



**NEW ZEALAND MARINE DEPARTMENT**

**FISHERIES TECHNICAL REPORT**

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**PILCHARD SURVEY NELSON 1964**

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WELLINGTON, NEW ZEALAND**

**1969**

FISHERIES TECHNICAL REPORT

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FISHERIES DIVISION, MARINE DEPARTMENT

(PRESENT ADDRESS

FISHERIES AND WILDLIFE  
DEPT., VICTORIA,  
AUSTRALIA.)

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I ABSTRACT

THIS STUDY REPORTS THE LOCATION AND ABUNDANCE OF PILCHARDS (SARDINOPS NEOPILCHARDUS) IN THE NELSON - MARLBOROUGH SOUNDS AREA AS DETERMINED IN SEPTEMBER - OCTOBER 1964.

It was circulated in cyclostyled form in 1965 to interested fishermen and companies associated with the fishing industry. It is now produced in more permanent form.

By the use of light aircraft for aerial spotting, and surface vessels for echo-sounding and sampling, shoals of midwater fish thought to be pilchards were found in Tasman Bay, Golden Bay and Pelorus Sound. Samples taken in Port Ligar were identified as pilchards (Sardinops neopilchardus) and ranged from 12.0 to 20.0 cm. in fork length.

Sixty-two shoals of varying sizes were located during the survey and were estimated to contain approximately 293 tons. There was a marked similarity between the echo-traces of shoals not positively sampled and those which yielded pilchards on sampling. Unfortunately it was not found possible to sample the shoals located in Tasman or Golden Bay with the available gear. The evidence, however, indicated the presence of pilchards. Nevertheless there is a possibility that the echo-traces come from other species.

## II INTRODUCTION

Little previous work has been done on Pilchards (Sardinops neopilchardus) in New Zealand waters.

This survey was conducted between 14th September and 10th October 1964 to investigate the location and abundance of pilchards in Tasman Bay, Golden Bay, and the Marlborough Sounds. Local fishermen supplied helpful information regarding areas frequented by pilchards.

A report on the survey was issued in cyclostyled form in 1965, to interested fishermen and fishing companies.

## III AREA SURVEYED

The survey area was covered twice during investigations:

(a) Surface Survey:

The surface survey, which lasted three weeks covered from Farewell Spit to Grenville Harbour on the west coast of D'Urville Island, and from Caroline Cove on the east coast, through to Endeavour Inlet in Queen Charlotte Sounds.

This part of the survey is shown in Figure 1.

(b) Aerial Survey:

This phase of the survey covered a larger area than the surface survey, that is, from Karamea on the west coast, to Kaikoura Peninsula on the east coast.

Full details of the area are given in figure 2.

Water temperatures varied over the survey from 11.8 degrees Centigrade in Golden Bay to 12.6 degrees Cent. in Marlborough Sounds.

IV METHODS(a) Surface Survey

Private launches were used on the surface survey, which lasted 3 weeks. A Simrad model EC4 (depth range 0-200ft) fish-finding machine was used as the main method for locating and plotting shoals of midwater pelagic fish. Although no surface shoals were visible many were located in midwater by this method. Using phase I (0-40 fathoms), the traces of small fish shoals registered sufficient depth of permanent marking on the recorder paper, operating on low sensitivity control, to allow for subsequent annotation, as shown in figures 3a to 13b.

The boat cruised at a speed of seven miles per hour with the finder recording continually for the duration of each run.

In order to take samples of the shoaling fish, four terylene gill nets were joined together to make a floating gill net sixty-six fathoms in length and three fathoms deep. The mesh size varied between one and  $1\frac{1}{2}$  inches (see fig. 3). The net could only be worked at night and was usually fished for 1 to  $1\frac{1}{2}$  hours at slack water.

The only method of obtaining samples during the day was by examining the stomach contents of sea birds feeding on shoaling fish. One Gannet was taken for such a purpose.

(b) Aerial Survey:

The fourth week of the survey was spent in aerial spotting from Kaikoura Peninsula to Karamea. The plane flew at a height of 300-500 ft. at a speed of 90-120 mph. Figure 2 shows the position of shoals spotted from the air.

(c) Occurrence of birds

The presence of the New Zealand gannet (Sula bassana serrator) is a consistent indicator of pelagic fish. Often, when gannets were flying in an area, midwater shoals of fish would be located, even when the gannets were not diving. Strong traces were received on the finder, indicating the presence of shoaling pelagic fish, on each occasion that the boat was run through an area where gannets were diving.

Other birds such as the pied shag (Phalacrocorax varius), mutton birds (Puffinus griseus), tern (Sterna striata), and the Fairy prion (Pachyptila turtur) were often associated with the diving gannets. However, flocks of these birds did not necessarily indicate fish shoals. On several occasions the boat was run through flocks of terns working patches of water, but no echo-traces of fish were obtained.

## V IDENTIFICATION OF FISH SHOALS

No shoals located during the day could be caught and positively identified with the gear available. However, local fishermen stated that the traces of the major pelagic fish shoals located by the sounder had the appearance of those typically made by pilchard shoals. Echo traces obtained in Port Ligar were similar to those obtained from the rest of the area surveyed, and subsequent fishing at night in this area with the set net took 120 lbs of pilchard. In this same area a commercial fisherman took 6 tons of pilchards. A gannet taken in Port Ligar was found to have 23 pilchards in its stomach. These birds were observed working many areas in Tasman and Golden Bay and Marlborough sounds. Subsequent investigations with the fish-finder recorded the presence of fish shoals with an echo-trace of a similar kind to that recorded in Port Ligar.

From the above it appears highly probable that the vertically elongated black traces recorded do represent shoals of pilchard.

## VI RESULTS

### (a) Surface Survey

A summary of the results obtained by using the fish-finder during the surface survey in Tasman Bay, Golden Bay, and Marlborough Sounds is given in Table 1. All traces of fish recorded by the sounder have been included in the calculations of the percentage of fish over a certain distance run by the boat.

The fish shoals in Port Ligar were sampled and identified as pilchards but it was not possible to sample shoals located in Tasman and Golden Bay. Positive identification depends on the actual sampling of shoals located by the sounder and although all the evidence indicates these were pilchards there is the possibility that they were shoals of some other species.

Location of pelagic fish shoals is shown fully in figure 1.

(b) Aerial Survey

The location of all shoals of pelagic fish, both pilchard and unidentified, sighted on the aerial survey is shown on figure 2.

TABLE I.

	Total Distance Travelled miles.	Total Distance Traces of fish recorded in miles.	% of area With fish traces present	Approx.No. major shoals	Approx.No. small shoals	Areas of concentrations
Nelson to Separation Pt.	31	15	48	3	20	Sth Tasman Bay
Golden Bay	55	22	40	10	70	Centre of Golden Bay
Nelson to Croixelles	23	13	56	2	76	Mackay's Bluff to Whangamo Hd.
French Pass to D'Urville Is.	41	Nil	Nil	Nil	Nil	Nil
Admiralty Bay	20	400 yards	1.51	1	Nil	Puketea Bay
Port Ligar	4	3 $\frac{3}{4}$	85	6	21	Fishing Bay Maou Bay
Pelorus Sound	43	8	18	10	35	East Maude Is. area
Pelorus to Queen Charlotte S	13	Nil	Nil	Nil	Nil	Nil
Queen Charlotte	14	Nil	Nil	Nil	Nil	Nil

VII LOCATION(1) Western Shore Tasman Bay Nelson to Separation Point(a) Surface Survey

Two runs were made in this area over an interval of four days.

The first small traces were located off Motueka, and these traces continued intermittently up the coast to Separation Point in 10-20 fathoms of water.

Shags were observed working fish opposite Motueka, and a run through this area with the sounder recorded the presence of two large shoals of fish just below the surface.

(Shown in fig. 3A).

Fig. 4 shows small shoals of fish in the vicinity of Tonga Island.

Further small shoals of fish were located in the centre of Tasman Bay on a line between Kaiteriteri and Pepin's Island.

Sea birds were abundant over the whole area and numbers of gannets were observed circling and working small shoals of fish in the vicinity of Astrolabe and the centre of Tasman Bay.

(b) Aerial Survey

The area was flown over on 5th October. The only activity was approximately one dozen gannets diving off Tonga Island and just south of Separation Point.

A second flight two days later located a small shoal of Kahawai  $\frac{1}{4}$  mile south of Separation Point.

(2) Golden Bay(a) Surface Survey

An examination of Golden Bay on 16 September showed a concentration of diving gannets and dolphins

in the centre of Golden Bay, opposite Wainui Inlet in 17 fathoms of water.

A run through this area with the sounder located several shoals of fish (Fig. 5).

Further strong traces of fish were obtained in a run of 6 miles from the above area into Tarakohe Wharf. (Fig. 6).

A run between Tarakohe and Collingwood over a distance of 11 miles, resulted in the trace seen in Fig. 7.

Numerous shoals of fish were located near the bottom in 6 - 15 fathoms, and although identification of all these is uncertain, some show typical pilchard echo traces.

Shoals of fish were located on a five mile run from Collingwood to the centre of Golden Bay. (Fig. 8). It is suspected that they would probably be the same shoals which were located and recorded on a previous run. (Fig. 5).

The greatest concentration of birds was on the centre of the Bay, in the same area where the fish shoals were recorded.

(b) Aerial Survey

The first flight was made after a period of bad weather, and no surface fish were present.

A second flight three days later located one large surface shoal of pilchards estimated to be 30-40 feet in diameter, and approximately 8 smaller shoals estimated to be 6-10 feet in diameter. The large shoal was elongated in shape, and the smaller shoals circular.

These shoals were in the centre of the Bay in the same locality where good echo-traces of fish shoals were recorded during the surface survey. (Fig. 5).

Another shoal of fish was located halfway between D'Urville Island and Golden Bay and this was being worked by 40-50 gannets.

(3) Eastern Side Tasman Bay - Nelson to D'Urville Island

(a) Surface Survey.

Two runs were made over this area. Concentrations of midwater fish were located by the sounder between the north end of the Boulder Bank and Whangamoia Head. (Fig. 9). A second run over the same area three days later resulted in Fig. 10. No surface shoals were seen in the area, although sea birds and dolphins were numerous. Gannets were few in number, the most common birds present being shags.

Several small shoals of fish were located by the sounder in Croixelles Harbour.

No fish were located in French Pass or off the west coast of d'Urville Island. Flocks of terns were working in several areas but no traces were recorded of fish.

(b) Aerial Survey.

Three flights were made over the area. Gannets were few in number and either circling or resting on the water, except that on one occasion a dozen gannets were observed diving off Grenville Harbour on the west side of D'Urville Island.

Four surface shoals of pilchards each approx. 6 feet in diameter were sighted near Mackay's Bluff just on dusk.

(4) Marlborough Sounds

(a) Surface Survey

Concentrations of fish were found in two areas. These were Port Ligar, in the entrance to Pelorus Sound and Maud Island to Tawero Point, halfway down the same Sound.

Small traces were recorded from other areas in Pelorus but were few in number and widely scattered throughout the Sound.

(i) Port Ligar

The first run made over this area located 6 large shoals of pilchards in Fishing Bay on the northern side of the Bay. (Fig. II). A second run 4 days later over a distance of 2 miles located 16 small shoals and a scattering of fish over the whole distance. (Fig. 12). Large numbers of gannets were diving in the Bay on both occasions and it was found by examining one gannet's stomach that they were taking pilchards. No fish were shoaling on the surface during the day, but at night they could be heard jumping out of the water. The gill net was set one evening for  $1\frac{1}{2}$  hours, and 120 lbs of pilchards were taken.

A commercial fisherman - Mr A. Fishburn, made two lifts one evening with a 150 fathom by 23 fathom Lampara net. The fish were attracted by lights, and encircled by the net. His total catch was approximately 300 cases, or 6 tons of pilchards.

Local fishermen report that Port Ligar and Bulwer Bay with a total area of 3 sq. miles are the main areas of pilchard concentration in the Marlborough Sounds.

(ii) Maud Island

Surface Survey. Three runs were made in this area over a period of 3 days, and on each occasion midwater echo traces of a characteristic pilchard shape were obtained. (Fig. 13a 13b).

No surface shoals were located and gannets were rare, although terns, fairy prion and dolphin were fairly common.

(iii) Admiralty Bay.

Surface Survey. One run was made through the bay. Gannets were observed working in 4 patches, and a run with the sounder over one of these patches resulted in the location of a small shoal of fish.

- (b) Aerial survey. A flight was made over the bay several days after the surface survey. Numbers of gannets were observed circling at random over the whole area.

It is likely that there were only a few small shoals of pelagic fish present, and these were most probably pilchards.

(i) West CoastAerial Survey.

A flight was made from Farewell Spit down the coast to Karamea. Weather conditions were marginal for spotting with a slight westerly chop. The whole area was void of birds and shoaling fish, except for one small school of kahawai and a few gannets just north of Karamea.

(ii) Admiralty Bay to Kaikoura Peninsula

Aerial Survey. A large flock of 40-50 terns and 3 smaller flocks of the same birds were working round the Chetwode Islands. One 15 foot shoal of barracouta was sighted in

the same area.

Ten flocks of terns were located working around Motungarara Island, but it is unlikely that these birds were fishing for pilchards.

Weather conditions were unsuitable for spotting between Cape Jackson and Cape Campbell.

Flocks of terns and mutton birds and schools of dolphins were common off the Clarence River. However, no fish were sighted until south of the Clarence River, where 9 shoals (6 - 10 ft in diameter) of kahawai were located.

Six large flocks of terns, with several hundred birds in each flock, were located, feeding on the water just north of the Kaikoura Peninsula.

Dolphins were very common south of Kaikoura Peninsula out to a distance of 5 miles from the coast.

There is no evidence that pilchard shoals were present in this area on the day of the survey.

#### VIII ESTIMATION OF ABUNDANCE

To estimate the abundance of pilchards in an area from the number and size of the echo traces, it is necessary that the shoal indicated on the sounder be taken in a net and the contents of the net compared with the size of the trace.

It is not possible to determine the density of a shoal from echo signals alone unless experience has been obtained by actually fishing an area.

It was not possible on this survey to catch midwater shoals located by the sounder. Therefore, in order to gain some idea of the quantity of fish in the shoals plotted by the sounder, certain results of investigations done by Rapson (1953) on pilchards in South Western Australia have been assumed to apply also to pilchard shoals in Nelson.

Rapson (1953) concluded that pilchard shoals are usually spheroidal in shape, and that the average density of fish in a shoal is one lb weight to 3 cubic feet of water.

It was calculated that with a boat speed of 10 feet per 1 second and a paper speed of 7 mm. in 60 seconds, each 1 mm. on the record paper was equal to an actual distance over the bottom of 80 feet.

An attempt was then made to measure the width of the echo traces, and to calculate the actual horizontal diameter of the shoals. However, most shoals formed a trace under 1 mm. in width on the echo paper and when the thickness of the stylus and the overlap between successive sound impulses were taken into account it was found almost impossible to estimate the shoal width.

In the case of traces several millimetres in diameter it was possible to determine the width of the shoal. In doing so, it was necessary to take into account that the sounder picks up the shoal before the ship is vertically above its front edge, and continues indicating beyond the point when the edge is left behind by the ship. In the particular traces obtained during the survey a deduction of one third of the measured width of the trace gave the approximate actual diameter of the shoal. However, the vertical diameter of fish shoals can be accurately measured, and this is the method used to calculate the size of the smaller shoals. If it is assumed that the shoal is spheroidal in shape, then the horizontal diameter of the shoal will be the same as the vertical diameter. The area of the shoal can then be calculated in cubic capacity and, with a known density of 1 lb. of fish to every 3 cubic feet of water, an estimate can be made of the total weight of fish in the shoal.

Tables 2, 3 and 4 give the number of major shoals located in each area and an estimate of the quantity of fish.

TABLE 2.

Number of Shoals	Location	<u>Tasman Bay</u>		Total weight of all shoals lbs.
		Diameter in feet	Weight of each shoal lbs.	
1	Motueka	150 x 10	73,920	73,920
1	Mackays Bluff	110 x 20	80,640	80,640
1	Separation Point	24	5,000	5,000
4	Tonga Isl.	18	2,000	8,000
14	Whangamoia Hd.	16	1,200	16,800
4	Motueka	12	570	2,280
8	Mackays Bluff	9	300	2,400
				lbs 189,040
				tons 84

TABLE 3.

	Location	<u>Golden Bay</u>		Total weight lbs.
		Diameter	Weight of each shoal	
1	Golden Bay	36	15,552	15,552
5	" "	30	9,000	45,000
5	" "	15	1,125	5,625
1	" "	8	170	170
				lbs 66,347
				tons 29½

TABLE 4.

	Location	<u>Marlborough Sounds</u>		Total weight lbs.
		Diameter	Weight of each shoal	
1	Port	100 x 60	200,000	200,000
1		36	15,550	15,550
1	Ligar	30	9,000	9,000
3		24	5,000	15,000
1		12	570	570
1	Maud	106 x 24	89,888	89,888
7		30	9,000	63,000
1	Island	24	5,000	5,000
1		18	2,000	2,000
				lbs 400,008
				tons 178

The total quantity of fish in the shoals examined in the three tables is estimated to be approximately 293 tons.

Other shoaling fish were recorded over large areas and in dense concentrations. Their identity is uncertain, and no attempt has been made to calculate their abundance. If they are pilchards, which is quite possible, then considerably greater quantities are present than estimated.

It must be pointed out that the estimates are very approximate, depending as they do on certain conditions prevailing in Australia which may not necessarily be comparable in New Zealand.

#### IX PREDATORS

No specific work was done on this subject but the following observations are of interest.

Barracouta were abundant in Port Ligar and had been taking pilchards. One snapper stomach was found to contain 8 pilchards. Fishermen have also reported that groper taken from 200 fathoms have been found with stomachs full of pilchards. Good catches of John Dory are made also when pilchards are present.

#### X POPULATION STRUCTURE

Fig. 14 shows the length frequency graph of a sample of 181 pilchards taken in a 1 and 1½" mesh gill net. This is not a truly representative sample of the population because of the selective action of the mesh.

Two peaks of abundance are present, and it is probable that the majority of the fish 14.0 cm. in length were taken in the 1" mesh, and those 17-18 cms. in length were taken in the 1½" mesh. However, the graph indicates that fish 12 to 20 cms. in fork length are present, and that they are more abundant in the smaller size range.

An examination of the growth rates of pilchards in other countries is one way of estimating the approximate age of the Nelson pilchards. The table below shows the different ages of the same sized fish from 3 countries:

Fish Length in cms.	Age in Years		
	NSW AUST.	BRITAIN	STH AFRICA
25	Not given	Not given	5
20	5	2½	3
15	2½	1	1
10	1¼	6 months	6 months

The age of Nelson pilchards 13-14 cms in length is likely to be between 1-2½ years, and the 17-18 cms. pilchards, between 2-3½ years.

It appears most likely that the Nelson pilchard have a rapid growth rate, and are of commercial value in under two years of age.

## XI SPAWNING

The spawning period of the Atlantic pilchard Sardina pilchardus is between April-July, a period of 4 months.

The South African pilchard Sardinops ocellata also has a protracted spawning period between September-February.

The eggs are free floating.

Twenty pilchards from Port Ligar were examined, and the gonads in both sexes were in a condition of inactive to active. The ovaries were just beginning to show some enlargement. They were slightly elongated and thickening up with a pinkish coloration. The testes were slightly elongated with a whitish coloration.

It is possible that the dispersal of the pilchards from the Tasman Bay area in February and March, is related to their spawning habits, and that they are similar to the Atlantic and South African pilchard with a summer spawning.

It is a characteristic of the South African pilchards that the ripening of the gonads occurs in waves and as each group of fish approaches spawning condition it leaves the shoaling area.

## XII CONDITION OF FISH

The pilchards taken on the survey were fat, with firm flesh and a high oil content. Samples were canned and found to be very edible.

The condition of the fish, i.e. texture of flesh and oil content, varies throughout the year, and at certain times the fish is of no commercial value. The South African pilchard is at its peak in March then declines in quality in autumn and winter; reaching a minimum condition in August and September.

## XIII INFORMATION FROM LOCAL FISHERMEN

The common comment was that the survey was too early as the pilchards had only just started to move into the area. They were not present all year round in Tasman and Golden Bay, but appeared in September, reaching a peak in December when they shoaled over a large part of Tasman Bay, then decreasing in number until by March they had gone from the area.

Roes are full by the end of November to December and there appears to be in inshore movement in spring and summer, with fish shoaling in the inner reaches of Pelorus and Queen Charlotte Sounds and the southern part of Tasman Bay.

Mr V. Macauley stated that years ago pilchards came into these areas as early as July and other fishermen say that they were more plentiful in the Queen Charlotte Sounds 20 years ago, and that they have only started to come back into both sounds in quantity in the last 3 or 4 years.

Rapson (1953) states that in the Marlborough Sounds area, where a fishery flourished for several short periods, hauls of over 10 tons were exceptional and the usual maximum size was 5 tons.

The only area where pilchards seem to be really abundant almost all year is Port Ligar, this area being fished by local fishermen to obtain bait for the groper fishery.

#### XIV SUMMARY

Shoals of midwater fish presumed to be pilchards Sardinops neopilchardus were found in Tasman Bay, Golden Bay and Pelorus Sound. Areas of greatest concentrations were Port Ligar and Maud Island in Pelorus Sound, the centre of Golden Bay and along the eastern side of Tasman Bay.

Aerial spotting located surface shoals up to 30 feet in diameter, and echo-traces recorded shoals up to 150 feet.

Sixty-two shoals of varying sizes were located over the whole area, and the total quantity of fish in these shoals was estimated at approximately 293 tons.

The presence of gannets was a reliable indication of pilchard shoals.

Pilchards of both sexes had inactive to active gonads.

Pilchards 12.0 to 20.0 cm. in fork length were caught in Port Ligar with the main size group being 13.0 to 14.0 cm. in length.

It was estimated that Nelson pilchards 14.0 cm in fork length were approximately 1 to 2½ years old.

Information from fishermen gave the peak of abundance during December with pilchards in the area between September and March.

#### XV ACKNOWLEDGEMENTS

Thanks are due to Messrs Pye Ltd for the loan of the fish-finding machine, and for the cooperation extended by the Nelson fishermen and other boat owners.

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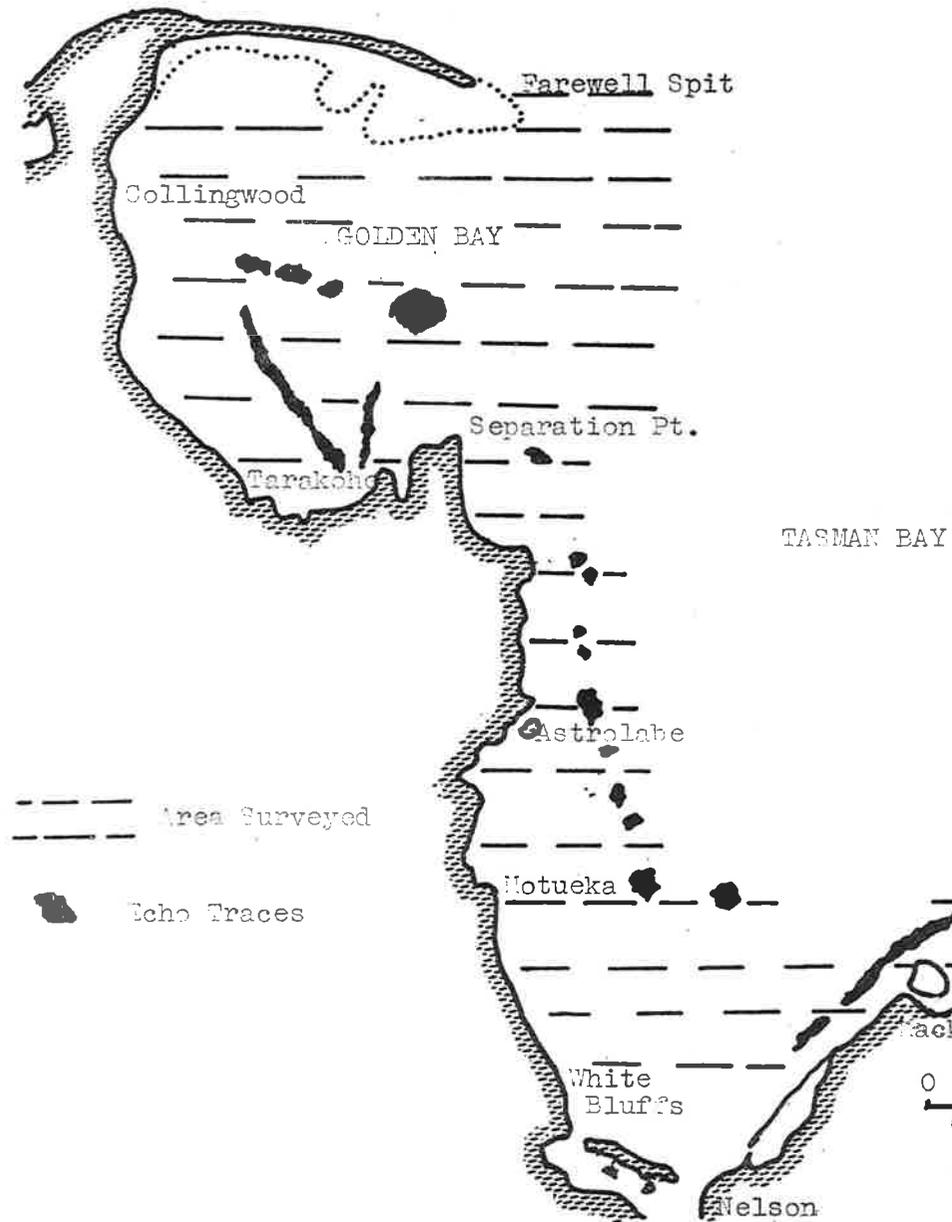
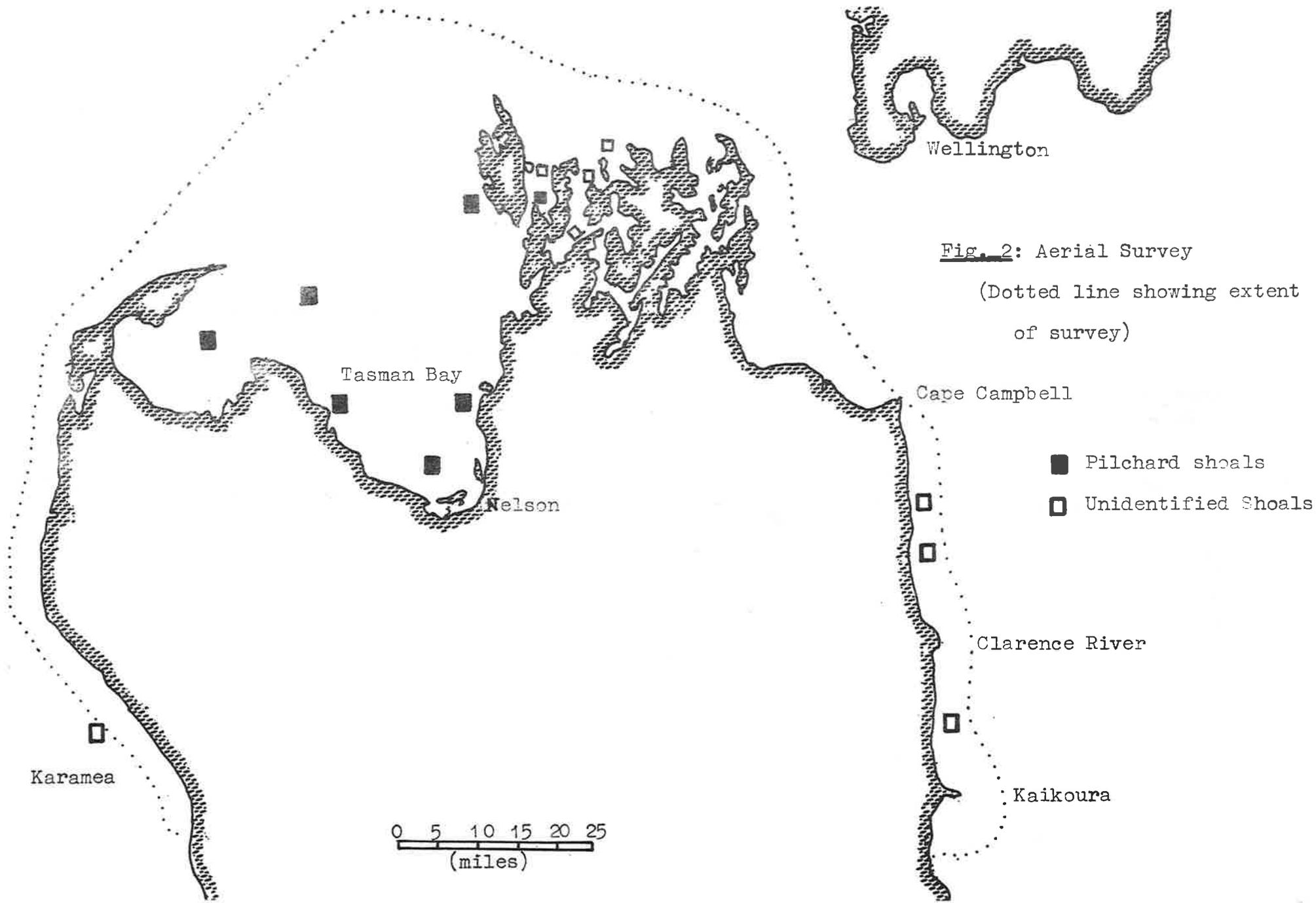


Fig. 1: Surface Survey and Location of Pelagic Fish Echo Traces.



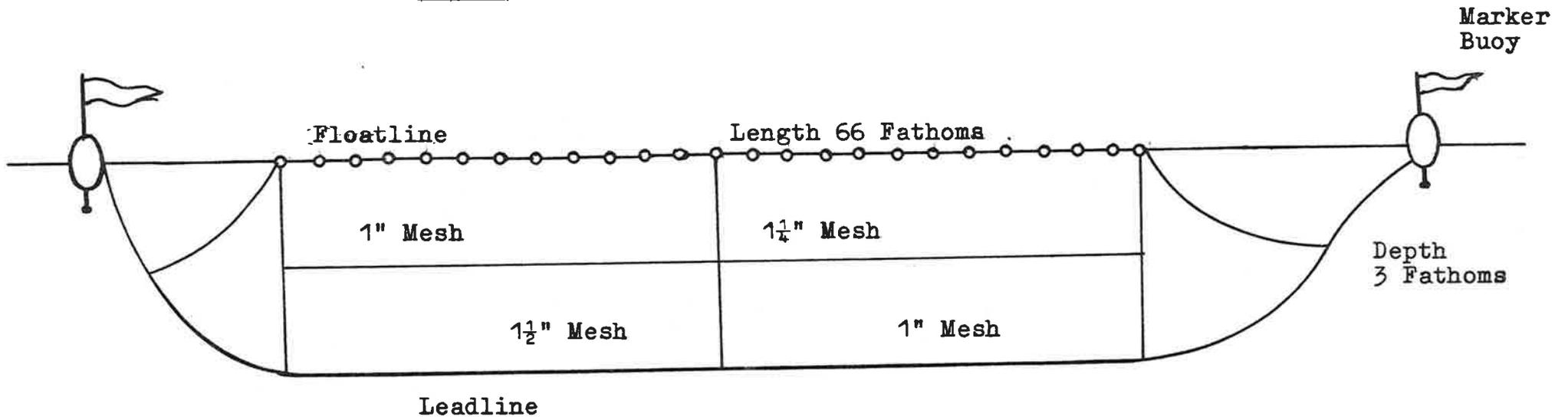


**Fig. 2: Aerial Survey**  
 (Dotted line showing extent of survey)

- Pilchard shoals
- Unidentified Shoals

0 5 10 15 20 25  
 (miles)

Fig. 3 Floating Gill Net.



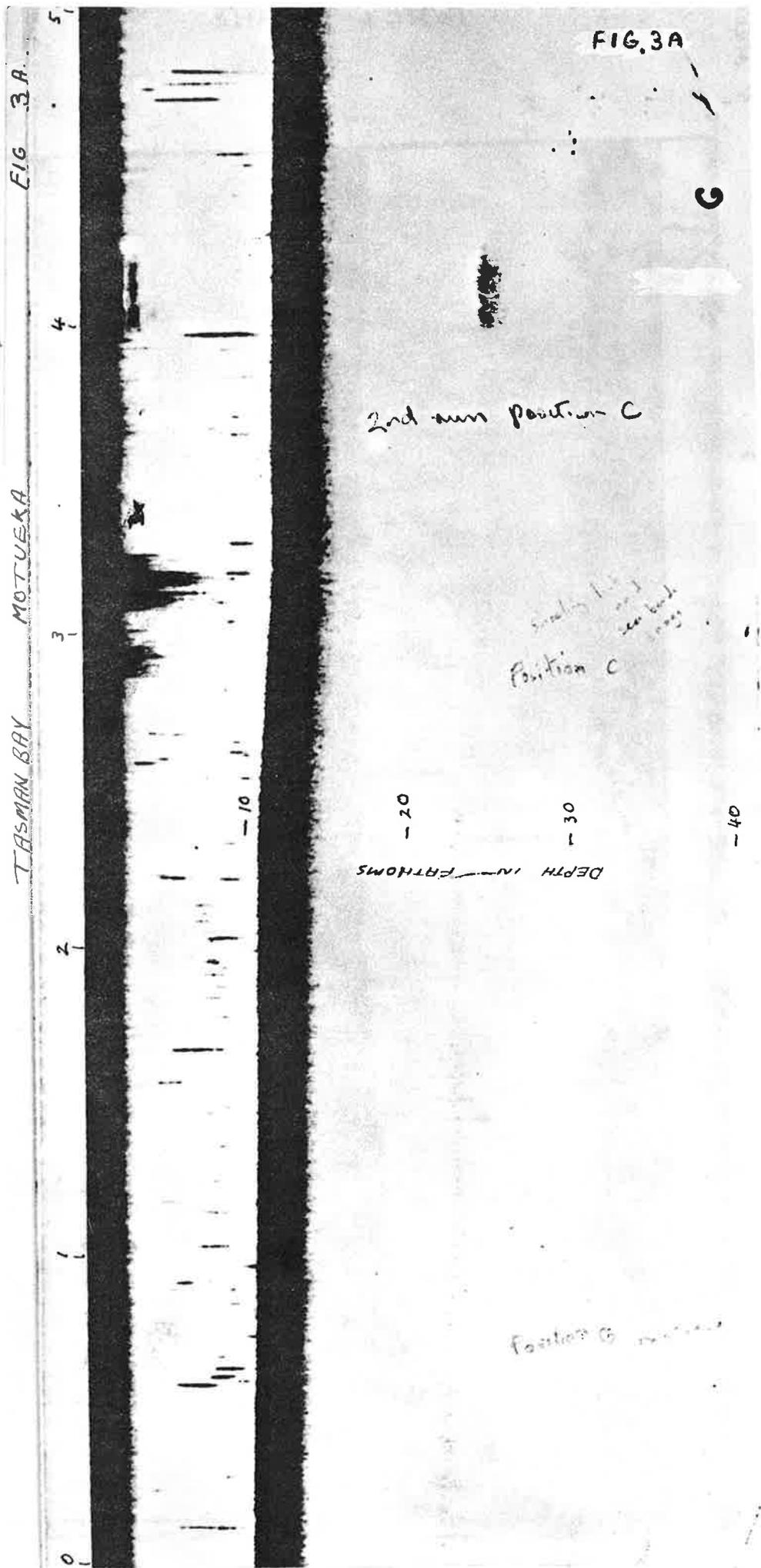


FIG 3A

MOTUEKA

TASMAN BAY

FIG 3A

G

2nd run position C

Position C  
 small 1st  
 sea level  
 1000

DEPTH IN FATHOMS  
 -20  
 -30  
 -40

0 1 2 3 4 5

Position B

TONGA ISLAND

FIG 4

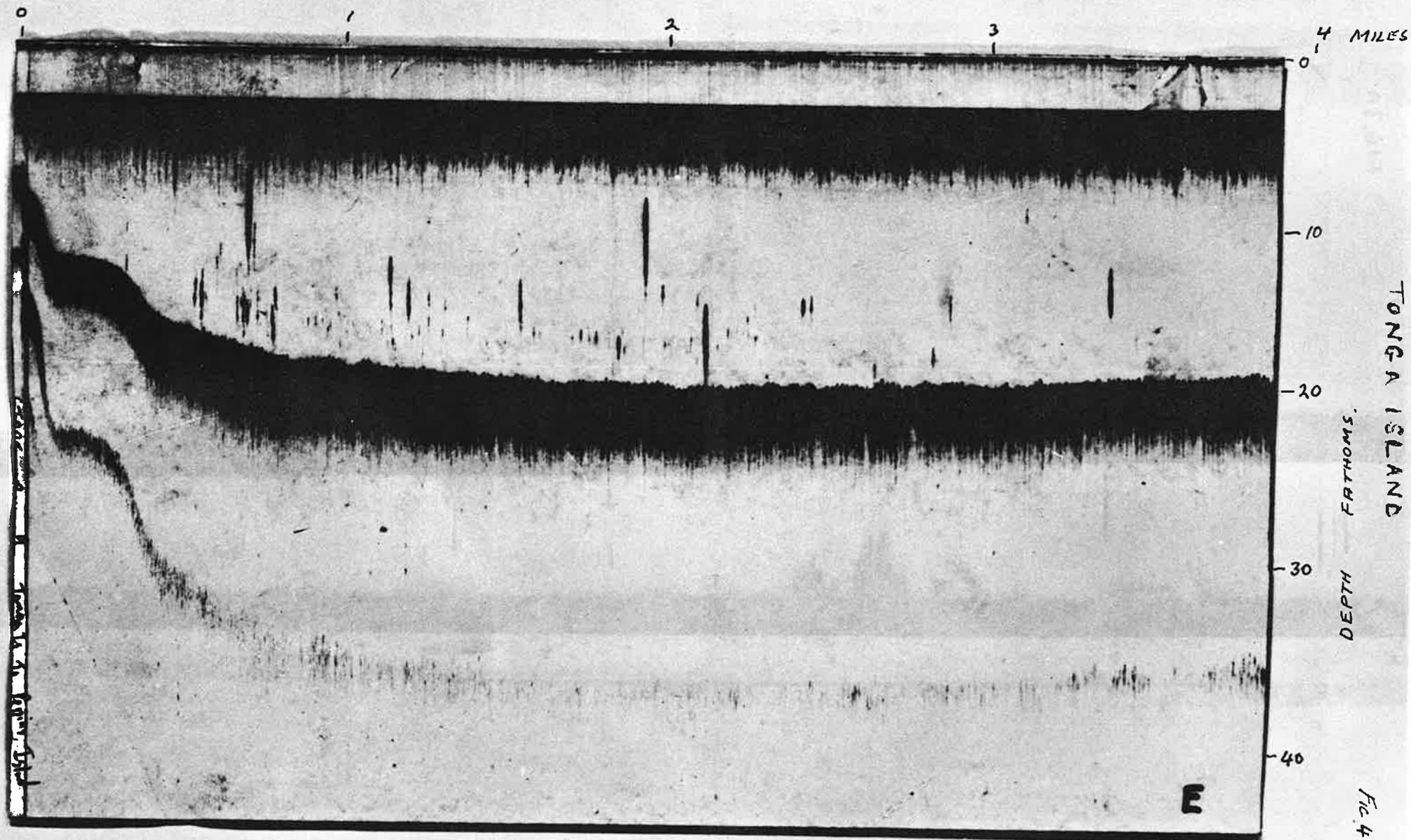
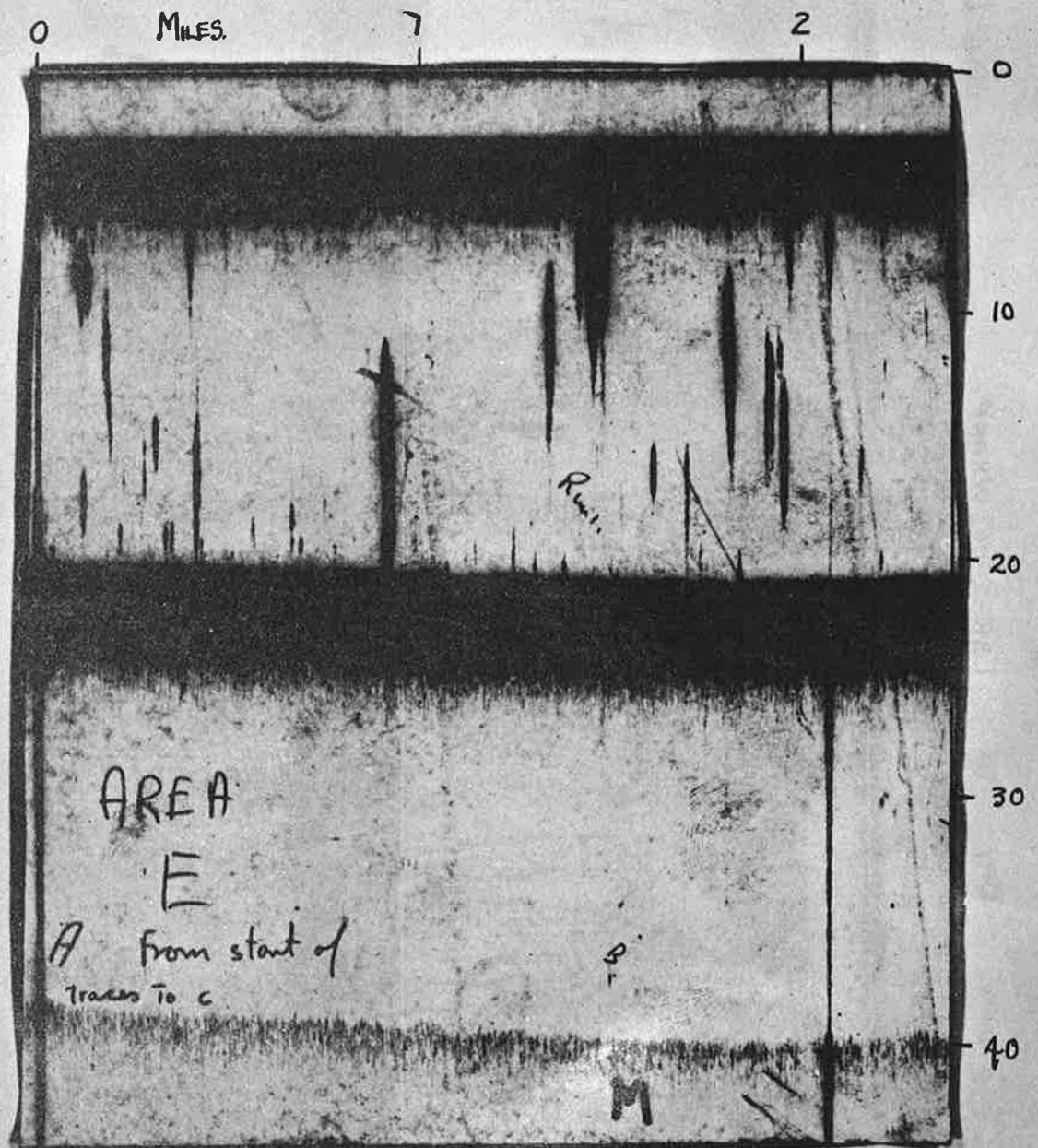


FIG 4

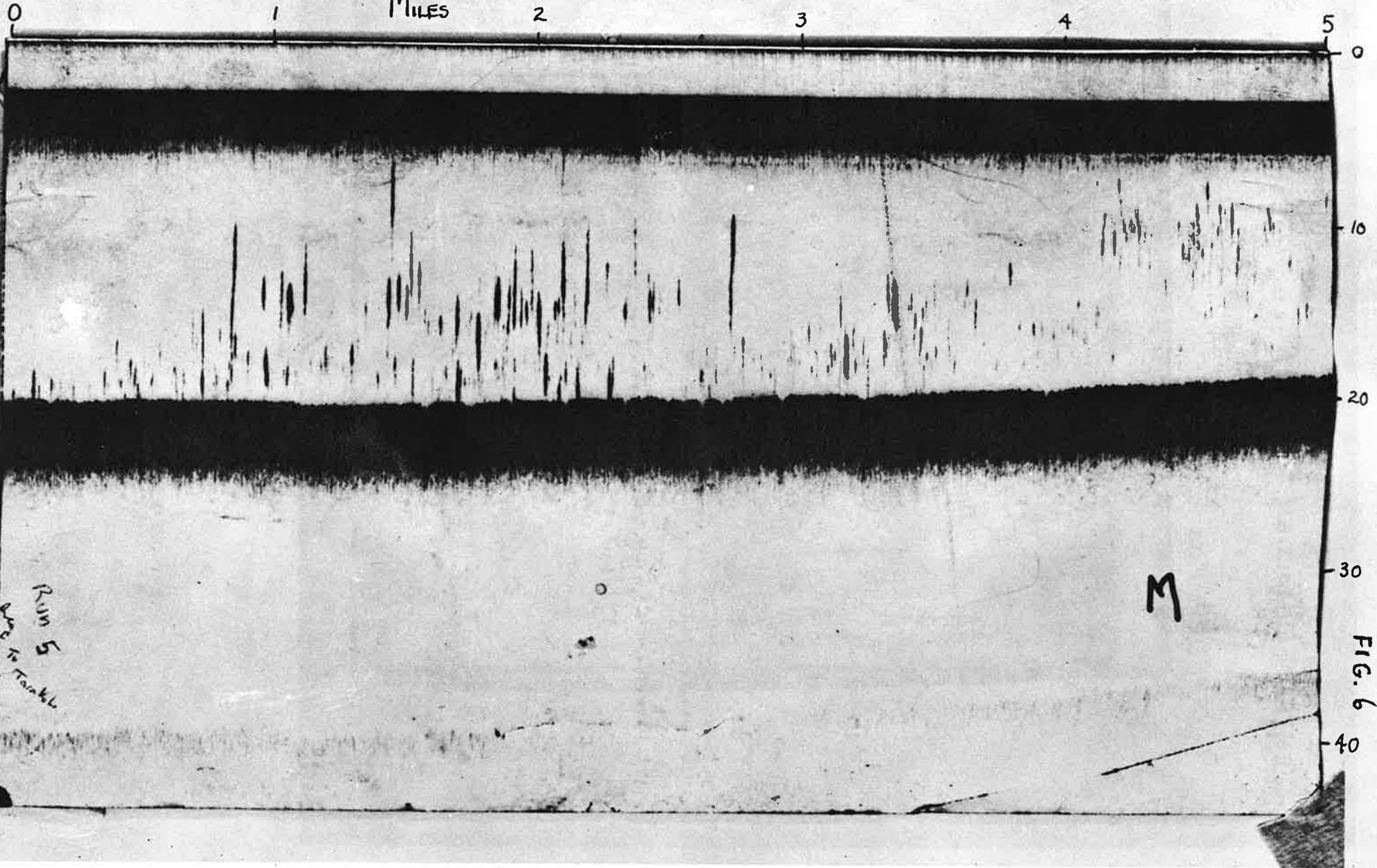
CENTRE GOLDEN BAY.

Fig 5.



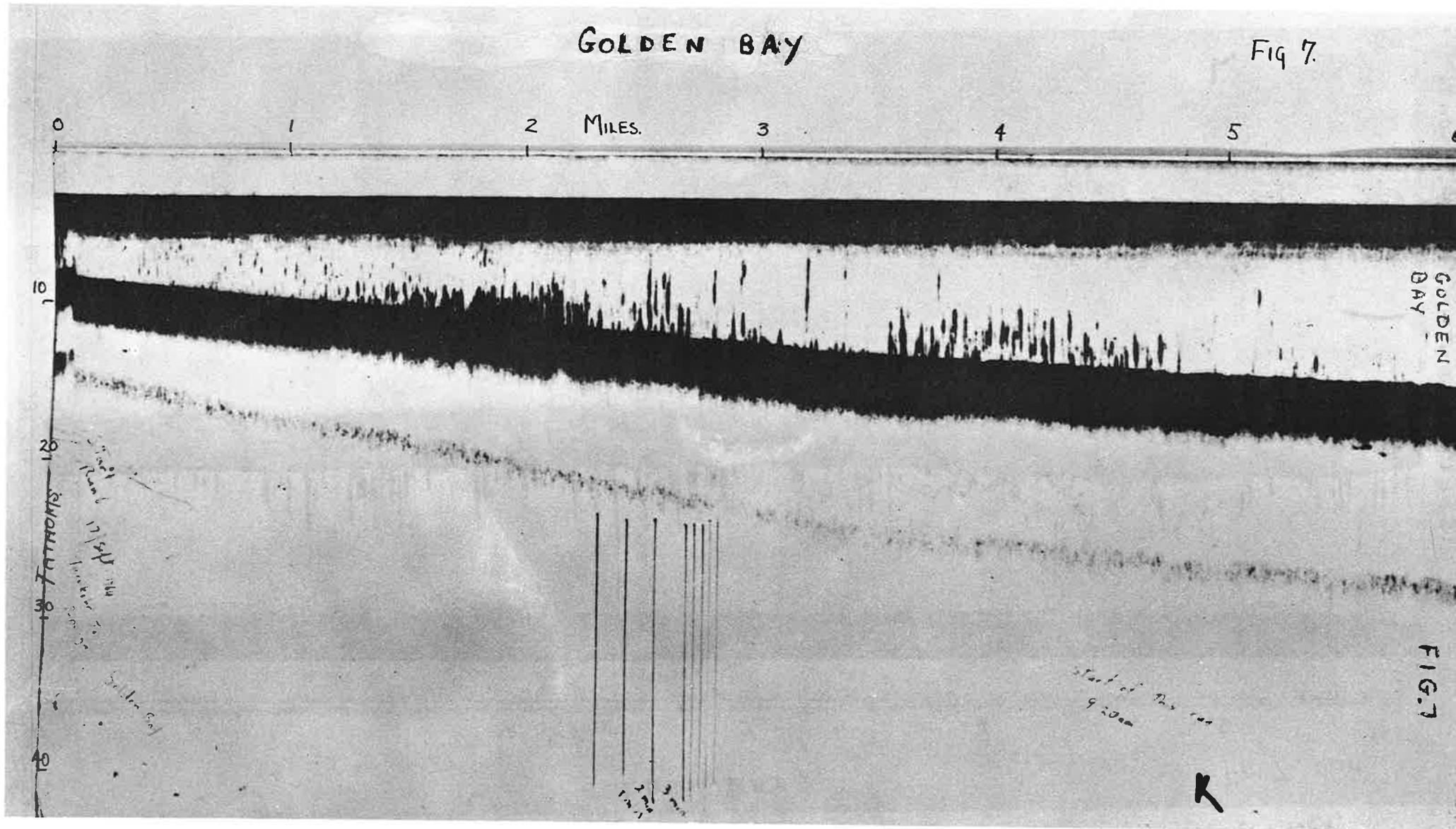
CENTRE GOLDEN BAY TO TARAKOHE WHARF

FIG 6



# GOLDEN BAY

Fig 7.



GOLDEN BAY

FIG. 7 CONT.

GOLDEN BAY

FIG 7 CONT.

5

4

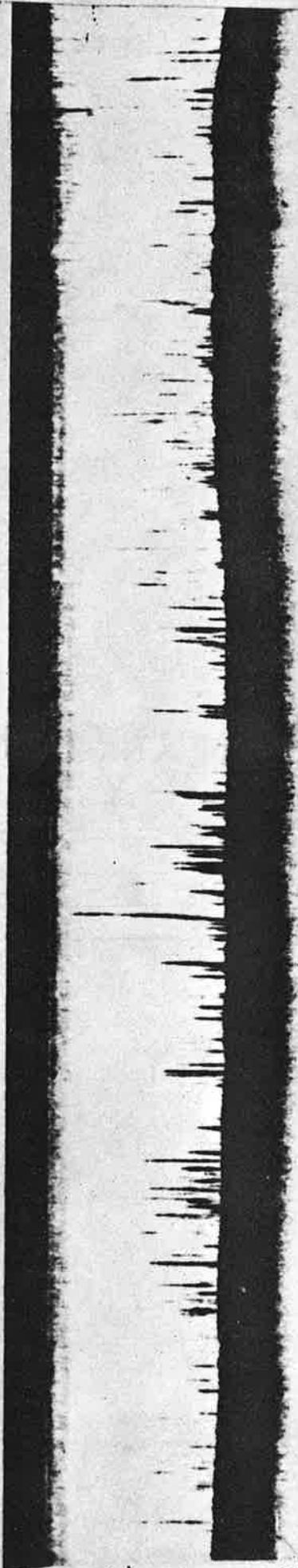
3

2

1

0

MILES



10

20

30

FATHOMS

40

h

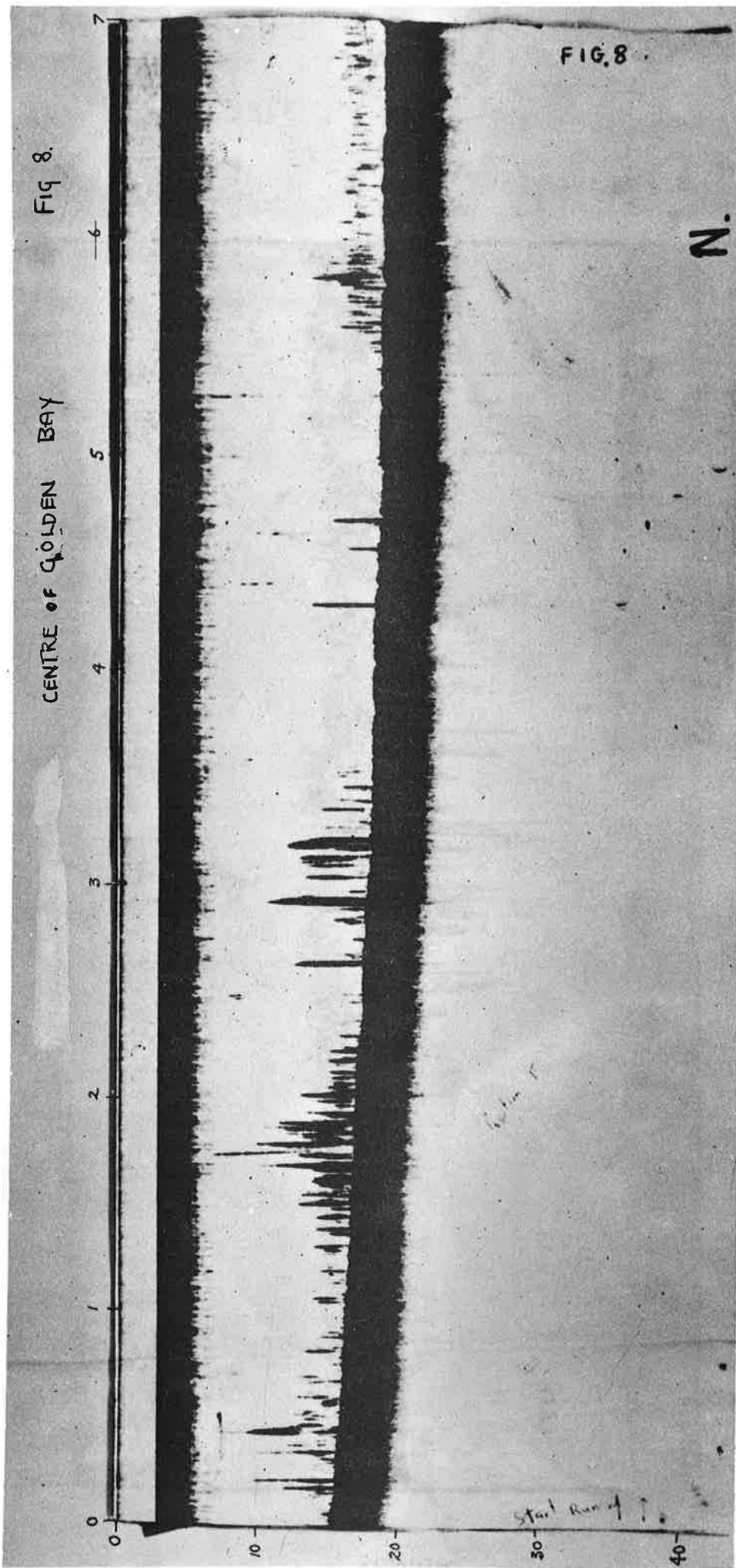


FIG. 9

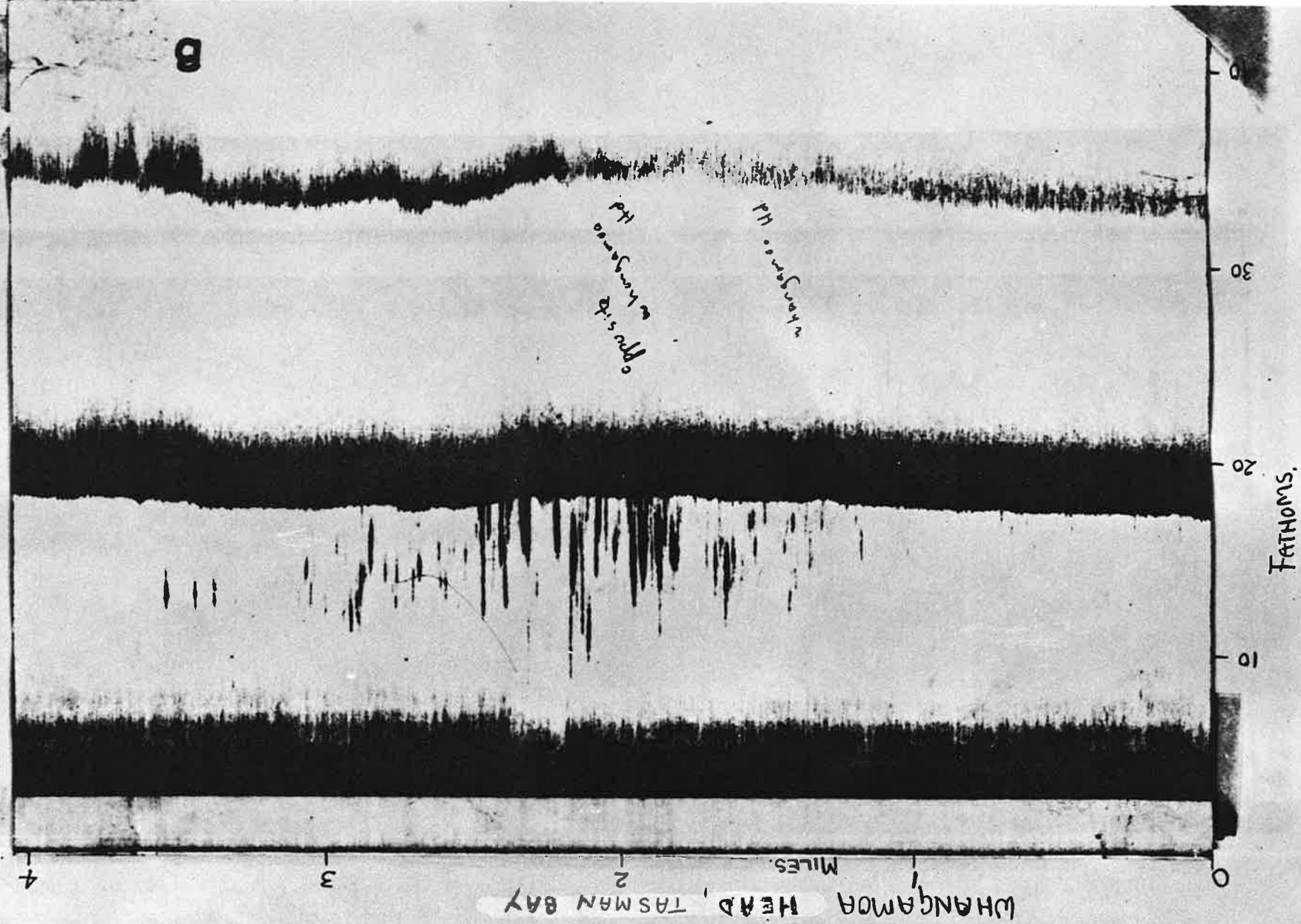


Fig 9

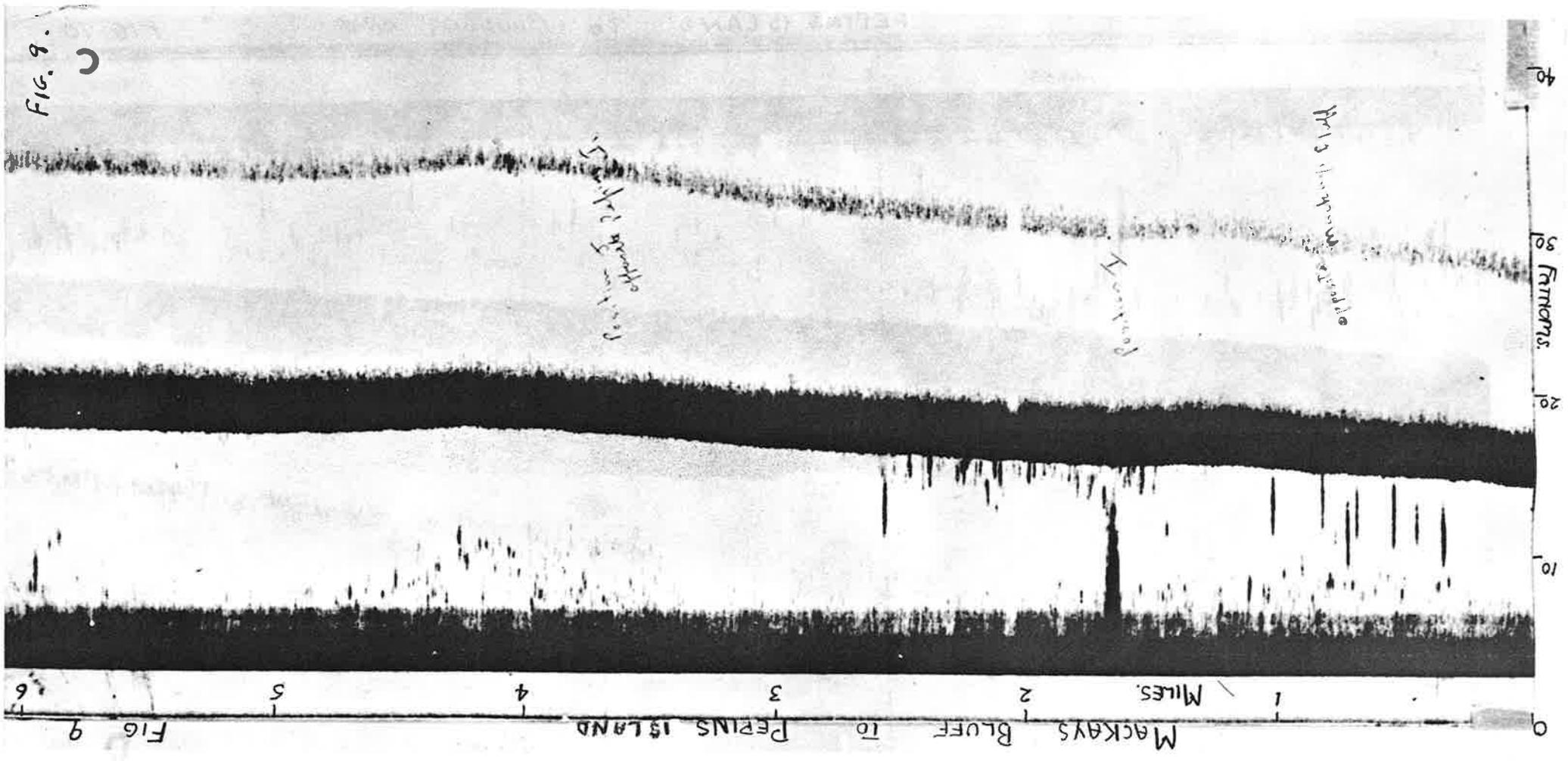


FIG. 9.

FIG 9

MACKAYS BLUFF TO PERINS ISLAND

MILES.

40

30

20

10

0

Fathoms

Mackays Bluff

Perins Island

Perins Island

C



FIG. 11

PORT LIGAR

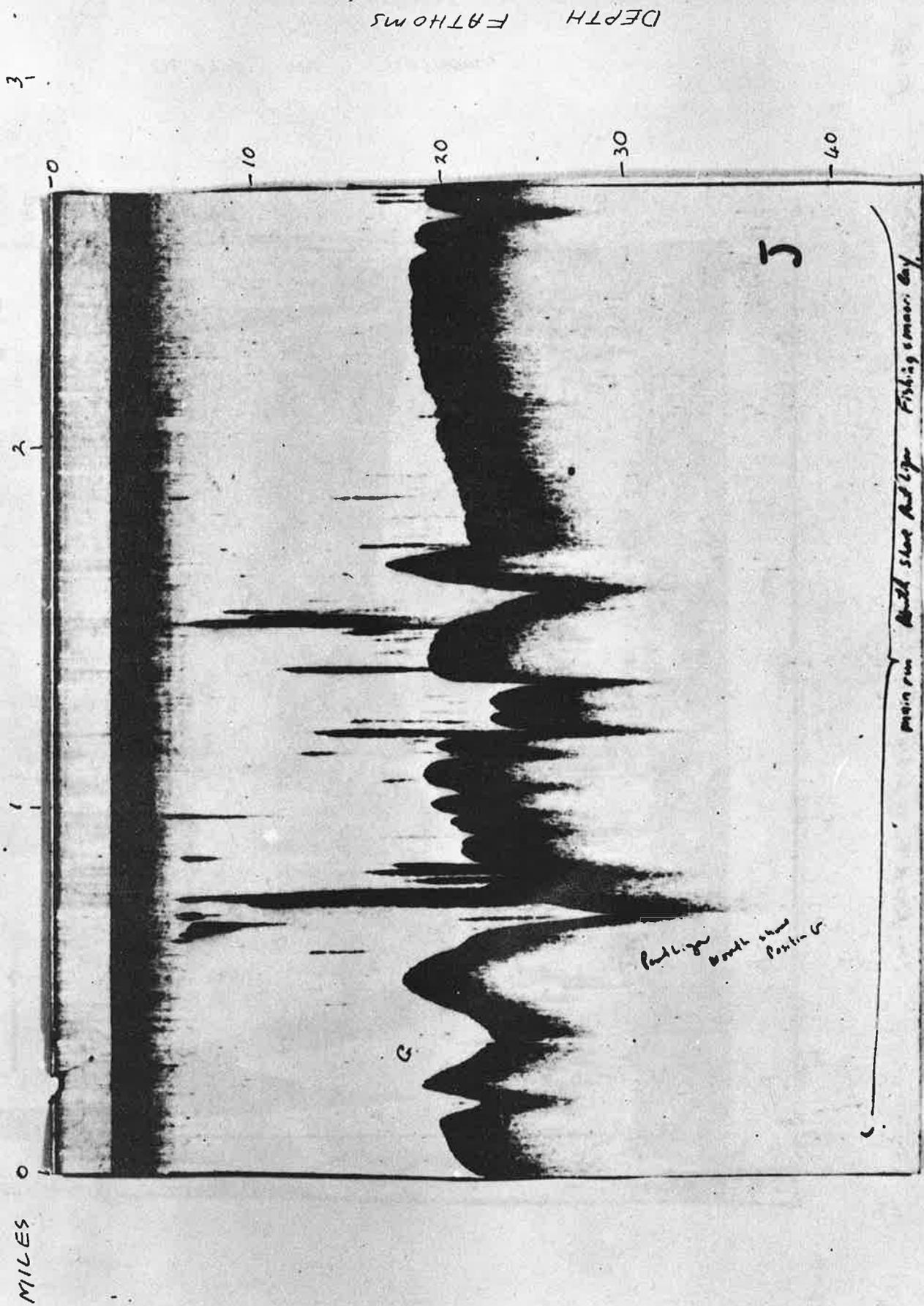


FIG. 11

FIG. 12

FIG. 12

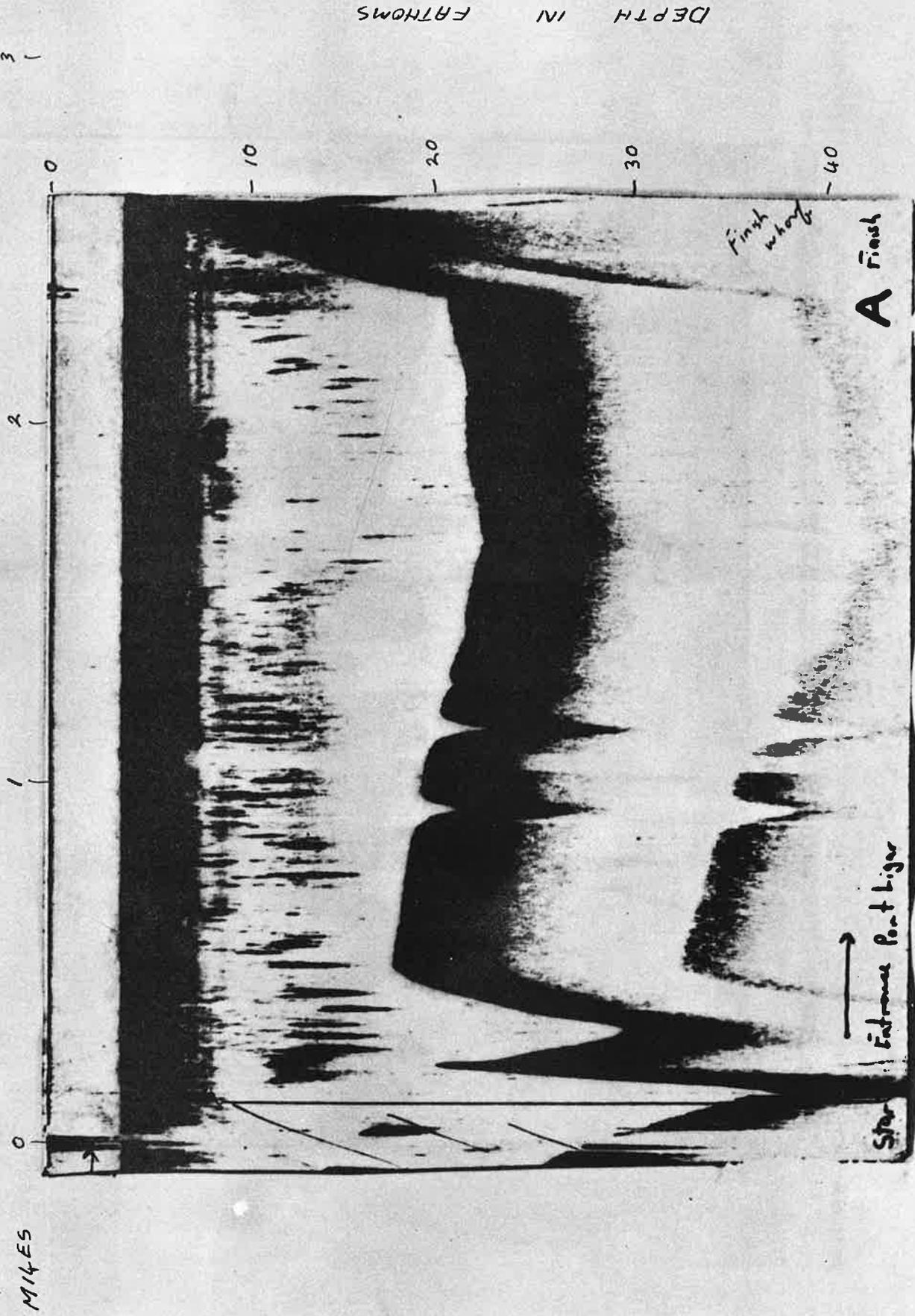


FIG 13.

MAUD ISLAND

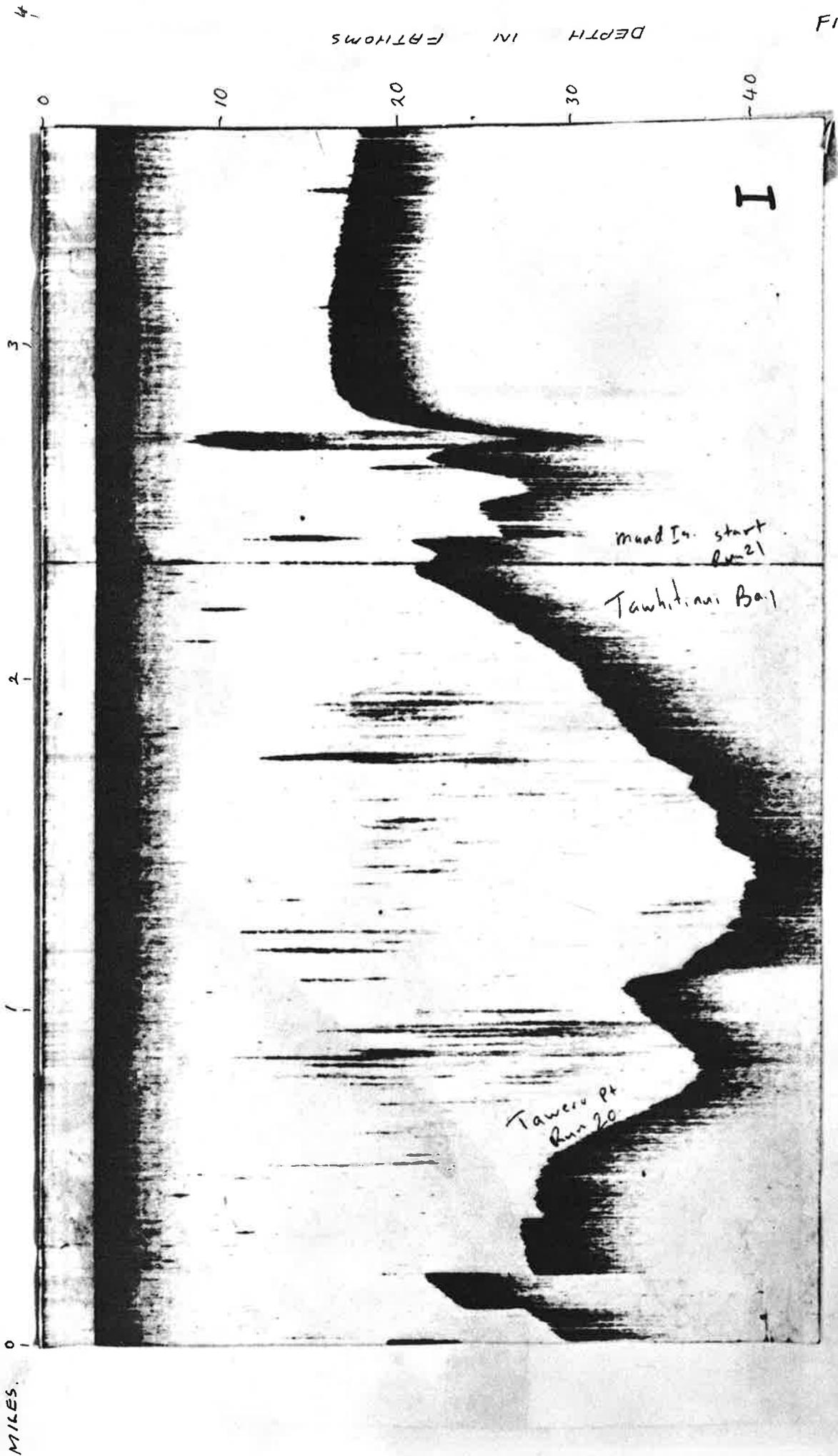


FIG 13

FIG 13.B.

MAUD ISLAND

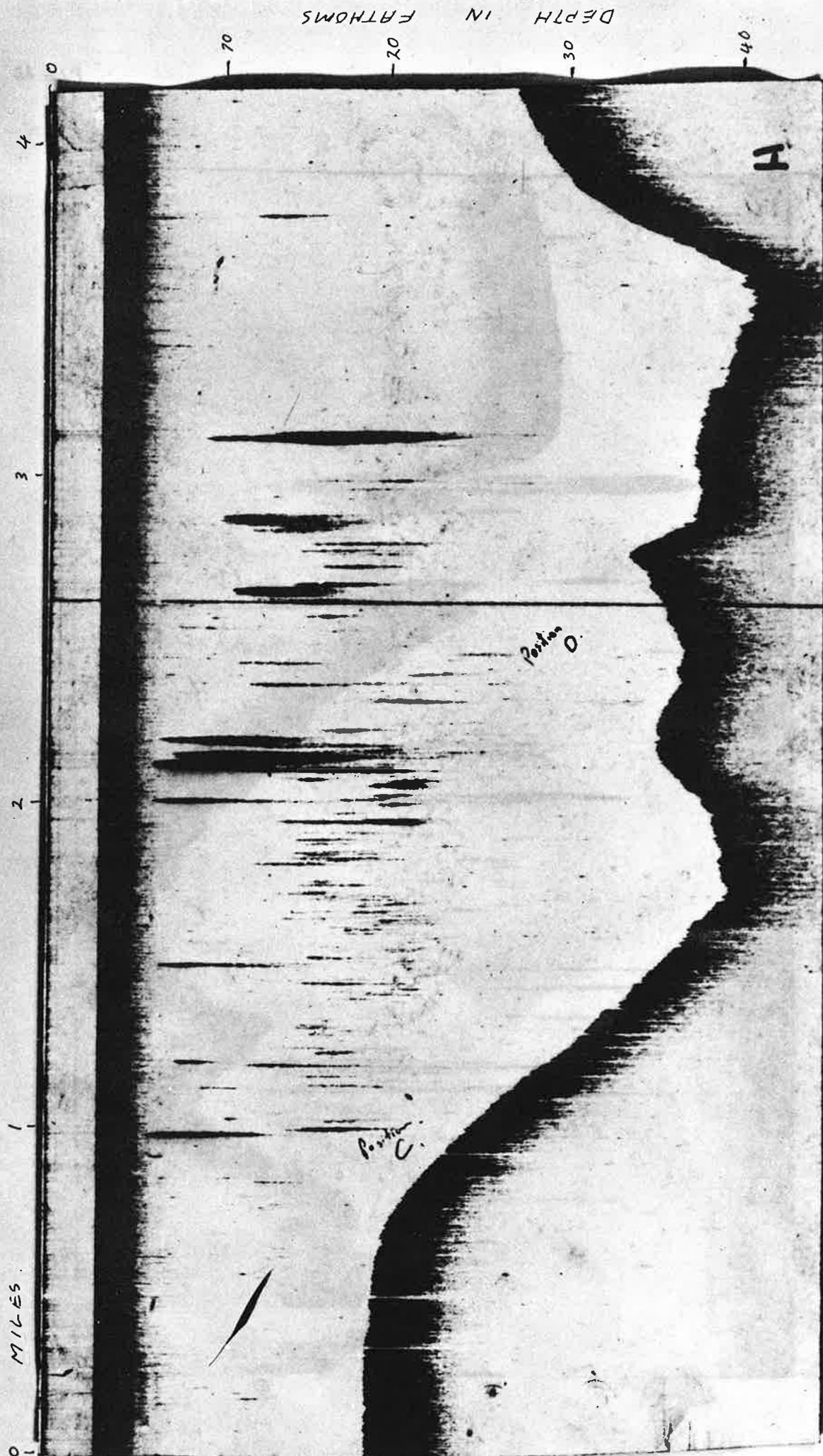


FIG 13.B

MAUD ISLAND

FIG 13.B

LENGTH FREQUENCY GRAPH PILCHARDS  
PORT LIGAR PELOBUS SOUND  
29 SEPTEMBER 1964

Fig. 14

