ANNEX A

THE THAILAND-SINGAPORE-MALAYSIA SUBMARINE CABLE
PRELIMINARY SURVEY MEETING

TELECOMMUNICATIONS HEADQUARTERS, KUALA LUMPUR, MARCH 6TH, 1978

LIST OF DELEGATES

JAPAN

1. KUNITO ABE (Leader)
   Vice Counsellor of Telecommunications
   Ministry of Posts & Telecommunications

2. HIKARU CHONO
   Ministry of Posts & Telecommunications

3. TERUO SHIBATA
   Submarine Cable Construction
   KDD

4. ROKURO KITSUTA
   KDD

5. TAISUKE KITAMURA
   KDD

6. AKIO ITOH
   Japan International Cooperation Agency (JICA)

MALAYSIA

Ir HAJI MOHD ALI YUSOFF
Controller of Telecommunications

ANNEX B

THE THAILAND-MALAYSIA-SINGAPORE SUBMARINE CABLE

PRELIMINARY SURVEY MEETING

TELECOMMUNICATIONS HEADQUARTERS, KUALA LUMPUR, MARCH 7TH, 1978

LIST OF DELEGATES

JAPAN

1. KUNITO ABE (Leader)
   Vice Counsellor of Telecommunications
   Ministry of Posts & Telecommunications

2. HIKARU CHONO
   Ministry of Posts & Telecommunications

3. TERUO SHIBATA
   KDD

4. ROKURO KITSUTA
   KDD

5. TAISUKE KITAMURA
   KDD

6. AKIO ITOH (Coordinator)
   Japan International Cooperation Agency
   (JICA)

7. H.TSUJIMOTO
   Embassy of Japan
   Kuala Lumpur

8. TOORU KASAI
   Japan International Cooperation Agency
   Kuala Lumpur

MALAYSIA

I.O. MERICAN
Deputy Director General of
Telecommunications

GOH KHEN WAH
Director of Telecommunications

Ir HAJI MOHD ALI YUSOFF
Controller of Telecommunications

AHMAD SOBRI ISMAIL
Assistant Controller of
Telecommunications

ANNEX C

THE THAILAND-MALAYSIA-SINGAPORE SUBMARINE CABLE

PRELIMINARY SURVEY MEETING

ECONOMIC PLANNING UNIT, KUALA LUMPUR, MARCH 7TH, 1978

LIST OF DELEGATES

JAPAN

1. KUNITO ABE (Leader)
   Ministry of Posts & Telecommunications

2. HIKARU CHONO
   Ministry of Posts & Telecommunications

3. TERUO SHIBATA
   KDD

4. ROKURO KITSUTA
   KDD

5. TAISUKE KITAMURA
   KDD

6. AKIO ITOH (Coordinator)
   Japan International Cooperation Agency
   (JICA)

7. TOORU KASAI
   Japan International Cooperation Agency
   Kuala Lumpur

MALAYSIA

BASHAH NORDIN
Economic Planning Department

Ir HAJI MOHD ALI YUSOFF
Telecommunications Department

ZULKIFLIABU HASSAN
Economic Planning Department

AHMAD SOBRI ISMAIL
Telecommunications Department

SAIKHOL ROSLI
Economic Planning Department

ANNEX D

SCOPE OF WORK

FOR

THE ROUTE SURVEY

OF

THE THAILAND-MALAYSIA-SINGAPORE SUBMARINE CABLE PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

1. Introduction

In response to the requests of the governments of Thailand, Malaysia and Singapore, the government of Japan has decided to conduct the route survey for Thailand-Malaysia-Singapore submarine cable project as a part of its technical cooperation programmes to foreign countries.

Based on this decision, the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the cooperation programmes has organized a team so as to carry out the survey.

The present document sets forth the scope of work in regard to the above mentioned survey which is to be carried out in close cooperation with the governments and authorities concerned.

2. Objective of the survey

The objective of the survey is to select the most suitable route for laying a submarine cable which links the cable landing sites in Thailand, Malaysia and Singapore and to provide these three countries with necessary data for designing and laying the submarine cable system.

3. Outline of survey work

The ocean survey will be made by using a Japanese survey vessel "DAISAN KAIKO MARU" (500t) on the following items.

1) Sounding

2) Subbottom profiling near the bottom surface

3) Observation of bottom surface condition by using Side Scan Sonar and underwater camera

4) Sampling bottom sediment

5) Observation of water temperature

Survey of the land portion from landing point to cable terminal site will also be made, if necessary.

4. Report

4.1 Preparation of report

JICA will prepare and submit required number of copies of the following reports in English to the three governments.

1) Interim report

   Within about two weeks after the completion of the ocean survey.

2) Draft final report

   Within about three months after submission of interim report. The governments concerned are requested to provide with their comments on the draft final report within two weeks after receiving the report from JICA.

3) Final report

   Within two months after receiving comments from the governments concerned.

4.2 Contents of report

The report will contain the following items.

1) Interim report

   a. Summarized result of the ocean survey

   b. Proposed cable route and route conditions

   c. Cable length required for the proposed route and other requirements for designing the cable system

2) Draft final report and final report

   a. Descriptions on survey method and equipment used

   b. Result of the ocean survey

   c. Proposed cable route and route conditions

   d. Cable length required for the proposed route and other requirements for designing the cable system

   e. Some data or informations for cable laying operation

5. Undertaking of the governments of Thailand, Malaysia and Singapore

1). To provide the survey team with data and information necessary for the survey.

2) To exempt the team from the taxes and duties on the material or equipment associated with the survey and on the personal effects brought into the countries by the team.

3) To assign the official counterparts during the ocean survey.

4) To make necessary arrangements for the team to bring out data or materials relating to the survey to Japan.

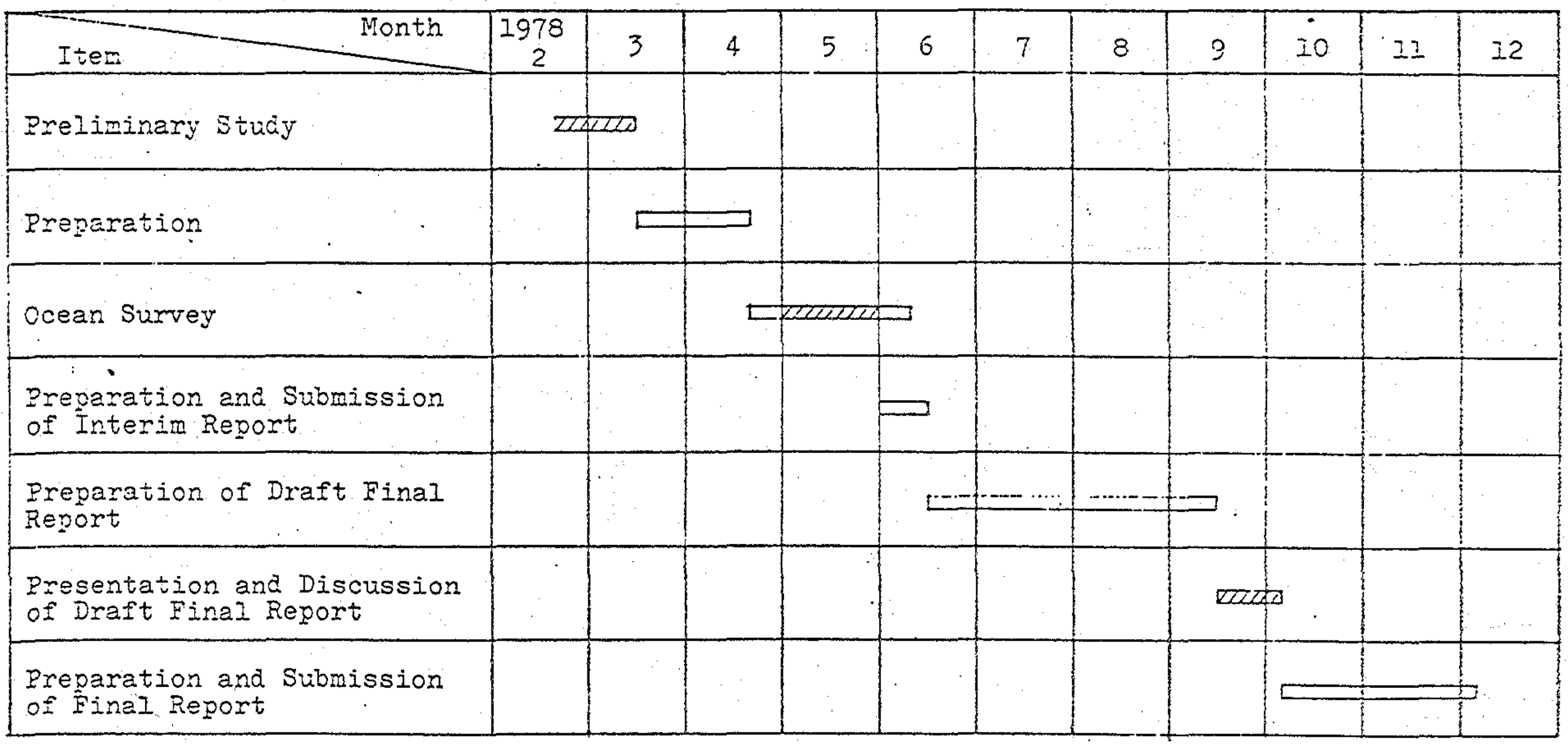
5) To grant necessary approvals for the implementation of the ocean survey in the territorial waters.

6) To give necessary notice to fishermen and other people working in the survey area and to take appropriate measures so that the survey work may be carried out without any hindrances.

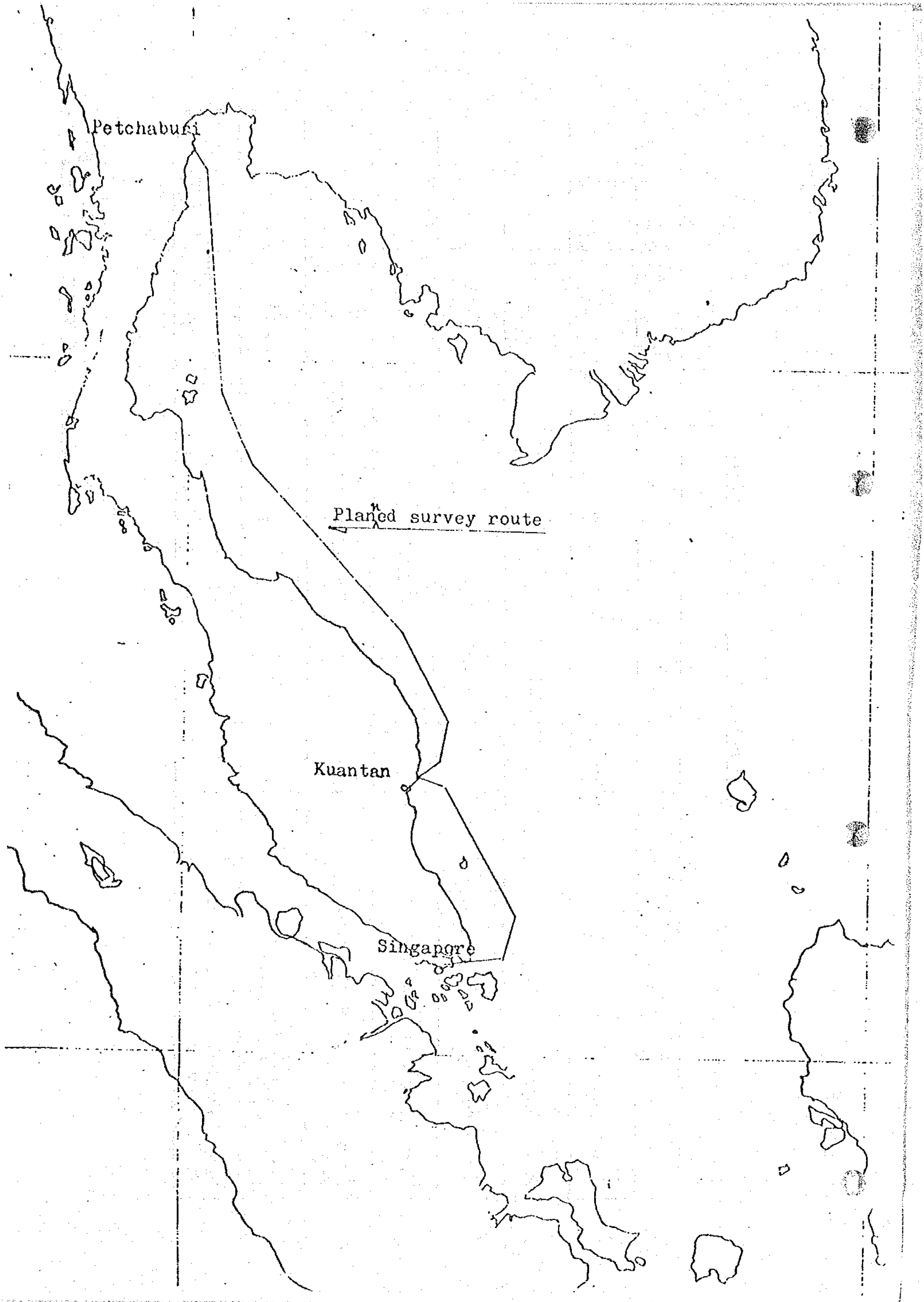
6. Schedule of survey

Refer to the attached paper.

Time schedule of the route survey



Remarks: [hatched bar] Work on the site


Petchabuŕi
Planed survey route
Kuantan
Singapore

REPORT OF THE MEETING BETWEEN JAPANESE SURVEY TEAM AND TELECOMS ON THE ROUTE SURVEY OF THAILAND/MALAYSIA/SINGAPORE SUBMARINE CABLE 10 - 15 MARCH 1978, SINGAPORE

Introduction

1 A meeting was held between the Japanese Survey Team and Telecommunication Authority of Singapore (Telecoms) on the route survey for the Thailand/Malaysia/Singapore Submarine Cable 10 - 15 March 1978, Singapore.

2 Mr Ng Hong Yew, Director of Corporate Planning, welcomed the delegates to the meeting.

3 The list of delegates is given in Annex I.

4 The approved agenda is given in Annex II.

1 Scope of Work

1.1 A paper on the scope of work for the Japanese Survey Team was tabled for discussion. The paper was adopted by the meeting. It is attached as Annex III.

1.2 It was confirmed that the report of the survey may be attached to the Tender Documents for information of the Tenderers.

2 Survey

2.1 A detailed survey work schedule was prepared and it is attached as Annex IV.

2.2 Telecoms requested that the shortest possible route should be chosen to achieve minimum cost.

2.3 Telecoms indicated that two representatives will be present for the survey.

3 Visit to Katong

3.1 A visit was made to the Katong landing point and the Katong Cable Station.

4.1 Telecoms provided the following information to the Japanese Survey Team.

(i) British admiralty chart 2403 and 3838 showing the routes of SEACOM, ASEAN PS and ASEAN IS Cable.

(ii) bottom water temperature-Singapore Continental Shelf.

(iii) bathymetric/sea bed feature chart and center-line profile chart of the Singapore Continental Shelf.

(iv) Katong plan showing landing point, beach manhole, cable duct.

(v) Port of Singapore Authority drawing GSP1 showing the anchorage area.

(vi) The coordinates of the sterilised cable corridor for cables landing at Katong.

(vii) PSA Singapore Tide Table and Port Facilities.

4.2 Should additional information be required the Japanese Survey Team would telex Mr Ma Chiu Tat Telecoms RS 21246.

Singapore

Date: 15th March, 1978

(Ng Hong Yew)
Director of Corporate Planning
Telecommunication Authority
of Singapore

(Kunito Abe)
Vice Counsellor of
Telecommunications
Ministry of Posts &
Telecommunications
Japan

ANNEX I

LIST OF DELEGATES

JICA

Messrs Kunito Abe
Hikaru Chono
Teruo Shibata
Rokuro Kitsuta
Taisuke Kitamura
Akio Itoh
Kikuo Sakamoto

TELECOMS

Messrs Ma Chiu Tat
Yan Man Fong
Alan Wong Kwok Wai
Wong Yau Liong
Tang Hoe Ming
Lo Loke Yee
Siew Ying Oak

ANNEX II

AGENDA

1 Scope of work.

2 Route survey.

3 Site visit to Katong landing point and Katong Cable Station.

4 Exchange of views and data on the proposed cable route and the routing of exisiting cable.

5 Any other business.

ANNEX III

SCOPE OF WORK
FOR
THE ROUTE SURVEY
OF
THE THAILAND-MALAYSIA-SINGAPORE SUBMARINE CABLE PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

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6) To give necessary notice to fishermen and other people working in the survey area and to take appropriate measures so that the survey work may be carried out without any hindrances.

6. Schedule of survey

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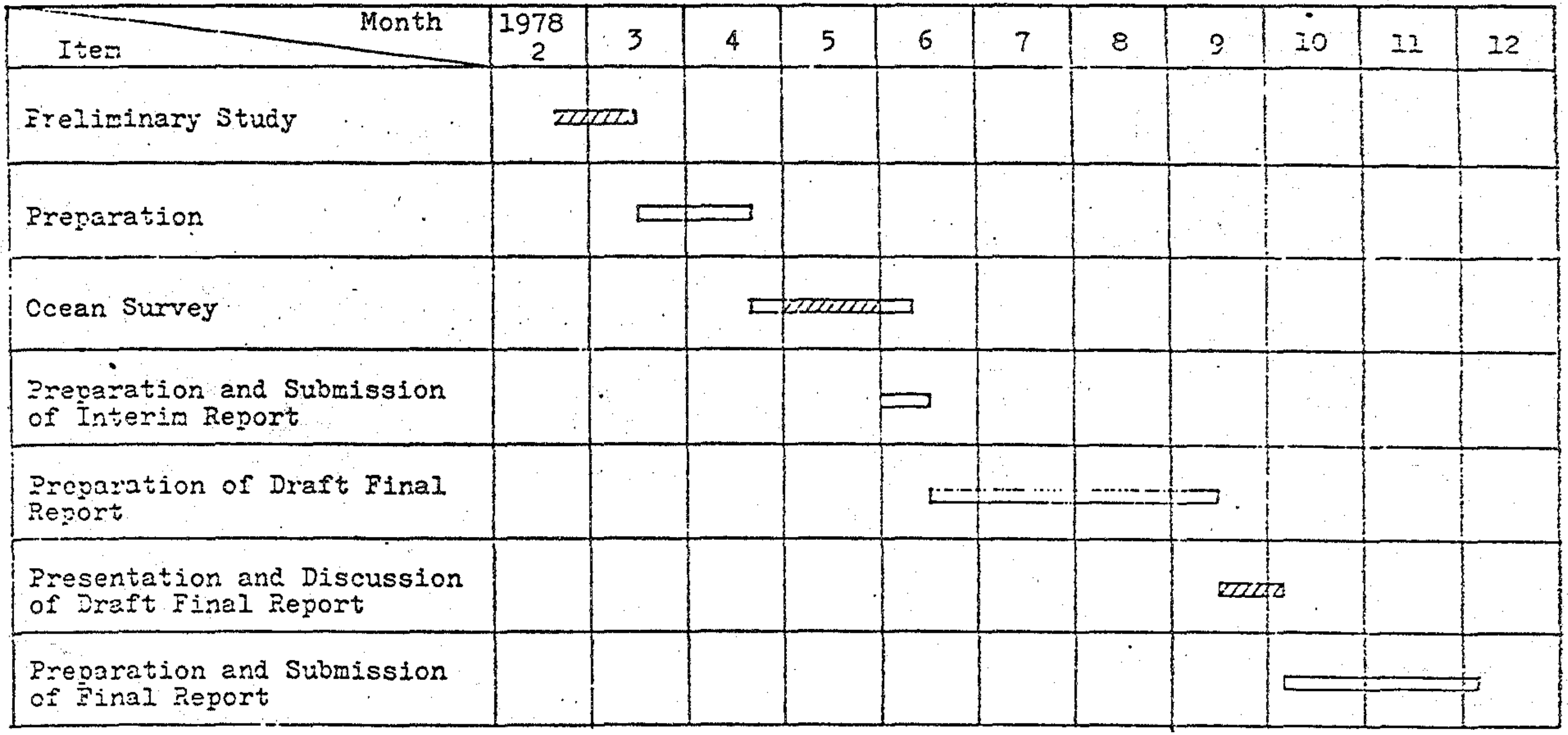
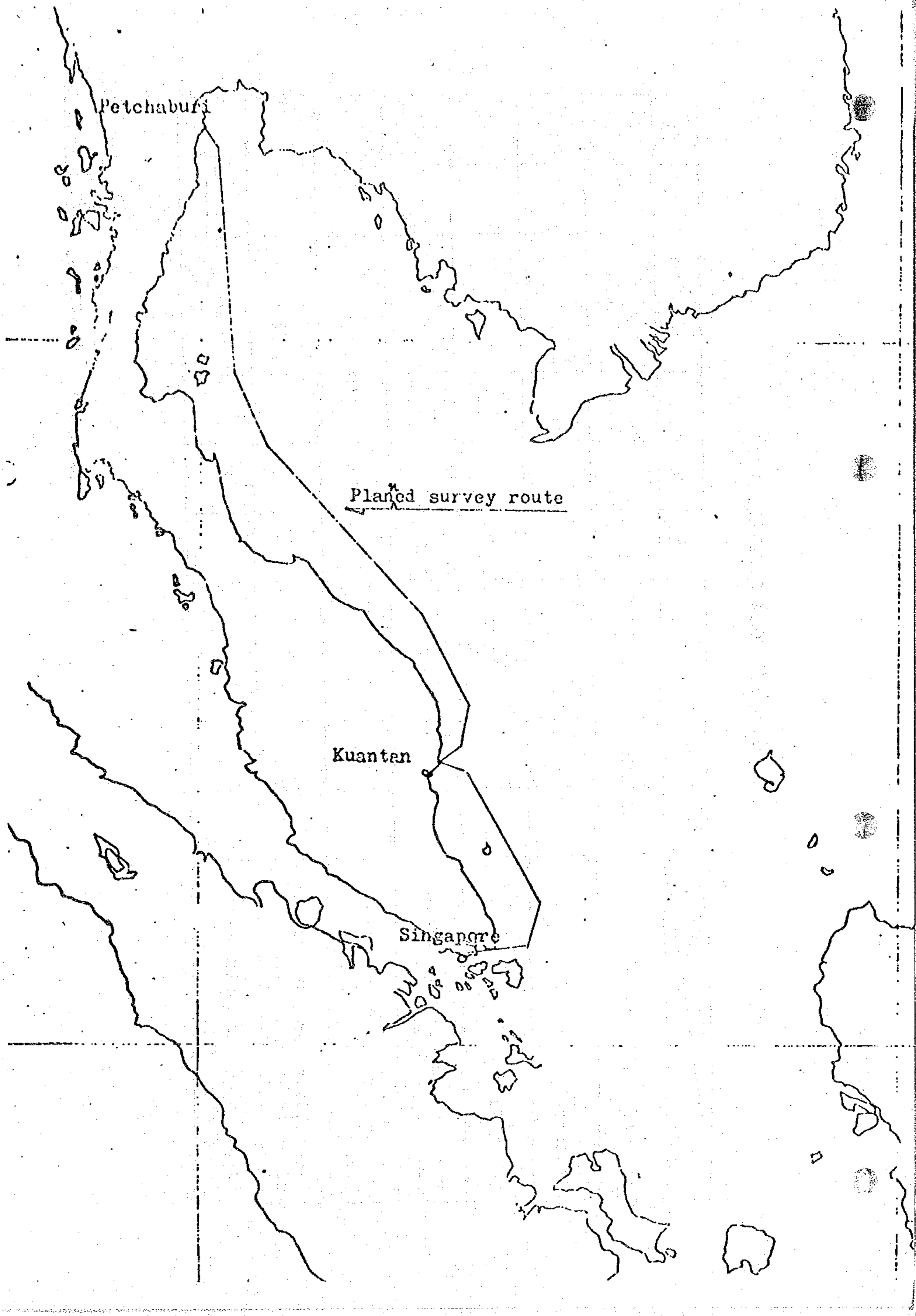
Time schedule of the route survey



Remarks: ▨ Work on the site



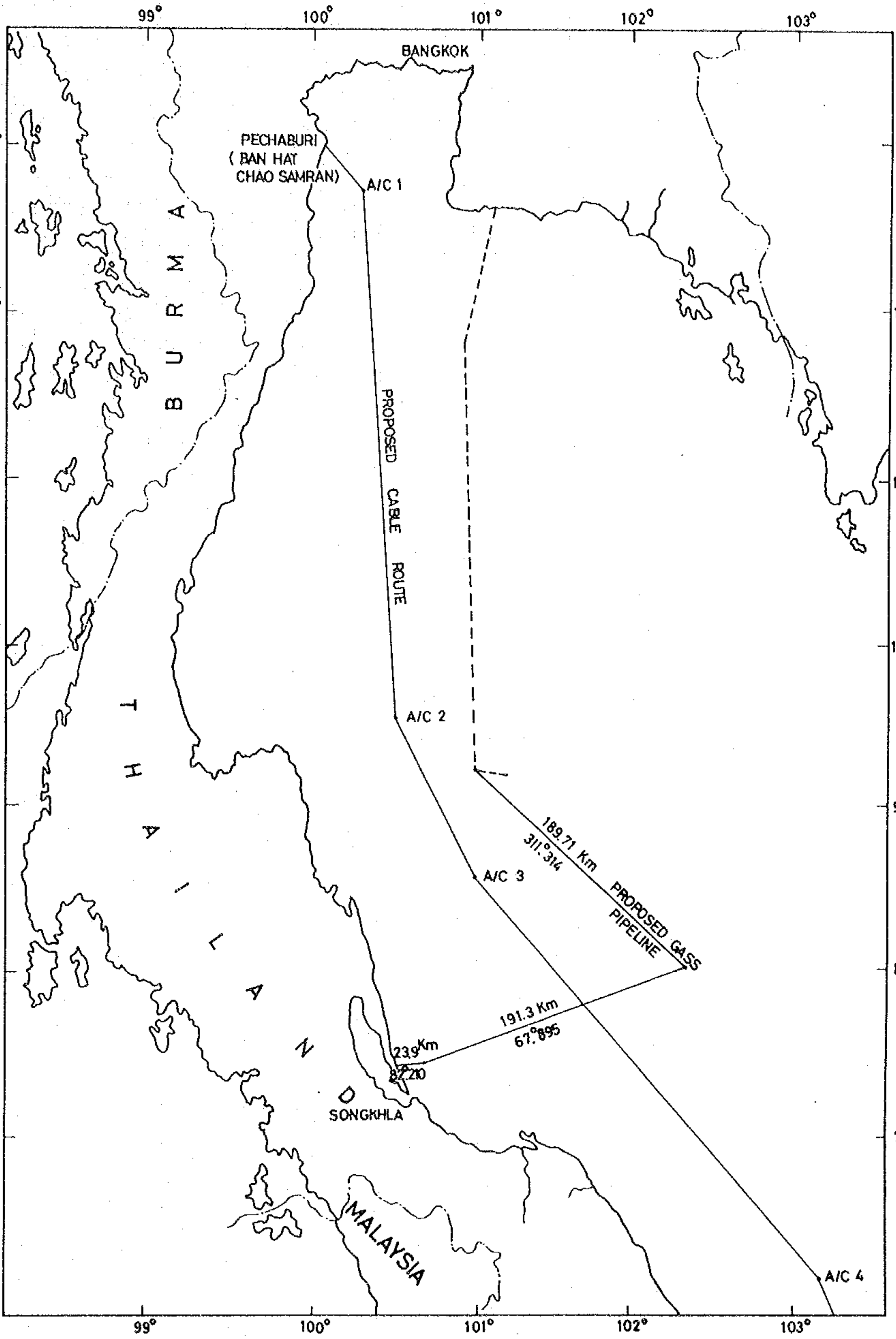
Petchaburi
Planed survey route
Kuantan
Singapore

ANNEX IV

SURVEY WORK SCHEDULE

The work shall be initiated immediately after the survey team and observers join the ship on the next day of ships arrival in Singapore.

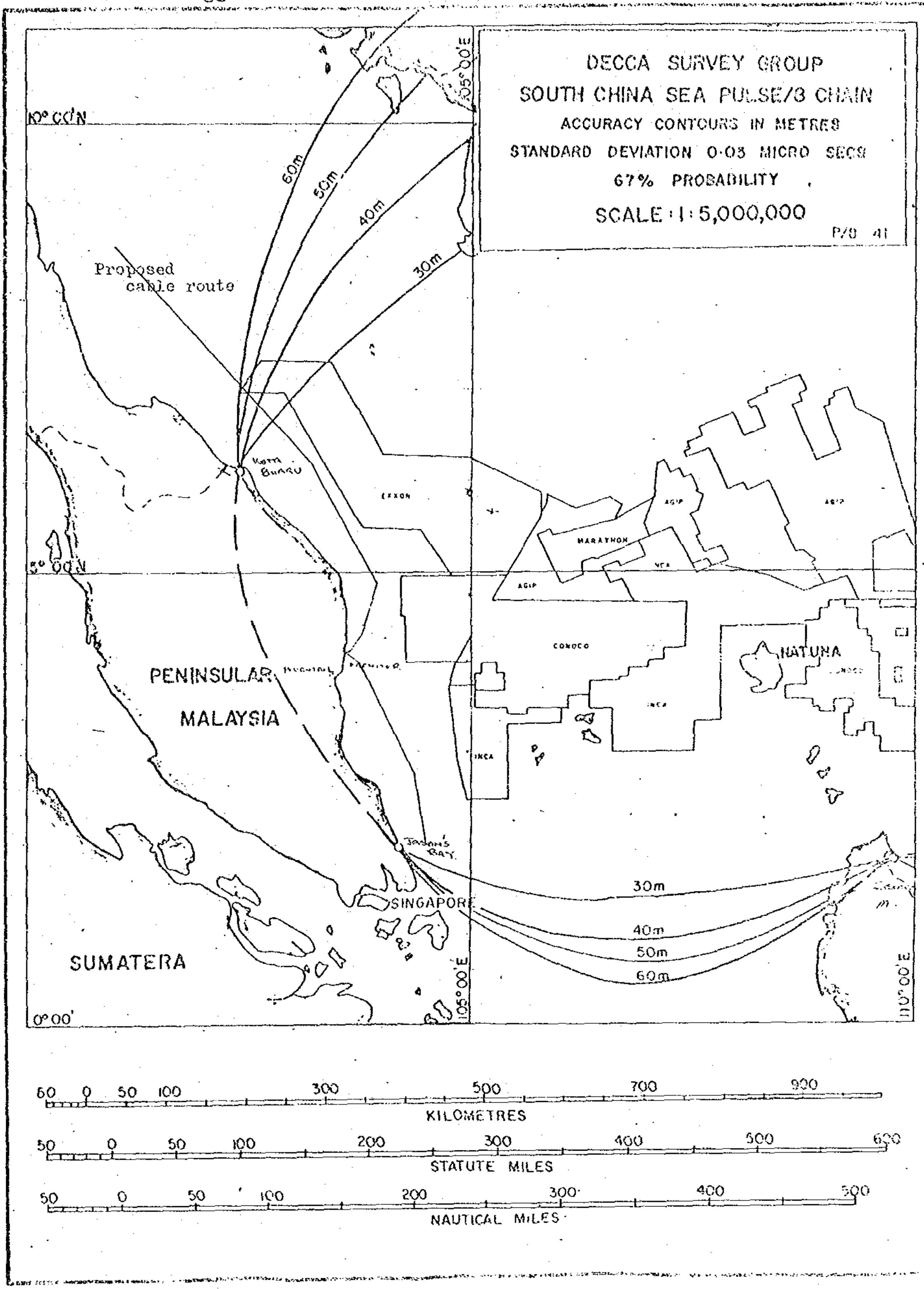
1st day	-	Outfitting of survey ship.
2nd to 4th	-	Going-run survey from Katong to Cherating (Sounding, subbottom profiling and side scan).
5th to 8th	-	Shore survey at Cherating (Sounding, subbottom profiling, side scan, Bottom sampling and Temperature observation - under position control by the Cherating shore).
9th to 15th	-	Going-run survey from Cherating to Petchaburi.
16th to 18th	-	Shore and land survey at Petchaburi.
19th to 25th	-	Returning-run survey from Petchaburi to Cherating. (Sounding, Bottom-sampling, Temperature observation and Bottom photographing)
26th to 29th	-	Returning-run survey from Cherating to Katong
30th to 31st	-	Shore survey at Katong.

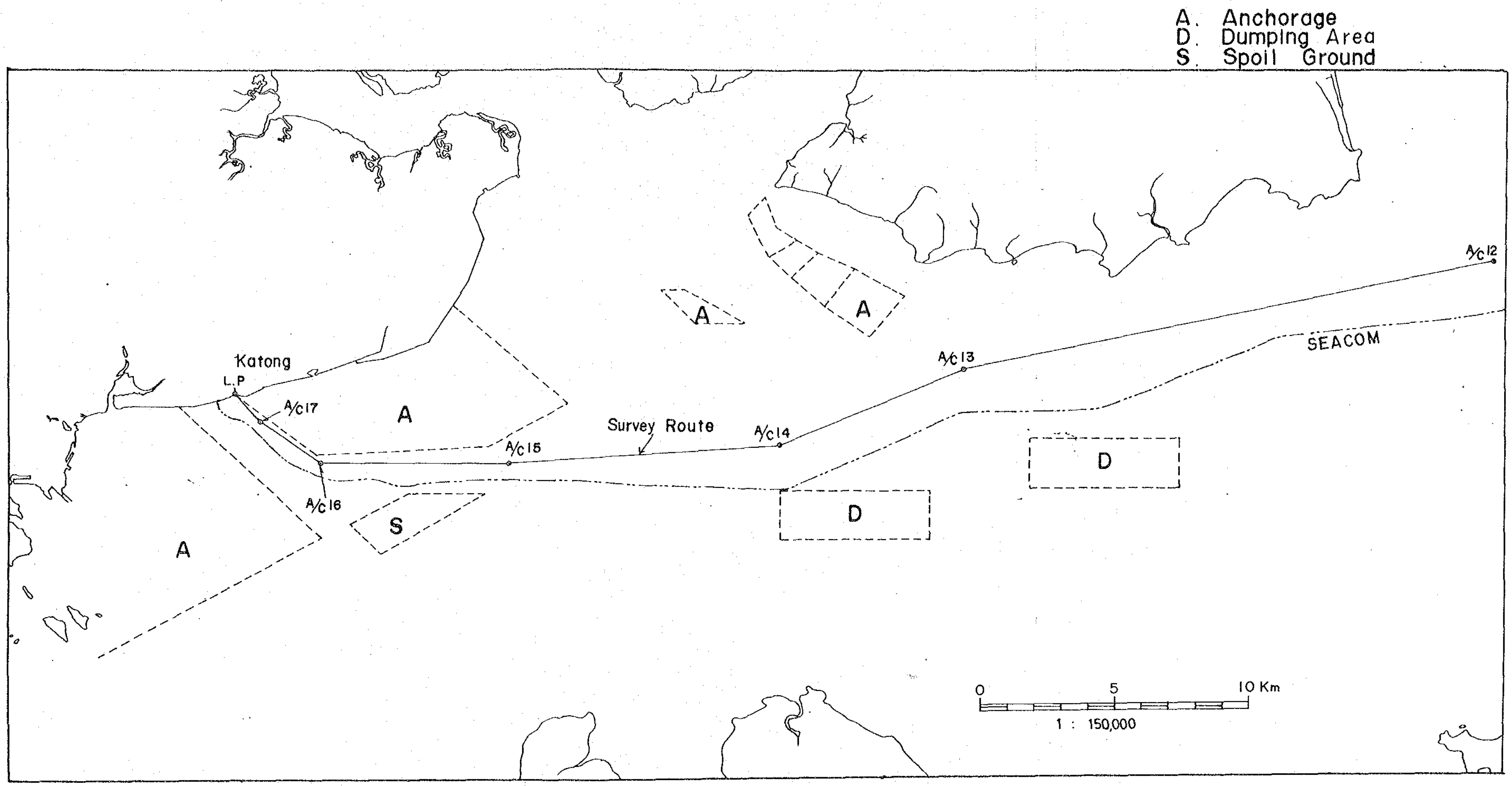


Appendix 4(a) PROPOSED CABLE ROUTE AND THE GASS PIPELINE IN THE GULF OF THAILAND

Appendix 4 (b)

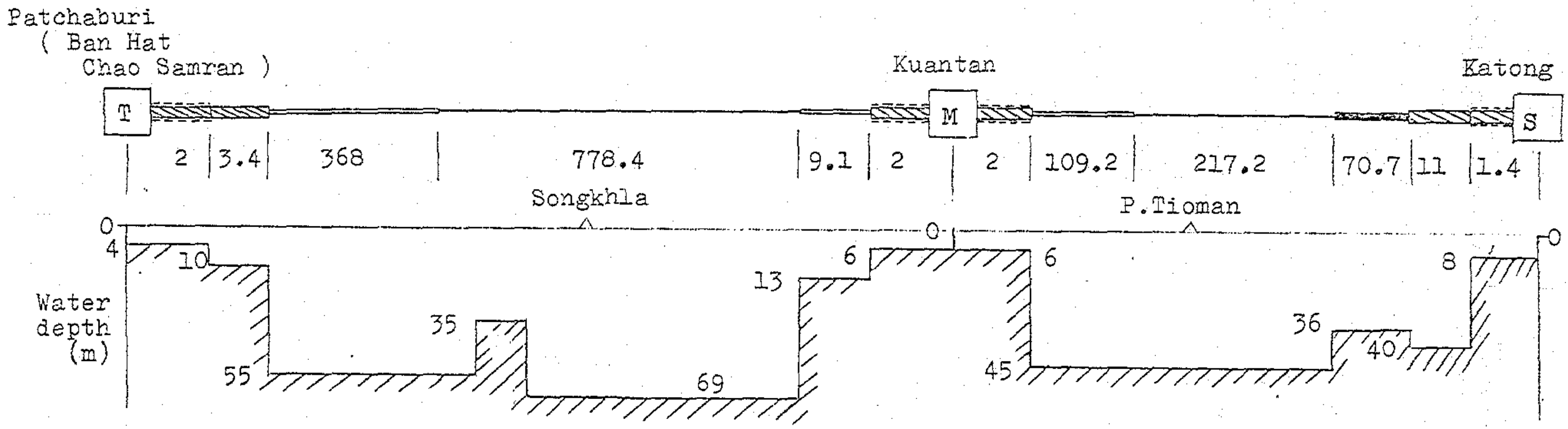
The proposed cable route and petroleum exploration blocks in off Trengganu





Appendix 4 (C) ANCHORAGE, EXISTING CABLES ETC IN STRAIT OF SINGAPORE

Appendix 5 An Example of Cable Types



Type of cables \ Cable length (km)	T - M	M - S	T - M - S
Double armored (8/6mm) (Screened)	4	3.4	7.4
Double armored (8/6mm)	3.4	11	14.4
Single armored (8mm)	-	70.7	70.7
Single armored (5mm) (Composite inner cond.)	377.1	109.2	486.3
Armorless	778.4	217.2	995.6
Total	1,162.9	411.5	1,574.4

1) No land cable is included
2) Average slack: 1%
3) Route length: T-M 1,151.4 km
M-S 407.4 km

Appendix 6 List of marine charts used in the route survey

The Japanese Chart

No.623	(1 / 150,000)
624	(")
740	(1 / 307,000)
741	(1 / 566,900)
745	(1 / 500,000)
748	(1 / 50,000)
749	(1 / 75,000)
750A	(1 / 50,000)

The US Chart

No.93010	(1 / 1,083,933)
93160	(1 / 242,900)
93220	(1 / 240,000)
93240	(1 / 240,000)
71024	(1 / 500,000)

The British Chart

No.2556	(1 / 27,500)
3542	(1 / 500,000)
3543	(1 / 500,000)
3839	(1 / 100,000)

Appendix 7 A typical example of cable route marker

A pair of cable route marker is designed depending on the applicable distance. An expected visible distance must be decided first, then the visible line connecting the maximum distant point on the sea with the top of sign board of front marker and the bottom of rear marker must be on a straight line. Respective height and distance between those two markers will be determined on the straight line depending upon topography of land and other restrictions. An idea for locating the route marker, an example of the basic design and an example of the configuration and size are shown in Figure1, 2 and 3 respectively.

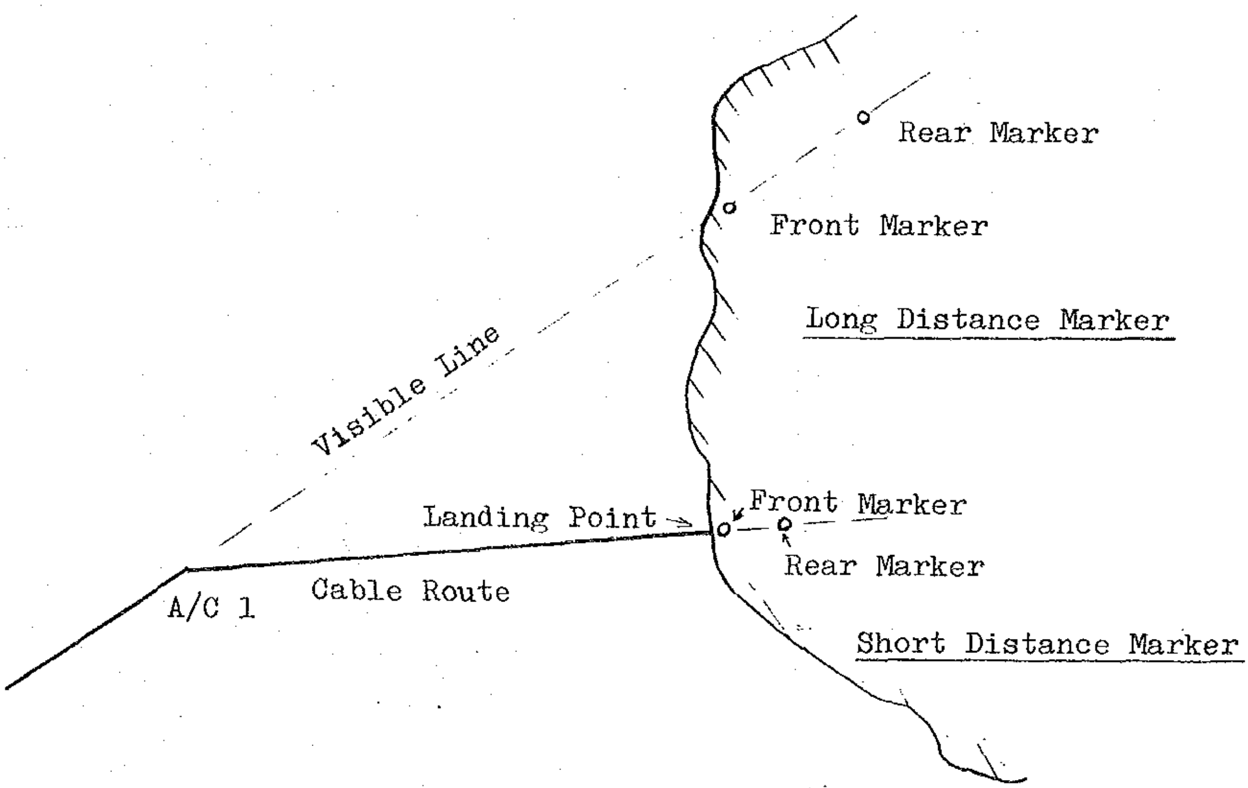
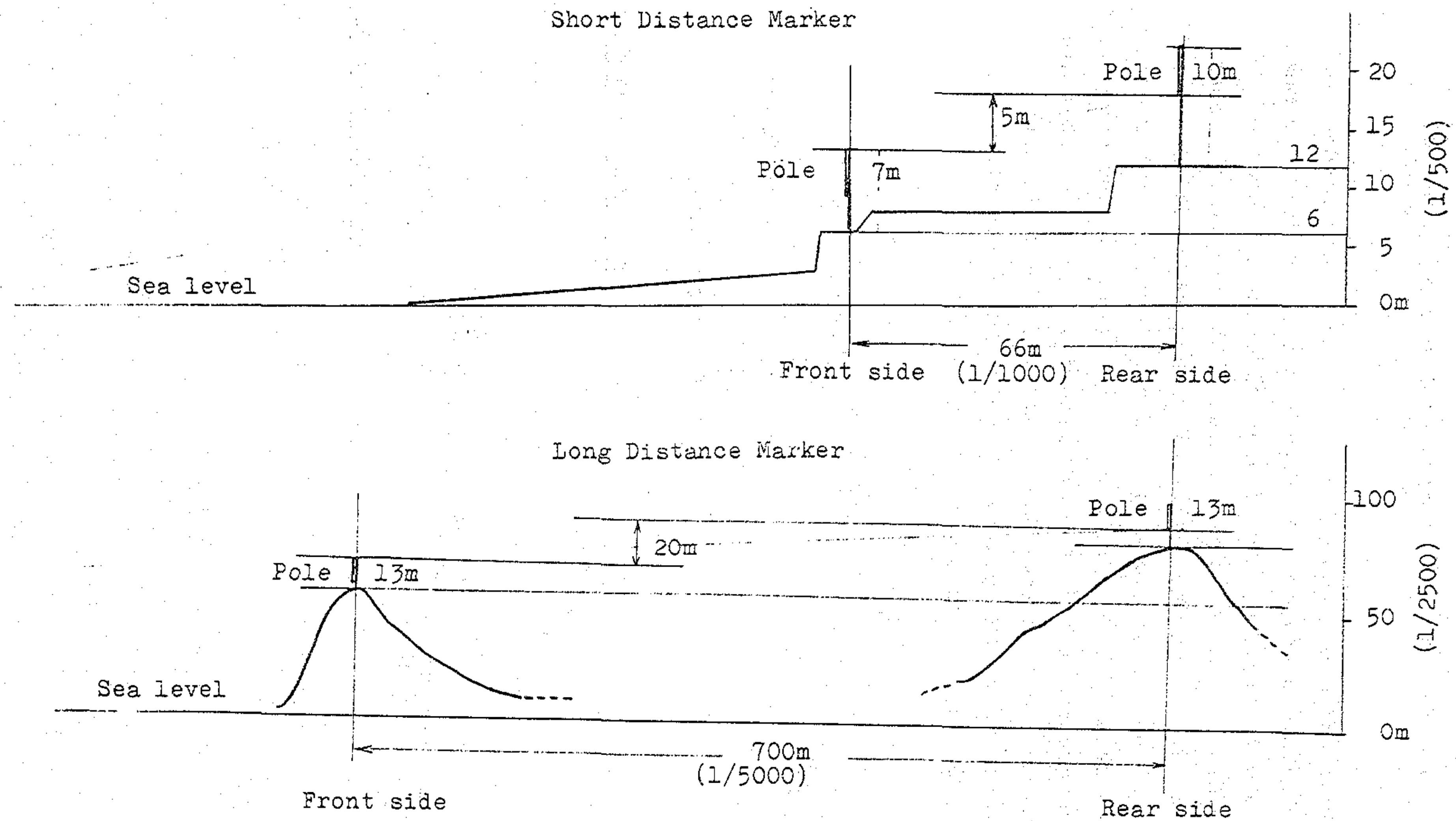
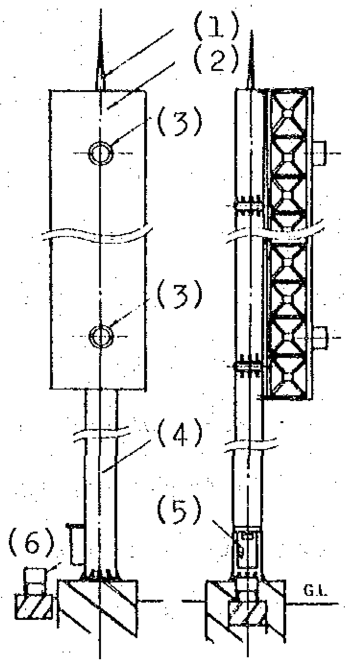


Fig. 1



Short Distance Marker
Pole
10m
5m
Pole
7m
12
6
20
15
10
5
0m
(1/500)
Sea level
66m
Front side
(1/1000)
Rear side
Long Distance Marker
Pole
13m
20m
Pole
13m
100
50
0m
(1/2500)
Sea level
700m
(1/5000)
Front side
Rear side

Fig. 2



Front View Side View

Note;

1) Visible distance at daytime and night time in fine weather, more than 7 km for short distance, more than 20 km and 30 km at daytime and nighttime respectively for long distance.
2) Color of projectors
Upper projectors are red for both short and long distance, lower one are blue and yellow respectively for short and long distance.

(1) Lightning rod

(2) Sign board (unit in meter)

1.0W X 4.0H for short distance
2.0W X 8.0H for long distance

(3) Projector (incandescent lamp)

300w X 2 for short distance
500w X 2 for long distance

(4) Pole

1.0H(front) and 7H(rear) for short distance
13H both front and rear for long distance

(5) Switch box or control board

(6) Transformer (if necessary)

Fig. 3

Appendix 8 Minimum distance of separation between cables

Minimum distance of separation between cables is required mostly for the purpose of maintanance (Cable repair work). Generally, it is necessary keeping the distance more than 5 times of the water depth for those cables in deep sea portion.

It is usually difficult to take enough distance of separeation, however intend to, between shore-end-cables which are laid in radical manner from a common landing station, and the distance of separation varies with distance from shore. So it can not be specified the minimum distance of separation between those cables. It should be kept as far as possible taking the repair into consideration for the purpose.

Appendix 9 Applicable water depth and burying depth by "Water Jetting method"

Water jetting method functions to bury cable system up to 5 meters depth bellow sea-bed surface by guiding cable and repeater into the ditch dug out by means of pressured water jet from the nozzles which are provided on the digging tool of the burying machine. A required jetting pressure will be decided depend on nature of sea bottom, 7-10 kg/cm^2 are common and it is said that 10 kg/cm^2 is enough for clay of sea-bed which is the most difficult to dig out.

Advantages of this method are that the digging tool can be prolonged and increased the number of nozzle lengthwise, so increasing depth of burying can be achieved and that can be performed either at the same time with cable laying and after cable laying.

The jetting method is effective to protect cable on such hazardous sea-bed where ship anchoring is anticipated as harbor, around sea route and so on. However, that the applicable water depth is limited up to around 50 meters on account of necessity of divers in auxiliary work and that slow burial speed of less than 1 nm per day (8 hours) are also disadvantages.

Appendix 10 Repair technique for buried cable

The cable buried in sufficient depth is far safer from trawling activities compared with unburied cable, it is almost free from artificial damage except heavy anchors which penetrate sea-bed beyond the cable burial depth. However, it is necessary to provide "Repair technique" for buried cable fault which is seldom anticipated.

Repair technique for buried cable must be capable up to the maximum water depth of the cable burying technique. The development of repair method for any buried cable is urgently requested.

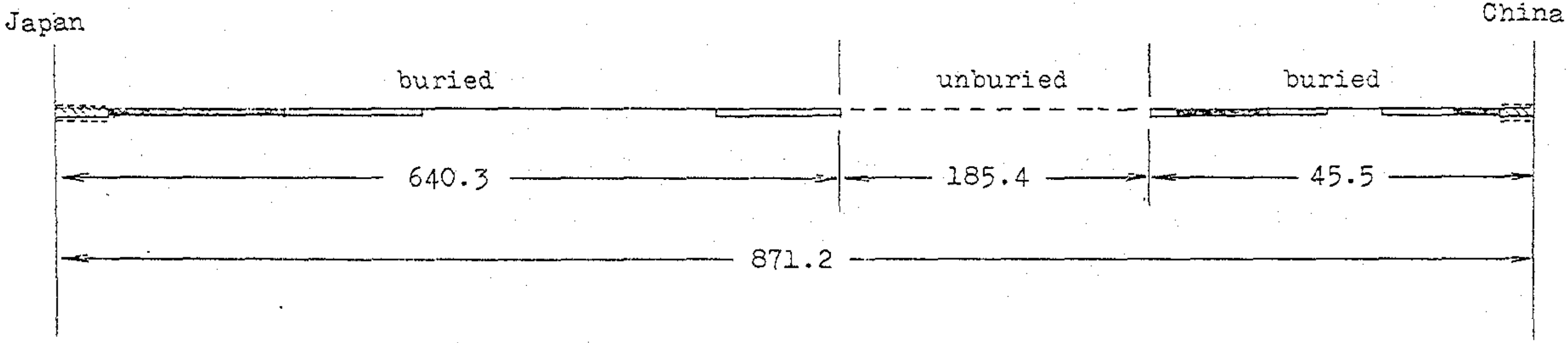
One of the repair method; so called "SCARAB System" is under developped at AT&T in the USA, which consist of a control equipment and a vehicle, the vehicle can be remote controlled by the control equipment on board. The vehicle can reach down to 1800 meters of sea-bed, it performs searching, digging, cutting the cable and fastenning the cable with lifting rope from the vessel.

Development of another method, simple and secure technique is beeing urgently proceeded at KDD and NTT in Japan. It is applicable down to 200 meters of water depth corresponding the maximum depth of cable burying. The KDD's method employs the multi-blade anchor equipped with magnetic or mechanical sensor for catching the cable. The cable caught is to be lifted up on board, extra cable (and repeater if necessary) is to be laid after repair and reburied.

In case sea bottom is hard, it may be difficult to lift up the cable on board unless the cable is cut at sea bed, if it is harder, suction pump may be necessary in addition for lifting the cable. In case of those situation, remote controlled cable-cutter and cable-grab must be provided.

The repair for buried cable in a range of around 50 meters water depth is to be achieved by the method mentioned above, and it is easy because of employing diver work. The cable cutting, cable holding for lifting can be done by divers if necessary, and reburying the cable is also available by water-jetting method.

Appendix 11. Various types of cable used in buried cable systems in Table 3.6.2 of the Final Report in page 165.



double armored (6/8mm) cable	5.1 km
single armored (6mm) cable	97.3 km
single armored (4.5mm) cable (Composite Inner Cond.)	230.2 km
light weight cable	353.2 km
total	685.8 km

<u>Japan - China Submarine Cable</u>

Appendix 11. Various types of cable used in buried cable systems inTable 3.6.2 of the Final Report in page 165.

double armored (6/8mm) cable	5.1 km
single armored (6mm) cable	97.3 km
single armored (4.5mm) cable (Composite Inner Cond.)	230.2 km
light weight cable	353.2 km
total	685.8 km

<u>Japan - China Submarine Cable</u>

Appendix 12 The relation with the current speed and the declination of the moon

Depending on the Newton's equilibrium theory of tide, the equilibrium height of lunar tide ($\bar{\eta}$) is shown as following;

$$\bar{\eta} = \frac{3}{2}\frac{M}{E}\left(\frac{R}{D}\right)^3 \cdot R\left(\cos \vartheta - \frac{1}{3}\right) \text{-----------------} (1)$$

M : Mass of the moon

E : Mass of the earth

: Geocentric zenith distance

R : Radius of the earth

D : Distance from the center of the earth to the center of the real moon

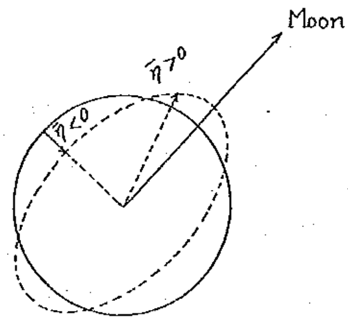


Fig.1 Equilibrium Height of Lunar Tide

The zenith distance ϑ in the formula (1) changes due to the terrestrial latitude of the observer and the moon position on the lunar orbit.

Let 0 be the center of the earth in Fig. 2. P and P', the north-pole and the south-pole in the celestial sphere; EAE', the equator of the celestial sphere ; M, the moon and φ, the terrestrial latitude; δ , the declination of the moon; h, the hour angle.

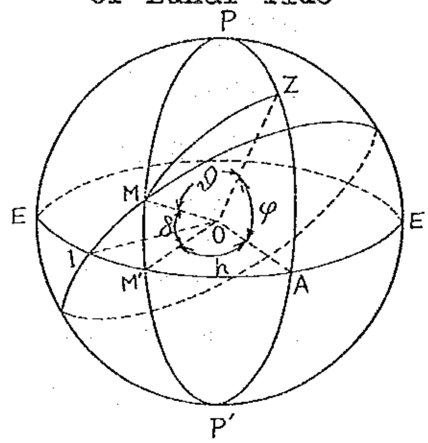


Fig.2 The Celestrial Sphere

In the spherical triangle MZP of Fig. 2, we know from the cosine formula of spherical trigonometry that

$$\cos \vartheta = \sin \varphi \cdot \sin \delta + \cos \varphi \cdot \cos \delta \cdot \cos h \text{ -------} (2)$$

After the substitution of (2) into (1), we obtain

$$= \frac{3}{4}\frac{M}{E}\left(\frac{R}{D}\right)^3 R\left\{\cos^2 \varphi \cdot \cos^2 \delta \cdot \cos 2h + \sin 2\varphi \cdot \cos 2\delta \cdot \cos h + 3\left(\frac{1}{3} - \sin^2 \varphi\right)\left(\frac{1}{3} - \sin^2 \delta\right)\right\} \text{--------------} (3)$$

This formula (3) shows the tide height caused by the moon's attraction at some place on the earth. The terrestrial latitude of the observer Z is constant. The declination of the moon changes with the time, but it is considered as the constant in a day. The hour angle h varies about 360° in a day, so cos 2h is the constituent with periods approximating a half day.

The first term in (3), containing cos 2h, includes the semidiurnal constituents with periods approximating a half lunar day. The second term, depending on cos h, determines the diurnal constituents with periods approximating that of lunar day (24h-50m), and the third term is independent of h but is subject to variations in declination and distance to the moon, both of which vary mainly in the course of month. The long-period constituents, therefore, generally have periods of a half month or longer.

We know the diurnal tide in Singapore strait. So the amplitude of the diurnal tide is given from the second term with cos h in (3) as following;

$$= H \sin \cdot \cos 2 \quad \text{-------------} \quad (4)$$

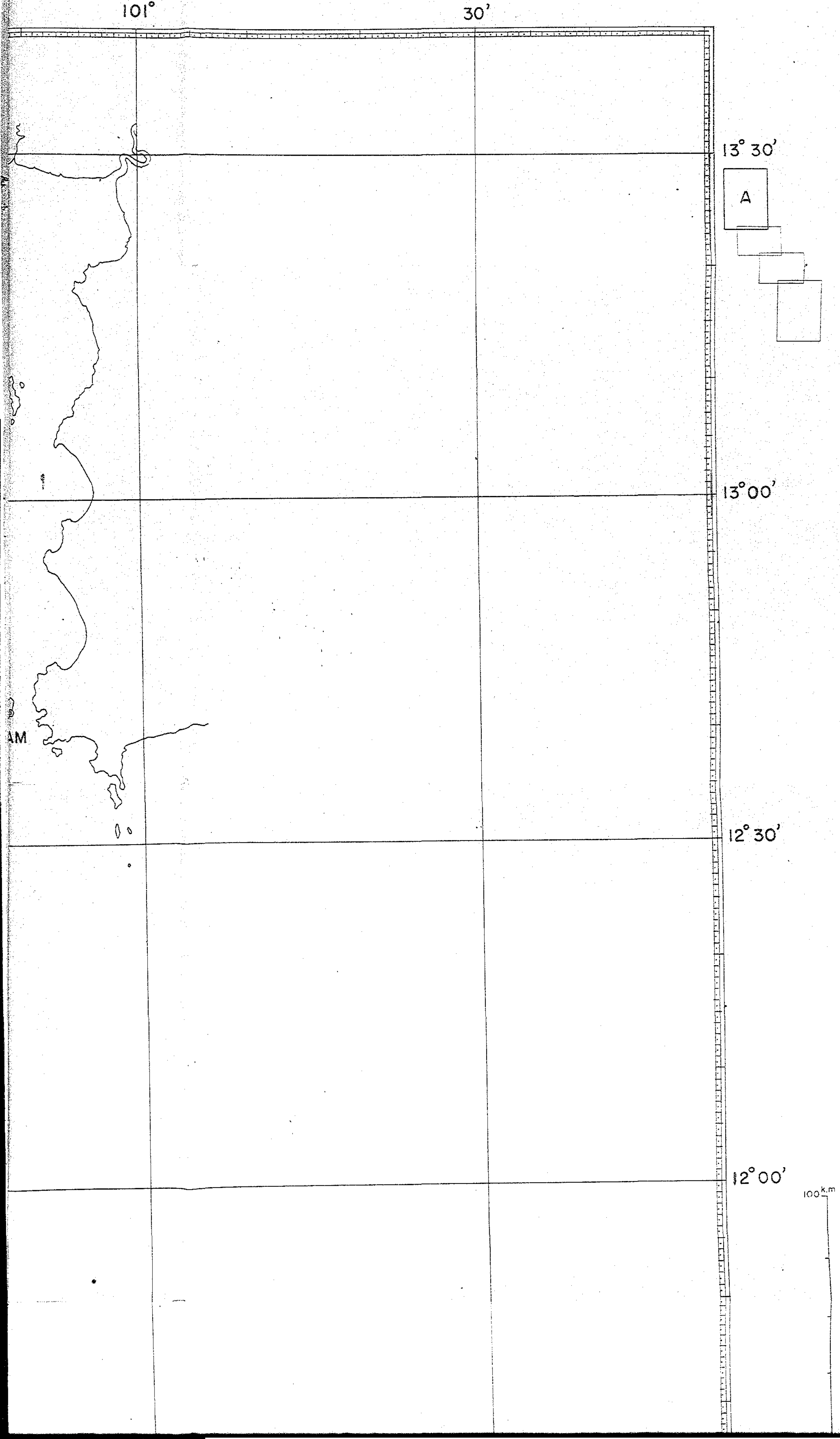
The amplitude of the diurnal tide is changed remarkably due to the variation of the declination of the moon. As the amplitude of the diurnal tide becomes bigger, the movements of the sea water increases. Consequently, the current speed becomes faster.

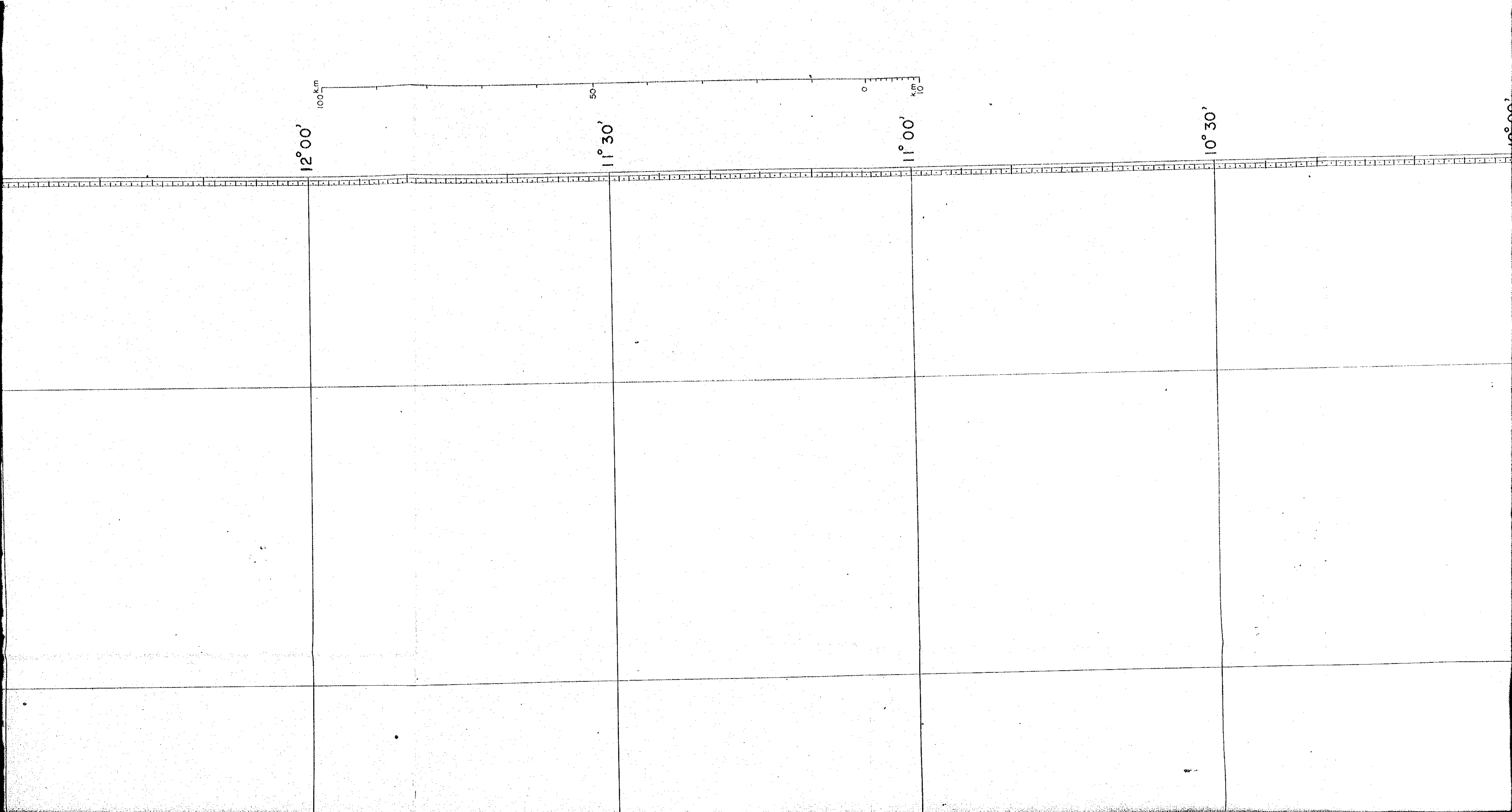
(Reference)

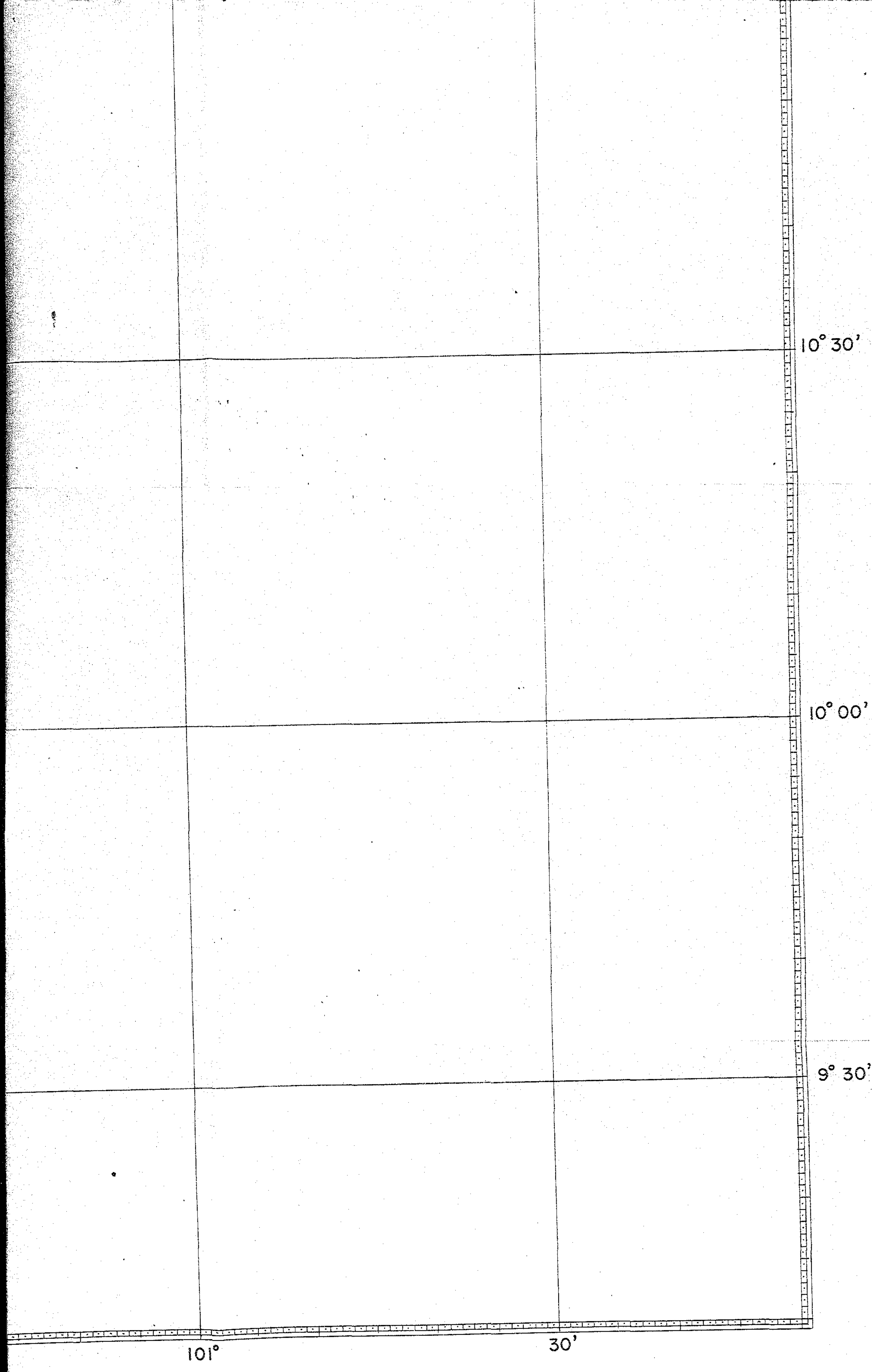
Dronkers, J.J., 1964: Tidal computations. North-Holland Publishing Co., Amsterdam

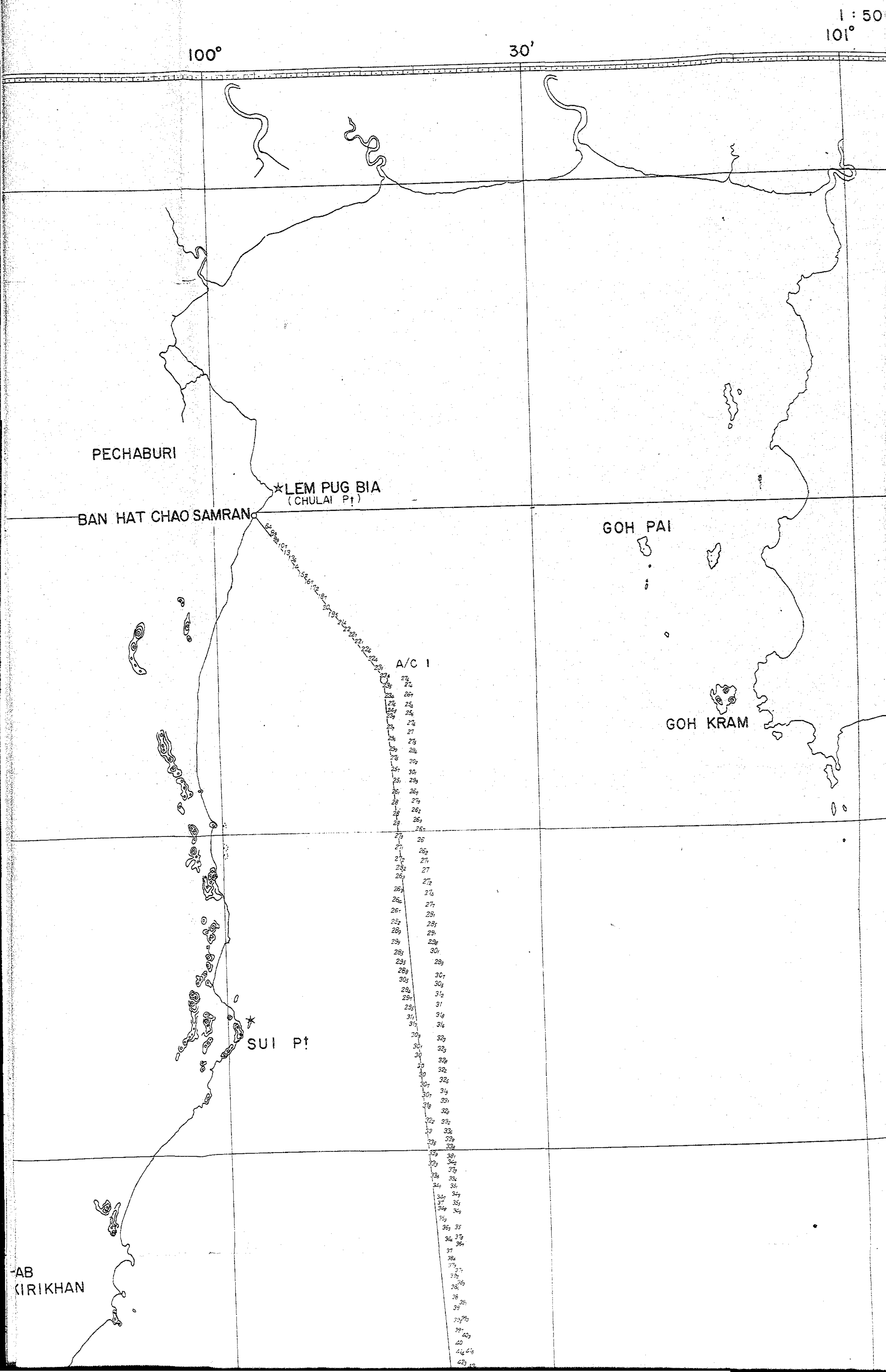
Fig. 3.5.1 (A) SOUNDING CHART

1 : 500 000 (at Lat. 7°00'N)

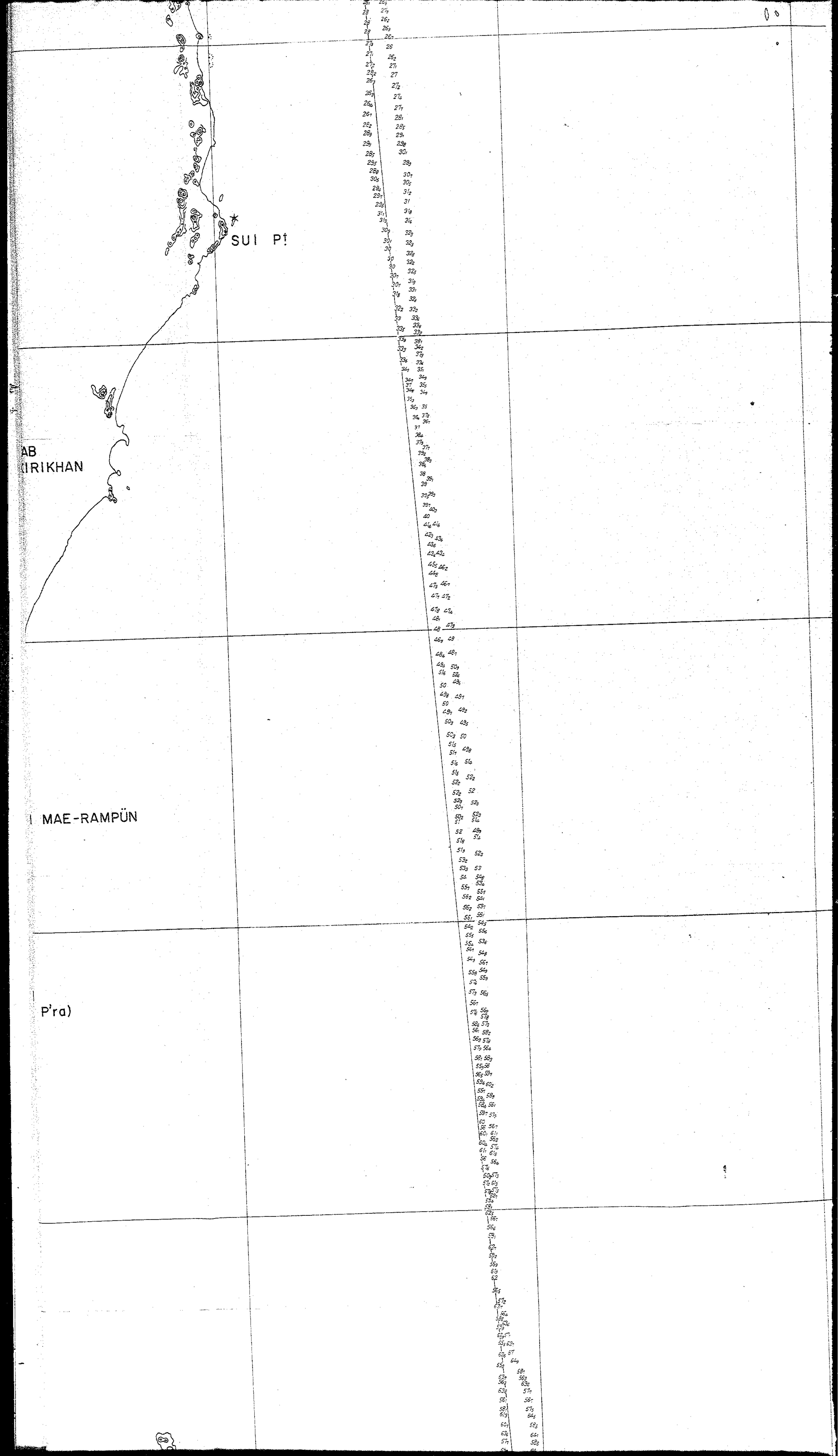


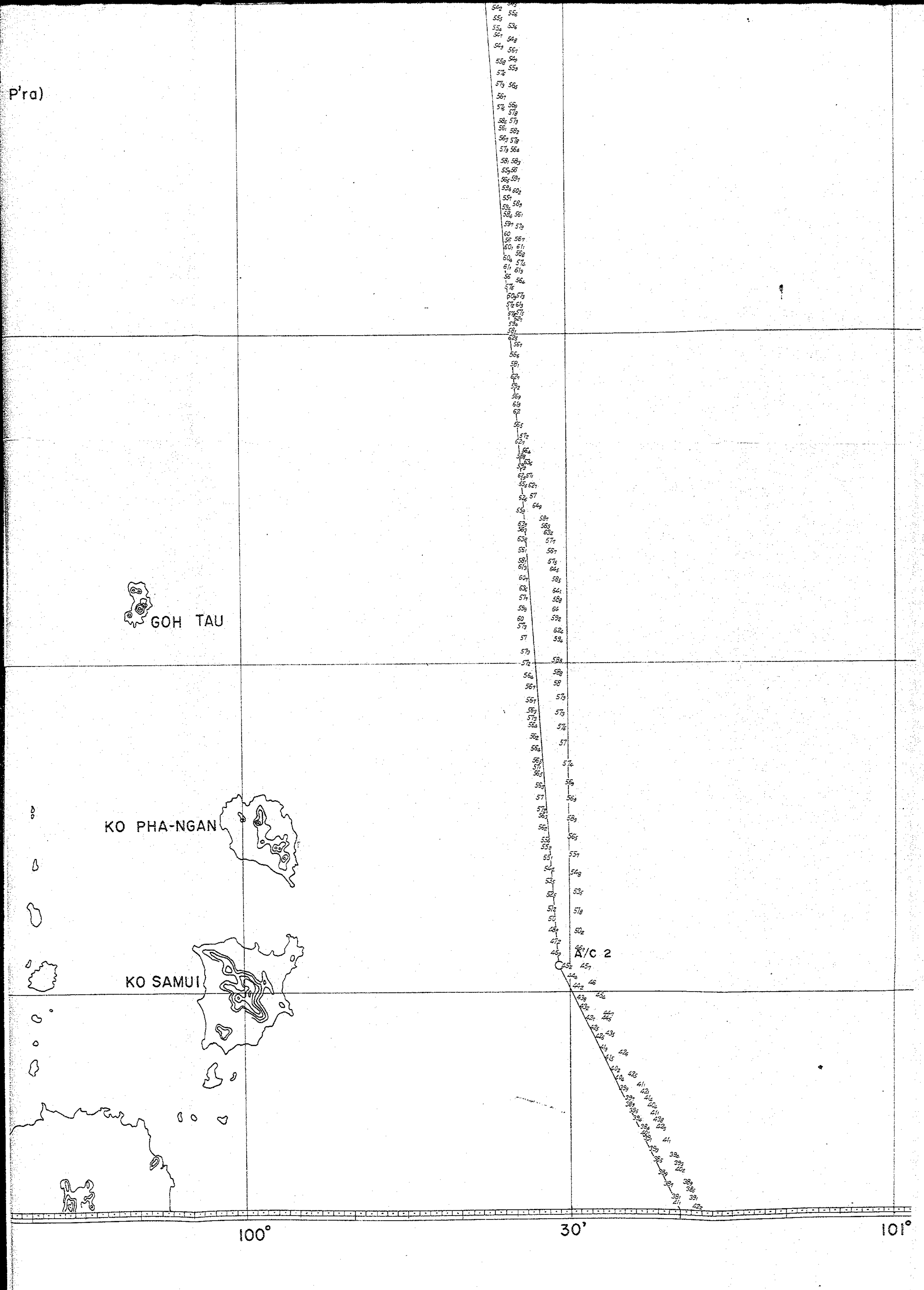

100 km
50
0
10 km
12°00'
11°30'
11°00'
10°30'

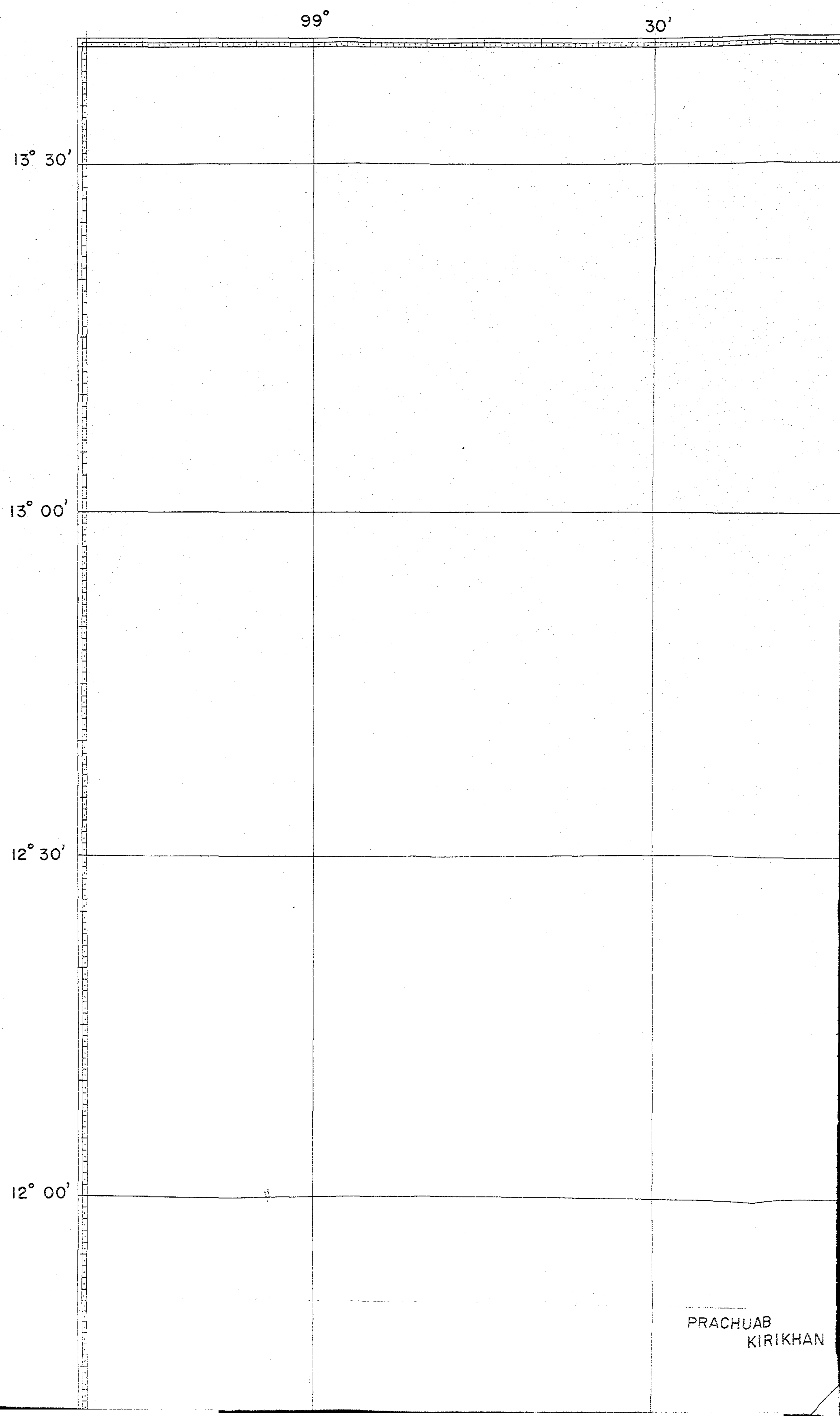

10°30'
10°00'
9°30'
101°
30'

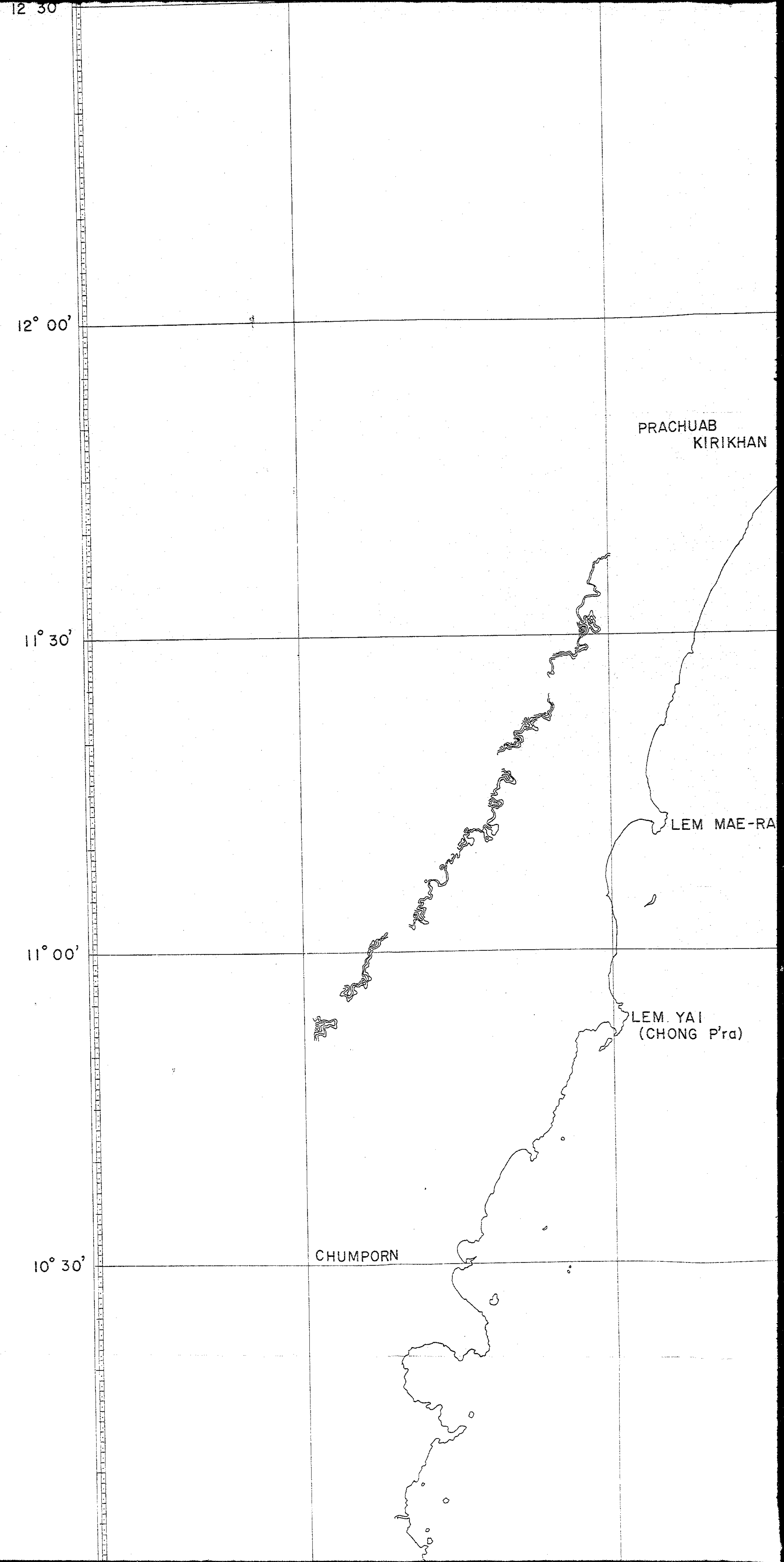


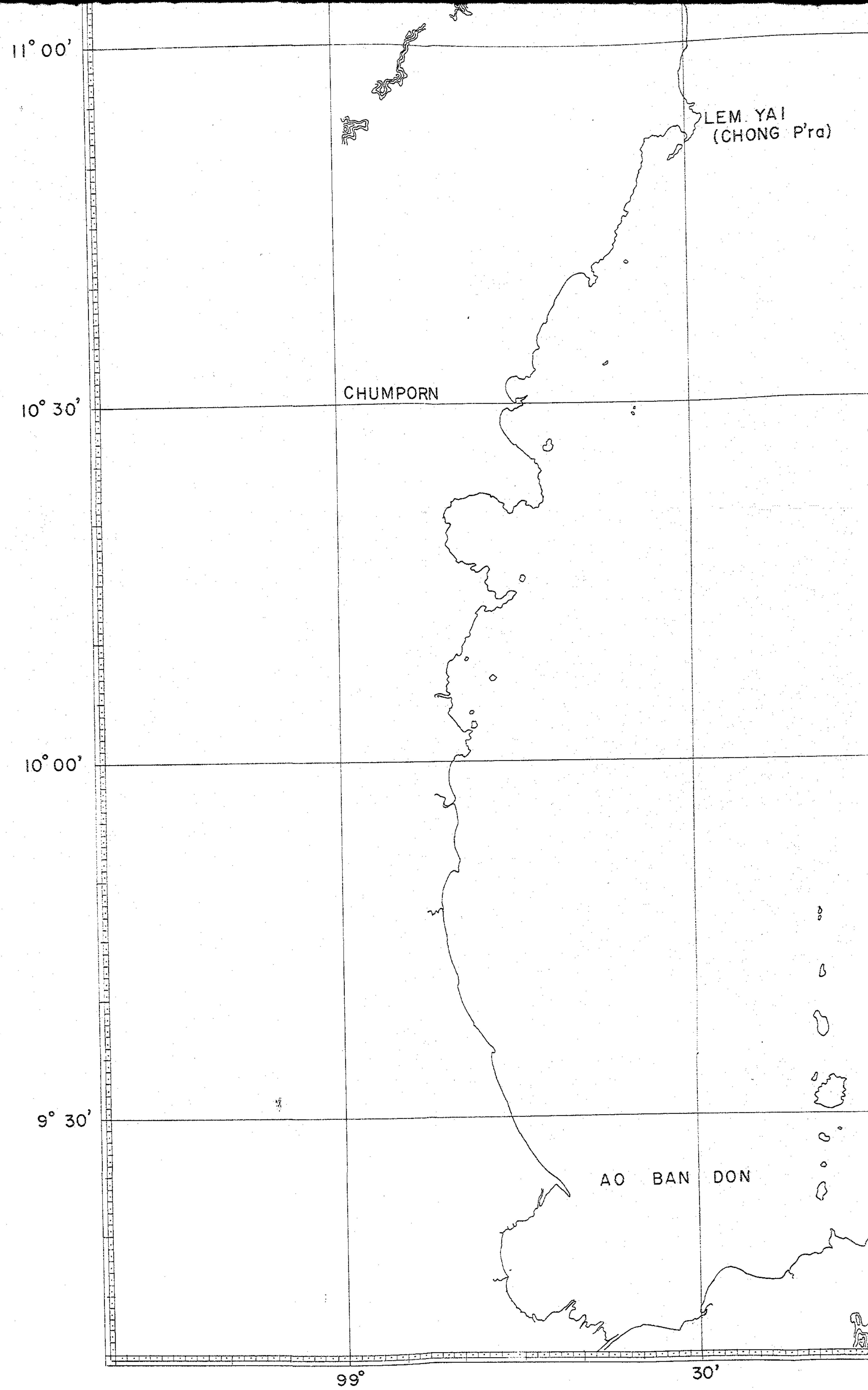
1 : 50
101°
30'
100°
PECHABURI
LEM PUG BIA
(CHULAI Pt)
BAN HAT CHAO SAMRAN
GOH PAI
GOH KRAM
A/C 1
SUI Pt
AB
KIRIKHAN


SUI Pt
AB
IRIKHAN
MAE-RAMPÜN
P'ra)


P'ra)
GOH TAU
KO PHA-NGAN
KO SAMUI
A/C 2
100°
30'
101°


99°
30'
13° 30'
13° 00'
12° 30'
12° 00'
PRACHUAB
KIRIKHAN


12 30
12° 00'
11° 30'
11° 00'
10° 30'
PRACHUAB
KIRIKHAN
LEM MAE-RA
LEM. YAI
(CHONG P'ra)
CHUMPORN


11° 00'
LEM. YAI
(CHONG P'ra)
CHUMPORN
10° 30'
10° 00'
9° 30'
AO BAN DON
99°
30'