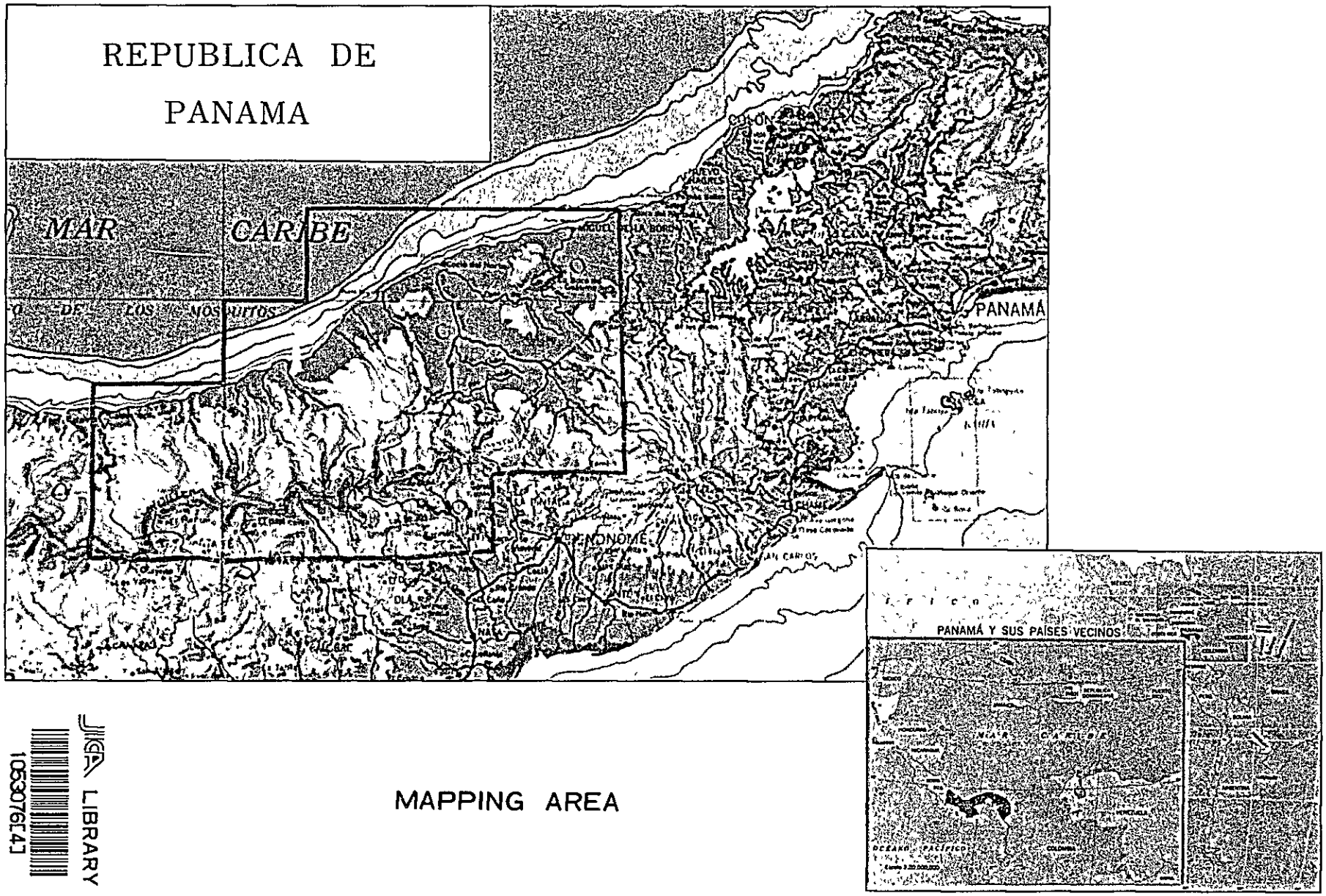
社会開発協力部報告書

REPORT ON THE TOPOGRAPHIC MAPPING PROJECT OF THE CARIBBEAN COASTAL AREA OF THE REPUBLIC OF PANAMA

Phase Two Work

March, 1980

JAPAN INTERNATIONAL COOPERATION AGENCY



MAPPING AREA

March, 1980

Mr. Keisuke Arita
President
Japan International Cooperation Agency
Tokyo

Dear Sir,

This report presents the progress of the phase two work of the Topographic Mapping Project of the Caribbean Coastal Area, the Republic of Panama, which was carried out in compliance with your request from August, 1979, to March, 1980.

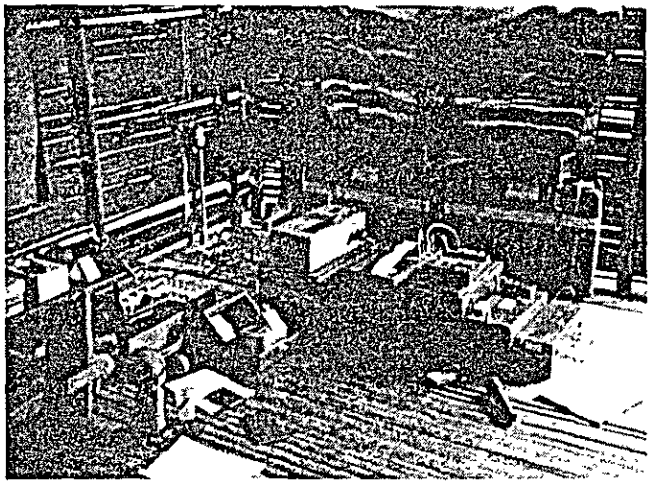
This report describes in detail the work carried out in the field, that is, ground control point survey, air-photo signalization, indirect leveling, pricking, field identification, and aerial photography, together with the aerial triangulation carried out in Japan. As a result of the phase two work, the field survey has been completed with exception of the field completion survey, resulting in a remarkable progress toward the preparation of the topographic maps. In addition, we are confident that a considerable contribution to the progress of the surveying techniques in Panama was made during this work, and the mutual understanding and the friendship cultivated meanwhile will contribute toward technical cooperation to be made in the future and eventually to the amity of the two nations.

We would like to express our hearty thanks to the members of the National Geographical Institute of Panama and other related authorities, and also to the Japanese Government officials including the staff of the Japan Embassy in Panama, the Japan International Cooperation Agency (JICA) and other related authorities for their earnest cooperation in this work. We hope also for a prompt and successful completion of this project with the execution of the phase three work.

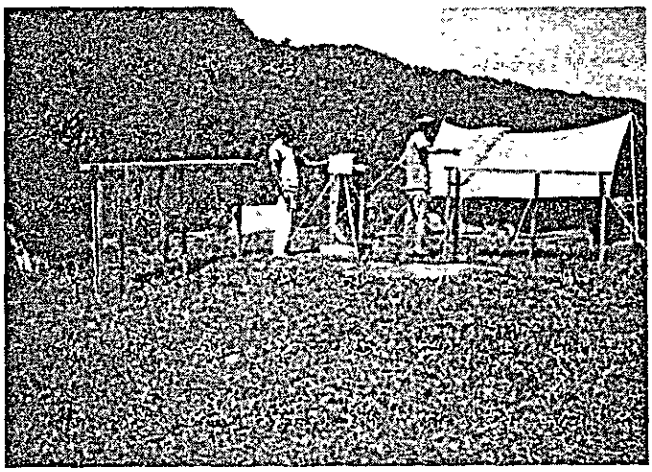
Yours sincerely,

Hiromichi Suzuki

Hiromichi Suzuki
Leader
Topographic Mapping Project Team
of the Caribbean Coastal Area
International Engineering
Consultants Association



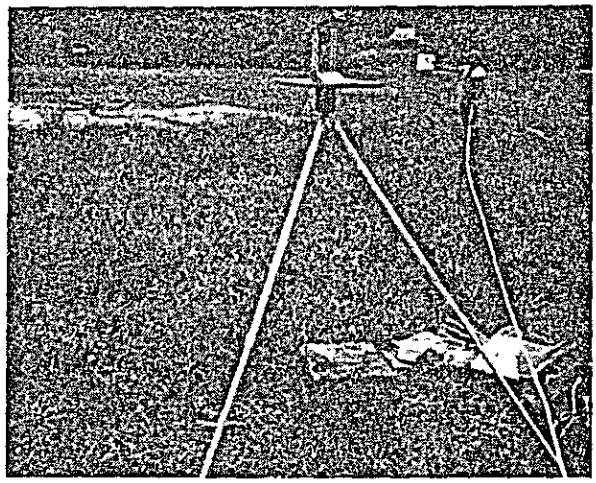
Observation with JMR-3



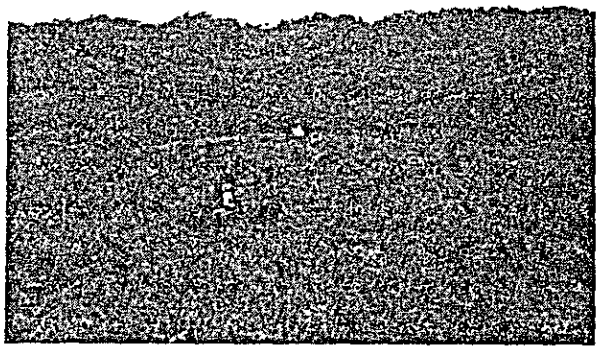
Air-photo signalization

Indirect leveling with barometer observation

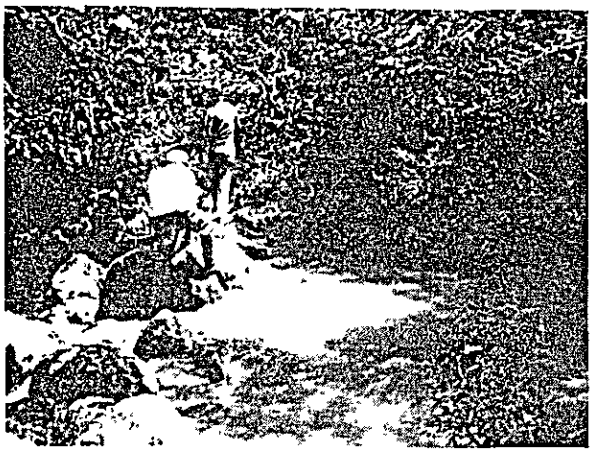
Pricking



Pricking, observation of elements of eccentricity



Neighboring of a NNSS observation station



Field identification work in mountainous area

Field identification work on seashore

Passing bad road by a land cruiser

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1. Summary of Work

I-1 History of work

The Scope of Work (S/W) of the Topographic Mapping Project of the Caribbean Coastal Area of the Republic of Panama was signed between the governments of Japan and Panama in February, 1979, and subsequently the ground control point survey and the aerial photography were carried out as the phase one work of the project. In the next fiscal year, the phase two work including most of the remaining field survey and a part of the work in Japan was carried out.

I-2 Object

The Caribbean coastal area in the north-western part of Panama is rich in mineral and forestry resources and an agricultural development project is planned. However, topographic maps of the scale 1:50,000 for that area have not yet been prepared.

The present project is to prepare twelve sheets of topographic maps with the scale of 1:50,000 for this region which will serve as a base for the various development projects in that area.

I-3 Project Area

The project area covers approximately 6,000 km^2, 12 map sheets and blank parts in the surrounding map sheets in the Caribbean coastal area of the north-western part of Panama. Since the number of existing control points in the project area

which can be utilized in the present mapping work is not sufficient, aerial photography was planned to cover approximately 8,000 km^2 including the neighboring area and minimum number of additional ground control points were estblished in the expanded area.

I-4 Types and Amount of Work

		Planned	Achieved	Accomplishment
Aerial photography		2,100 km^2	2,085 km^2 (131 photos accepted)	99.3% 1)
Ground control point survey		4 points (including 3 new points)	4 points	100%
Air-photo signalization		4 points	4 points	100%
Indirect leveling		7 points	7 points	100%
Pricking	Control point	8 points	8 points	100%
	Bench mark	400 km	400 km (70 points)	
Field identification		Whole area	Whole area	100%
Aerial triangulation		100 models	100 models	100%

Remark: 1) Aerial triangulation is possible for the whole area.

The aerial photography in the phase two work covered almost all of the area which remained unfinished in the phase one work,

except a small part of one course in the central mountainous region, where acceptable photos could not be obtained due to existence of clouds. However, some photographs are usable for the aerial triangulation and stereo-plotting among photographs which were taken supplementarily in the phase one and two works. As a result, aerial triangulation to cover the whole project area and stereo-plotting are possible for most of the mapping area except a very small area, approximately 15 km^2.

The ground control point survey was carried out by NNSS satellite observations using the translocation method.

At four ground control points, air-photo signals were established.

Indirect leveling by means of precise aneroid barometers was carried out to determine the height of 5 newly established control points and 2 new vertical control points established in the eastern part of the project area where insufficient number of vertical control exists.

Pricking was carried out at 4 existing and 4 newly established control points, and at 70 bench marks along the level line with a total length of approximately 400 km.

The field identification was carried out throughout the whole mapping area.

The aerial triangulation was carried out for approximately 1/3 of the whole work.

I-5 Organization and Period of Work

Team leader (General)

Hiromichi Suzuki	Aug. 29 - Sept. 17, 1979
	Dec. 8 - Dec. 27, 1979

Deputy Leader (also supervisor of aerial photography)

Masao Sato	Aug. 29 - Dec. 27, 1979

Member (Coordination)

Toshio Hayashi	Aug. 29 - Dec. 27, 1979

Member (Liaison)

Shuichi Onda	Aug. 29 - Dec. 28, 1979

Member (Aerial photography inspector)

Ryoichi Wakayama	Oct. 1 - Nov. 14, 1979

Member (Surveyor)

Hiromasa Takahashi	Aug. 29 - Dec. 23, 1979

Member (Surveyor)

Tadayoshi Uchiyama	Aug. 29 - Dec. 23, 1979

Member (Surveyor)

Nobuo Shimizu	Aug. 29 - Nov. 14, 1979

Member (Surveyor)

Yoshihiro Azuma	Sept. 11 - Dec. 23, 1979

Member (Surveyor)

Yoshikazu Yoshimoto	Sept. 11 - Dec. 23, 1979

Member (Surveyor)

Kiyoshi Watanabe	Sept. 11 - Dec. 23, 1979

Member (Surveyor)

Hiroshi Hatashita	Sept. 11 - Dec. 23, 1979

Member (Surveyor)

Koichi Tanaka Sept. 11 - Dec. 23, 1979

I-6 Equipment used

JMR-3 Doppler survey set		3 sets
Contents: Receiver, Microprocessor		3
Interface, Power unit		3
Cassette recorder		3
Signal simulator		1
Pateic 9-track tape recorder		1 set
SP-2T translocation program		1 set
Electronic computer	OUK-90-700	1 set
Electro-optical distancementer	AGA-76	1 set
Theodolite	WILD T2	1 set
Level	Sokkisha B-2	4 sets
Aneroid barometer	(Negretti & Zambra) MK2 M 2236	3 sets
"	(") MK2 M 2236A	2 sets
Short wave radio transceiver	ST7	6 sets
"	(Provided by IGN)	2 set
Toyota Land Cruiser	(Provided by JICA)	5 (4 with winch)
"	(Hired in Panama)	1 (with winch)
4 wheel drive middle size truck	(Provided by IGN)	1 (with winch)
4 wheel drive wagon	(")	1
Helicopter Bell HU-1	(Hired in Panama)	1
" " 47G	(")	1

Airplane	Lear Jet 25C	1
Aerial camera	Zeiss RMK-4 12/23	1 set
Photographic processing equipment		1 set
Film developer, film drier, printer		1 set each
Pricking device	KRP	4 sets
Stereo-comparator	WILD STK-1	1 set
	Zeiss Jena Stekometer	1 set
Electronic computer (for aerial triangulation)	DEMOS-E1200D,-F200D, OUK-90-700	1 set each
PAT-M	(for analytical aerial triangulation, independent model method, block adjustment program)	1 set

I-7 Weather during the Period of Work

The period during field work was in the rainy season in Panama, from April to December, and violent weather changes, that is, occurrence of squall, thunderclouds, low clouds, mist etc. took place locally within the project area. Even if weather is recorded as fair or cloudy in the following table, there occurred concentrated heavy rain at some places. Thus, the operation of vehicles and helicopters was extremely difficult.

Following Table shows statistical data of the weather.

	August	September	October	November	December	Total	Percentage
Fair	- days	14days	7.5days	7.5days	10.5days	39.5days	34%
Cloudy	2 days	15.5	18.5	13	10.5	59.5	50
Rain	-	0.5	5	9.5	4	19	16
Total	2	30	31	30	25	118	100

I-8 Daily Schedule

Aug. 29, 1979	Mr. Kuriyama, Geographical Survey Institute, leader Suzuki, deputy-leader Sato, members Hayashi, Onda, Takahashi, Uchiyama and Shimizu left Japan.
"	Concluded contract for aerial photography with Mark Hurd Aerial Survey Inc. in Los Angeles.
Aug. 30	Above 8 members arrived in Panama city.
Sept. 1	Opening of the headquarter office in Panama city. Takahashi, Uchiyama and Shimizu start reconnaissance survey of the project area and inspection of equipment and materials.
Sept. 3 - 14	Discussions on the work plan with the National Geographical Institue (IGN).
Sept. 4	Transportation of the fuel for helicopters started. Mr. Ichiro Yamanouchi, President of IECA, and Mr. Masao Horie, both members of the House of Councilors of Japan visited the IGN and the Ministry of Public Works of Panama.
Sept. 6	Reconnaissance survey with a light airplane by Mr. Kuriyama, Suzuki and Uchiyama.
Sept. 7 - 8	Field reconnaissance survey with vehicles (land cruiser) and helicopter by Mr. Kuriyama, Suzuki and Sato.

Sept. 8 - 11	Patrol survey of the project area for selecting ground control points and preparation of the work by Takahashi, Uchiyama, Shimizu and Panamanian counterparts.
Sept. 12	Members Azuma, Yoshimoto, Watanabe, Hatashita and Tanaka arrived in Panama city.
Sept. 13	Record of discussions (R/D) signed.
Sept. 14	Reconnaissance survey with a light airplane by Yoshimoto, Watanabe and Hatashita.
Sept. 15	Mr. Kuriyama and Suzuki left Panama city. Field survey started.
Sept. 25	Mr. Fumio Hibi, the Ministry of Foreign Affairs and Mr. Hiroshi Kimura, JICA, arrived in Panama city.
Sept. 28	Field observation of the project area with a helicopter and vehicles by Mr. Hibi and Mr. Kimura accompanied by Sato.
Setp. 29	Transportation of the helicopter fuel finished.
Oct. 2	Mr. Hibi left Panama city. Member Wakayama arrived in Panama city.
Oct. 6	Authorization to enter into the Indians reservation area obtained.
Oct. 8	Mr. Kimura left Panama city.
Oct. 9	Aerial photo-taking plane and its crew arrived at Tocumen international airport in Panama city.

Oct. 10	Setting of air-photo signalizations finished. Discussions on work for air-photo taking carried out among the Japanese mission, IGN and airplane crew.
Oct. 12	Work on air-photo taking started.
Oct. 24	Ground control point survey (NNSS observations) and indirect leveling finished.
Oct. 25 - Nov. 2	Field survey team members meet at Penonome base-camp for arrangement of the observed results. Calibration of the barometers in Panama city.
Nov. 2	Inspection of aerial films by Wakayama.
Nov. 3	Field surveys including field identification and pricking work re-started.
Nov. 6	Discussions on the operations with the three IGN department chiefs.
Nov. 8	Work on air-photo taking finished.
Nov. 9	The photo taking plane and the crew left Panama. Shimizu went back to Panama city with the observation record.
Nov. 13	Wakayama and Shimizu left Panama city.
Nov. 22	Discussions on the map symbols with the IGN staff started. Pricking of the ground control points finished.

Nov. 23	All field work on the Caribbean coastal side completed.
Dec. 1	Hayashi went to observation site for accounting work and arrangement of the equipment and materials.
Dec. 9	Suzuki arrived in Panama city.
Dec. 11	Mr. Agata, Mr. Kai and Mr. Tsuburaya, JICA, observed the team. Mr. Nishimura, Geographical Survey Institute, and Mr. Kimura, JICA, arrived in Panama city.
Dec. 12	Pricking at bench marks and field identification work finished. Arrangement work continued.
Dec. 13 - 17	Discussions with IGN on the progress of the phase two work, plan for the coming year, technical problems, etc.
Dec. 14	Members of the field survey team went back to Panama city. Preparation for returning to Japan.
Dec. 16	Mr. Nishimura and Mr. Suyama, the Embassy of Japan, observed the survey site by a light airplane accompanied by Sato.
Dec. 19	Takahashi, Uchiyama, Azuma, Yoshimoto, Watanabe, Hatashita and Tanaka left Panama city.

Mr. Nishimura and Suzuki visit Penonome and Coclesito with vehicles, accompanied by Sato.

Dec. 20 R/D signed.

Dec. 24 Sato and Onda left Panama city and received part of the results of the aerial photographs in Los Angeles.

Dec. 25 Mr. Nishimura, Mr. Kimura, Suzuki and Hayashi left Panama city.

I-9 Supervision and Observation

During the surveying work, the following persons visited Panama to supervise the work, give advice, discuss with the Panamanian government officials and receive and maintain the survey vehicles.

Technical advisor

Mr. Minoru Kiriyama

Chief of the National Large Scale Mapping Division, Topographic Department, Geographical Survey Institute, Ministry of Construction

From August 29 to September 17, 1979

Mr. Keiji Nishimura

Deputy Director General, Geographical Survey Institute, Ministry of Construction

Chairman, Supervisory Committee for Mapping Project, JICA

From December 10 to December 27, 1979.

Advisor

Mr. Fumio Hibi

Development Cooperation Division, Economic Cooperation Bureau, Ministry of Foreign Affairs

From September 24 to October 4, 1979.

Mr. Hiroshi Kimura

Senior staff, Development Survey Division, Social Development Cooperation Department, JICA

From September 24 to October 10, 1979 and

From December 10 to December 27, 1979.

I-10 Discussions with the Panamanian Government

Discussions on the implementation of the project were carried out both at the beginning and the end of the work at the National Geographical Institute (IGN), between the staff members of IGN, the Panamanian side, and the members of the Japanese mission.

I-10-1 Discussion at the Beginning of Work

On September 3, 4, 5 and 13, meetings were held for explanations of the work plan of the phase two work and discussions on the cooperation in the execution of the work, data to be provided by IGN and map symbols to be adopted in the present mapping work, etc. On the map symbols and its application, a detailed discussion was carried out to prevent any problems during field identification.

As the result of these discussions, it was decided that

place-names and annotations will be described on the aerial photographs in Spanish by the Panamanian counterparts and the chief counterpart will confirm the descriptions by signature on each photograph.

The contents of the discussions are recorded in Annex 1.

I-10-2 Discussion at the End of Work

On December 12, 13, 14 and 20, meetings were held for discussions on the progress of the phase two work, the outline of the work to be carried out in the future, air-photo taking of the remaining blank parts by IGN, and data already provided or to be provided by IGN, etc.

As for the map symbols and its application, it was confirmed that the field identification work had been carried out according to the results of the preceding discussions. Technical problems referring to the work to be carried out in Japan in the future were also discussed. As for the aerial photography of the remaining blank parts, IGN expressed its intention to conduct air-photo taking for the area as the priority work, with its own expense, that is, with its airplane and personnels.

The contents of the discussions are recorded in Annex 2.

II. Field Work

II-1 Organization and Sub-Division of Work

The field work carried out this year can be divided into two categories.

1) Aerial photography
2) Ground surveying work

As in the phase one work, the aerial photography was carried out by Mark Hurd Aerial Survey Inc., Minneapolis, Minnesota, USA.

The persons involved in this work are listed below.

Survey team

Photography supervisor	Masao Sato
Photography inspector	Ryoichi Wakayama

Panamanian counterpart

	Domingo Requelme M.
	Head of IGN
	Photography section

Photography crew of Mark Hurd Inc.

Pilot and photographer	R.H. Miller
Copilot	W. Paulin
Photograph engineer	R. Larsen

The ground surveying work covers various kinds of surveying, such as ground control point survey, air-photo signalization, indirect leveling, pricking and field identification.

Some of these items require several surveyors at the same time. Thus, in the field work, a position was not assigned to each member and practically all members of the team participated in most of the above mentioned works.

Chief of the field survey team: Hiromasa Takahashi

Chief counterpart: Ing. Temistocles Rodriguez C.
Chief of the Geodetic Department,
IGN

II-2 Preparation of Work

Negotiations concerning a contract for the aerial photography were done by correspondence and telex with Mark Hurd Aerial Surveys Inc., as in the case of the phase one work. On the way to Panama in Los Angeles, on August 29, we met Mr. Powers, the president of that company, for final negotiation. A contract was concluded on stand-by basis similar to that of the phase one work.

Soon after the arrival of the survey team, the headquarter office was opened on September 1, in Panama city. In parallel with the discussions with IGN, preparatory work was started. Most of the project area can be accessed only by using helicopters and its utilization as a means of transportation is indispensable for the execution of the work. At first, some members of the team visited the main villages in the project area and asked for cooperation concerning the establishment of the base-camp, and sub-camps and execution of the field work. With the cooperation of the National Guard of Panama,

the transportation of helicopter fuel was started on September 4, by using a large size jet helicopter as in the phase one work and 3,850 gallons of fuel were stored at the sub-camps, Coclesito and Cocle del Norte. In this work, Tambo was used as a relay base and a part of the fuel was kept at Concepción. Since it was in the rainy season, operation hours of the helicopter in a day were restricted and the work was difficult.

II-3 Headquarter and Base Camp

The headquarter office was opened at the following location as in the phase one work:

Address: c/o Cobre Panama
Panama city, Zona 4, 10730 (P.O.Box)

Telephone: Panama 64-1628

The base camp for the field work was established in the city of Penonome, as in the phase one work. The sub-camp were established at Coclesito, Cocle del Norte and Concepción. A short wave radio set was equipped at each of these sub-camps for the communication with the headquarter or other camps.

II-4 Ground Control Point Survey

As in the phase one work, ground control point survey was carried out by observing Doppler shifts of radio wave frequencies transmitted from NNSS satellites with the JMR-3 Dopoler survey sets. Simultaneous observations at a newly established point and a fixed point located at an existing control point in Penonome were performed in order to adopt the translocation

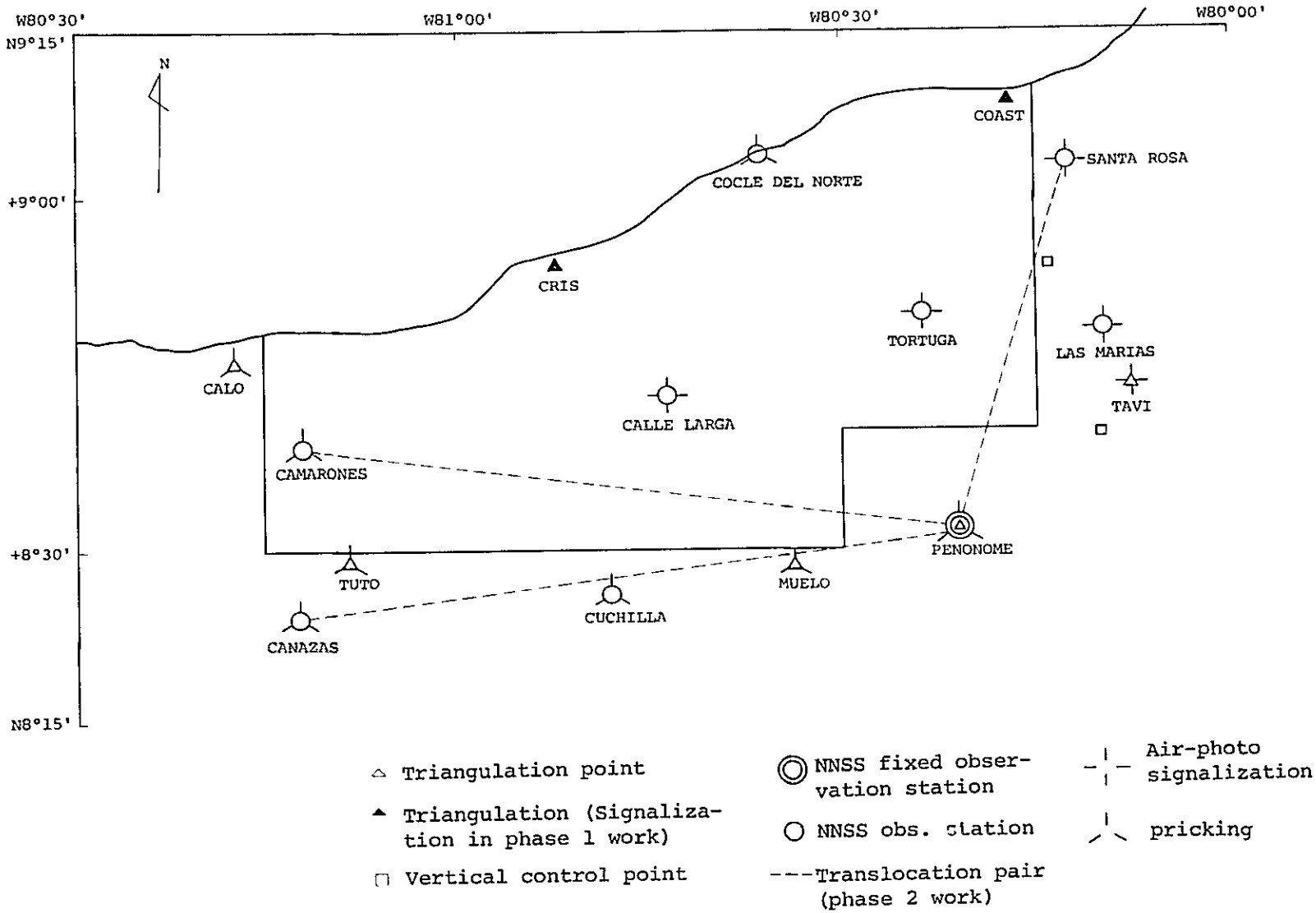
method to determine the positions of the new point relative to the existing geodetic net. Three new ground control points were established by this method.

As for the new point at Camarones, it was planned to locate this point about 50 km east of the present site because of better distribution of the control points but we were compelled to select the present site because the authorization to enter into the reservation area for Indians in which the new point was planned to be located was not obtained within the required time.

At the newly established ground control points, similar monumentation was performed to that of the phase one work. Owing to the observation experiences with the JMR-3 in the phase one work, we did not experience difficulties as in the last work but field observations work for satellite geodesy is not very easy.

The distribution of the observed ground control points is shown in Figure 1.

Fig. 1 Ground control point survey, air-photo signalization and pricking at control points



II-5 Air-photo Signalization

Similar signalization to that in the phase one work was set at 5 points within the photo taking area covered this time. (Figure 1)

II-6 Indirect Leveling

As vertical control point for the present mapping work, existing and newly established control points were used as well as existing bench marks. In the eastern part of the mapping area, however, number of vertical control points above mentioned were not sufficient and at least 2 more vertical control points were necessary. Since it required much time and labor for executing direct or triangulation leveling in this area, we observed the height of these 2 new vertical control points and also 5 newly established control points by indirect leveling with barometers.

Indirect leveling was carried out by simultaneous observations with the aneroid barometers, M-2236 (observation range up to 1,000 m) and M-2236A (up to 1,500 m), both with the minimum reading of 1/100 mb, at an unknown point and at three surrounding bench marks. The average distance between the observation points is approximately 35 km and the maximum 72 km. One series of observations was made during 3 days, with readings at every hour from 7 AM to 8 PM. From these results, the difference in height between the known and the unknown point was calculated. The average of the three differences was taken to determine the height of the unknown point. A final accuracy of the height

thus determined is estimated to be about 2 m, which is sufficiently accurate for our purpose.

After finishing field observations, the barometers were calibrated by observing at the meteorological station in Tocumen airport in Panama city to determine instrumental constants.

The following formula was used for height calculation.

$$H = 18464 \ (\log B_o - \log B)(1 + 0.003665 \ t) \qquad (m)$$

where

B_o, B: Atmospheric pressure at the known and unknown point (mb)

t : Average temperature

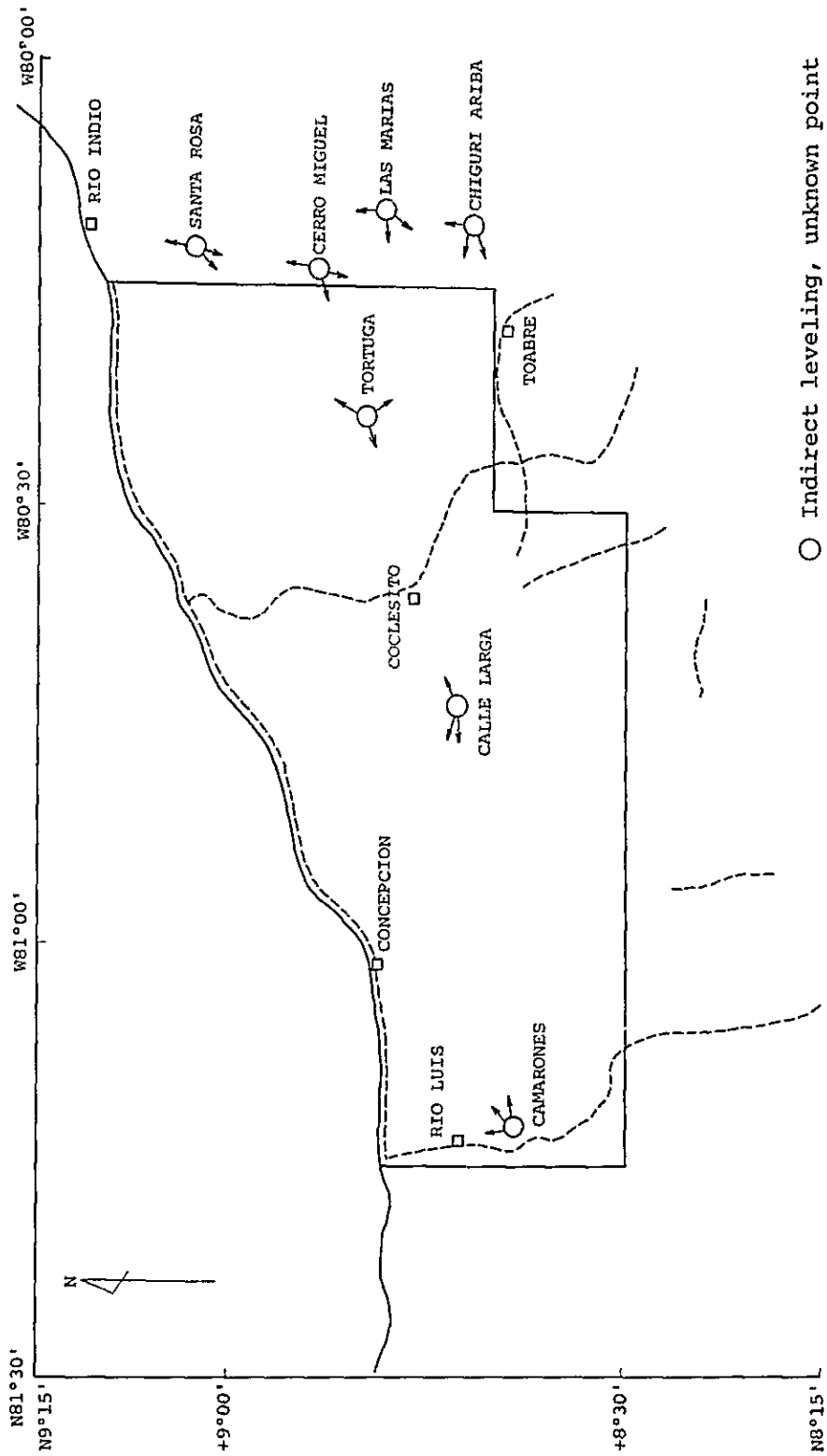
The distribution of the observation points is shown in Figure 2.

II-7 Pricking

The pricking was carried out at 4 existing triangulation points, 4 newly established control points at which no signalization was set. (Figure 1) At each point, clearly identified object on the ground was pricked on a 6 times (6x) enlarged photograph. The eccentric distances were less than 20 m and the azimuth was measured with a compass.

The pricking was also carried out at 70 bench marks situated along level line with a length of approximately 400 km using 4x enlarged photographs. (Figure 2).

Fig. 2 Indirect leveling and pricking at bench marks



II-8 Field identification

In order to execute the field identification, a complete agreement is required between the survey team and the IGN counterparts with regard to the map symbols and its application. Thus, most of the time of the discussions at the beginning of the work was used for this matter. The Japanese side presented questions and the Panamanian side answered. Then discussions were carried out in detail. There are not many experts on this problem and technical manuals are not sufficient in Panama. However, thanks to these discussions, it was possible to conclude the field identification, by repeating additional discussions with the counterparts in the field work.

In the field identification, observed items were recorded on the 2x enlarged photographs with the cooperation of the Japanese survey team and the Panamanian counterparts. Place-names were described on a contact print of photographs by the Panamanian counterparts, who prepared a list of the place-names, that is a gazetteer.

There was a reservation area for Indians in the western part of the mapping area requiring authorization to enter into this area for field works. Because it took much time to obtain this authorization, we did not have sufficient time for field identification work in detail in this area.

II-9 Aerial Photography

The aerial photographs were taken for areas which were not covered by the phase one work. As in the preceding work,

a wide angle aerial camera was used and photo-scale was 1:60,000 at a height of approximately 9,000 m above sea level. The camera and the jet-plane used this time were the same as those of the phase one work.

II-9-1 Aircraft Base

The airplane arrived at Tocumen international airport on October 9, 1979, with the crew composed of three members. The Tocumen airport was used as the base for this work as in the preceding year. The processing of the photographs was done by using the facilities of the IGN provided for this purpose as in the phase one work.

II-9-2 Photo Taking

After discussions among the Japanese mission, the IGN and the crew, photo taking was started on October 12, 1979. The present work was conducted during the rainy season in Panama and we were afraid to miss even few chances of photo taking. Fortunately, however, the field survey teams were working in the project area in this season and information on the local weather was obtained from these teams every morning by radio communication. This was very beneficial in our choice for photo taking. At two occasions, the airplane left the base under rain with rader guided take-off, carried out photo taking and returned again to the base under rain. On many occasions, the area finished in the phase one work was cloudy but we found several chances to take photographs in the present project area. This

was a positive effect of changing the epoch of air photo taking from the dry season in the phase one work to the end of rainy season in which we might find some intervals of heavy rains.

However, the project area was covered with thick cloud almost every day, and the chance for photo taking were very much restricted. By repeating air photo taking for most difficult course, all project area was photographed but there remained several very small areas which were obstructed by clouds. Because of these situations, we had to finish the photo taking on November 8.

The photo taking courses are shown in Figure 3 and the schedule is given below.

(Table)

Date	Take off	Landing	Flight time	Flight height	Course No.	Direc-tion	Photo No.
				ft			
10/14	8:31	9:38	1:07	31,000	2	W	481∿492
24	8:15	9:32	1:17	31,000	3	E	493∿513
					4	W	514∿535
					5	E	536∿553
30	8:15	9:21	1:06	31,000	6	W	554∿567
					5	W	568∿586
					2	E	587∿600
31	8:16	9:21	1:05	31,000	6	E	601∿622
					5	W	623∿638
					12	S-E	639∿657
					11	N	658∿676
					11	W	677∿695
11/ 1	8:00	9:56	1:56	31,000	7	W	696∿719
					6	E	720∿735
					6	E	736∿749
					12	E-N	750∿762
2	8:13	9:30	1:17	31,000	7	E	763∿790
3	8:17	9:22	1:05	31,000	11	S-N	791∿797
					7	W	798∿810

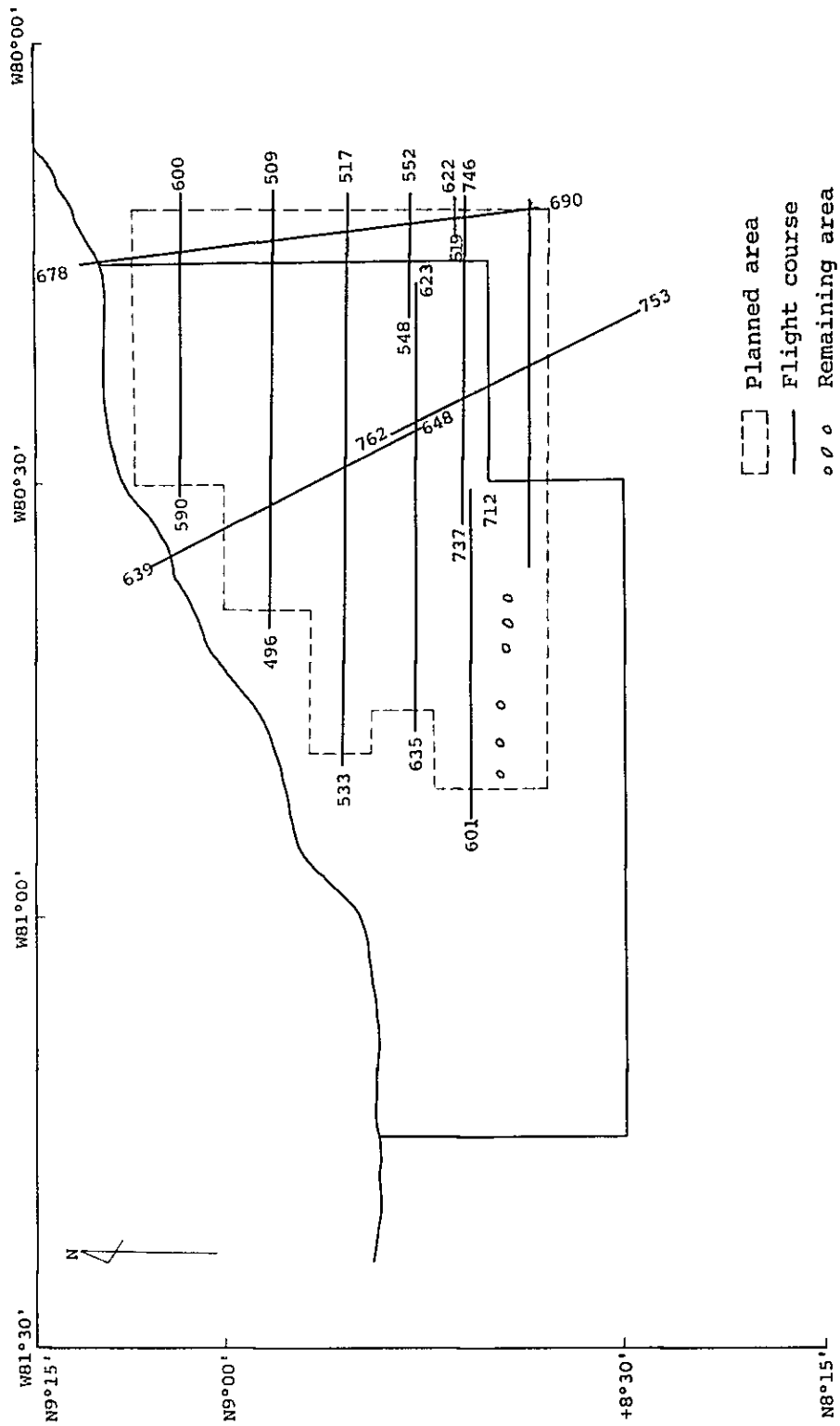


Fig. 3 Aerial photography course

III. Work in Japan

III-1 Calculation of the Control Point Survey Results

III-1-1 Horizontal Coordinates

The establishment of the new ground control points by means of NNSS is to supplement basic geodetic control points. The result of new control points should coincide with the existing geodetic coordinate system. Considering these circumstances, the observations were made by translocation method with an existing control point.

From the NNSS observation results, latitude and longitude are determined originally on the WGS-72 ellipsoid. Assuming the latitude and longitude at the existing control point at Penonome coincides with the geodetic results, above mentioned values were converted into those on the reference ellipsoid adopted in Panama, that is, the Clarke 1866 ellipsoid based on the North American Datum 1927.

Besides Penonome, 3 more existing control points were occupied by the JMR set in the phase one work. These 4 points are located at four corners of the project area. For these 3 points, horizontal coordinates were obtained also referring to Penonome. Obtained results were compared with the existing geodetic results as shown in the left column of the following table.

Station	Difference NNSS value - Geodetic value		Residual	
	X (north positive)	Y (east positive)	X	Y
	m	m	m	m
Penonome	0.00	0.00	- 1.69	+ 3.00
Calo	+ 7.56	- 0.89	+ 5.07	+ 1.13
Coast	+ 0.49	- 6.44	- 0.61	- 4.07
Canazas	- 0.03	- 2.57	- 2.77	- 0.06

X, Y : U.T.M. coordinate values

These differences are small and can be regarded as an error in NNSS observations. However, systematic erros may exist and it is recommended to convert them into coincident values with the existing geodetic results by a reasonable method. Since the project area has an extent of only 80 km x 100 km, and the observations at the known points are made at only 4 points, the following linear conversion formula, Helmert's transformation, was adopted:

$$X_G = a X_N + b Y_N + X_o$$

$$Y_G = - b X_N + a Y_N + Y_o$$

X_G, Y_G : Coordinates in Geodetic coordinate system

X_N, Y_N : Coordinates obtained by NNSS observations

a, b, X_o, Y_o : Transformation constants (to be determined)

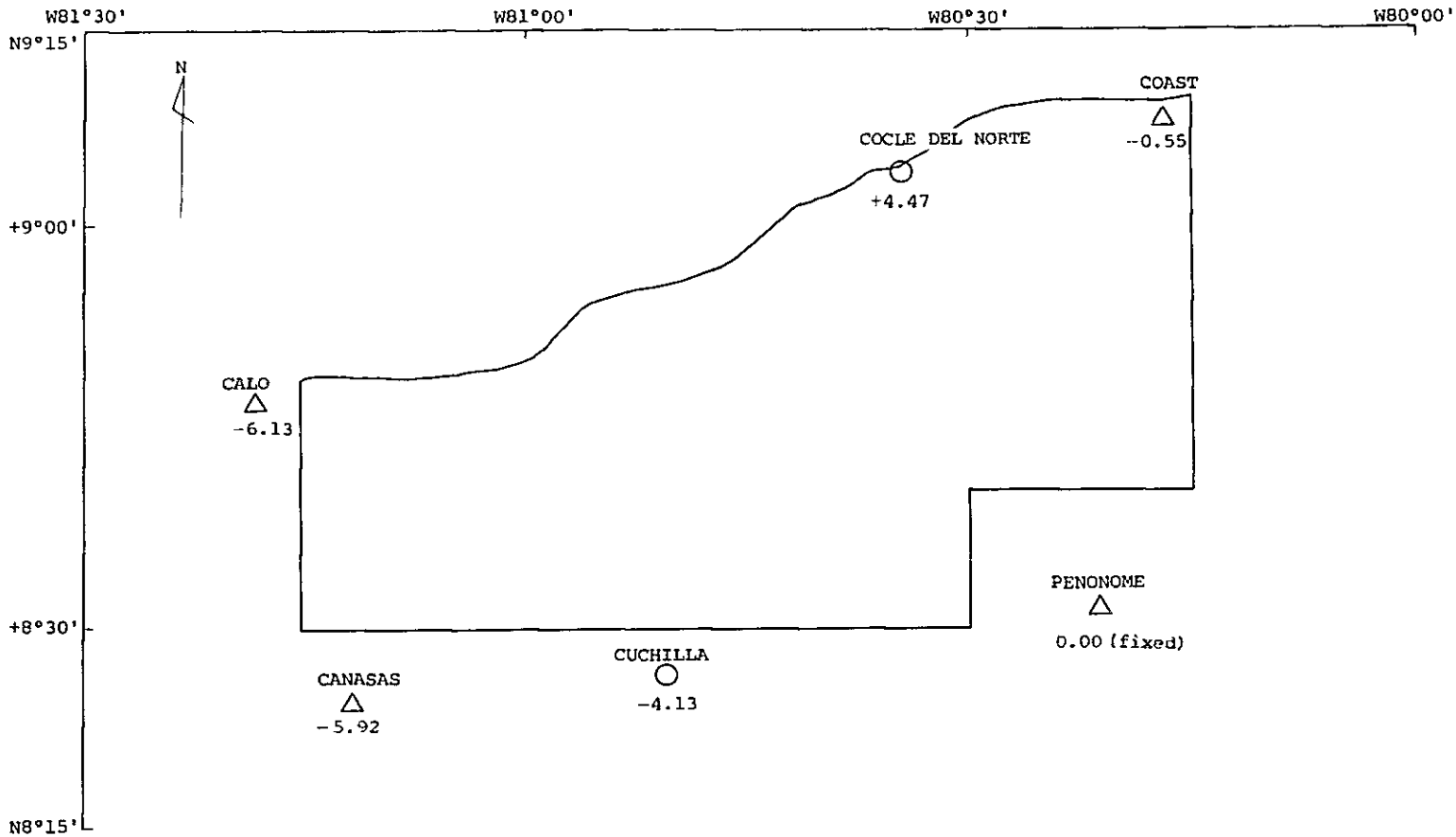
The residuals, calculated by using the determined transformation constants are given in the right column of the preceding table. These values are small enough and there is no problem

considering the accuracy of the control points required for present mapping, that is, 0.1 mm on the map corresponds to 5 m.

III-1-2 Height

The differences in height between the existing geodetic result and the NNSS values for the 4 points mentioned above are shown in Figure 4. In this figure, differences in height at 2 newly established points in which geodetic heights were determined by direct leveling from the existing bench marks are also shown. These points are marked by a small circle. The amount of these values can be regarded as errors in the NNSS observations as in the case of horizontal coordinates and no conversion was made.

Fig. 4 Differences in height
NNSS value - geodetic result (in m)



III-1-3 Ground Control point Survey Results

The final coordinate values of the ground control points were determined as described below.

1) As for the existing triangulation points, the existing geodetic results will be used for both horizontal and vertical coordinates.

2) As for the horizontal coordinates of the newly established control points by NNSS, the results converted as described above will be adopted.

3) As for the height of these new control points, if direct leveling was done from existing bench marks, the results of the leveling will be adopted without any modification. For other points, where no leveling was done, the NNSS results will be adopted.

The final coordinate values of the ground control points thus obtained are summarized in the following table.

Station	Coordinate value		
	X	Y	H
	m	m	m
Penonome	941,253.04	571,565.80	88.94
Coast	1,012,306.23	579,182.02	72.52
Calo	966,551.71	470,722.04	511.15
Canazas	921,722.93	478,872.59	708.26
Cuchilla	931,090.76	516,685.04	591.81
Cocle del Norte	1,003,223.68	547,153.28	1.46
Tortuga	981,454.92	567,456.83	65.82
Las Marias	982,571.41	585,915.22	205.13
Calle Larga	966,892.10	529,311.57	91.01
Camarones	951,542.15	476,716.08	187.07
Santa Rosa	1,000,175.19	588,680.48	12.27
Canazas (eccentric station)	923,201.32	478,111.73	680.20
Coclesito	973,617.05	548,733.02	60.51

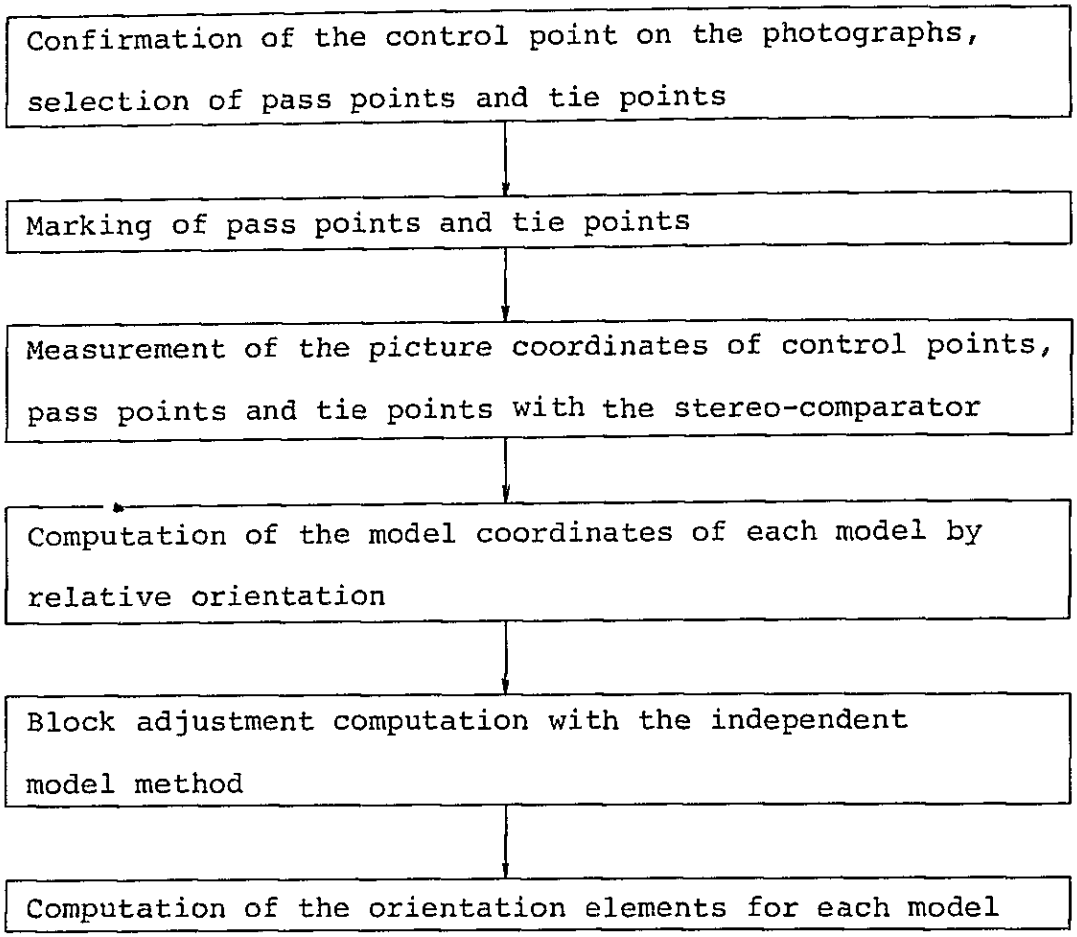
III-2 Aerial Triangulation

The aerial triangulation was carried out with the analytical method by using the block adjustment method with independent model. The program used in this work is the independent model method program developed by Stuttgart University, West Germany, popularly known as PAT-M.

Followings are the outline of the specifications of this work.

Number of models	100 models in phase two work (250 models in total)
Number of courses	10
Photographic scale	1:60,000
Principal distance	15 cm
Overlap	60%
Sidelap	30%
Flight height	9,000 m
Pass point	6 point per model
Tie point	0.5 "
Number of horizontal control points	12 points
Number of vertical control points	23 points
Coordinate measurement instrument	Stereo-comparator
Mapping scale	1:50,000
Maximum topographic height difference	1,500 m

Followings are the flowchart of the analytical triangulation.



As a result of the serial triangulation, following accuracy was obtained which is precise enough for our work.

Residual of horizontal coordinate of the control points.

mean square error 1.50 m, maximum 4.29 m.

Residual in height

mean square error 1.08 m, maximum 3.05 m.

IV. Findings and Comments

The field surveying of the present mapping project was a hard work under severe natural conditions. However, we are very glad to conclude the work without any serious troubles. We regret that a small residual area was not covered by the aerial photography. In spite of our efforts, the bad weather in this area did not give us a chance of success. With regard to the remaining blank area, the Panamanian authority expressed their intention of taking aerial photographs as soon as possible and we wish a successful completion of that work.

As a result of the execution of the phase one work and the visit of Mr. Tejada, Director of IGN, to Japan, the mutual comprehension between the Panamanian and the Japanese sides rapidly deepened and the support of the Panamanian side during the phase two work was of invaluable importance. The execution of the work was considerably facilitated and we are strongly convinced that the Panamanian side had the chance of learning useful information on the modern surveying techniques, especially the planning, organization and execution of a big mapping project like the present one.

In addition, with regard to the aspect of friendship, the members of the Japanese mission and the IGN counterparts held two softball games and the IGN invited the Japanese mission to their Christmas party. A very friendly relation has been kept between them. We believe that this relation will be very helpful for the future work and also for the

friendship between both countries.

The phase three work will mainly be conducted in Japan, but field completion survey is planned in Panama. According to our experiences, the field surveying work implies many difficulties, even in a case of a small scale work, and a careful planning and preparation are required. By executing the phase three work, we hope to complete fine topographic maps in the near future.

Appendix 1

ACTA DEL REGISTRO DEL PROYECTO DE MAPAS TOPOGRAFICOS DEL AREA COSTERA DEL CARIBE DE LA REPUBLICA DE PANAMA

La Agencia Internacional de Cooperación del Japón, (que de aquí en adelante se llamará JICA y el Instituto Geográfico Nacional "Tommy Guardia" (que de aquí en adelante se llamará EL IGN) han tenido reuniones en el IGN los días 3, 4, 5 y 13 de Septiembre de 1979.

1.- JICA ha explicado al personal del IGN el Plan de Operaciones de la fase II de trabajo como se muestra en el apéndice. El IGN está de acuerdo con este programa. El IGN estuvo de acuerdo de proporcionar una contraparte consistente en un coordinador de proyecto y cuatro (4) técnicos, para el período de estudios Barométricos proporcionará dos (2) técnicos adicionales.

2.- El IGN suministró a "JICA" copia de la Carta Hidrográfica DMA 26AC026069.

3.- El IGN proporcionará al JICA dos (2) juegos de fotografías aéreas ampliadas dos (2) veces, tan pronto como las fotografías aéreas sean tomadas en la fase II.

4.- El IGN proporcionará a JICA los siguientes materiales a finales de Octubre del presente año;

1. Muestras de manuscritos y sobrepuestas de las hojas de mapas.
2. Información marginal, separación de colores de las hojas.

3. Una de cada una de los mapas adyacentes para el empalme de las hojas del Proyecto.

5.- JICA acordó aplicar modificaciones en el "MANUAL TECNICO DE CONVENCIONES TOPOGRAFICAS ("TCT) adoptadas por el ICN para su trabajo actual de mapeo. Para la aplicación de símbolos en los mapas, este tema se discutió en detalles y se aceptó que no habrá ningún problema en el trabajo de Clasificación de Campo.

6.- JICA y el ICN acordaron tomar los siguientes pasos en la Clasificación de Campo; nombres geográficos y cualquiera otra anotación serán anotadas en español en las fotografías aéreas por la contraparte panameña y el jefe de la cuadrilla firmará cada fotografía para hacerse responsable y confirmar estas descripciones.

Dado en la ciudad de Panamá septiembre 13, de 1979.

Sr. [illegible]
Asesor Jefe de la
Misión Técnica del Japón

Dr. J. [illegible] O. OLO P.
Director Nacional a.i.
IGN-I.A.

RECORD OF DISCUSSION ON THE TOPOGRAPHIC MAPPING PROJECT OF THE CARIBBEAN COASTAL AREA OF THE REPUBLIC OF PANAMA

The Japan International Cooperation Agency (hereinafter referred to as "the JICA") and the National Geographical Institute (Instituto Geográfico Nacional "Tommy Guardia", hereinafter referred to as "the IGN") have had discussions at the IGN on 3rd, 4th, 5th and 13th September 1979.

1.- The JICA explained to the staff of the IGN the Plan of Operations of the phase II work as shown in appendix. The IGN agreed to this program. The IGN also agreed to provide counterparts consisting of a project coordinator and 4 technicians and for the period of barometric survey, 2 additional technicians.

2.- The IGN provided to the JICA a copy of hydrographic chart, DMA 26AC026069.

3.- The IGN will provide to the JICA 2 times (x 2) enlarged aerial photographs as soon as the photographs are taken in the phase II work.

4.- The IGN will provide to the JICA following materials by the end of coming October:

1) Samples of manuscripts and overlays of map sheets.
2) Marginal information, color separation scribed sheets.
3) Tie-strips, in one color, of surrounding maps including those for blank parts in the maps.

5.- The JICA agreed to apply modifications in "Manual Técnico de Convenciones Topográficas (MTCT)" which are adopted by the IGN for the present mapping work. For the application of map symbols, detailed discussions were held and it was confirmed that there would be no problem in the field identification work.

6.- The JICA and the IGN agreed to take following process in the field identification; geographical names and any other annotation will be put on aerial photographs in Spanish by Panamanian counterparts and the chief counterpart will sign on each photo sheet to take responsibility to confirm these descriptions.

At Panama City, September 13, 1979.

on behalf of the JICA:

Minoru Kuriyama

Mr. MINORU KURIYAMA
Technical Advisor of the
Japanese Mission

on behalf of the IGN:

Dr. JULIO C. MOLO P.
National Director
MOP-IGNTG

PLAN OF OPERATIONS OF THE PHASE II WORK

THE TOPOGRAPHIC MAPPING PROJECT OF THE
CARIBBEAN COASTAL AREA OF THE
REPUBLIC OF PANAMA

1. Aerial Photography

a. Area to be covered: Remaining area (about 2,100 km^2)

b. Photo-scale and camera: Approximately 1:60,000
with a wide angle precision camera.

This work will be carried out by Mark Hurd Aerial Surveys Inc., Minneapolis, Minnesota, U.S.A., under a contract with I.E.C.A.

Detailed schedule will be arranged in a preparatory meeting among IGN staff members, the Japanese technical mission, and the Mark Hurd aircraft crew.

2. Ground Survey

a. Ground Control Point Survey:

At 4 stations, 3 new points and 1 existing triangulation station, NNSS satellite Doppler observations will be made by translocation method.

b. Leveling:

At 7 points, elevation will be determined by using precise barometers referring to those at sorrounding known points.

c. Signalization:

At 4 points which were established by NNSS method air photo signal will be made.

d. Pricking:

At 8 ground control points,
including 6 points established by NNSS method and
2 existing triangulation stations.

Also at bench marks along leveling routes.

Its total length is 400 km.

e. Field Identification:

For all mapping area,
observations for some areas,
observations along roads, rivers, and sea coast and
observations at some points of interest.

Details of this work will be arranged in preparatory meetings among IGN staff members and the Japanese mission.

Area to be surveyed is shown in the attached figure.

3. Aerial Triangulation

Aerial triangulation will be carried out after the technical mission get back to Japan.

4. Time schedule

Period of the work:

Headquarters: From August 31 to December 24, 1979,

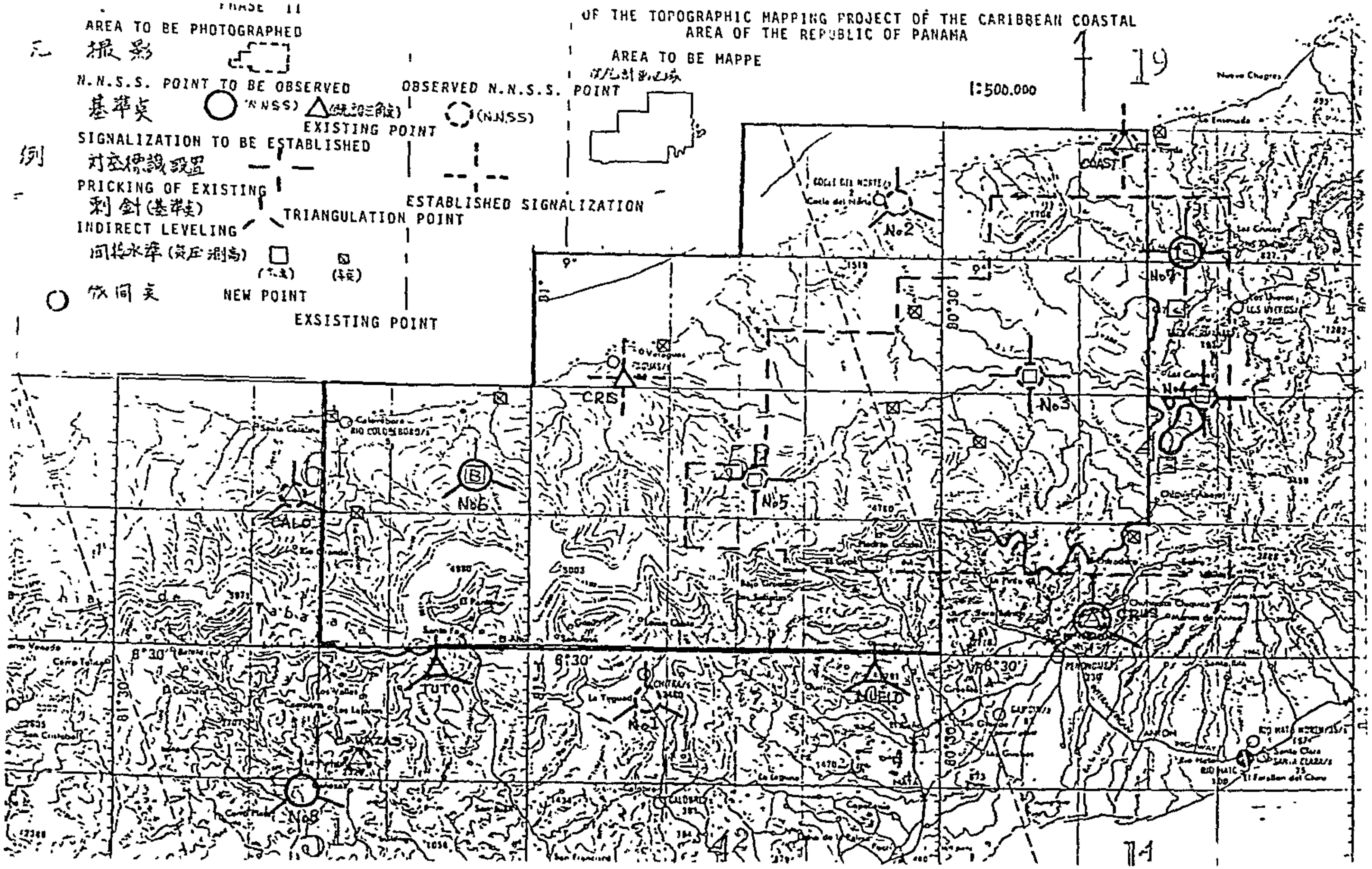
Aerial Photography: From October 7 to November 6, 1979,

Ground Survey: From September 13 to December 18, 1979.

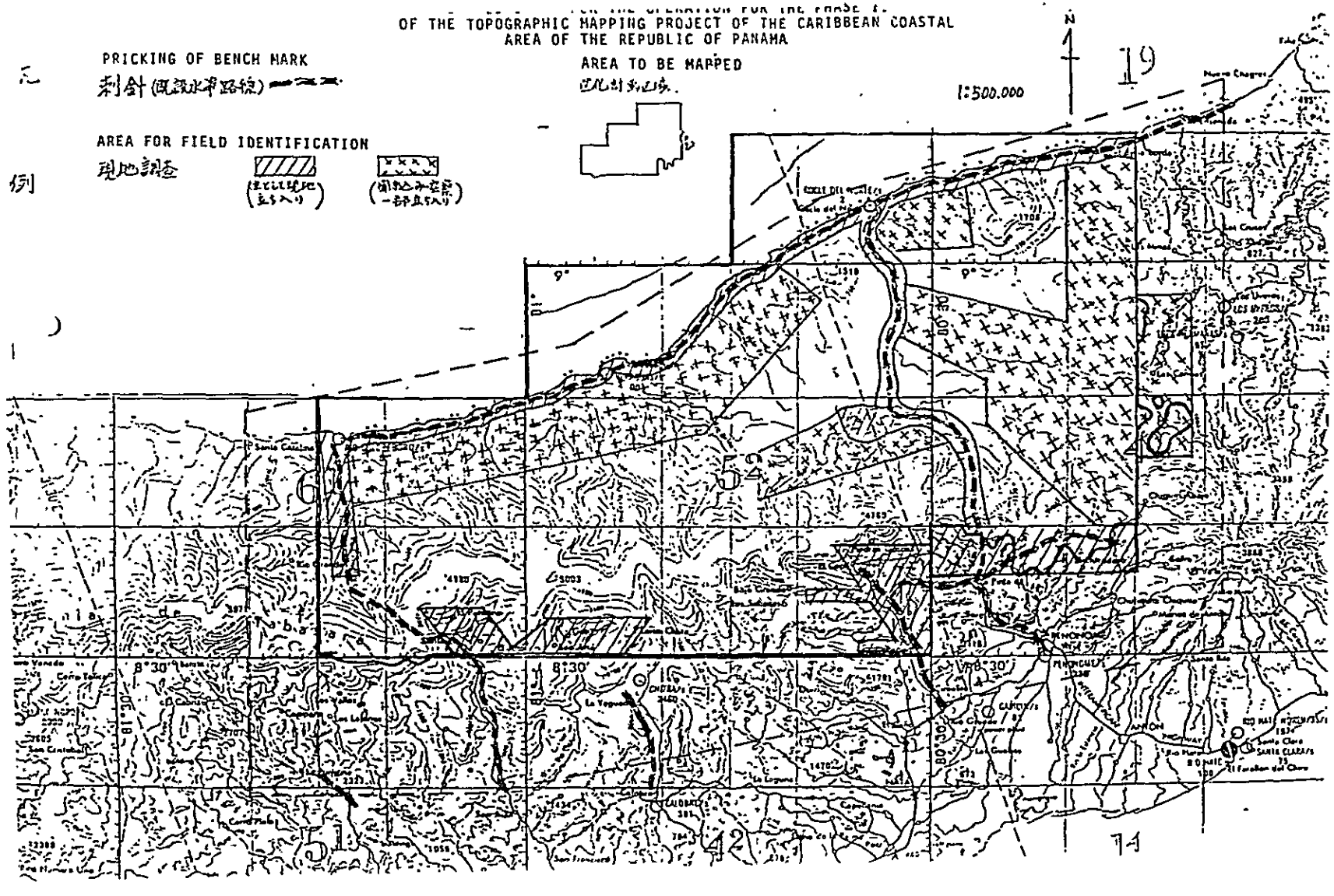
5. Headquarters Office and Residence

a. Headquarters office: c/o COBRE PANAMA
Panama City, Zone 4, 10730(P.O.Box)
Telephone: Panama 64-1628

b. Residence: Hotel Granada
Telephone; Panama 64-4900
Room 810 (T.Hayashi)



PHASE II
OF THE TOPOGRAPHIC MAPPING PROJECT OF THE CARIBBEAN COASTAL AREA OF THE REPUBLIC OF PANAMA
AREA TO BE MAPPE
1:500,000
凡例
AREA TO BE PHOTOGRAPHED
撮影
N.N.S.S. POINT TO BE OBSERVED
基準点
EXISTING POINT
OBSERVED N.N.S.S. POINT
SIGNALIZATION TO BE ESTABLISHED
対空標識設置
ESTABLISHED SIGNALIZATION
PRICKING OF EXISTING
刺針(基準点)
TRIANGULATION POINT
INDIRECT LEVELING
間接水準(気圧測高)
NEW POINT
EXSISTING POINT
No2
No3
No4
No5
No6
No7
No8
CRIS
COAST
CALO
TUTO
NUELO
9°
8°30'
80°30'
81°30'


OF THE TOPOGRAPHIC MAPPING PROJECT OF THE CARIBBEAN COASTAL
AREA OF THE REPUBLIC OF PANAMA
PRICKING OF BENCH MARK
AREA TO BE MAPPED
1:500,000
AREA FOR FIELD IDENTIFICATION
例
N

Appendix 2

A C T A D E

LAS DISCUSIONES SOBRE EL PROYECTO DE ELABORACIÓN DE MAPAS TOPOGRAFICOS DEL AREA COSTANERA DEL CARIBE DE LA REP. DE PANAMA

La Agencia para la Cooperación Internacional del Japón (que en adelante habrá de mencionarse como JICA), y el Instituto Geográfico Nacional "Tommy Guardia" (que en adelante habrá de mencionarse como IGN) realizaron discusiones en el IGN, sobre la implementación del Proyecto de Elaboración de Mapas Topográficos del Area Costanera del Caribe de la República de Panamá (que en adelante habrá de ser mencionado como el Proyecto), los días 13, 14, y 20 de diciembre de 1979 como sigue:

1.- Progresos alcanzados en los trabajos de la Fase II

JICA explicó al IGN los progresos alcanzados en los trabajos de la Fase II (Fotografías aéreas y levantamiento de campo) que fueron realizados durante el período comprendido de septiembre a diciembre de 1979.

(Ver Apéndice 1)

1.1.- Con relación a los símbolos que serán utilizados en los mapas, JICA se refirió, al mútuo entendimiento alcanzado al finalizar las discusiones previas, que se realizaran en detalle

al inicio de los trabajos de la Fase II en septiembre de 1979. Los entendimientos mútuos fueron compendados en el Memorandum que se encuentra en el Apéndice 2.
Ambas partes confirmaron que, la identificación de campo en los trabajos de la Fase II, se realizaron en base a estos entendimientos.

(Ver Apéndice 2)

II.- Esbozo de los Trabajos Futuros

JICA explicó sobre el trabajo remanente de la Fase II (Triangulación Aérea) y los próximos a realizarse en la Fase III (Estereotrazado y Compilación, Revisión de Campo, Grabado y Separación de Colores, Impresión, etc.), algunos de los cuales se llevarán a cabo en el Japón, con la participación de la contraparte del IGN.

(Ver Apéndice 3)

II.1.- Especificaciones sobre el Trabajo de Mapeo

Concerniente al trabajo de mapeo, se realizaron discusiones sobre las especificaciones, en detalle

(Ver Apéndice 4)

II.2.- Detalles Técnicos

También ese realizaron discusiones sobre los detalles técnicos, en relación a los trabajos ulteriores.

(Ver Apéndice 5)

III.- Tomas de fotografías aéreas que serán realizadas por el IGN.

JICA informó al IGN que, tal como se describe en el Apéndice 1, la toma de fotografías aéreas de la Fase II, fué realizada exitosamente casi en su totalidad, exceptuando una pequeña porción (aproximadamente 15 KMS^2) aún no cubierta, a pesar de los ingentes esfuerzos realizados por el grupo JICA.

En conexión con lo que antecede, el IGN expresó la intensión de realizar, por sus propios medios y dándole primera prioridad, la toma de fotografías aéreas del área no cubierta, prometiendo enviar los resultados a JICA tan pronto sea posible.

(Ver Apéndice 6)

IV.- Materiales suministrados por el IGN.

Los materiales que ya han sido suministrados por el IGN, así como aquellos que habrá de proporcionar en el futuro, han sido listados por separado en el Apéndice 7.

(Ver Apéndice 7)

Firmado en la Ciudad de Panamá a los 20 días del mes de diciembre de 1979.-

en representación de
JICA

Mr. KEIJI HISHIMURA
Asesor Técnico de la Misión
Técnica Japonesa
(Subdirector del GSI, Japón)

en representación de
IGN

Ing. JOSE A. TEJADA S.-
Director Nacional del
IGNTG - MOP

RECORD OF DISCUSSIONS
ON
THE TOPOGRAPHIC MAPPING PROJECT
OF
THE CARIBBEAN COASTAL AREA,
THE REPUBLIC OF PANAMA

The Japan International Cooperation Agency (hereinafter referred to as "the JICA"), and the National Geographical Institute (Instituto Geográfico Nacional "Tommy Guardia, hereinafter referred to as "the IGN") have had discussions on the implementation of the topographic mapping project of the Caribbean Coastal Area of the Republic of Panama (hereinafter referred to as "the Project") at the IGN on December 13, 14 and 20 1979, as follows:

I.- Progress of the Phase II Work

The JICA explained to the IGN the progress of the Phase II Work (Aerial Photography and Ground Survey) which was conducted during the period of September - December, 1979.

(See Appendix 1)

I.1.- Referring to map symbols to be applied, the JICA referred to mutual understandings obtained at the result of previous discussions which were made in detail at the commencement of the Phase II Work in September, 1979. The mutual understandings were summarized in Memorandum shown in Appendix 2.

It was confirmed by both sides that the field identification in the Phase II Work was carried out based on these understandings.

(See Appendix 2)

II.- Outline of the Future Work

The JICA explained the remaining Phase II work (Aerial triangulation) and the forthcoming Phase III works (Stereoplotting and compilation, Field Completion, Color Separation Drafting, Printing, etc.), parts of wich are to be carried out in Japan with the participation of the IGN counterparts.

(See Appendix 3)

II.1.- Specification of the Mapping Work

Regarding the mapping work, discussions were made on the specification in detail.

(See Appendix 4)

II.2.- Thechnical Details

In relation to the further works, discussions were also made on the technical details.

(See Appendix 5)

III.- Air-Photo Taking to be made by the IGN

The JICA reported to the IGN that, as described in Appendix 1, the Phase II aerial photography was almost succesfully conducted with result of a small portion (about 15 Km^2) remained as blank area despite of strenuous efforts of the JICA team.

In this connection, the IGN expressed its favourable intention to conduct by itself an air-photo taking over the blank area with the first priority and promised to deliver its results to the JICA as soon as possible.

(See Appendix 6)

IV.- Materials Provided by the IGN

Materials already provided by the IGN and those to be provided in the future are separately listed in Appendix 7.

(See Appendix 7)

At Panama City, December 20, 1979

on behalf of the JICA:

Mr. KEIJI NISHIMURA
Technical Advisor of the
Japanese Mission
(Deputy Director General of
GSI, Japan).

on behalf of the IGN:

Ing. JOSE A. TEJADA S.
National Director
MOP - IGNTG

Appendix 1

PROGRESS OF THE PHASE II WORK

1.- Aerial Photography

a.- Period: October 10 - November 8

b.- Coverage: Most of the proposed area (2,100 km^2)

A small part in the proposed area was not covered by the present aerial photography. However, by using photographs which were taken by the Phase I Work and were not accepted because of partial existence of clouds, the aerial triangulation will be completed for the entire mapping area. Also, by using these photographs, stereo-plotting will be carried out for the most of that area except a very small part (about 15 km^2).

c.- Photo-scale and camera: Approximately 1/60,000 with Zeiss RMK-A 15/23

d.- Accepted exposures: 131 exposures

e.- Material delivered to IGN: Contact print 1 set

Index map 1 sheet

Index photo (negative and contact print) 1 sheet

2.- Ground Survey

a.- Period: September 7 - December 14

b.- Ground control point survey: 4 points

At 3 new and 1 existing triangulation points, NNSS observations were made with translocation method.

c.- Indirect leveling: 7 points

The elevation was determined by using precise barometers.

d.- Air-photo signalization: 5 points

e.- Pricking: 8 ground control points and 75 bench marks

The pricking was made at 4 NNSS stations and at 4 existing triangulation points as well as at 75 bench marks along leveling routes of total length 400 km.

f.- Established monumentation: 3 points

g.- Field identification: all mapping area

h.- Data delivered to IGN:

NNSS observation data	1 set
Location map	1 sheet
Observation data of indirect leveling	1 set

Appendix 2

MEMORANDUM ON THE PHASE II WORK

1.- Application of Map Symbols

The IGN explained that "Manual Técnico de Convenciones Topográficas (MTCT)" is the basis for the mapping work in the IGN. However, there are several items in MTCT which are to be corrected or revised. Although the revised edition should be prepared by the Pan-American Institute of Geography and History (PAIGH), the IGN has adopted some modifications in MTCT. The most important one which is concerned with the present mapping work is:

Symbol 355 stands for "high plantation" which is taller than human height and not for "permanent plantation".

Symbol 356 stands for "low plantation" which is lower than above and not for "temporary plantation".

An errata or a list of errors in MTCT will be provided by the IGN.

As a reference, the IGN provided the following documents:

3 copies of "Manual Técnico TM-45", I.A.G.S. 1968,

3 copies of "Manual Técnico No.23-A, Simbolos para Mapas de Escala Grande sin Reducción", I.A.G.S. 1965.

2 copies in English and 1 copy in Spanish of "TPC TM S-1" Chap 6, sec X, Nov. 70.

2.- Mutual Understandings on the Map Symbols

1) Nos. 103, 105 and 106

"Angosta" will be regarded as one lane.

2) No.110

Specification for road number will be provided by the IGN.

3) No.111

An end of a street will be closed if cars cannot pass through. Segment of a street shorter than 12.5 mm (0.5") on map scale will not be shown.

4) No.116

There are no symbols for through roads in urbanized area. Through roads are shown in the same way as those in outside area.

5) No.147

High tension electric lines will be shown as provided by the IGN.

6) Nos.149, 150,151, 159 and 160

Buildings or huts and stables or deposits will be distinguished.

7) Nos.165 and 205

No.165 stands for area of prospecting and No. 205 for mines in productive operations.

8) Nos.206 and 207

Not to be distinguished. Area where many little mines exist will be shown by broken lines and map symbol of M S No.35 A.

9) Nos.212 and 214

Aerotriangulation stations will not be shown in final maps, and auxiliary vertical control stations will be shown only for those used in surveying work. Elevation of a spot height will be shown in brown letter and that checked by field survey in black letter.

10) Nos.227 and 228

For a boundary line which runs along a distinct line (road or single line river), only third mark will be shown in the final map.

11) Nos.258 and 259

No.258, depth is measured with electronic equipment.

No.259, by lead line.

12) No.293

This symbol stands for a stream which is not shown by any other symbol.

13) No.302

This is not common in Panama.

14) No.310

This does not appear in Panama.

15) No.359

This stands for plants in sea water area.

16) No.362

This stands for plants in fresh water area and does not appear in Panama.

17) The size of letters will be selected according to the length and width of the area in question. A template is used for this purpose.

18) For single line river, standards are given by TPC TM S-1 Chap 6, Sec X-1.

A river will be shown by double line if its width is larger than 0.5 mm on map scale.

19) "Elementos hipsograficos" means topographic features shown by contour lines. Size of letters will be selected according to the length and width of the area.

20) No.167

Sects in religions are not distinguished in cemetery.

21) Bridges will not be distinguished by their structure but distinguished whether they are for cars or footpath.

22) No.324

Symbol for cliff is not usually used in Panama. Cliff will be shown by contour lines.

23) Roads under construction will be shown in 1:50,000 scale map but those in planning will not be shown. Roads partly completed and used will be shown according to the present status.

24) Supplementary contour lines will be shown if they are of significant in topographic expression.

Appendix 3

OUTLINE OF THE FUTURE WORK

A.- Phase II

1.- Aerial triangulation (January - May, 1980)

Aerial triangulation (about 300 models) will be done by analytical method in Japan with the participation of the IGN counterparts.

B.- Phase III

1.- Stereo-plotting and compilation (May - June, 1980)

a.- Scale: 1/50,000

b.- Quantity: 12 map sheets and some blank parts of the surrounding map sheets

This work will be done in Japan with the participation of the IGN counterparts.

2.- Field completion (July - August, 1980)

For all mapping area.

3.- Color separation drafting (September - December, 1980)

For 12 map sheets (in Japan).

4.- Inspection of proof prints (January - February, 1981)

Proof prints will be inspected by the IGN counterpart (in Japan).

5.- Printing (February - March, 1981)

1,000 copies for each sheet.

6.- Presentation of the final results (May or July, 1981)

Appendix 4

SPECIFICATION OF MAPPING WORK

STEREO-PLOTTING

1.- Polyester base to be used

a.- Ratio of elasticity:	Less than 0.05 %
b.- Thickness:	More than 0.12 mm
c.- Size:	76.2 cm x 61 cm

2.- Plotting instrument

Second order plotting instrument shall be used.

3.- Orientation

3.1- Relative orientation

Residual parallax:	Less than 1/2 of diameter of mess mark

3.2- Absolute orientation

Discrepancy of X and Y	Less than 0.5 mm on the map

4.- Detail compilation

According to the IGN standard, necessary information shall be described.

If a discrepancy of contour lines or other objects between the existing map and a new map is larger than 1 mm on the map, the result shall be reported to the IGN and shall not be adjusted.

5.- Spot elevation

6 - 7 points per 10 cm x 10 cm on the map.

Elevation shall be observed by 1 m.

6.- Contour line

Contour interval

Intermediate contour line: 20 m

Index contour line: 100 m

Supplementary contour line: 10 m

Supplementary contour lines shall be drawn, if necessary.

7.- Accuracy

Spot elevation: Better than 2/3 of contour interval,

Contour line: Better than 1/1 of contour interval.

MAP COMPILATION

1.- Compilation

According to the IGN standard, necessary information shall be compiled.

2.- Source maps

Undermentioned source maps shall be made.

a.- Compiled draft map

b.- Overlay of annotation

c.- Overlay of water system

d.- Overlay of road information

e.- Overlay of vegetation

Appendix 5

TECHNICAL DETAILS

1.- It is understood that the JICA may use available materials for plotting, scribing and printing, which are similar to those adopted by the IGN. Particularly in scribing, the following materials may be used.

Scribe base:	K&E #500, Color: Yellow
Polyester base:	#500, materials made in Japan (sample as shown)
Proof base:	Polyester base #500 or Kakurâku #300 (sample as shown)

2.- Although every step of mapping works adopted usually by mapping agencies in Japan is not very same as that adopted by the IGN, it is understood that the JICA may adopt suitable method for the present mapping work provided that the final results, printed maps and other materials, are presented as described in the Scope of Work. Particularly the JICA may adopt the following processes.

2.1- Compiled draft map will be drawn by pencil without inking.

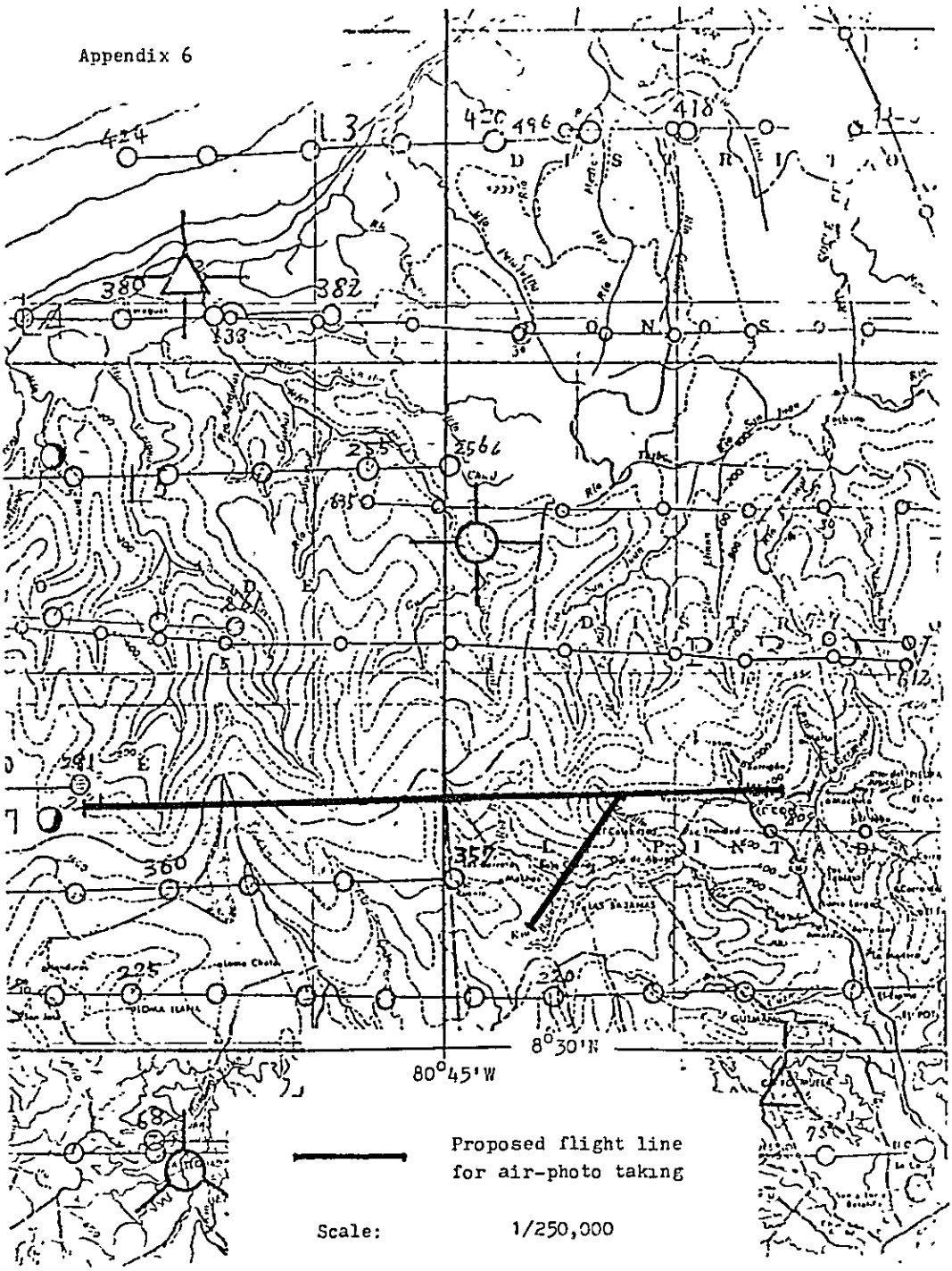
2.2- Punched hole for scribed sheets will be that of Japanese style, smaller than that the IGN is using and is shown by a sample, provided that pins fit for the hole will be delivered to the IGN.

3.- In photo-lettering, the JICA may use available letter styles for those which are not used in Japan. Particularly, for SPARTAN MEDIUM ITALIC, E 16-25 in the photo-letter sample, No.28, may be used.
For LIGHT COPPER GOTHIC, E 11-04 of the same may be used.
For AMS SCOPE GOTHIC, E 11-05 of the same may be used.

4.- It is understood that, for the blank part in the surrounding map sheets, stereo-plotting and compilation work will be carried out by the JICA in Japan and the results will be presented to the IGN.

5.- Although 1,000 copies of topographic maps for each sheet will be prepared and presented to the Government of the Republic of Panama according to the Scope of Work, it is understood that the JICA may print some other additional copies for each sheet for delivery to the Japanese Government authorities concerned.

Appendix 6


8°30'N
80°45'W
Proposed flight line
for air-photo taking
Scale: 1/250,000

ANEXO 7A

MATERIALES Y DOCUMENTOS ENTREGADOS POR EL IGN A LOS MIEMBROS DEL JICA, EL DIA VIERNES 14 DE SEPTIEMBRE DE 1979 PARA TRABAJOS DE LAS FASES II Y III DEL PROYECTO LEVANTAMIENTO DE MAPAS TOPOGRAFICOS DEL AREA COSTANERA DEL CARIBE DE LA REPUBLICA DE PANAMA

MATERIAL O DOCUMENTACION	HOJA No.	PELICULA POS.	PELICULA NEG.	ACETATO	FOTOCOPIAS	POLIVINIL	DIMENSIONES (PULGADAS)
COMPILACION BASICA DE LA YEGUADA	4041 III	1					24 X 30
SOBRE DE CLASIFICACION DE PEDREGAL (CAMINOS, NOMBRES, HIDROGRAFIA, VEGETACION Y CONTROL)	4343 III			5			24 X 30
SEPARACION DE COLORES DE DATOS MARGINALES DE PEDREGAL	4343 III	6					
FAJAS DE DETALLES DE HOJAS ADYACENTES PARA EMPALME DEL PROYECTO	3941 II	1					5 X 30
	4041 III	1					
	4041 II	1					
	4141 IV	2					
	4142 II	1					
	4142 I	1					
	4143 II	1					
	4143 I	1					
PRUEBA DE COLORES DE PEDREGAL	4343 III					1	24 X 30
COPIAS DE TRAMAS DE REPRODUCCION 181, 193, 197 y 203			4				24 X 30
ESTILOS Y TAMAÑOS DE TIPOS			4		1		8 1 2 X 11
IDENTIFICACION ACTUALIZADA DE TRAMAS DE REPRODUCCION					6		8 1/2 X 11
MUESTRA DE MATERIALES DE SEPARACION DE COLORES					12		8 1/2 X 11
MTCT (No 321 DEL IPGH CON CORRECCIONES SEÑALADAS)					3 X 92		8 1 2 X 11

MATERIALES O DOCUMENTACION	HOJA No	PELICULA POS	PELICULA NEG	ACETATO	FOTOCOPIAS	POLIVINIL	DIMENSIONES (PULGADAS)
CLISES No 14 A, 35 A Y 280 A		3					5 X 7
NOMBRES DE ALGUNAS HOJAS DEL PROYECTO					3		8 1 2 X 11
LISTA DE LUGARES POBLADOS CON POBLACION Y VIVIENDAS POR MAPAS DEL PROYECTO					30		8 1 2 X 13
LISTA DE ESCUELAS					5		8 1 2 X 11
LISTA DE LUGARES POBLADOS CON ACUEDUCTOS					2		8 1 2 X 11
LISTA DE AEROPUERTOS Y AERODROMOS					1		8 1 2 X 11
MAPA DE YACIMIENTOS MINERALES CON LEYENDA					6		8 1 2 X 13
MAPAS CENSALES DEL AREA CON INDICACION DE SERVICIOS ARRIBA MENCIONADOS					12		24 X 30
LISTA DE CENTROS DE SALUD					1		8 1 2 X 11

GN

MATERIAL Y/O DOCUMENTOS ENTREGADOS POR EL IxG A LOS MIEMBROS DE JICA, EL DIA JUEVES 20 DE DICIEMBRE DE 1979 PARA TRABAJOS DE LA FASE II Y III DEL PROYECTO LEVANTAMIENTO DE MAPAS TOPOGRAFICOS DEL AREA COSTANERA DEL CARIBE DE LA REPUBLICA DE PANAMA

ANEXO 7B

MATERIAL Y/O DOCUMENTOS	HOJA No.	PELICULA POS.	PELICULA NEG	ACETATO	FOTOCOPIAS	POLIVINIL	DIMENSIONES (PULGADAS)
HOJA MODELO 1 50,000		1					24 X 30
COPIAS DE TRAMAS DE REPRODUCCION AMS No 161, 167, 174, 175, 177, 184, 186, 191, 198, 205 y 212		7	4				24 X 30'
INFORMACION HIDROGRAFICA DE LAS HOJAS QUE POSEEN COSTA	3941 I 4042 IV 4043 II 4042 I 4143 III	5					24 X 30"
CALCULO DE LA DECLINACION MAGNETICA DE LAS HOJAS DEL PROYECTO					18		8 1 2 X 11
DETALLES LINEALES (PLANIMETRIA DRENAJE Y RELIEVE) DE LA ESQUINAS DE MAPAS QUE FORMAS DIAGONAL CON EL AREA DEL PROYECTO	3941 III 4141 III 4141 I	1 1 1					6 X 6
HOJA CON FUENTES INFORMATIVAS PARA TODOS LOS MAPAS					3		8 1 2 X 11
NOMBRES DE LOS MAPAS DEL PROYECTO					3		8 1 2 X 11
MAPAS DE LA RED VIAL NACIONAL ESCALA 1 500,000 1979					1		54" X 24'
ALFABETO Y NUMEROS EN TODOS LOS ESTILOS Y TAMAÑOS CARTOGRAFICOS (11 ESTILOS DIFERENTES)		3 DE C/U					8 1 2 X 11
PATRONES UTILIZADOS EN ESTE TIPO DE MAPAS AMS 161, 167, 174 175, 177, 181, 184 186 191, 193, 197, 198, 203, 205 y 212		3 DE C/U					8 1 2 X 11
CLISES UTILIZADOS EN ESTE TIPO DE MAPAS No	132A 859A 883A 885A 886A 887A 902 IGN-MOP 843A	3 3 3 3 2 15 3	7				VARIABLES

MATERIALES Y/O DOCUMENTOS QUE ENTREGARA EL IGN A JICA EN EL PROXIMO AÑO 1980

MATERIALES Y/O DOCUMENTOS	FECHA APROXIMADA	SE ENVIARA CON:
DIAGRAMAS PARA CADA MAPA:		
a). LIMITES	FEBRERO DE 1980	Ing. TEMISTOCLES RODRIGUEZ
b). HOJAS ADYACENTES	FEBRERO DE 1980	Ing. TEMISTOCLES RODRIGUEZ
c). COMPILACION	FEBRERO DE 1980	Ing. TEMISTOCLES RODRIGUEZ

NOTA: EL PUNTO DE EJEMPLO DE COORDENADAS CUADRICULARES SERA ESCOGIDO EN JAPON POR LA CONTRAPARTE PANAMEÑA CUANDO SE HAYAN CONFECCIONADO LAS HOJAS BASES.