社会開発協力部報告書

No. 9

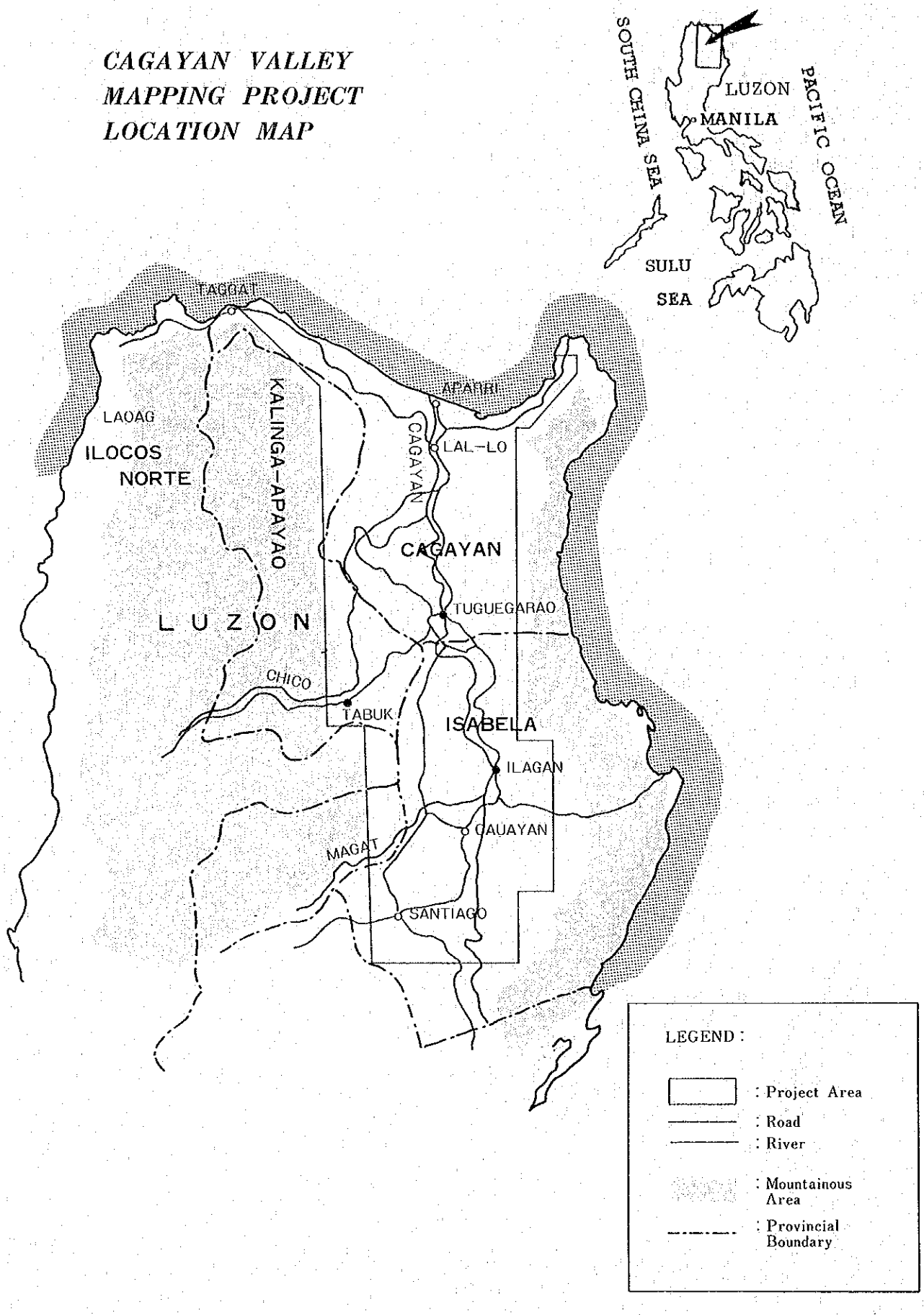
REPORT ON TOPOGRAPHIC MAPPING PROJECT FOR CAGAYAN VALLEY, THE REPUBLIC OF THE PHILIPPINES (FOURTH YEAR)

AERIAL TRIANGULATION
STEREO PLOTTING
COMPILATION
ORTHOPHOTO
FIELD COMPLETION SURVEY

MARCH, 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

CAGAYAN VALLEY
MAPPING PROJECT
LOCATION MAP



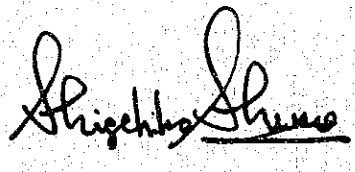
LETTER OF TRANSMITTAL

Mr. Keisuke Arita, President
Japan International Cooperation Agency

The Report on the Fourth Year Survey Work (Aerial Triangulation, Stereo Plotting, Compilation, Orthophoto, Field Completion) of the Topographic Mapping Project of the Cagayan Valley, the Republic of the Philippines, conducted from June 1981 through March 1982 in compliance with your request, is herein submitted to you.

On behalf of the Survey group, I would like to express my wholehearted appreciation to the Bureau of Coast and Geodetic Survey, the officials of the Japanese Embassy in the Philippines, the Manila Office of the Japan International Cooperation Agency, and those of other agencies concerned for their guidance and cooperation.

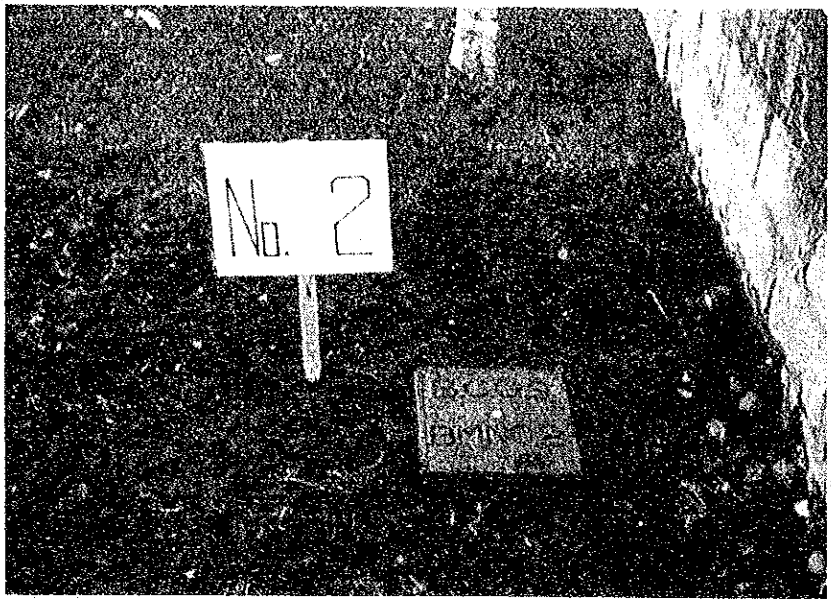
March 1982



Shigehiko Shino
Leader, Topographic Mapping
project of the Cagayan
Valley, the Republic of the
Philippines,
International Engineering Consultants
Association

Cagayan Valley River Basin

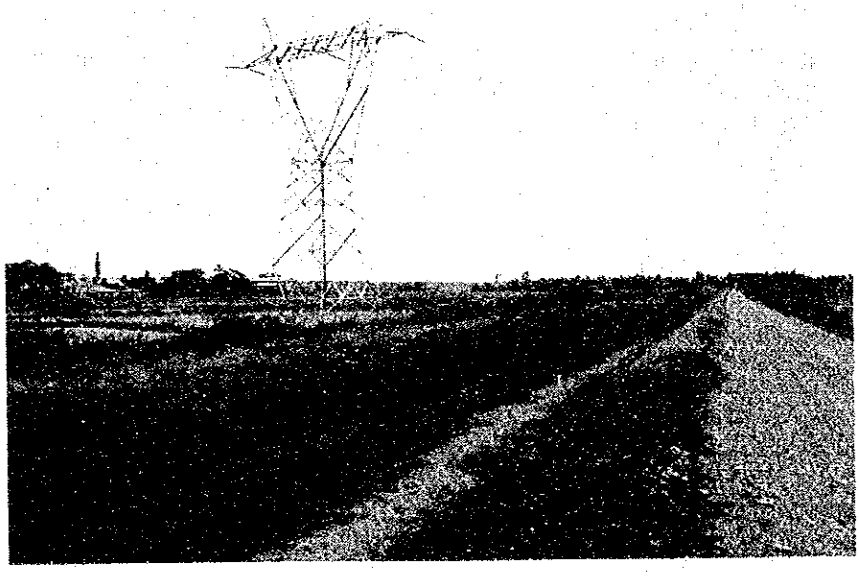
Meeting on Survey work with BCGS



Bench Mark

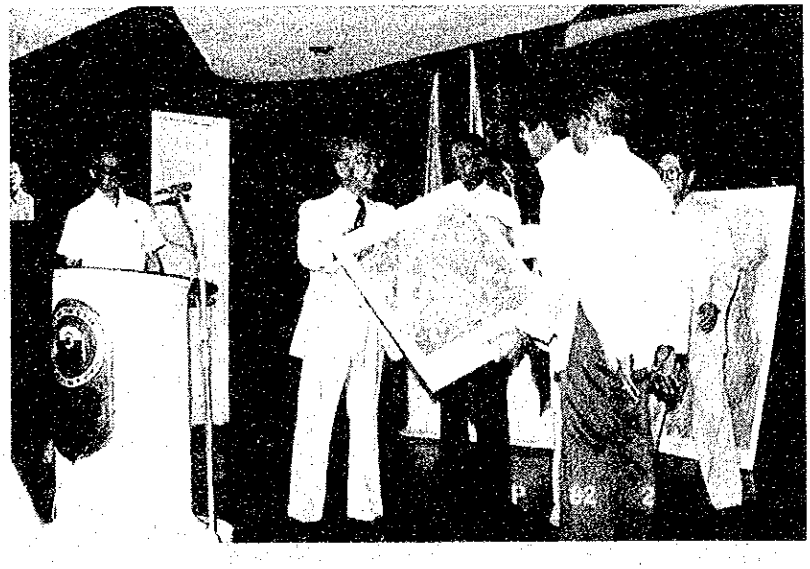
Field Completion Survey (Plane Table Surveying)

Check Survey (Distance Measuring)



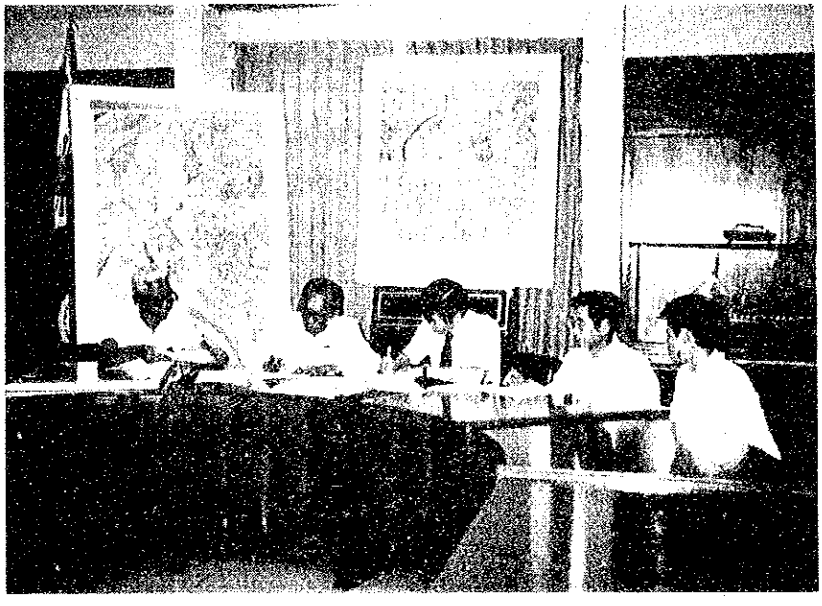
Modification work for Type of Changes

Reconnaissance by helicopter



Presentation of Orthophoto Map

Meeting with BCGS counterparts



Affixing Signature to the Minutes

Table of Contents

I. Outline of Work

I - 1 Objective

The objective of the Fourth Year Work of the Cagayan Valley Topographic Mapping Project was to produce the compiled draft maps (11,200 km^2) and the orthophoto maps (1/10,000. 300 km^2) as required for preparation of the 1/25,000 topographic maps, and to accomplish technology transfer to Philippine engineers in the course of the work.

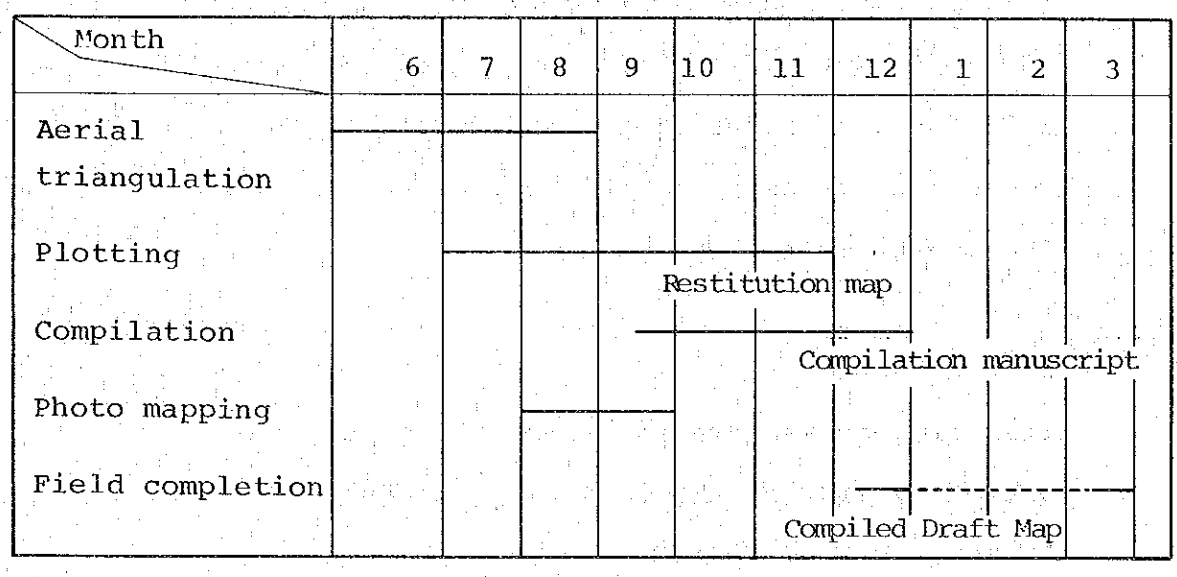
I - 2 Work Schedule

This project was started from 1978 to be completed by 1982 on the following schedule in Japanese Fiscal Year Order.

First Year	(1978)	Photographing.
Second Year	(1979)	Control point survey.
Third Year	(1980)	Photo processing, levelling, field survey.
Fourth Year	(1981)	Aerial triangulation, plotting, compilation, orthophoto mapping, field completion.

Fifth Year (1982) Cartographic work, plate making, printing.

The work for this year was conducted taking a period of about 9 months from June 1981 to March 1982 on the following schedule.



——— Work in Japan

..... Work in the Philippines

I - 3 Work Volume

Aerial triangulation	1,151 models	(15,000 km^2)
Stereo plotting 1/25,000	72 sheets	(11,200 km^2)
Compilation	72 sheets	(11,200 km^2)
Orthophoto mapping	12 sheets	(300 km^2)
Field Completion		(11,200 km^2)

I - 4 Work Performed by the Philippine Government

The Bureau of Coast and Geodetic Survey (BCGS), Official Survey Agency of the Philippine revised the map symbols. The revised symbols were made available to the survey team in September and the plotting was conducted accordingly.

I - 5 Technology Transfer

Technology transfer was accomplished through training of 6 Philippine engineers in Japan in the following fields:

Aerial triangulation

Plotting

Compilation

On-site training was also conducted in the field at the time of actual survey work and through discussion meetings as well.

I - 6 Final Delivery Items

The items delivered as final results were as follows.

(1)	Final results of aerial triangulation	1 set
(2)	Final results of stereo plotting	1 set
(3)	Final results of compilation	1 set
(4)	Final results of orthophoto map	1 set
(5)	Final results of field completion	1 set
(6)	Reports	1 set

II. Work

II - 1 Work in Japan

II - 1 - 1 Aerial Triangulation

(1) Work Period and Work Volume

The work period was three months from early June to the end of August 1981. The work covered the entire area of 15,000 km^2.

(2) Work Method

Work was performed according to the standard procedures of the analytical method of aerial triangulation. Namely, the following were performed.

Block formation

Point selection and pricking

Photo coordinate measurements

Coordinate conversion

Adjustment computations

Accuracy check

(3) Equipment Employed

Precision pricking device PUG-4

Stereo comparator

Electronic computer MELCOM-COSMO 500

(4) Materials Used

Contact aerial photos		1/30,000	2,701 sheets
Diapositives	(1)	1/30,000	1,240 sheets
Diapositives	(2)	1/30,000	66 sheets

The above were prepared in the Third Year Work (1980).

(5) Block Formation

The entire project area of approximately 15,000 km^2 was divided into 5 blocks as necessary for block adjustment.

(2) - 1 Work Method

Since the UTM coordinate system was applied in the plotting, the control points which were computed in the PTM coordinates were all converted to the UTM. The orthophoto mapping was based on the PTM and, therefore, the UTM coordinates of pass points and tie points were converted to PTM coordinates. The analytical method was employed for aerial triangulation. Considering the locations

of the ground control points, the entire area was divided into 5 blocks. As for such courses that have many models, division was made so that, in principle, 2 to 4 models would overlap at the main course, and the blocks were formed so that the course containing the control point and the main course containing the control point and the main course would overlap between the blocks. (See Figure 1) The common course between blocks, the numbers of courses and the numbers of models that comprised the respective blocks, and the numbers of ground control points employed were as follows.

Block No.	Overlapping Course No.
1 - 2	C-9A
1 - 3	BC-2A, C-15C
2 - 3	BC-2B
3 - 4	BC-3A, BC-3B, C-13D
4 - 5	BC-4

Block No.	No. of courses	No. of models	No. of control points	
			Planimetry	Height
1	18	257	29	194
2	16	223	27	214
3	21	339	42	160
4	17	233	30	134
5	18	284	39	127

(2) - 2 Point Selection and Pricking

Point slection was performed by streo-scopically viewing each model and points were pricked and marked on the positive film using a precision pricking device.

(2) - 2 - 1 Pass Points

Pass points were selected, in principle, except for the sea and lakes, one in the vicinity of the principal point of photograph and one at each end of a line running through the vicinity of the principal point nearly normal to the principal point base line. Points were chosen at such locations in flat land that can be viewed streo-scopically on three consecutive photo

sheets, and then pricked and marked with a red circle.

(2) - 2 - 2 Tie Points

More than one tie point were chosen for each model at such locations that allowed measurement in overlapping portions of adjoining courses.
In pricking of the tie points, pass points were also utilized as much as possible. Where pricking was difficult, wing points were chosen, pricked and marked with a blue circle. The tie points were distinguished by letter "T" put at the end of each point name.

(2) - 2 - 3 Pricking of Ground Control Points

From the ground control survey results, the points pricked in the field were transferred accurately onto the positive film using a precision pricking device as they were viewed streoscopically.

(2) - 3 Measurement of Picture Coordinates

Measurement of picture coordiantes was

performed by means of a streo-comparator. Measurement was made twice of the fiducials, pass points, tie points, ground control points contained in the respective models, each separately. When discrepancy between two measurements exceeded 0.02 mm, one additional measurement was taken and the mean value of all measured values was adopted. After computation, if the residual error of fiducials was larger than 0.03 mm , the residual parallax of relative orientation more than 0.03 mm on the positive film, and the discrepancy of pass points between adjoining models in excess of 0.5‰ of the photographing altitude both in planimetry and in height, then the model in question was reasured again.

(2) - 4 Computation for Conversion to Geodetic Coordinates

Ground control points, pass points, and tie points were each given a serial number since they were input in a computer, before picture coordiantes were measured and adjustment computations performed.

Considering the status of the ground control points in each model, a conversion formula was determined that suits the respective models, and adjustment computations were performed for planimetry and heights for each block. The serial numbers were given in the following manner.

a. Ground control points

300010 ... JMR 1

300011 ... Eccentric point of JMR 1

400010 ... Bench mark

500010 ... Picture point 1

500011 ... Eccentric point of picture point

b. Pass points and tie points

21012 .... Course 2A, Photo No.1, Pass point No.2.

- Pass point number
- Photo number
- Course number .... Course 2A..21
  .... Course 2B..22
  .... Course 2C..23

(2) - 5 Results of Adjustment Computation and their Accuracy

Block adjustment computations were performed for planimetry and heights separately by means of a

conversion fomula chosen to suit the respective courses. The ground control points and tie points were weighted equally and weight modification was repeated. As for those points that exceeded the specified limits, every effort was made to improve the accuracy.

The adjustment computations were made for each block separately and all points were converted to the geodetic coordinates. To indicate the accuracy of the adjustment computations, the mean square error and the maximum error for each computed block are given in the following table. They are all within the specified limits.

Block No.	No. of models	No. of Control points		Control point residual error (Planimetry)		Control point residual error (Height)		Tie points Planimetry	Pass points Height
		Planimetry	Height	Mean square error	Max. value	Mean square error	Max. value	Mean square error	Max. discrepancy
1	257	29	194	$2^{m}.12$	$3^{m}.31$	$1^{m}.20$	$3^{m}.30$	$3^{m}.31$	$3^{m}.41$
2	223	27	214	2.28	3.25	1.17	3.28	3.33	3.35
3	339	42	160	2.23	3.41	1.42	3.35	3.24	3.34
4	233	30	134	2.06	3.29	1.18	-2.80	3.35	3.29
5	284	39	127	2.27	3.23	1.31	3.33	3.46	3.33

II 1 - 2 Stereo Plotting

(1) Work Period and Work Volume

4 months from August to November 1981, covering the entire area (see the attached figure) of about 11,200 km^2.

(2) Work Method

Work was performed according to the following procedure of plotting.

Preparation

Orientation

Stereo plotting

Plotting of contour lines

Measurement of spot heights

Connection between sheets

Results

(3) Equipment Employed

Highspeed automatic plotting instruments

Autograph A10, Stereo plotter A8, Metrograph, Topocart, Planicart, Planimat, PG-2.

(4) Materials Used

Contact photos, 1/30,000, 2,701 sheets

Diapositives, 1/30,000, 2,701 sheets

Bench mark pricked photos

Field Identifies photos

Polyester base #500, etc.

(2) - 1 Preparation

Based on the data and information resulting from the Third Year Work, the results of aerial triangulation, and the map symbols determined after the consultation with the Philippine Government, conversion to the UTM coordinates from the longitudes and latitudes

of neat lines and lengths and diagonal lengths of neat lines were computed by computer. On the polyester base #500, the four corners of neat lines, longitudes and latitudes for every 2'30", 1 km grids, ground control points, pass points and tie points were plotted to make the restitution map. For restitution map plotting, every effort was made to enhance accuracy and maintain the quality and uniformity using plotting instruments.

(2) - 2 Orientation

After the relative orientation, absolute orientation was performed by using the pass points and the points determined from aerial triangualtion, pricked control points, pricked bench marks, and the results were recorded. The tolerance of errors in absolute orientation was 0.5mm in planimetry and 2.5 m in height. All the errors were within the tolerance and good results were obtained for each model.

(2) - 3 Stereo Plotting

By referring to the field photos taken during the Third Year Work, running features such as roads, rivers, etc. followed by small features, vegetation, etc. were plotted in defferent colours on the restitutuion map. When features as found in the field were different from what was found through the plotting instruments, they were marked in yellow on the field photos at the time of plotting for verification in field completion.

(2) - 4 Plotting of Contour Lines

Contour line intervals were 10m and 50m for the index contour lines. The half interval contour lines of 5m and quarter interval contour lines of 2.5m were drawn as necessary. In plotting, particular attention was paid so as not to misrepresent the unique topographic features of the mapping area.

(2) - 5 Measurement of Spot Height

In general, heights were measured at points including ground control points and bench

marks, with a distance of approximately 5cm apart on the map. Heights of such points that represent road junctions, mountain tops, valleys, etc. in particular were measured. Two readings were made in terms of 0.5m and their mean value was applied.

(2) - 6 Tying between Map Sheets

There was no existing map of the same scale covering the project area and, therefore, no need to be concerned with connection to any other maps, but only with connection between the map sheets being produced. For tie strips, the duplicate map was used with a standard of 10cm inside of the inner neat line.

(2) - 7 Results

The results were checked in terms of ground control points, pass points, length of neat lines, absolute orientation errors in orientation records, discrepancies of spot height measurements, lack of correspondence between contour lines and height values, missing plots,

referencing to field photos, connections to other sheets.

II - 1 - 3 Compilation

(1) Work Period and Work Volume

About 4 months from mid-September to December, 1981, covering the entire area (see the attached figure) of about 11,200 km^2.

(2) Work Method

Work was perfomed according to the following procedure of compilation.

Preparation.

Preparation of planimetric sheet

Preparation of contour line/vegetation sheet

Preparation of ground control point chart map

Preparation of annotations

Preparation of Road Data Map

Arrangement

Connection between map sheets

Results

(3) Equipment Employed

High speed automatic plotter

(4) Materials Used

Contact Photos

Bench mark pricked photos

Field Identification photos

Polyester base #500, etc.

(2) - 1 Preparation

Based on the restitution map prepared in the plotting work, data were organized for preparation of the original compiled draft maps, data sheets including marginal information and connections. The original compiled draft map was prepared on the base of the same specifications as that of the restitution maps and plotting was performed by a high speed automatic plotter. In view of the characteristics of the project area, compilation was done on the separate sheets of planimetry and contourline/vegetation using different colours for distinction.

(2) - 2 Preparation of Planimetric Sheet

The planimetric sheet was compiled on the basis of the restitution map, various other

data and in accordance with the map symbols and the Mannual of Guidelines for Field Identifications. In view of the characteristics of the project area, different colours were used to distinguish them. Questions raised during compilation were referred to field completion. Isobathymetric lines were given not on the contour lines/vegetation sheet but on the planimetric sheet, considering the subsequent scribing. The data for isobathymetric lines were provided by BCGS and they were represented to a maximum depth of 200m.

(2) - 3 Preparation of Contour lines/Vegetation sheet

Contour lines and vegetation were represented on a separate sheet as destinguished from the planimetric sheet in view of the characteristics of the project area.

(2) - 4 Preparation of Ground Control Point Chart Map

Of the control point data prepared in the plotting stage, those spot heights to be dropped were marked with X for deletion in compilation.

(2) - 5 Preparation of Annotations

Letters and lettering to be used for annotations were prepared in the proper arrangement, size, style, spacing, and position in accordance with the BCGS specifications. Questions raised in the course of annotation preparation were referred to field completion and consultation and consultation with BCGS.

(2) - 6 Preparation of Road Data Map

The Road Data Map was prepared with a specified legend representing administrative classifications, road widths, etc.

(2) - 7 Arrangement

Marginal information to be represented on the compiled draft map was prepared following the samples provided by BCGS in principle.

(2) - 8 Tying between sheets

There was no existing map for the project area and, therefore, no need for tying with any other map but only between sheets being produced under this project. Particular attention was paid to the matching of areas

overlapping with the photo maps (1/10,000) being prepared simultaneously in this project.

(2) - 9 Results

The results were checked for each process to ensure compliance with the specified criteria, and reference was made to all relevant data.

II - 1 - 4 Photo Map (Orthophoto) Preparation

(1) Work Period and Work Volume

2 months from August to September 1981, covering the specified area (see the attached figure) of 300 km^2.

(2) Work Method

Work was performed according to the following procedure of photo mapping.

Planning and definition of methodology

Diapositives to be used

Preparation of Orientation sheets

Map symbols, etc.

Sectional scanning

Preparation of photo map negative films

Contour line plotting and annotation

Fair Drawing

Preparation of marginal information sheet

Printing of photo maps

Preparation of original negative films for printing

Results

(3) Equipment Employed

Precision Pricking Device PUG-4

Automatic Plotter
Topoart BE
Stereo-plotter A8

Large capacity vacuum printer

Automatic film developing instrument

(4) Materials Used

Contact photos

Diapositives

Photo printing paper

Gravure films

Polygraph films(Polyester type films)

Mazenda contact screens(screened positives)

Others

(2) - 1 Planning and Methodology

The 1/10,000 photo maps were to be produced using the results of aerial triangulation (conversion from the UTM to the PTM) made for topotraphic mapping and the data acquired from the field work.

(2) - 2 Diapositives for Use

The positive films produced as part of the work done in Japan during the Third Year (those finished in soft tones) were used for photo mapping. Efforts were made to use those of similar colour tones for sectional scanning.

(2) - 3 Preparation of Orientation Sheets

The orientation sheets for scanning were made sepratetly from the ones for contour line plotting. Plotting was conducted by means of a high speed auto-plotter for control points, pass points, tie points , on each sheet. The plotting accuracy was within 0.2 mm on map.

(2) - 4 Map Symbols, etc.

The BCGS map symbols and speciafications were applied.

(2) - 5 Scanning and Photo Processing

a. Orientation

Orientation was performed in relation to ground control points, bench marks, pass points, and tie points, Clearly recognizable planimetric features were plotted as necessary for use in determination of positions during the photomap mosaicing to be mentioned later.

b. Width of Slits

Paying due attention to the terrain features within each model, the width of slits was determined as 4 mm.

c. Scanning Speed

Paying due attention to the relative height differences within each model, the scanning speeds were adjusted as necessary for an appropriate speed.

(2) - 6 Preparation of Photo Map Negative Films

The negative films after exposure for scanning were developed and then printed on the Polygrph (polyester type film). Mosaicing was done in keeping with the inner neat lines, pass points and planimetry. The mosaics were photographed to made negative films for photo mapping.

(2) - 7 Contour Line Plotting and Annotation

a. Contour line plotting

Contour lines were so designed as to represent the topographic characteristics as much in detail as possible with intermediate contour lines of a 5 m interval and index contou line of 25m interval as well as half interval contour lines of a 2.5m interval as appropriate for topographic features.

b. Editing and annotation

The contour line plotted maps and the photo maps were checked for matching or compatibility and modified as necessary. Annotations were prepared on the basis of the field survey photos taken for the 1/25,000 topographic mapping and the field notes as well.

For the lettering style and letter sizes, the new BCGS specifications were applied.

(2) - 8 Fair Drawing

From the contour line map manuscript after proof-checking, the original contour line map sheet was prepared by scribing. With respect to annotations stick-up work was performed for items to be annotated to make the original annotation sheet.

(2) - 9 Preparation of Marginal Information Sheet

Based on the samples of marginal infomation sheets provided by BCGS, the marginal information sheets were prepared for each map sheet. Both PTM and UTM were represented together for this time.

(2) - 10 Photo Map Printing

The marginal information sheet negative films, the photo map negative films, and the contour line/annotation sheets (printed on clear base material) were overlaid and printed on the photo printing paper using a vacuum printer.

(2) - 11 Preparation of Original Positive Films for Off-set Printing

The photo map negative films, the screened negative films of photo maps, and the contour line/annotaion sheet (printed on clear base material) were overlaid and printed on films using a vacuum printer.

(2) - 12 Results

The results were checked for ground control points, pass points and so forth in the same manner as for the plotting work, and all necessary checking relative to photo mapping was performed.

II - 2 Field Work

1. Period

From: January 4, 1982

To : March 4, 1982

2. Area

An area of approximately 11,200 km^2 as defined for field completion in the Cagayan Valley in Northern Luzon. (See attached Figure 1)

3. Types of Work and Work Volumes

1) Check survey of Planimetry:

4 areas

2) Check survey of height:

4 areas

3) Modificaiton due to secular changes:

Entire project area

4) Verification and representations of planimetric features for annotation:

Entire project area

5) Clarificaitons of questions raised during compilation:

Entire project area

6) Verification of administrative boundaries, place names, names of roads and rivers:

Entire project area

4. Organization of Survey Team

Leader: Shigehiko Shino Sept.2-11, 1981
Jan.4-23, 1982
Feb.18-Mar.4,1982

Dept. Leader: (Surveying in general)
Toshimasa Nagashima
Jan. 4 - Mar.4, 1982.

Coordinator:	Atsushi Okuizumi	Jan.4-Mar.4,1982
Mechanic :	Isamu Saito	Jan.4-Mar.4,1982
Field completion:		
	Chuji Misawa	Jan.4-Feb.28,1982
Field completion:		
	Eiichi Taguchi	Jan.4-Feb.28,1982
Field completion:		
	Takashi Harada	Jan.4-Feb.28,1982
Field completion:		
	Masaji Koyama	Jan.14-Feb.28,1982
Field completion:		
	Naoyuki Sato	Jan.14-Feb.28,1982
Field completion:		
	Fumiaki Sato	Jan.14-Feb.28,1982
Field completion:		
	Hiroshi Fukazawa	Jan.14-Feb.28,1982
Field completion:		
	Yuichi Kato	Jan.14-Feb.28,1982
Field completion:		
	Katsuhiro Kato	Jan.14-Feb.28,1982
Field completion:		
	Kazuhiro Chiba	Jan.14-Feb.28,1982
Field completion:		
	Yoshiharu Katamine	Jan.14-Feb.28,1982
Cartography:	Yoshihiro Kuriyama	Jan.6-Jan.19,1982

5. Weather Conditions during Work Period

Weather	January	February	March	Total	%
Fair	14.0	19.5	1.5	35.0	60.3
Cloudy	13.0	8.5	2.5	24.0	39.7
Rain	0.0	0.0	0.0	0.0	0.0
Total	27.0	28.0	3.0	59.0	100.0

The listed numbers of days do not include the days of departure from and return to Japan. Localized rainfalls and those of short duration were disregarded.

6. Conditions of the Project Area

At the outset of the Third Year Work, the project area was hit by a strong typhoon flooding rivers, destroying bridges and ferry stations. The transportation network was disrupted and the project work was significantly affected. But they had been all restored to normal by the time of this year's work.

At two locations on the Chico River and the Magat River, though outside of the project area, dams were under construction. And downstream, irrigation

works were under way to provide water tapped by the dams for the lower hills areas extending to the east. The one in the Tabuk area on the Chico River was particularly large in scale causing tremendous changes in the area. The construction of high voltage power transmission towers which had been under way at the hands of the power authorities since the latter period of the Third Year was completed on the Santiago - Tuguegarao route.

7. Chronological Records

January

4 : Mr. Nofuku of JICA, Shino (Leader), Nagashima(Deputy Leader), Misawa, Harada, Taguchi, Okuizum (Coordinator), Saito (Mechanic), arrived in Manila.

5 - 14 : Consultation with BCGS. Preparation for moving to site. Vehicle check-up.

6 : Kuriyama (Team Member) arrived in Manila.

(continuded - January)

11 : Mr. Yaguchi (Field Inspector) arrived in Manila.

14 : Koyama and 7 other team members arrived in Manila.

14 - 18 : Shino and Nagashima inspected the site.

15 - 18 : Mr. Yaguchi inspected the site.

16 - 18 : Mr. Nofuki inspected the site.

16 : Misawa and 12 other team members moved to the site by land.

19 - 22 : Consultation with BCGS.

17 - Feb. 21 : Field completion.

19 : Kuriyama left Manila for Japan.

20 : Provisional presentation (turn-over) of orthophoto maps to BCGS.

21 : Signing of the Minutes.

23 : Mr. Yaguchi, Mr. Nofuku, Leader Shino left Manila for Japan. Nagashima left Manila to arrive in Tuguegarao.

February

18 : Inspector Saita, Mr. Wada, Leader Shino left Japan.

19 - 21 : Mr. Saita, Mr. Wada, Shino, inspected the site.

(continued - February)

22 : Messrs. Saita, Wada; and Shino and 14 other team members left the site to arrive in Manila. Shino and Nagashima on the way visited the Ifugao Provincial Government for data collection.

24 : Orthophoto maps turned over to Philippine Minister of National Defense Enrile by Ambassador Tanaka in the Hall of Flags, Defense Ministry, and 8 vehicles presented to BCGS Director by Mr. Miura of JICA.

23 - Mar. 3 : Consultations with BCGS.

26 : Certificates of appreciation presented by BCGS Director to all survey team members.

28 : Misawa and 10 other team members left Manila and returned to Japan.

March

3 : Signing of the Minutes.

4 : Inspector Saita, Wada, Shino, Nagashima, Okuizumi, Saito, left Manila and returned to Japan.

8. Field Inspection and Wrok Control

During the work period, following people came to the Philippines for inspection, instruction, and consultation with the Philippine Government.

Mr. Akira Yaguchi	: Geographic Survey Institute of Japan, Ministry of Construction. From January 11 to 23, 1982.
Mr. Fuminori Nofuku	: Japan International Cooperation Agency. From January 4 to 23, 1982
Mr. Ryo Saita	: Geographic Survey Institute of Japan, Minstry of Construction. From February 18 to March 4, 1982
Mr. Haruo Wada	: Japan International Cooperation Agency. From February 18 to March 4, 1982

9. Work Performed by BCGS

During the work period, BCGS conducted the following surveys in accordance with the Implementing Agreement.

1) Survey of administrative boundaries.
2) Survey of place names.
3) Survey relative to roads.
4) Survey relative to rivers.

II - 2 - 1 Execution of Work

1. Preparation

Seven members of the survey crew, i.e.,Leader Shino, Deputy Leader Nagashima, Okuizumi, Misawa, Taguchi, Harada, Saito, departed from Japan on January 4, 1982. In Manila, Saito and Okuizumi lined up a complete fleet of vehicles consisting of 1 truck, 6 Landcruisers, 1 hard-top, at the BCGS for check-up. At the same time, they arranged for check-out of the equipment from Japan, hiring of drivers, purchasing of supplies, bank arrangement, transportation of equipment and materials.

Leader Shino, Deputy Leader Nagashima, Kuriyama (arrived Jan. 6), Misawa, Harada, Taguchi, accompanying Messrs. Yaguchi, Inspector, (arrived Jan. 11) and Nofuku, visited BCGS for briefing and consultation on the year's work.

Okuizumi moved to Tuguegarao on January 11 to engage in renting of an office space, bank account opening, arranging boarding facilities, and returned to Manila on January 13.

On January 14, Shino and Nagashima along with Counterpart Lt. Muyargas went to Tuguegarao by land. Mr. Yaguchi and Mr. Nofuku moved to Tuguegarao on January 15 and 16 respectively, both by air, to pay courtesy to the government agencies concerned and inspected the site by helicopter. Thirteen survey team members moved to Tuguegarao by land on January 16 to start setting up an office on the 17th for completion on the 19th. Some of the team members conducted aerial survey by helicopter for secular changes.

2. Headquarters and Base Camp

2 - 1 Headquarters Office

The headquarters office was set up at the address given below. Tuguegarao is the capital of Cagayan Province and the center of transportation and culture. Situated geographically in the center of the project area, it was best for location of the headquarters. The functions of the headquarters office included work control and management, storage of materials, logistical supplies, vehicle check-up, communications and coordination with Japan, accounting.

Office Address: Perez Compund, Balzain
Tuguegarao, Cagayan 1101
Telephone : Tuguegarao 446-1768

2 - 2 Base Camp

The base camp was set up in a pension at a distance of 7 to 8 minute walk from the headquarters office.

2 - 3 Communications

Prior to the survey, the official permit for use of the radio equipment brought from Japan was obtained from the Bureau of Telecommunications in accordance with the Implementing Agreement. Communications between the field parties were conducted by means of the wireless radio equipment.

3. Feild Completion

3 - 1 Objective

The objective of the field completion for the 1/25,000 topographic mapping of an 11,200 km^2 area in the Cagayan Valley Region was to verify important features as represented in the compilation manuscript and to conduct field completion and check survey to enhance and maintain the accuracy and quality.

3 - 2 Review of Map Symbols Prior to Field Completion

Compilation work was completed based on The Specification and Symbols for Philippine 1 : 25,000 Topographic Map. The questions

raised in the course of compilation work were discussed with the Philippine side to confirm agreements and understanding between the two sides. The discussions were formalized in the Minutes to be annexed to the official documentation, and they provided guidelines for field completion. The consultations took place at the BCGS in principle, but for those questions raised in the field, the BCGS counterpart was authorized to provide consultation.

3 - 3 Preparation

Immediately after moving into the site, the survey team started preparation. Individual team members were made to fully understand agreements, modifications, additions made in consultation with BCGS. Division of work, method, supplementary work to preliminary photo interpretation, method to deal with secular changes, coordination with the BCGS survey team, were finalized taking into account the characteristics of the area.

3 - 4 Execution of Work on Site

Prior to the work, preliminary surveys were conducted in a comprehensive manner covering the entire survey area flying in a helicopter to understand at first hand the secular changes and vegetation. Based on the findings of the preliminary surveys, priority was given to the field completion with regard to changes resulting from the construction of high voltage power transmission towers and agricultural developments, and the most efficicient method of such methods as offset, planetable, distance/angle measurement, and distance/plane table, was employed.

3 - 4 - 1 Check Survey of Planimetry

Check survey was conducted of planimetry by choosing an ideal portion of area considering the characteristics of the survey area and the status of ground control points in the area. The results of the check survey were all within the tolerance limits. (See the attached table.)

3 - 4 - 2 Check Survey of Heights

Check survey was conducted of heights by choosing an ideal portion of area considering the existing first order levelling route, the triangulation points established in the Second Year, the levelling route and aerial triangulation done in the Third Year. The results of the check survey were all within the tolerance limits.

3 - 4 - 3 Modifications due to Secular Changes

Modifications were made with regard to the changes that have taken place to date since the time of aerial photographing by the best possible method depending on the level of importance and sizes. (For types of changes to be dealt with, see the Minutes dated January 21.)

3 - 4 - 4 Confirmation with regard to Annotations

The questions raised in the course of compilation and preliminary photo inter-

pretation were clarified at BCGS and later confirmed on the site.

3 - 4 - 5 Questions Raised during Compilation

Questions raised with regard to roads, waterways, land classifications, housing, landforms, were clarified and modifications made as necessary.

3 - 4 - 6 Data Sorting and Organization

The results of field completion were noted on the duplicate maps and the data were organized to be properly incorporated in the compiled draft map. (For items, see the Minutes.)

3 - 4 - 7 Work Performed by BCGS

The following were performed by BCGS covering the entire project area.

i) Survey of administrative boundaries

ii) Survey of place names

iii) Survey and verification relative to roads

iv) Survey and verification relative to rivers

The above surveys were conducted on the basis of data and information made available from the Regional Office of Bureau of Land, the Regional Office of Ministry of Public Works & Highways, the Provincial Government and Municipal Office.

With respect to the results of the above surveys, it was agreed, in the interests of subsequent work, with BCGS that they should be properly incorporated in the compilation manuscript and no change should be made to them.

4. Demobilization

Check-up of survey equipment, crating, closing of the office, check-up of vehicles, supplies storage, were performed for demobilization.

5. Check-up of Vehicles

The vehicles were checked and repaired. Neceaary parts but not available in the Philippines were shipped from Japan. Individual survey team members kept the mechanic constantly aware of the conditions

of the vehicles so that the vehicles were always in good condition.

A. Consultations with BCGS

Consultations were held with BCGS at start and completion of the Fourth Year Work to discuss the following.

B. Consultation at start of the Fourth Year Work

i) Items discussed concerning the Third Year Work

a) JMR results, missing bench marks.

b) Field survey

c) Revised map symbols

(For details, see the Appendix.)

ii) Items discussed concerning the Fourth Year Work

a) Submission of the final results of photo mapping

b) Japanese proposal on field completion and discussions about it

c) Data related to isobathymetric lines

d) Confirmation of work to be performed by BCGS

C. Consultation at completion of the Fourth Year Work

The progress and achievements of the project were explained by both sides of the Philippines and Japan for confirmation regarding:

1. Field completion
2. Work performed by BCGS

(See the Minutes.)

D. Items discussed concerning the Fifth Year Work

The Fifth Year Work covers the following.

a) Fair drawing 11,200 km^2 ; 72 map sheets

b) Printing 1,000 copies each map sheet

i) Fair drawing

It will be performed in accordance with JICA Overseas Surveying Work Procedures and methodology and accuracy requirements were made clear.

ii) Map symbols

See the Minutes.

iii) Printing

See the Minutes.

iv) Training

See the Minutes.

v) Existing data and information

See the Minutes.

III. Characteristic Features of Philippine Mapping Sepcifications

The Manual of Guidelines for Field Identification essential to the field work of the Third Year Work was prepared by the Japanese side. It provided the basis for common understanding for both Philippine and Japanese sides in the execution of the poject work. The Philippine side contributed greatly to the preparation of this manual. The Philippine map specifications made on the basis of this manual were provided to Field Inspector Yaguchi, Survey Team Leader Shino, and Mr. Murayama, when they were in the Philippines in September 1981.

The map specifications were made incorporating desires of Philippine government agencies and private users and taking the present Philippine technical capability levels into account. The features of the specifications can be summarized as follows.

a. Five-colour printing for enhanced ease with which for users to read the maps.
b. Much masking was applied for vegetation classifications and super-imposing vegetation symbols, omitting land classification boundaries.
c. Names of running features such as rivers, mountain ranges are given in slanting and those of places and structures in upright lettering.
d. Name annotations are given in letters of different sizes commensurate with levels of importance.

The maps produced accordingly should look good but production processes are made more complex.

The survey team prepared "the Specification and Symbols for Philippine 1 : 25,000 Topographic Map" by simplifying portions of the Philippine proposed specifications under the guidance of the Geographic Survey Institute of Japan and paying attention not to impair the Philippine concept of mapping design. It was finalized and agreed to in cosultation with BCGS in January 1982 with some modifications. See the Minutes dated January 21, 1982, for details.

IV. Presentation of Orthophoto Maps

On Fbruary 24, starting at 10:00 a.m., the presentation ceremony took place in the Hall of Flags of the Ministry of National Defense, where the orthophoto maps of Tuguegarao, Ilagan, Gonzaga and Csanbarangan were displayed. The Gonzaga sheet was handed over personally by Japanese Ambassador Tanaka to Philippine Minister of National Defense Enrile. It was followed by presentation of the vehicles used for the survey work to the Philippine Government by JICA Manila Office Manager. For details of the agenda of ceremonies, see the Minutes in Appendix 2 annexed to this report. The speeches made by Mr. Shino, Ambassador Tanaka, Defense Minister Enrile are attached in the following.

P R O G R A M

MINISTRY OF NATIONAL DEFENSE
BUREAU OF COAST AND GEODETIC SURVEY
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE JAPANESE EMBASSY

PRESENTATION CEREMONY
OF ORTHO-PHOTO MAPS TO BE HELD
ON 1000 HRS. 24 FEBRUARY 1982 AT
MOND HALL OF FLAGS
Camp Aguinaldo, Quezon City

TURN OVER OF THE ORTHO-PHOTO MAPS OF THE BCGS - JICA
MAPPING PROJECT IN CAGAYAN BY JAPANESE GOVERNMENT
TO THE PHILIPPINE GOVERNMENT

1.	NATIONAL ANTHEMS - - - - - - - - - - - - - - - - - - -	PHILIPPINES AND JAPAN
2.	OPENING REMARKS BY - - - - - - - - - - - - - - - - - -	ANTONIO P. VENTURA Commodore, BCGS (Ret.) Director, BCGS
3.	STATEMENT BY JICA - IECA REPRESENTATIVE - - - - - - -	MR. SHIGEHIKO SHINO
4.	PRESENTATION OF THE ORTHO-PHOTO MAPS BY THE JAPANESE AMBASSADOR TO THE PHILIPPINES - - - - - - -	HON. HIDEHO TANAKA
5.	ACCEPTANCE AND RESPONSE BY THE MINISTER OF NATIONAL DEFENSE - - - - - - - - - - - - - - - - - -	HON. JUAN PONCE ENRILE
6.	PRESENTATION OF THE DONATION OF VEHICLES BY MR. HIDEKO MIURA TO THE DIRECTOR, BCGS.	

COCKTAIL FOLLOWS

THE BRIEF STATEMENT BY
JICA-IECA REPRESENTATIVE MR. S.SHINO
(CAGAYAN VALLEY MAPPING TEAM LEADER)

H.Exc. Juan Ponce Enrile, Minister of National Defence, Hon. Hideo Tanaka, The Embassador of JAPAN, Distinguished Guests and My Colleagues from BCGS and My Team, it is my honor and pleasure to have a statement in this occasion for the Turn-Over of the Ortho-Photo Maps to the Government of the Philippines.

Since I have been involved in this project from the phase of contact and feasibility study mission in 1978 as a JICA Delegate, and as Team Leader for the Project Execution from 1979; allow me to give brief explanation on the Project.

This project has been excuting from 1979 as a part of Technical Cooperation by the Japanese Government, in responce to the request made by the Philippine Government, which fulfill the need of your government to accerelate National Mapping Program and development of the country.

The area, is ranging from Claveria as North-West and San Vicente as North East end and Cabarroguis as South end, and is covering Cagayan River Basin of Provinces of Cagayan, Isabera, Kalinga-Apayao, Quirino, Ifugao and part of Mountain Province, for Topographic Map of 1/25,000 and also project includes Ortho-Photo Maps of 1/10,000 for Ilagan, Tuguegarao, Gonzaga and Port Irene.

We are now in the end of 4th year stage and we will complete cartographic and reproduction work in the beginning of 1983. And final products, 1/25,000 five color print map of 72 sheets covering 11,500km^2 will be turned over to your government in March 1983.

Ortho-Photo Maps, which are now going to turnover to your Excellency by my Ambassador, are not aerial photo mosaic.

Ortho-Photo Map is orthogonaly projected aerial photographs, which are eliminated all distortions of terrain relief due to the central projected image through aerial camera lens system, and as accurate as large scale line map but includes much more detailes and informations, and further includes elevation information i.e. contour line and spot height.

Therefore, this 1/10,000 Ortho-Photo Map can be used as Town Planning Map for urban and community development and also as Engineering Map for various infrastructure planning.

We will turn over to BCGS Original Ortho-Photo, which is now on display to the guests, and also some 20 extra copies for immidiate use for various agancies concerned. Delivery items include, also, positive transparencies, ready for Off-Set Printing for publication by my Counter Part BCGS. I do hope the publication come out by BCGS very soon.

In this oportunity, I want to emphasize to the Guests that the Geodetic Controls, Topo-Map including Ortho-Photo and Hydrographic Chart are the BASIC SOCIAL CAPITAL and the Basic Tools for the development of the country and peoples. This is my philosophy.

Beside technical matters, we have completed all field works in Cagayan River Basin and have used 6 Land Cruisers, 1 Hard Top and 1 Truck as our legs. Allow me to announce that JICA will donate all vehicles to our counter part BCGS. All vehicles, which are now line-uped in front of this building, are kept very good condition by my staff mechanic.

Before conclude my adress, I want to add, with my proud, that my team members have work hard in the project area, with well-standing desciplines and keeping good public relations, friendship and courtesy to the peoples of the region. This could only be done with the good partnership between BCGS Counterpart directed by Commodore Ventura and also with the coordination between Northern Command, commanded by

B. Gen. Gattan and the 2nd Regional Command, commanded by B. Gen. Custodio and they look after our safety.

Thank You and Salamat Po!

(at the Hall of Flags,MOND, Feb. 24th, 1982)

REMARKS TO BE DELIVERED BY AMBASSADOR HIDEHO TANAKA ON THE TURN-OVER CEREMONY OF ORTHO-PHOTO MAPS OF CAGAYAN VALLEY ON WEDNESDAY, 24 FEBRUARY 1982 AT CAMP AGUINALDO.

- -

HIS EXCELLENCY JUAN PONCE ENRILE, MINISTER OF NATIONAL DEFENCE, COMMODORE VENTURA OF THE BUREAU OF COAST & GEODETIC SURVEY, STAFF OF THE MINISTRY OF NATIONAL DEFENCE, MEMBERS OF THE JICA STUDY TEAM, LADIES AND GENTLEMEN:-

IT IS INDEED A GREAT PLEASURE AND HONOR FOR ME TO PARTICIPATE IN THIS TURN-OVER CEREMONY OF THE ORTHO-PHOTO MAPS OF THE CAGAYAN VALLEY.

CAGAYAN VALLEY TOPOGRAPHIC MAPPING PROJECT PREPARES THE TOPOGRAPHIC MAPS WHICH IS THE MOST IMPORTANT BASIC INFORMATION FOR AERIAL AND SOCIAL DEVELOPMENT PLANNING AS WELL AS THE TRANSFER OF THE MAPPING TECHNOLOGY TO THE STAFF OF THE PHILIPPINE GOVERNMENT WHO WORK ON THIS PROJECT.

CAGAYAN RIVER BASIN IS BLESSED WITH NATURAL RESOURCES AND IS HIGHLY DETERMINED TO DEVELOP. THEREFORE, THE JAPANESE GOVERNMENT HAS BEEN IN FULL COOPERATION WITH THE PHILIPPINE GOVERNMENT IN IMPLEMENTING THE JICA-BASED CAGAYAN INTEGRATED

/ AGRICULTURAL

AGRICULTURAL DEVELOPMENT PROJECT, THE FEASIBILITY STUDY OF THE MATUNO RIVER DAM IRRIGATION AND GENERATION PROJECT, THE FEASIBILITY STUDY OF PORT IRENE AND THE OECF-BASED CAGAYAN VALLEY ELECTRIFICATION PROJECT. FURTHER, WE MAY RECALL THE PHILIPPINE-JAPAN FRIENDSHIP HIGHWAY PROJECT WHICH RUNS FROM CAGAYAN TO THE EXTREME SOUTHERN END OF THIS COUNTRY.

WE ARE QUITE SURE THAT THESE MAPS WHICH COVER 11,200 KM^2 OF THE CAGAYAN VALLEY AND SCALE OF 1/25,000 WILL BE COMPLETED IN MARCH OF NEXT YEAR AND WILL BE USEFUL TO THE FURTHER DEVELOPMENT OF THE REGION.

THE ORTHO-PHOTO MAPS WHICH COVER TUGUEGARAO, CASAMBLANGAN, GONZAGA AND ILAGAN IN THE CAGAYAN VALLEY ARE THE FRUITS OF THIS THREE-YEAR WORKS. THEY CAN PROVIDE MUCH INFORMATION NOT ONLY TOPOGRAPHICAL CHARACTERISTICS BUT ALSO LAND USE PATTERN.

MAY I HAVE THE HONOR NOW TO PRESENT THESE ORTHO-PHOTO MAPS AS WELL AS THE EIGHT (8) VEHICLES WHICH WERE USED BY THE STUDY TEAM FOR FIELD SURVEY.

FINALLY, I WOULD LIKE TO EXPRESS MY BEST HOPE FOR THE DEVELOPMENT AND SUCCESS OF THE CAGAYAN VALLEY.

THANK YOU.

BRIEF STATEMENT BY
HONORABLE JUAN PONCE ENRILE, MINISTER OF NATIONAL DEFENSE
ON THE OCCASION OF THE TURN-OVER OF ORTHO PHOTO MAPS
BY THE JAPANESE GOVERNMENT TO THE REPUBLIC OF THE PHILIPPINES

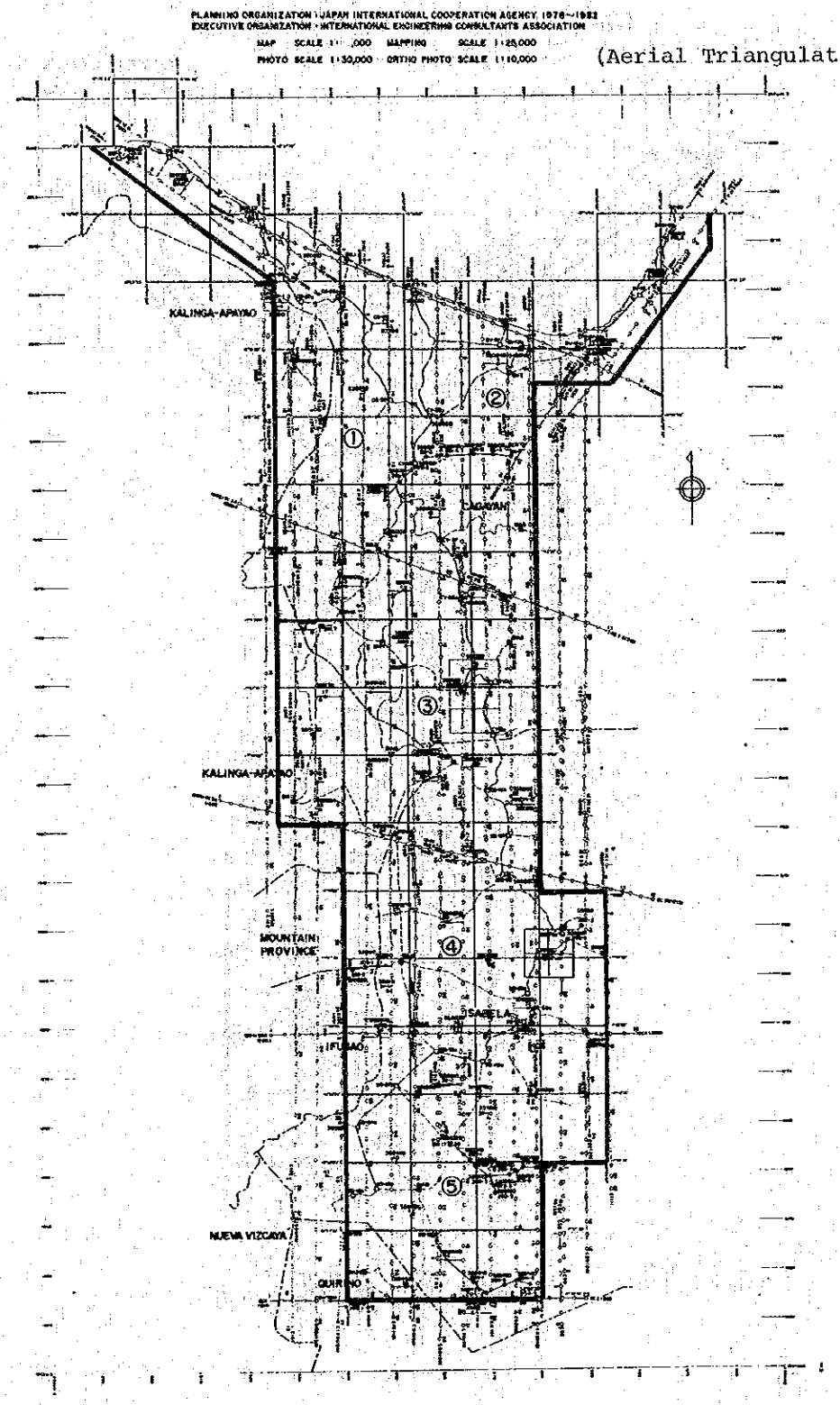
Mr. Ambassador, on behalf of the Republic of the Philippines, I should like to express our deep appreciation for the assistance which the Japanese Government has extended to our country. We fully recognize the untiring efforts and utmost cooperation in the production of large-scale topographic maps of a significant area in our country. The Cagayan River Valley has been identified by our top national economic bodies as among the most depressed areas of the region. It is our hope that these large-scale maps which will be the eventual products of this cooperative mapping program between the Japanese Government and the Republic of the Philippines will lead to agricultural and industrial progress in the area, and the integrated development in the region. On a more personal note, I should like to express, on my own behalf, my profound gratitude for your endeavor, since it is no secret that I personally come from that region. It is perhaps understandable that I harber comforting thoughts, when in future years, looking over the green valleys and lush countrysides of the Cagayan Valley, that I have in a modest way contributed to the advancement and progress of the region.

It is with this thoughts in mind, Mr. Ambassador, that I am deeply honored to accept these ortho photo maps from the Japanese Government as the initial product of this cooperative mapping effort between your government and the Republic of the Phlippines. I should like to reiterate, on behalf of the Republic of the Philippines, and on my own behalf, our profound gratitude for this gesture of cooperation that should contribute to understanding and goodwill between our two countries.

JUAN PONCE ENRILE
Minister of National Defense

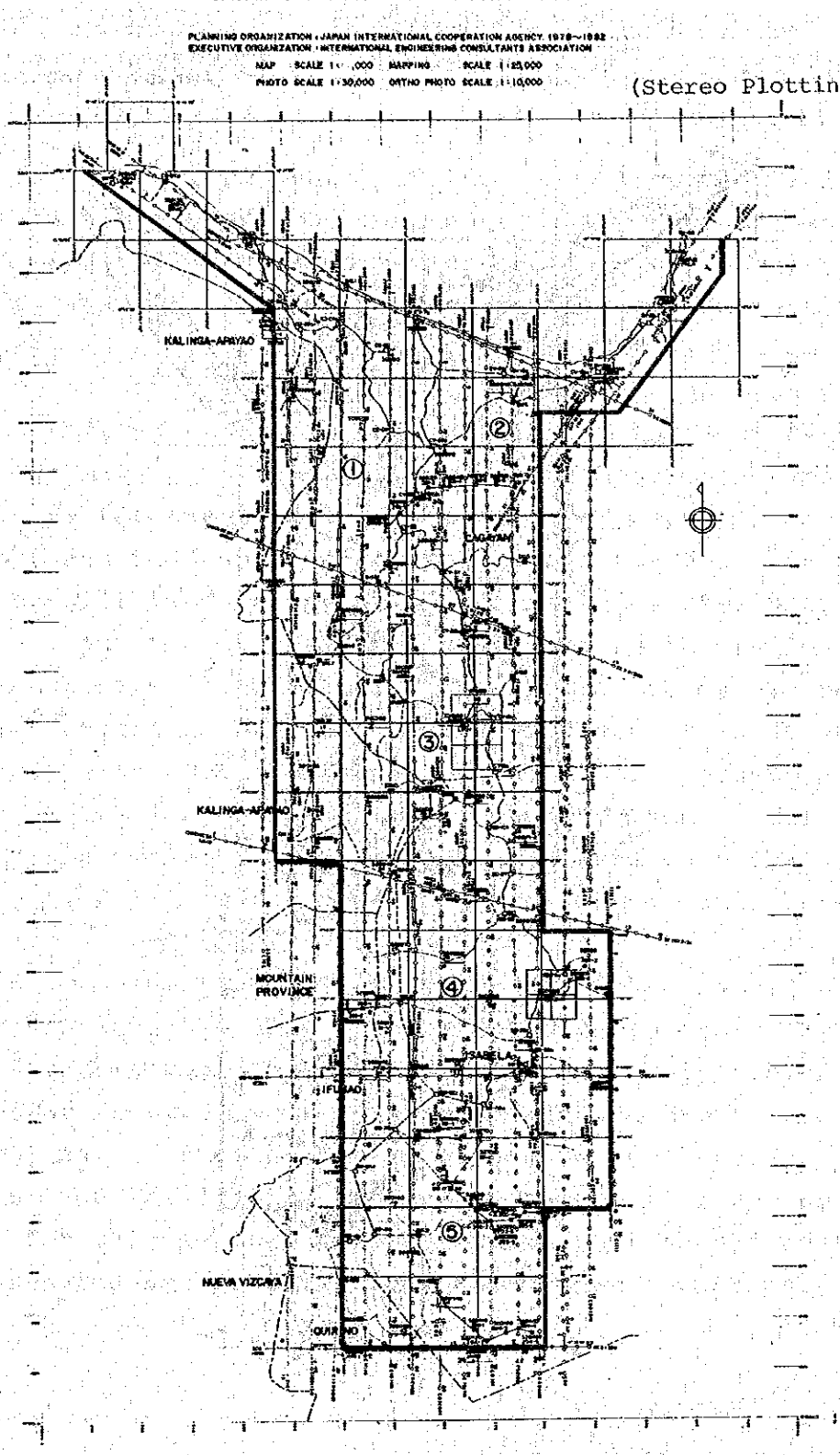
(Figure 1)

CAGAYAN VALLEY TOPOGRAPHIC MAPPING

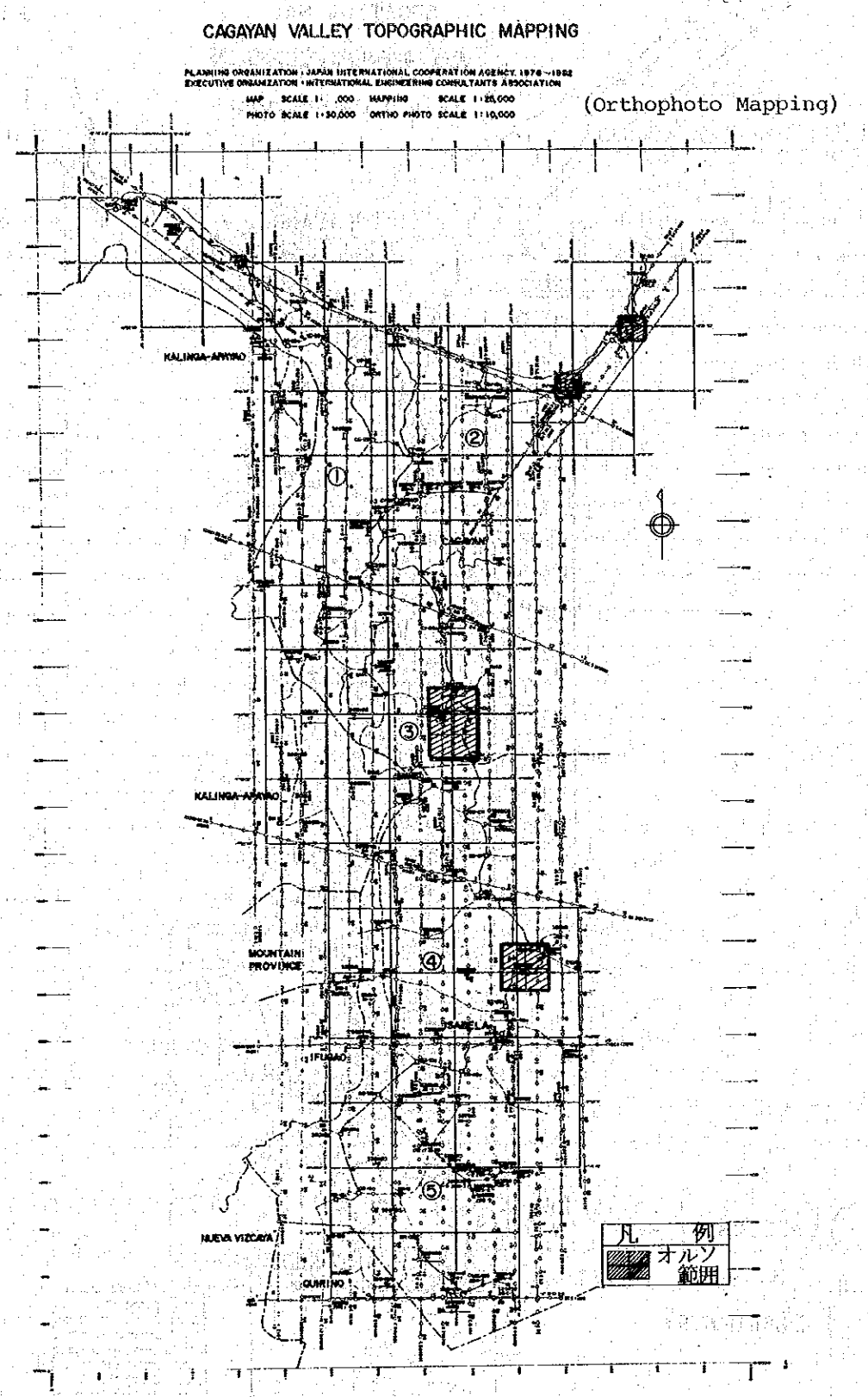


(Figure 2)

CAGAYAN VALLEY TOPOGRAPHIC MAPPING



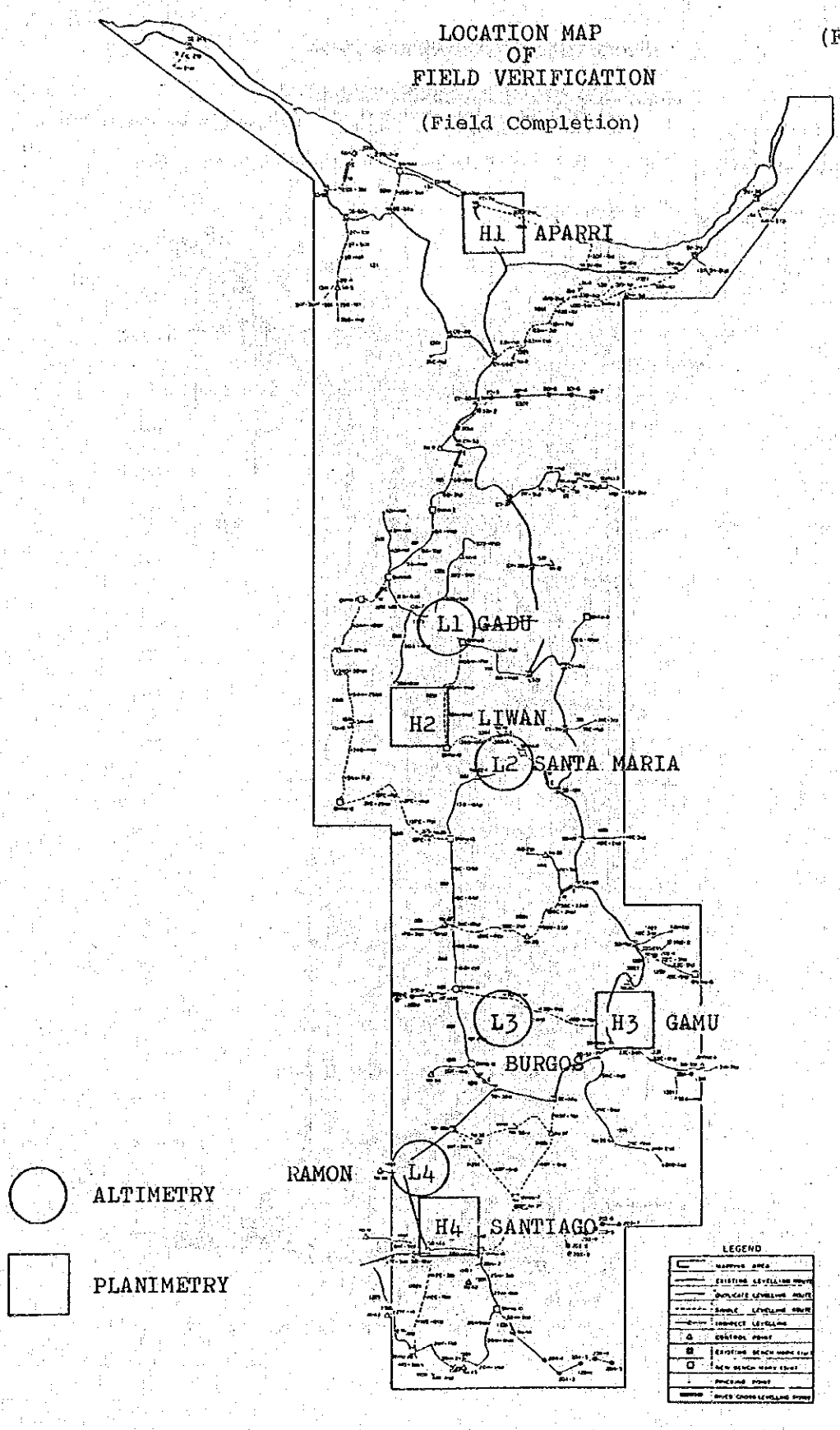
(Figure 3)


CAGAYAN VALLEY TOPOGRAPHIC MAPPING
PLANNING ORGANIZATION : JAPAN INTERNATIONAL COOPERATION AGENCY, 1976 ~1982
EXECUTIVE ORGANIZATION : INTERNATIONAL ENGINEERING CONSULTANTS ASSOCIATION
MAP SCALE 1: ,000 MAPPING SCALE 1:25,000
PHOTO SCALE 1:30,000 ORTHO PHOTO SCALE 1:10,000
(Orthophoto Mapping)
KALINGA-APAYAO
CAGAYAN
KALINGA-APAYAO
MOUNTAIN PROVINCE
ISABELA
IFUGAO
NUEVA VIZCAYA
QUIRINO
①
②
③
④
⑤
凡 例
オルソ範囲

CAGAYAN VALLEY TOPOGRAPHIC MAPPING

LOCATION MAP
OF
FIELD VERIFICATION
(Field Completion)

(Figure 4)



FIELD CHECKING SHEET

AREA: H 1 — PLANIMETRY. ALTIMETRY

No.	DISCREPANCY			REMARKS
	1/25,000 (mm)	GROUND (m)	D^2	
1.	0.1	2.5	6.25	
2.	0.0	0.0	0.00	
3.				
4.				
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25.				

ACCURACY OF PLANIMETRY A CLASS	N - 1	D^2	$\sqrt{\frac{D^2}{N-1}}$ (m)	1/25,000 (m)
	1	6.25	2.5	0.1

FIELD CHECKING SHEET

AREA: H 2 — PLANIMETRY.ALTIMETRY

No.	DISCREPANCY			REMARKS
	1/25,000 (mm)	GROUND (m)	D^2	
1.	0.1	2.5	6.25	
2.	0.8	20.0	400.00	
3.	0.4	10.0	100.00	
4.				
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ACCURACY OF PLANIMETRY A CLASS	N - 1	D^2	$\sqrt{\frac{D^2}{N-1}}$ (m)	1/25,000 (m)
	2	506.25	15.91	0.6

FIELD CHECKING SHEET

AREA: H 3 — PLANIMETRY.ALTIMETRY

No.	DISCREPANCY			REMARKS
	1/25,000 (mm)	GROUND (m)	D^2	
1.	0.1	2.5	6.25	
2.	0.5	12.5	156.25	
3.	0.2	5.0	25.00	
4.				
5.				
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24.				
25.				

ACCURACY OF PLANIMETRY A CLASS	N - 1	D^2	$\sqrt{\frac{D^2}{N-1}}(m)$	1/25,000 (m)
	2	187.50	9.68	0.4

FIELD CHECKING SHEET

AREA: H 4 — PLANIMETRY. ALTIMETRY

No.	DISCREPANCY			REMARKS
	1/25,000 (mm)	GROUND (m)	D^2	
1.	0.2	5.0	25.00	
2.	0.5	12.5	156.25	
3.	0.7	17.5	306.25	
4.				
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ACCURACY OF PLANIMETRY A CLASS	N - 1	D^2	$\sqrt{\frac{D^2}{N-1}}$ (m)	1/25,000 (m)
	2	487.50	15.61	0.6

FIELD CHECKING SHEET

AREA: L 1 — PLANIMETRY.ALTIMETRY

No.	DISCREPANCY			REMARKS
	1/25,000 (m)①	GROUND (m)②	①-②=D (m)	D^2	
1.	58.	60.3	- 2.3	5.29	
2.	43.	45.5	- 2.5	6.25	
3.	36.	38.0	- 2.0	4.00	
4.	40.	42.9	- 2.9	8.41	
5.	46.	46.4	- 0.4	0.16	
6.	39.	41.3	- 2.3	5.29	
7.	38.	40.8	- 2.8	7.84	
8.	38.	38.3	- 0.3	0.09	
9.	29.	27.5	1.5	2.25	
10.	22.	25.3	- 3.3	10.89	
11.	67.	67.2	- 0.2	0.04	
12.	69.	69.3	- 0.3	0.09	
13.	51.	49.5	1.5	2.25	
14.	46.	45.5	0.5	0.25	
15.	40.	37.7	2.3	5.29	
16.					
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19.					
20.					
21.					
22.					
23.					
24.					
25.					

ACCURACY OF PLANIMETRY A CLASS	N - 1	D^2	$\sqrt{\frac{D^2}{N-1}}$ (m)	1/25,000 (m)
	14	58.39	2.04	

FIELD CHECKING SHEET

AREA: L 2 — PLANIMETRY.ALTIMETRY

No.	DISCREPANCY				REMARKS
	1/25,000 (m)①	GROUND (m)②	①-②D (m)	D^2	
1.	36.	35.9	0.1	0.01	
2.	36.	35.7	0.3	0.09	
3.	54.	51.6	2.4	5.76	
4.	56.	55.3	0.7	0.49	
5.	41.	40.2	0.8	0.64	
6.	62.	61.5	0.5	0.25	
7.	54.	53.5	0.5	0.25	
8.	54.	51.7	2.3	5.29	
9.	32.	29.2	2.8	7.84	
10.					
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ACCURACY OF PLANIMETRY A CLASS	N - 1	D^2	$\sqrt{\frac{D^2}{N-1}}$ (m)	1/25,000 (m)
	8	20.62	1.60	

FIELD CHECKING SHEET

AREA: L 3 — PLANIMETRY.ALTIMETRY

No.	DISCREPANCY				REMARKS
	1/25,000 (m) ①	GROUND (m) ②	①-② D (m)	D^2	
1.	48.	50.8	- 2.8	7.84	
2.	49.	50.2	- 1.2	1.44	
3.	49.	48.4	0.6	0.36	
4.	47.	48.5	- 1.5	2.25	
5.	50.	50.9	- 0.9	0.81	
6.	48.	47.8	0.2	0.04	
7.	49.	49.2	- 0.2	0.04	
8.	49.	50.3	- 1.3	1.69	
9.	52.	51.8	0.2	0.04	
10.	57.	57.5	- 0.5	0.25	
11.	62.	61.0	1.0	1.00	
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					

ACCURACY OF PLANIMETRY A CLASS	N - 1	D^2	$\sqrt{\frac{D^2}{N-1}}$ (m)	1/25,000 (m)
	10	15.76	1.26	

FIELD CHECKING SHEET

AREA: L 4 — PLANIMETRY.ALTIMETRY

No.	DISCREPANCY				REMARKS
	1/25,000 (m) ①	GROUND (m) ②	D (m) ①-②	D^2	
1.	75.	74.3	0.7	0.49	
2.	73.	72.9	0.1	0.01	
3.	71.	70.8	0.2	0.04	
4.	69.	69.4	- 0.4	0.16	
5.	71.	70.9	0.1	0.01	
6.	72.	72.0	0.0	0.00	
7.	73.	73.1	- 0.1	0.01	
8.	74.	74.4	- 0.4	0.16	
9.	76.	75.3	0.7	0.49	
10.	78.	77.5	0.5	0.25	
11.	77.	77.0	0.0	0.00	
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					

ACCURACY OF PLANIMETRY A CLASS	N - 1	D^2	$\sqrt{\frac{D^2}{N-1}}$ (m)	1/25,000 (m)
	10	1.62	0.40	