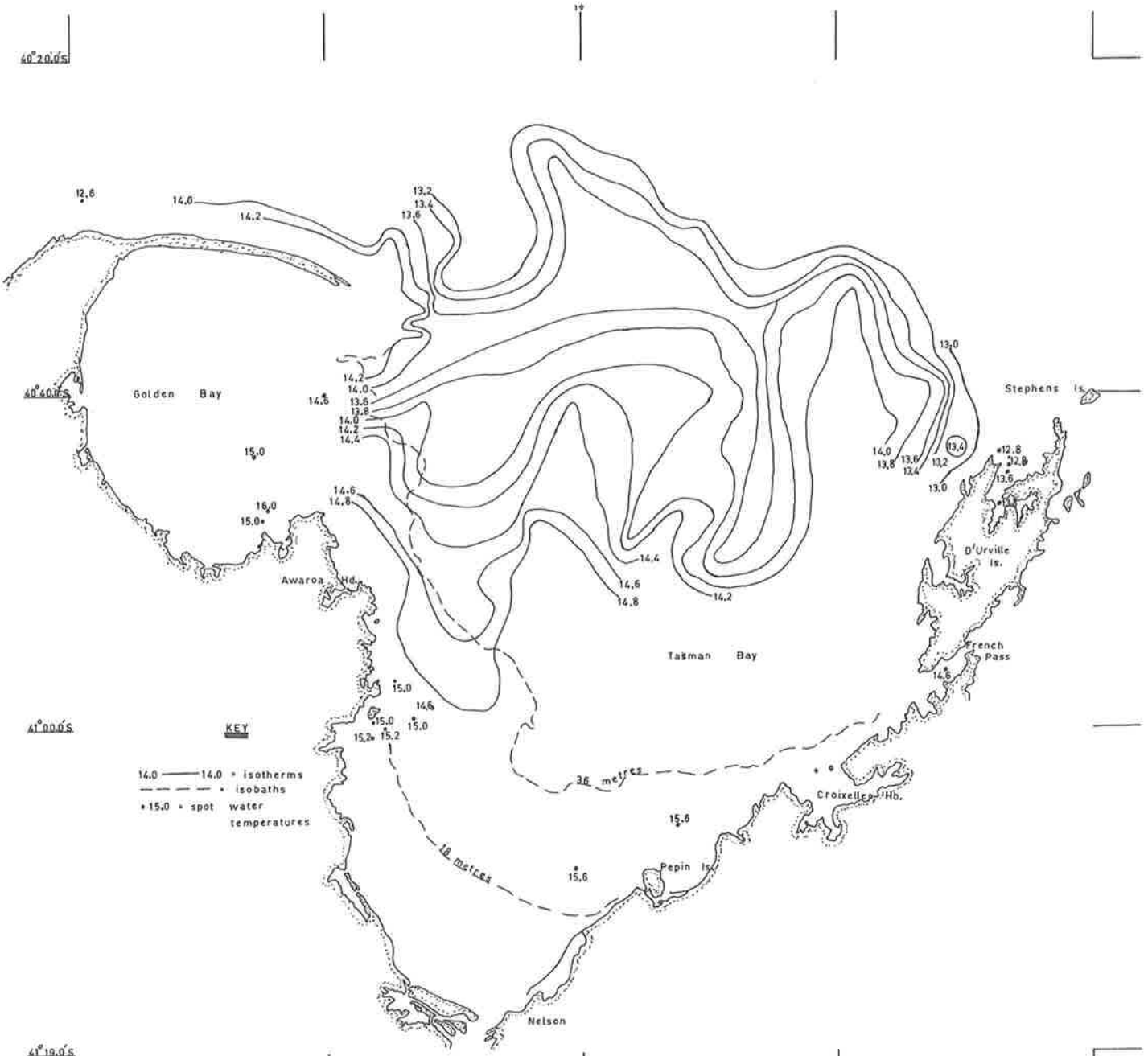

FIG. 5a Surface water temperatures and isotherms (°C) plotted for December 1968, Tasman Bay area, recorded from "W. J. Scott".

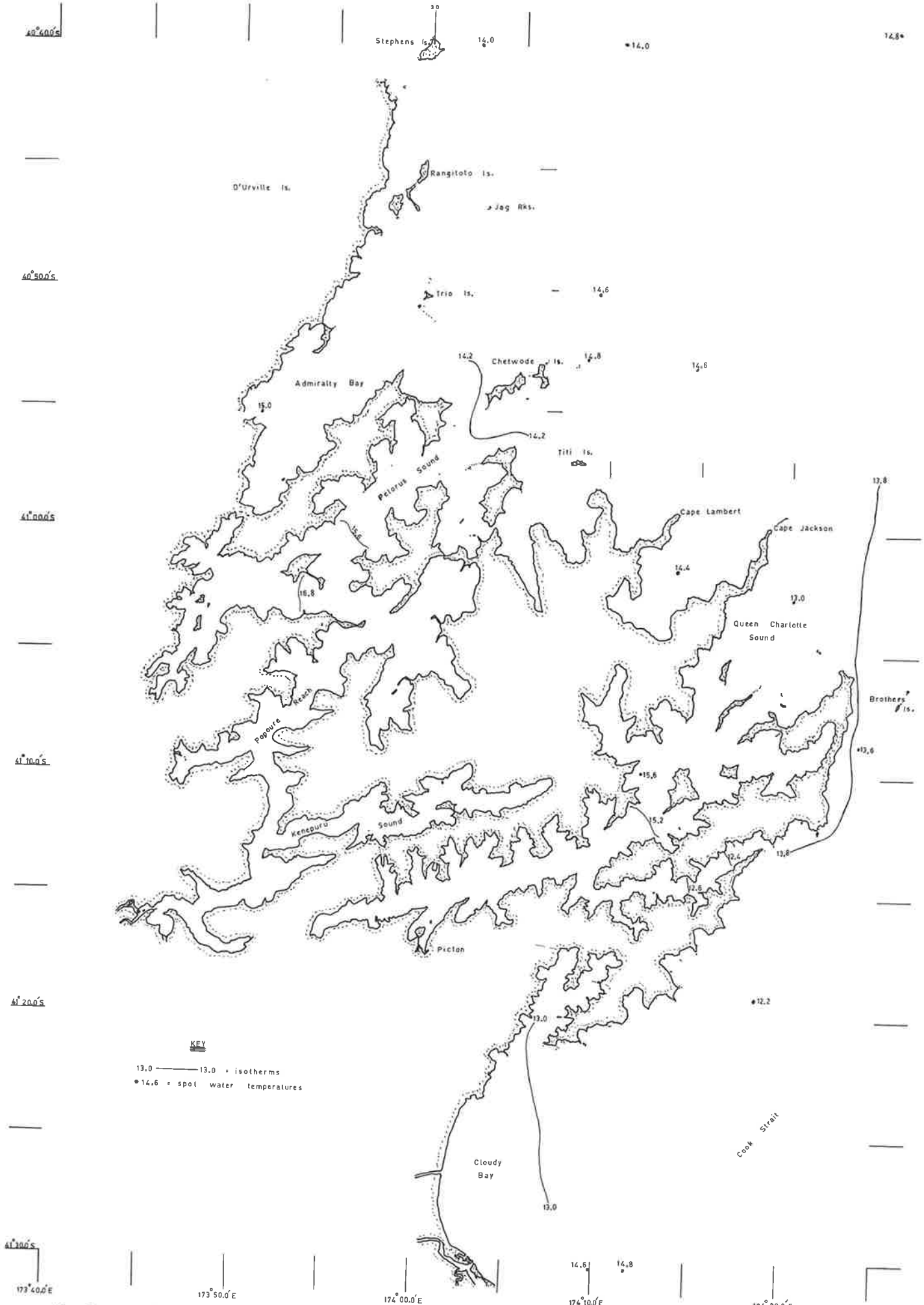

FIG. 5b Marlborough Sounds; surface water temperatures (°C); December 1968.

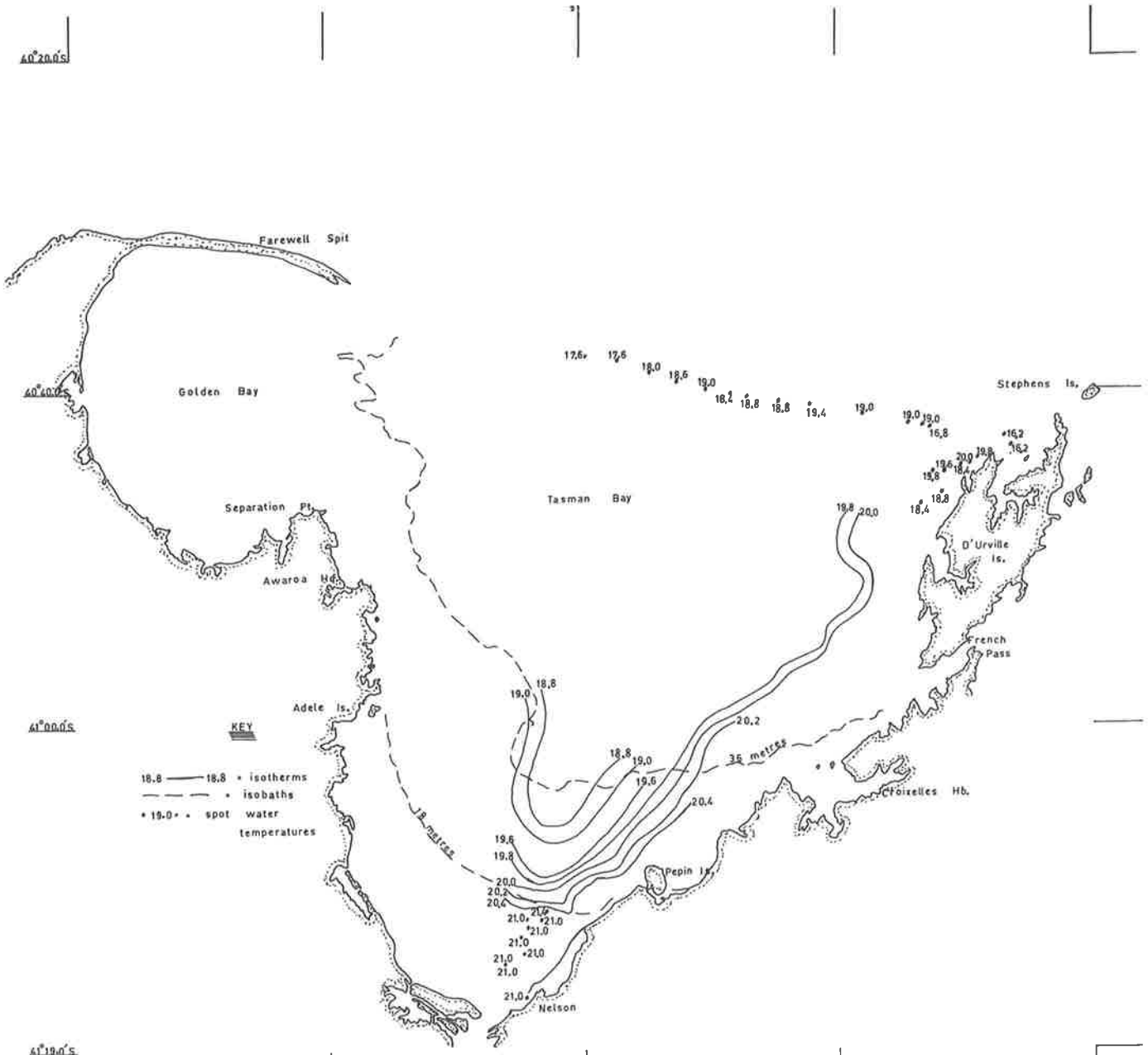

FIG. 6 Surface water temperatures and isotherms (°C) plotted for January 1969, Tasman Bay area, recorded from "W. J. Scott".

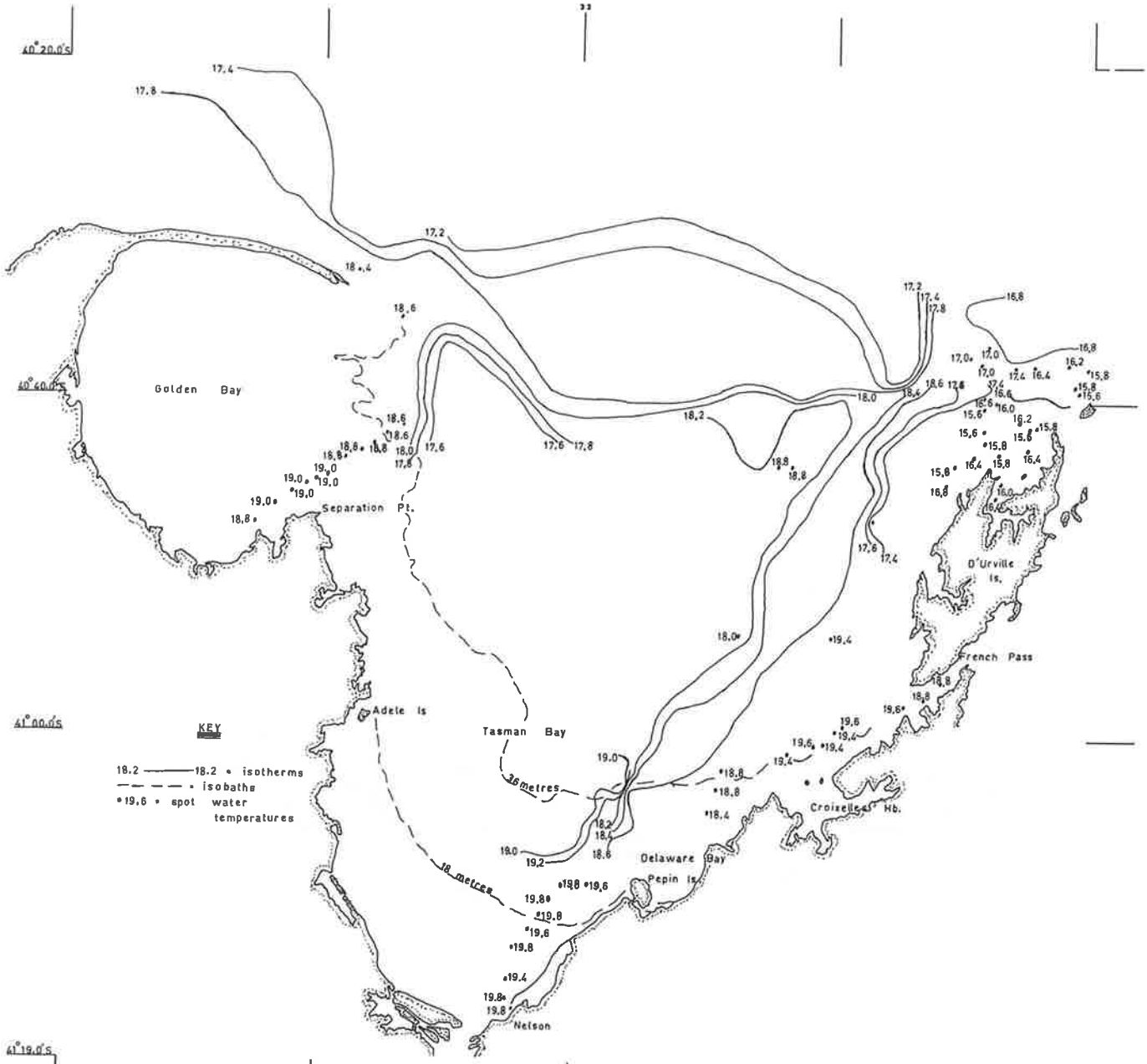

FIG. 7a Surface water temperatures and isotherms (°C) plotted for February 1969, Tasman Bay area, recorded from "W. J. Scott".

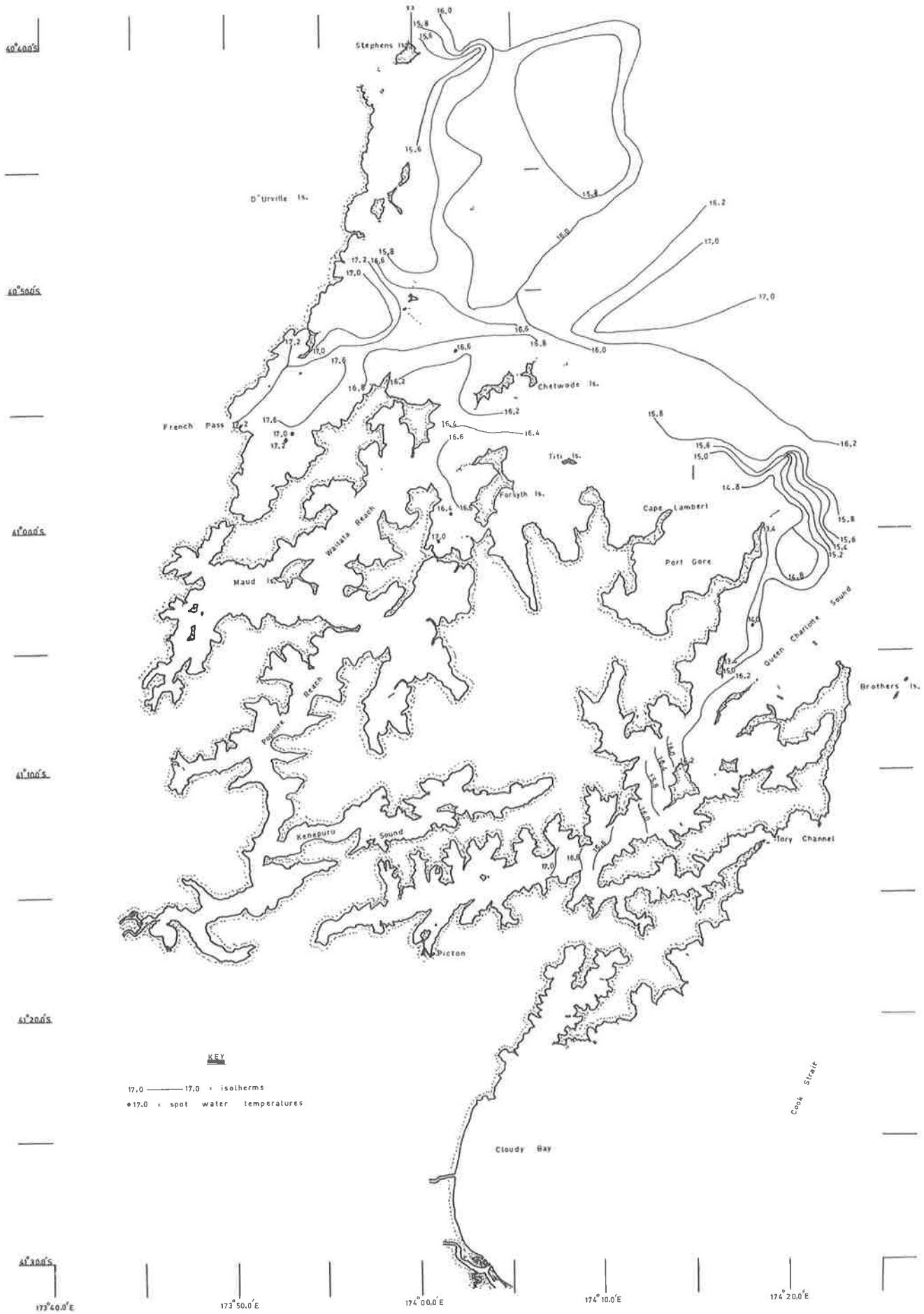

FIG. 7b Marlborough Sounds; surface water temperatures (°C); February 1969

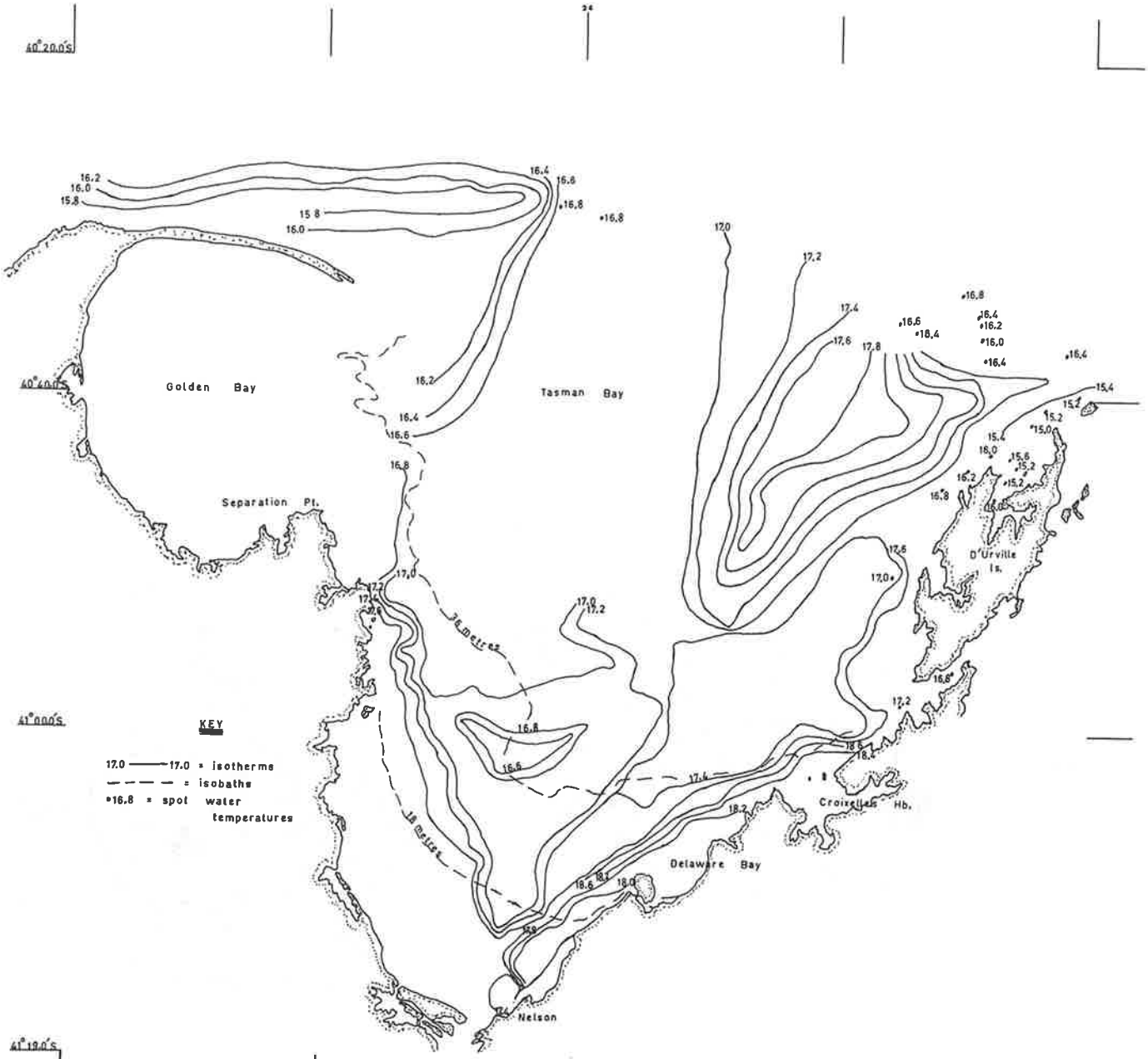

FIG. 8a Surface water temperatures and isotherms (°C) plotted for March 1969, Tasman Bay area, recorded from "W. J. Scott".

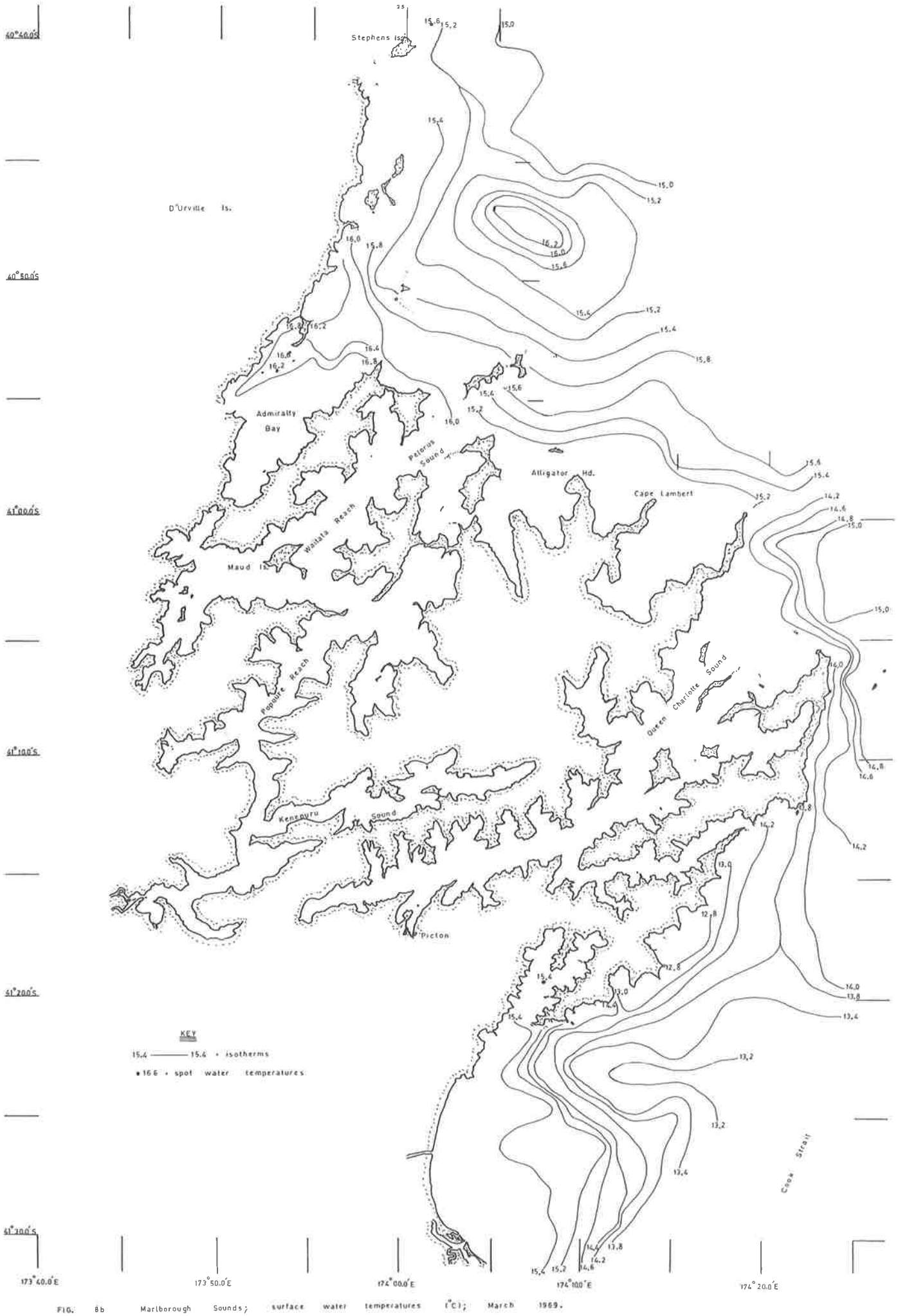

FIG. 8b Marlborough Sounds; surface water temperatures (°C); March 1969.

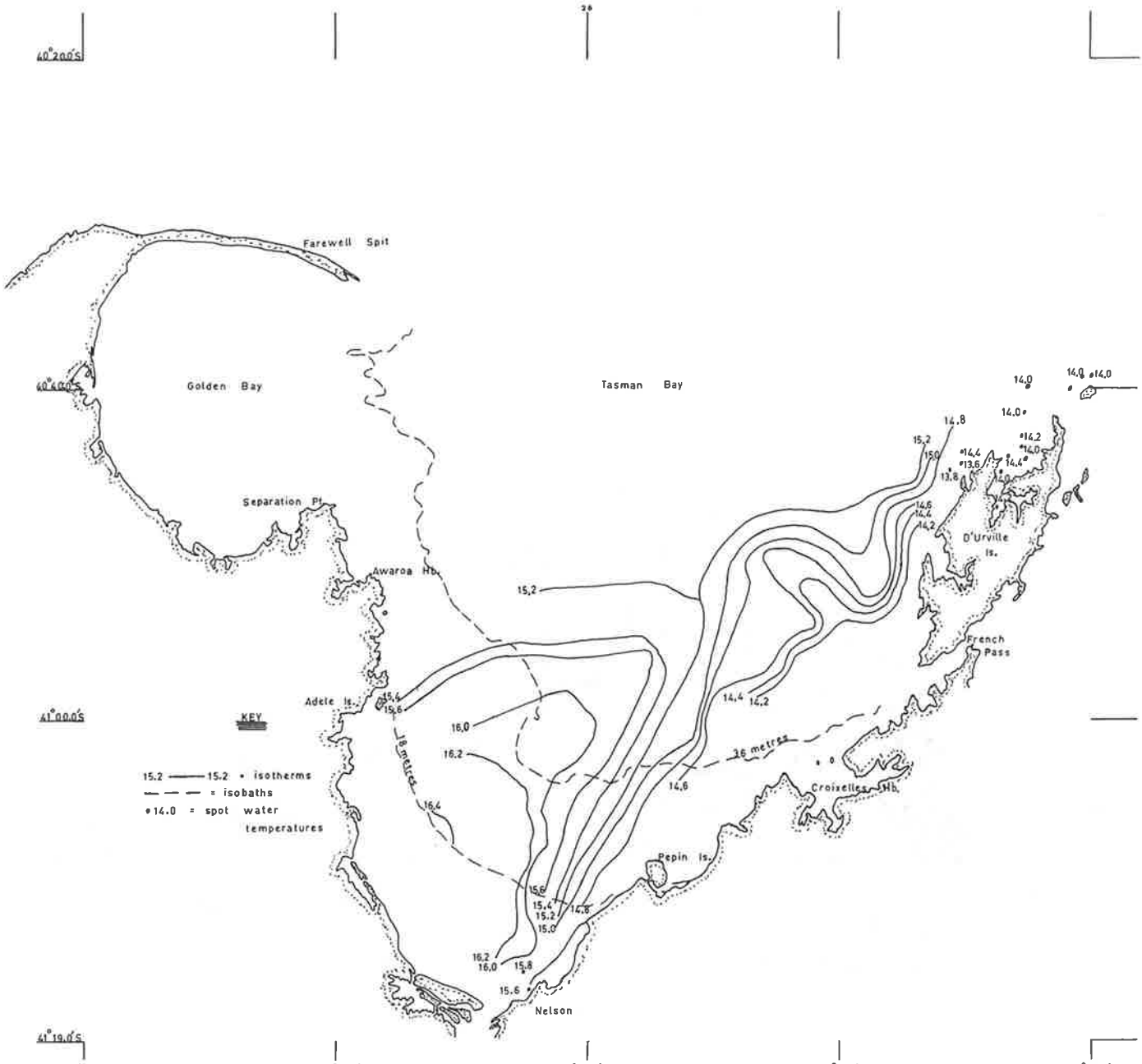

FIG. 9a Surface water temperatures and isotherms (°C) plotted for April 1969, Tasman Bay area, recorded from "W. J. Scott".

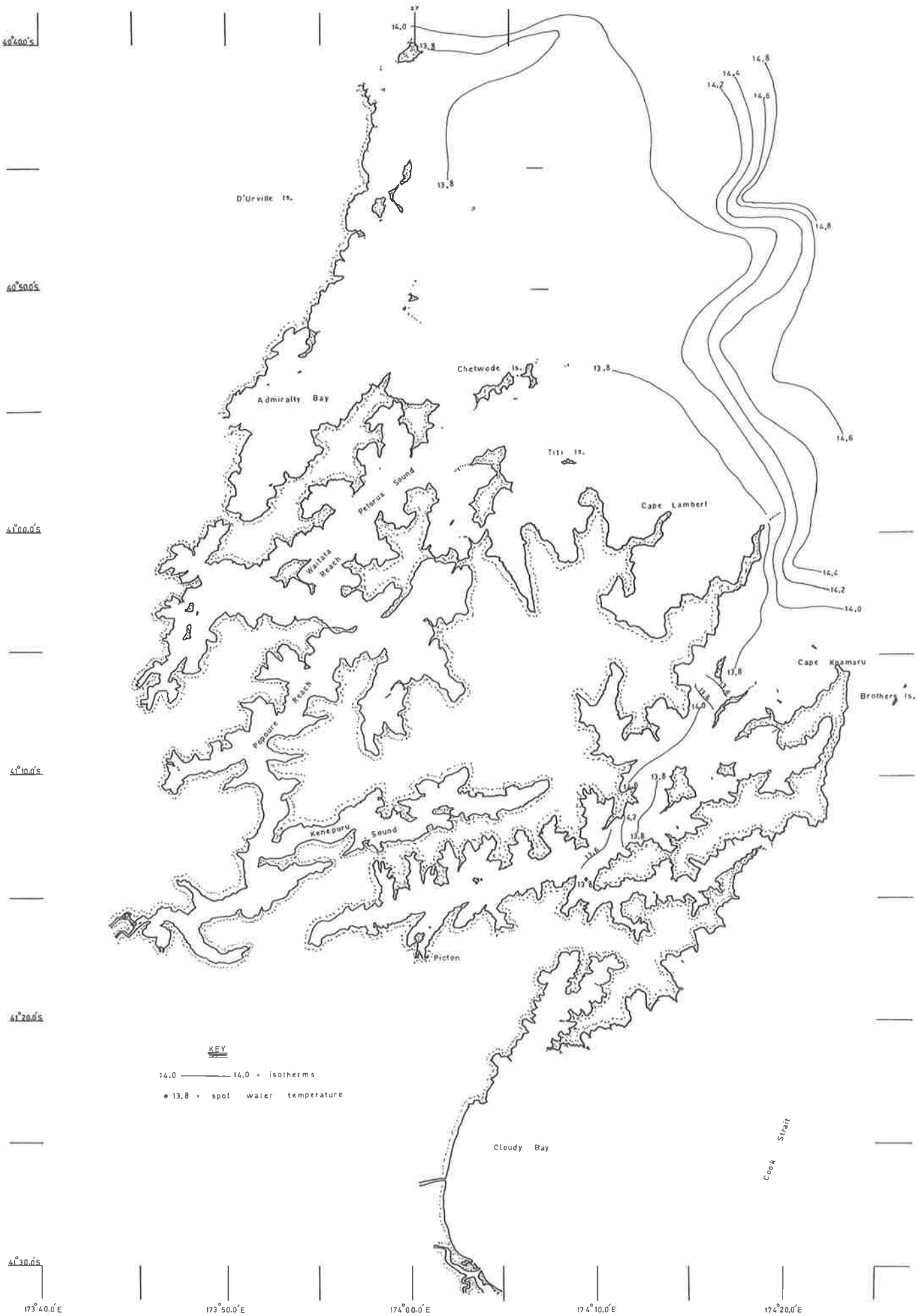

FIG. 9b Marlborough Sounds; surface water temperatures (°C); April 1969.

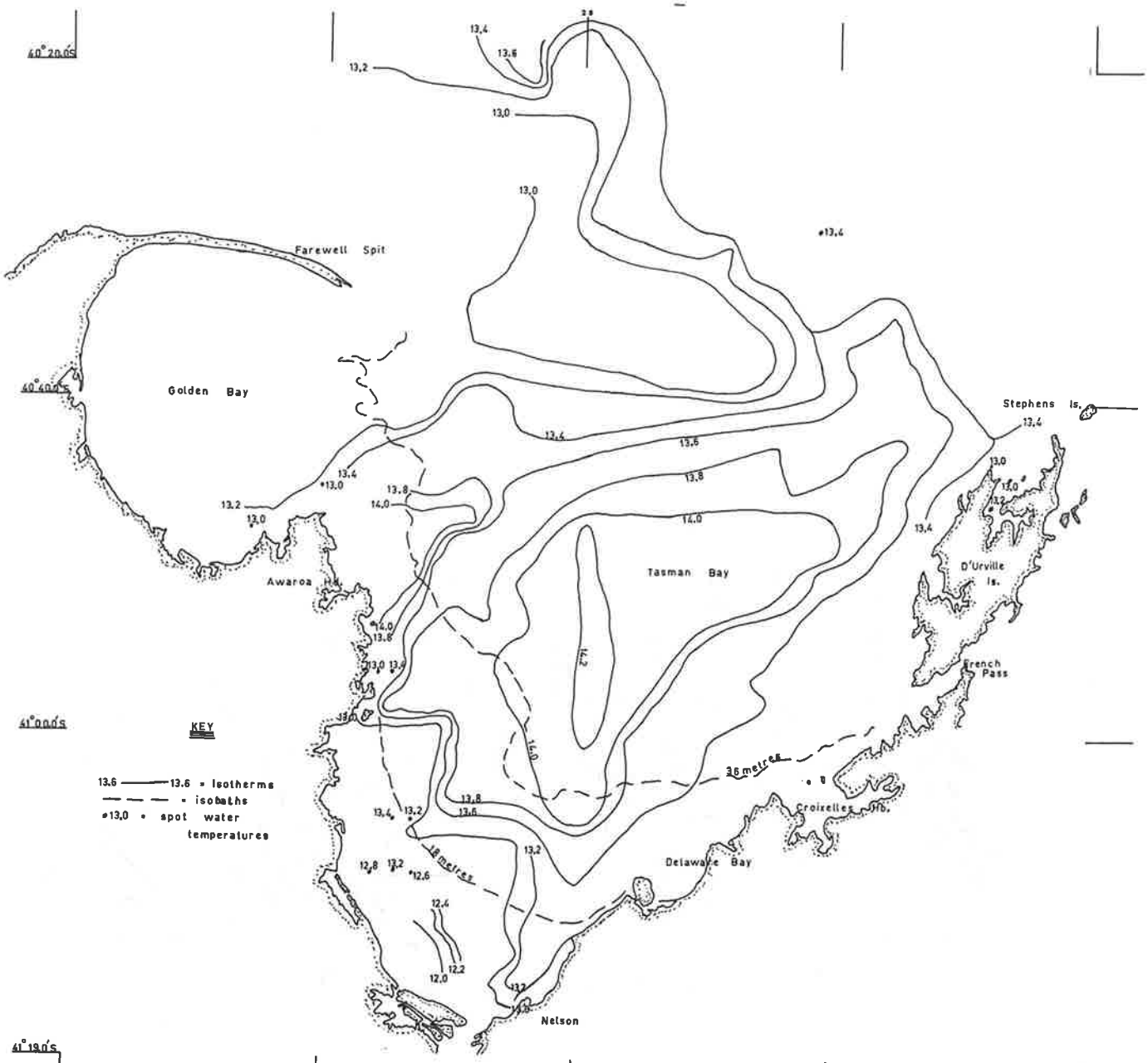

FIG. 10 Surface water temperatures and isotherms (°C) plotted for May 1969, Tasman Bay area, recorded from "W. J. Scott".

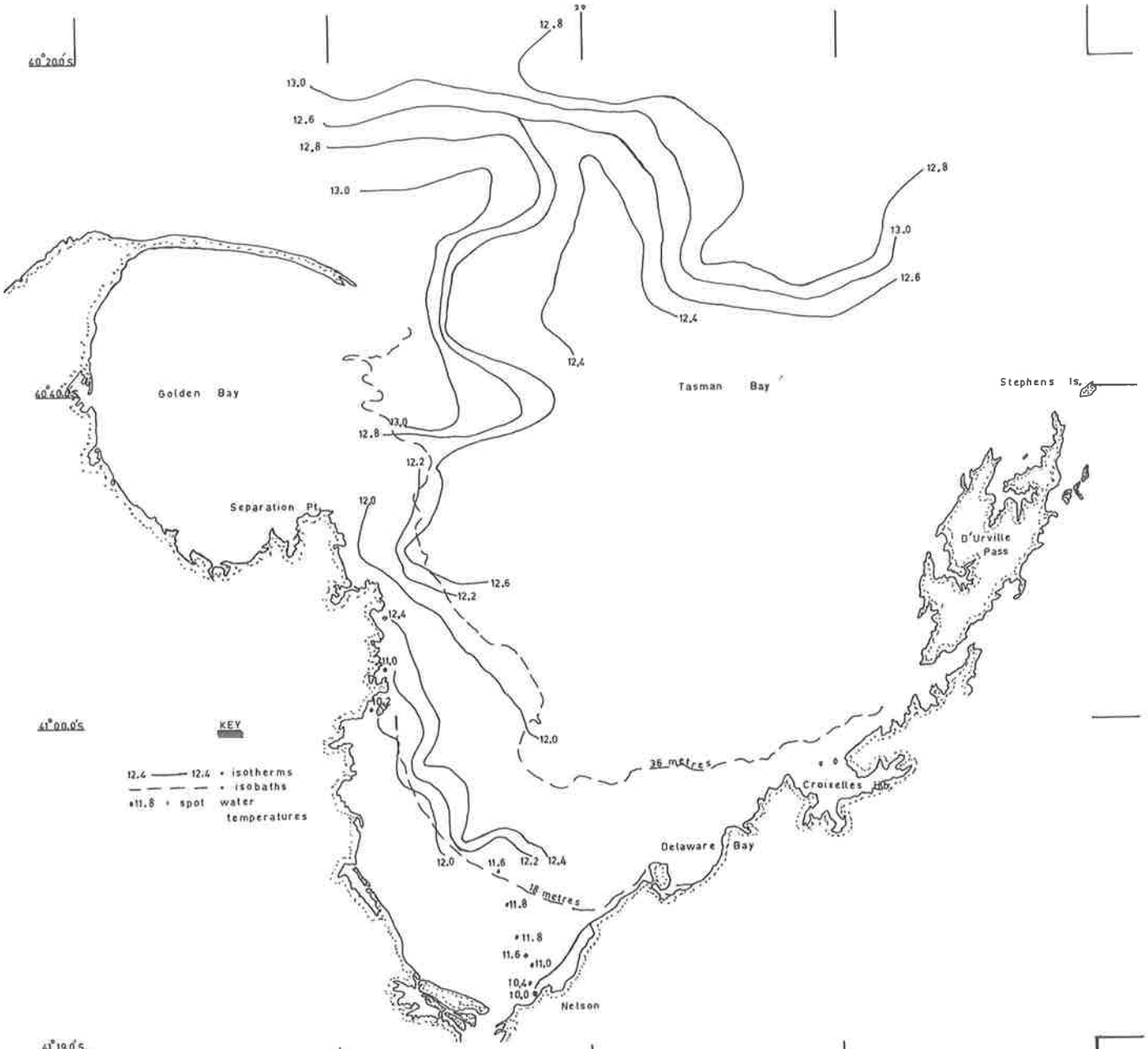

FIG. 11 Surface water temperatures and isotherms (°C) plotted for June 1969, Tasman Bay area, recorded from "W. J. Scott."

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