社会開発協力部報告書

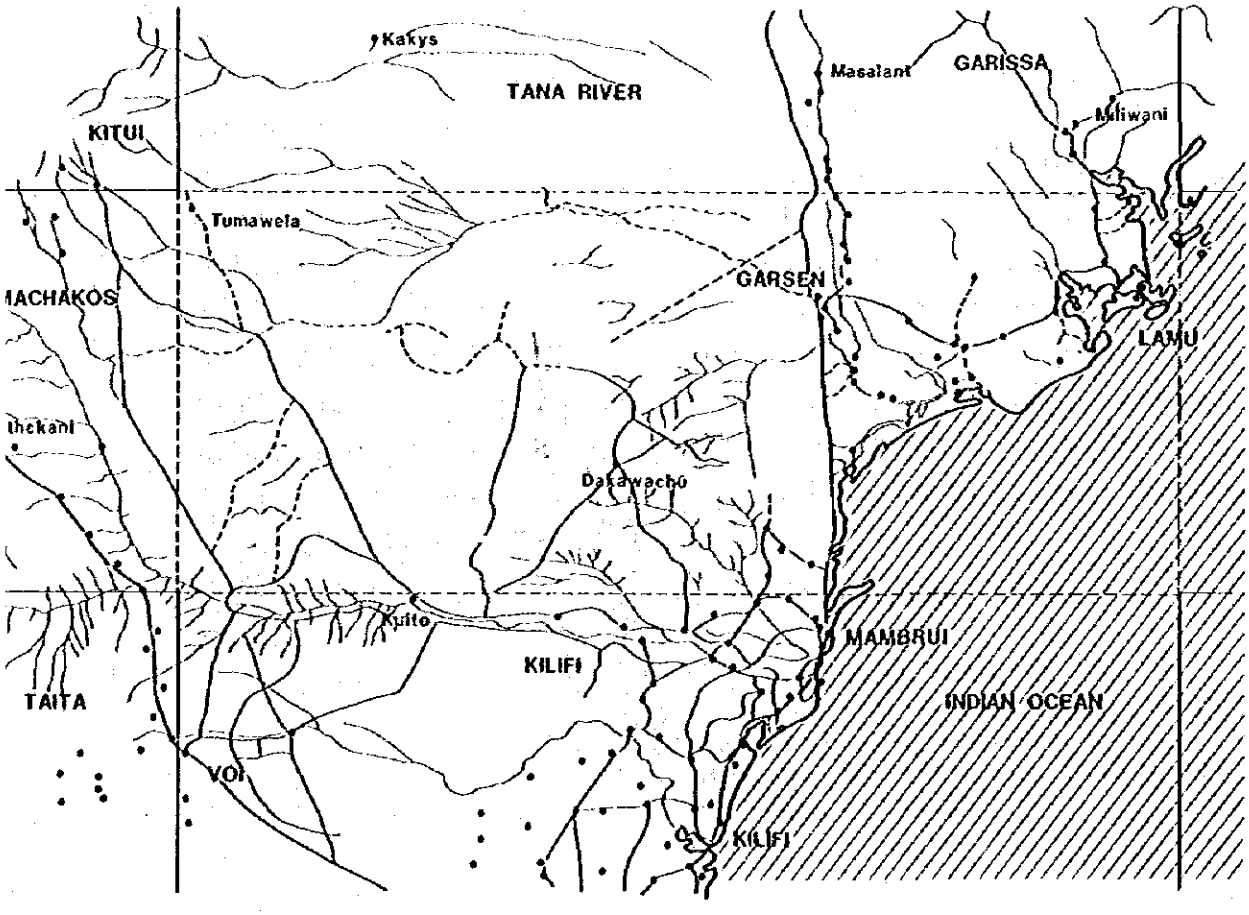
REPORT ON TOPOGRAPHIC MAPPING PROJECT FOR EAST KENYA AREA, REPUBLIC OF KENYA

(Fifth Year)

March, 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

Location Map of Project Area



Road — Sea and River [ ] Project area

LETTER OF TRANSMITTAL

Mr. Keisuke Arita
President
Japan International Cooperation Agency

The Report on the Fifth Year Survey Work of the Eastern Area of the Kenyan Topographic Mapping Project, conducted during fiscal year 1979 in compliance with your request, is herein submitted to you.

In this report are described the details of the fifth year survey work (pricking, field identification, aerial triangulation and stereo-plotting). I feel confident that the results of the survey work conducted during this period as well as the Japanese survey techniques employed will greatly contribute to future development planning for the eastern part of Kenya and to improvement of Kenya's survey techniques.

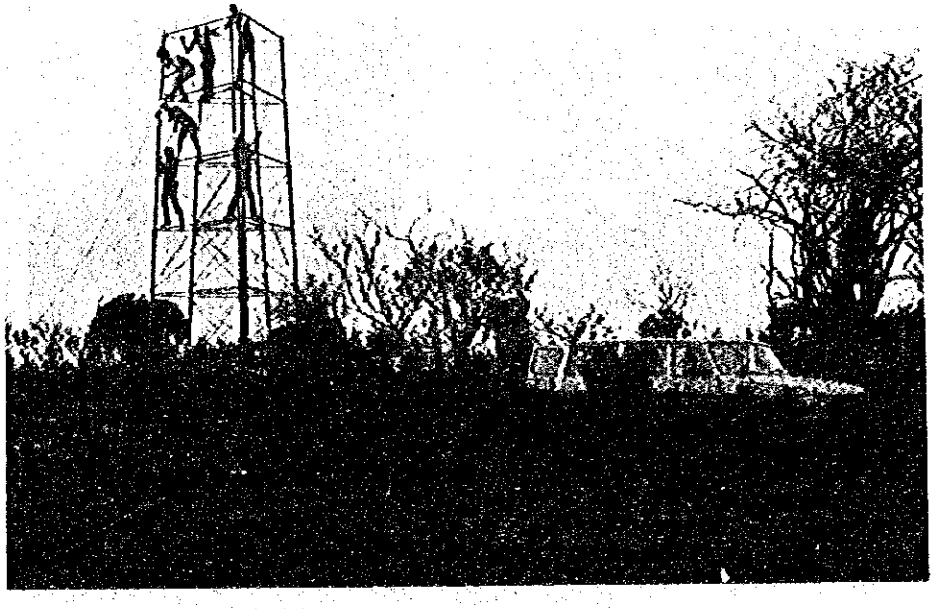
On behalf of the Survey Team, I would like to express our most sincere appreciation to Mr. Omondi, Director of the Survey of Kenya, Ministry of Lands and Settlement, Government of Kenya, and his staff personnel, Ambassador Saiki and the officials of the Japanese Embassy in Kenya, Mr. Okabe, Head of the Nairobi Office of the Japan International Cooperation Agency and his staff, who assisted us during the period of the survey work. At the same time it is hoped that the work for the sixth year will be conducted without delay.

March 1980

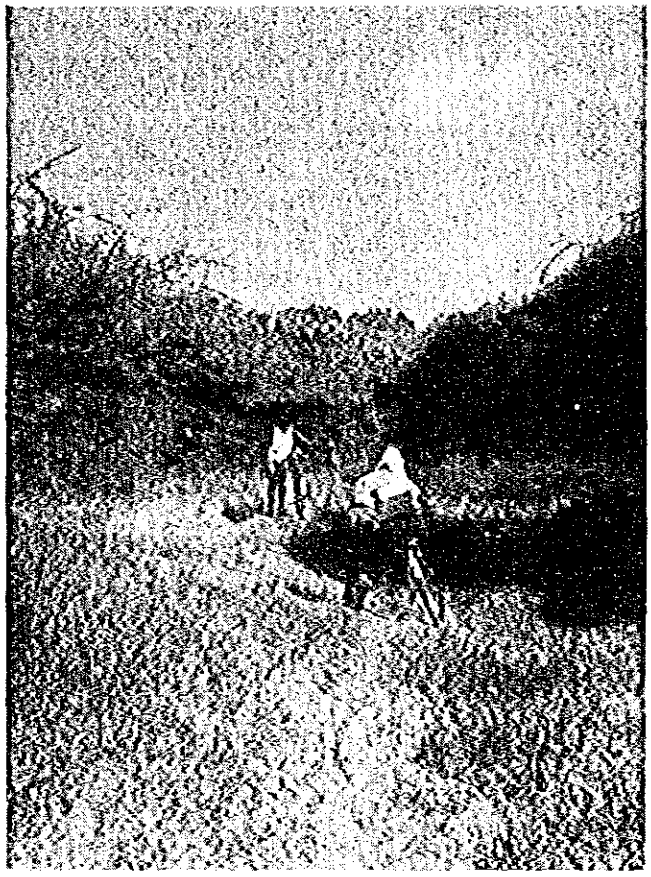
Sukeshige Buso

Sukeshige Buso
Leader, Topographical Mapping Group
of the East Kenya Area, Kenya
International Engineering Consultants
Association

Inundated trunk road.



Construction of observing tower.



Field identification of island on bicycle.

Review of survey results at the Suuvey of Kenya.

CONTENTS

PART II DOMESTIC WORK

PART I FIELD WORK

Pricking
Field Identification

I. Field Work

A. Outline of Field Work

1. Purpose

The 1 : 50,000 scale Base Map Preparation for Eastern Kenya has been under way since 1975 under the International Technical Cooperation Program. As the Fifth Year Phase of this project, the pricking and the field identification required for the base map preparation were conducted.

2. Area

Tsavo, Malindi and Lamu areas in Eastern Kenya covering approximately 27,000 km^2 as designated for the 1 : 50,000 scale base mapping.

3. Period

The 163 day period from June 14, 1979 to November 23, 1979. The beginning and ending dates of the period correspond to those of the departure from and return to Japan of the Survey Team respectively.

4. Types and Volumes of Work

Pricking	12 points
Field Identification	Approx. 27,000 km^2

5. Weather Conditions during the Work Period

	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Total	%
Fine	17	20	23	18	28	10	116	71.2
Cloudy	0	10	8	11	3	10	42	25.8
Rainy	0	1	0	1	0	3	5	3.0
Total	17	31	31	30	31	23	163	100

The above table covers all the days of the work period, i.e., from the date of departure from Japan and to that of return to Japan of the Survey Team.

Localized rains and rain showers of short duration are not included in in the 'rainy' category in the table.

6. Conditions of the Survey Site

The above weather table does not include morning and evening rain showers. When considering them, there was much rainfall on the whole for the dry season. The only

long spell of dry weather with no rainfall at all during the work period was the one month period of October. It appeared that there was noticeably more rainfall in April and May of 1979 than in the average year in Kenya. Consequently, compared with the past project years, there were more areas of muddy grounds to be dealt with. In fact, there were some roads that were made impassable by pools of water forcing the vehicle to detour by driving through shrubs. The road running east from Garsen to Mokowe was destroyed at several locations to prevent the passage of vehicles until mid-September. As a result, the affected areas to be covered for pricking had to be reached via Garissa by driving back and forth the distance of 600 km one way. The small lanes and alternative roads that had to be used were mostly covered densely with grass as to make it difficult even to identify them. To prevent the grass from stuffing into the radiator grill, a net of fine meshes was mounted up front on the vehicle. But with all that, the engine tended to get overheated, thus requiring constant attention.

The secular changes resulting from the developments of roads and settlements were not so significant except for the area northwest of Malindi where the agricultural development project was being undertaken by Australia.

This year as in the past project years, there was no casuality sustained from wild life or assaults by poachers. What was new about this year was a large number of snakes encountered by the Survey Team members. Their kind is unknown in Japan. Thick and short, the snakes are deadly poisonous. They were run into often, sometimes as often as two or three times a day. The team members had to be watchful to stay clear of them. There were many mosquitoes as usual. Preventive medicine against malaria was taken regularly without fail. Fortunately, there was no case of injuries by scorpions this year.

In hiring the auxiliary work force, those were given the first priority who had experience of working with us on the site in the first three years of this project, considering their familiarity with the conditions of the survey site, the Japanese way of working as well as with the specific work procedure.

Beginning from July 17, the Base Camp was set up, preparatory work done and the field work started. On August 1, Mr. Kasyi, Provincial Surveyor of Coast Province at Mombasa, and the labor officer of Malindi made a trip to the Base Camp to discuss with Mr. Buso, Leader, and Mr. Suzuki, Administrative Coordinator, both representing the Japanese

survey team, the employment conditions for the local workers. The conditions as agreed between the two sides were explained to the workers and their employments officially effected in the presence of the two Kenyan officials.

The regular full employment contract would require a one-month advance notice in case of dismissal and continued payment of wages during the absence due to sickness. Also it would have taken complex and time-consuming computations for over-time payments. In view of the short duration of work period, therefore, all employments were made on the temporary worker status. The temporary worker is supposed to get paid on a daily basis but since our work site was out in the field, the workers were paid once or twice a month.

Gasoline supplies which were essential as fuels for vehicles were made available in enough amounts in Malindi. On the other hand, there was practically no supply of gasoline in Garsen and other towns possibly due to the bad road and it had to be carried from Malindi in drum cans. The gasoline price was 25% higher than in the fourth project year, i.e., January - March 1979. The increase in the gasoline cost was absorbed by savings on other items so

as to stay within the overall budget. All other commodities including liquors, cigarettes, hotel rooms, etc. which are apparently under government control were higher in price than the previous time. Rice and flours were on the ration. Even with the special permit of the District Office, it took ten days to get them.

Despite the fact that estimatedly more than 30% of all the motor vehicles used in Kenya were Japanese, replacement parts were mostly difficult to obtain not only in Malindi but also even in Mobasa and Nairobi. Other daily necessities were available in ample supplies.

B. Execution of the Work

1. Organization of the Survey Team

The Survey Team for this year was organized as follows.

Responsibilities & Job Classifications	Periods of Service	Name
Leader (Responsible for general management of entire work)	Jul. 12 - Nov. 23	Sukeshige Buso

Coordinator (Administrative coordination & general affairs)	Jun. 14 - Nov. 23	Shigeo Suzuki
Mechanic (Vehicles)	Jun. 14 - Nov. 23	Yutaka Asami
Chief Surveyor (Chief of field work)	Jul. 12 - Nov. 12	Fumio Ohdaira
Surveyor (Pricking)	Jul. 12 - Sep. 7	Shigeo Ono
Assistant Surveyor (Pricking)	Jul. 12 - Sep. 7	Takashi Aoki
Assistant Surveyor (Field Identification)	Jul. 12 - Nov. 12	Masashi Otogawa
Assistant Surveyor (Field Identification)	Jul. 12 - Nov. 12	Minoru Arai
Assistant Surveyor (Field Identification)	Jul. 12 - Nov. 12	Takashi Satoh
Assistant Surveyor (Field Identification)	Jul. 12 - Nov. 12	Toshio Yamagata
Assistant Surveyor (Field Identification)	Jul. 12 - Nov. 12	Terutaka Ohkura
Assistant Surveyor (Field Identification)	Jul. 12 - Nov. 12	Takashi Kitani
Assistant (Pricking)	Jul. 12 - Sep. 7	Osamu Tonegawa
Assistant (Pricking)	Jul. 12 - Sep. 7	Hidetaka Suzuki
Assistant (Field Identification)	Jul. 12 - Nov. 12	Kenichi Sato

2. Preparations

An advance party of Messrs. Shigeo Suzuki and Yutaka Asami departed Japan on June 14, 1979, to make local preparations including check-up of vehicles. Immediately after their arrival in Nairobi, they took the vehicles to the garage for check-up and provided detailed instructions. At the same time, they cleared the replacement parts shipped from Japan through the customs on June 21 and delivered them to the garage, where the two members oversaw the check-up of the vehicles. They also arranged for the inspection of the truck, acqusition of the road licenses, vehicle insurances, acquisition of the wireless licenses and the selection of the wireless type.

On June 24, after a meeting with the Provincial Surveyor in Mombasa, they moved to Malindi where they were engaged in the renting of a house for office use, opening of a P.O. Box and a bank account for foreign exchange and arrangements for hiring the local auxiliary work force, to return to Nairobi on June 28.

Starting from July 6, the vehicles were inspected as they were checked up and readied and on July 12, all the vehicles became fully operative.

On July 12, the 13 member main party led by Mr. Buso and accompanied by Mr. Yukio Kitani, Chief, Survey Guidance Division, the Geographical Survey Institute of Japan, who also served as Technical Advisor, and Mr. Hideo Murayama, Development Survey Division, Social Development Cooperation Department, Japan International Cooperation Agency, left Japan. Arriving in Nairobi, they met with the Director of the Survey of Kenya and his staff members and received the identification cards and official passes to the National Parks.

On July 16, four members, Messrs. Aoki, Yamagata, Sato (Takeshi) and Sato (Kenichi) moved ahead to Malindi. The rest of the members followed them to Malindi on July 17 after checking out the survey equipment from the customs.

To set up the Base Camp, the same materials used for the third year and subsequently stored in the warehouse of the Survey Department at Mombasa were delivered in several shipments to the site. Other preparations included construction of a garage for check-up of vehicles, installation of wireless poles and equipment, fencing of the camp compounds, uncrating and checking of survey equipment, purchasing of work materials, preparation for

sub-camp setting. All preparatory work was finished by July 24.

Mr. Buso, who arrived in Malindi on July 19 together with Mr. Kitani and Mr. Murayama, inspected the road conditions in the Garsen and Galana areas. He got the permission to set up a sub camp from the manager of the Galana Camp. On July 23, he reported to the local government agencies concerned in Malindi to complete all preparatory arrangements.

3. Pricking Work

3 - 1 Purpose

With respect to the 12 points where the aerial signals could not be identified on the aerial photos taken in 1977 and 1979, their locations were identified on the ground and pricked directly on the photo sheets partly enlarged to four times or pricked to eccentric points on nearby features clearly recognizable on the photo. They were made to serve as basic information for aerial triangulation and plotting.

3 - 2 Field Identification and Direct Pricking

Depending on the road conditions and other site conditions at the time of field survey, the observation towers had to be brought in for eccentric observation. Since the control points were not accessible by a large size truck and the increased number of eccentric points to be observed would mean an increase in the number of work days and in the costs of rented vehicles with a possible result of exceeding the budget, it was an urgent task to determine the number of eccentric points. For this reason, the work was started from the Asa Village area located in the north central of the survey area and the point south of Galana where the road was distant away and the control point appeared to be difficult to find but eccentricity should be required.

By August 10, it was found that there were two points that would require eccentricity and the other points could be directly pricked. By the end of August, we became confident that all the points could be covered by pricking on schedule. Among the planned points, Control Point 177-ST4 established by British D.O.S. supposedly located approximately 40 km straight west from Asa Village could not be found after repeated attempts and

all possible efforts. It was signalized in 1975 and restored twice in 1976 and 1977. Search was made for the point repeatedly, a total of six times in this year namely three times by the pricking party joined by Mr. Ohdaira, Field Chief, who was engaged in the signalization of this point in 1975, additionally employing a guide from Asa Village, and another three times subsequently by the field survey party, but all failed to find the point. The search had to cope with such difficult conditions as unusually much rainfall and heavily growing grasses and shrubs that covered the alternative roads and the ground. Besides all that, the monument of this particular control point was 0.3 m above the ground while the other D.O.S. established control points were monumented at a height of more than 1 m. If it had been found, however, it would not have permitted the observation tower to be brought in and direct pricking would have been infeasible after all.

Point 177-ST5 east of the above control point, close to Asa Village, was found on the second search attempt. This point originally was not considered for pricking but with the approval of the authorities concerned, it was applied as the alternative to 177-ST4 for pricking. Point 177-ST5 was formerly designated as 177-T1. It was

changed to the present designation apparently when the D.O.S. conducted the up-date surveying but there were no monumentation records available. As in the third year, a request was made in meetings with the S.K. held on July 24 and September 4, that the monumentation records be made available for use by the Survey Team. Acting on the request, the S.K. contacted the D.O.S. Headquarters in Britain and the records were made available to the Survey Team on September 20. The records were sent immediately to Tokyo for use in the computations of aerial triangulation. The other points for direct pricking could be identified by way of nearby features plainly recognizable on the photo such as trees and bare founds and by black-white contrasts on the Photo.

3 - 3 Construction of High Observing Tower

The points requiring eccentric observation turned out to be 184-ST5 and 192-S6. Towers were built at these points. The towers were transported in a large rented truck for the road distance of approximately 100 km from the Base Camp at Malindi to the Sub Camp at Galana and in the team's truck for the 75 km from the Sub Camp to Point 184-ST5 and the 30 km to Point 192-S6 in two

installments for each tower. The towers were erected right on the point at 184-ST5 and at an eccentric distance of 15.91 m at 192-S6, standing to the heights of 15.32 m and 15.17 m from the ground respectively.

It took two days to build the tower at each point working from the Sub Camp and one day each to dismantle them. A total of four units of high observing towers, two 15 m units and two 20 m units, were used. After the pricking work was completed, they were checked up to be presented to the S.K. as a gift of the Survey Team.

3 - 4 Eccentric Observation

Eccentric observations were made from the above mentioned points for two points including an auxiliary point for each. All four eccentric points were identified with a clearly recognizable feature such as a tree or shruverry on the photo and their tops were observed for heights.

For horizontal angle observation, two pair observations were conducted using WILD T3. For the determination of the zero direction, a helio-trope was used as a target without erecting an observing tower. For vertical angles,

the two-pair observations were performed both ways, forward and backward, using WILD T3 and T2. With respect to the eccentric point (P_1) of 184-ST5, since there was not much of distance involved, differences in elevation instead of angles were observed. Distances were measured with Tellurometer MRA 101 in two sets of gross read-outs and five sets of precise readouts, both ways forward and backward for each point.

Meteorological observations were made twice for one half set of read-outs, before and after each obseravtion. As for the eccentric point (P_1) of 184-ST5, since it was located 26.41 m from the control point, one set of direct measurements, forward and backward, were taken with a steel tape.

The distances of eccentricity for the other points were as follows.

184-ST5	(P_2)	406.67 m
192-S6	(P_1)	1,572.32 m
192-S6	(P_2)	1,979.11 m

3 - 5 Reduction to Center

Based on the field records of horizontal angles, vertical angles and distances as measured, the original draft result tables were made respectively and average values were computed after necessary corrections. At the same time, the observed values were checked for specified tolerances. Subsequently, with respect to 192-S6 for which the observed point was not the control point, eccentric corrections were performed and the spheroidal distance was concerted by computation to the horizontal distance. Further, form the UTM coordiantes of each given control point, the longitudes and latitudes were obtained by conversion. The computations to determine the azimuth between the zero direction and the control point from their longitudes and latitudes were performed by computer. From the above elements, the UTM coordinates of the eccentric points and elevations were computed to provide the final results.

3 - 6 Accuracy of Eccentric Observation

The observation results for the respective eccentric points are given in the table below.

As can be seen from the table, all the values met the specified tolerances.

Point name	Horizontal Angle						Vertical Angle			Distance	
	Double angle	Double angle difference	Limit	Discrepancy	Observation difference	Limit	Height constant	Const. dif.	Limit	Discrepancy btwn sets	Limit
							39.8"	6.3"			
	66.6"			-4.2"			46.1				
192-S6 (P_1)	65.8	0.8"	20"	+4.6	8.8"	10"	59'53"	13	15"	0.07m	0.075m
							0'06"				
							43"9	1.8			
	58.2			-5.4			45.7				
192-S6 (P_2)	65.1	6.9	20	+1.1	6.5	10"	7"	2	15"	0.05	0.075
							9				
							51.8	0.3			
	107.1			-0.9			51.5				
184-ST5 (P_2)	105.2	1.9	20	-2.8	1.9	10"	6	2	15"	0.06	0.075
							4				
	88.6			-7.6							
184-ST5 (P_1)	102.2	13.6	20	-2.4	5.2	10"	(Elevation difference observed by Direct levelling)			(Distance measuring by steel tape.)	

The observation results for the respective eccentric elements at Point 192-S6 were as given below.

Point name	Double angle	Double angle difference	Limit	Discrepancy	Observation difference	Limit	Vertical angle	Distance measuring
192-S6 (c)	119.3" / 140.2	20.9"	3'	-20.3" / +17.8	38.1"	2'	(Levelling)	(Steel tape)

$$\frac{S}{e} = \frac{1557.81m}{15.91} = 98$$

The tolerances for the respective eccentric elements were based on those for the third order control point surveying as provided for in the Overseas Surveying Specifications.

3 - 7 Final Results

In the final detailed table of the pricked points, the directly pricked points and the eccentrically pricked points are represented in terms of the UTM coordinates and the elevations based on the control point data provided by the Survey of Kenya for the former points and on the results of eccentric observations for the latter. In addition, the sketches of the immediate areas of the pricked points, the heights of the monuments and the heights of tree tops for the eccentric points were listed. The ground photos and

the portions of aerial photos enlarged to four times covering the pricked points are also attached.
In addition to the above final detail table of the pricked points, the observation field book, the original draft result table and eccentric observation computation records were compiled into one book of report.

4. Execution of the Field Identification

4 - 1 Purpose

Based on the East Africa Specifications provided by the Survey of Kenya, such planimetric features as roads, buildings and structures, vegetations, rivers and swamps, etc. that must be represented in the 1:50,000 scale base maps were surveyed on the ground and then identified in colors on the contact prints of aerial photos to be plotted finally in the maps. The work, however, did not include the surveys of geographical names of natural features such as rivers as well as place names which were supposed to be done by the Survey of Kenya.

4 - 2 Review of the Specifications prior to the Survey

At the request of the Survey Team, a meeting was held

on July 31 at the Base Camp in Malindi between the Kenyan Side represented by Mr. Ogutu, Senior Cartographer, and Mr. Odero, Surveyor, and the Japanese Side represented by Messrs. Buso, Ohdaira and Suzuki and the field survey staff to clarify the nature of the Specifications, levels of representation and its method. The meeting discussed the following.

(1) Criteria for road classifications and method of representation on the field identification photos.

(2) The date to receive the survey data on place names from the S.K.; survey results by the Japanese Survey Team (particularly road classifications); and the procedure to get agreement from the S.K.

On August 1, the second meeting was held between the two sides with Mr. Kasyi, Provincial Surveyor of Mombasa, joining the Kenyan Side and Messrs. Buso, Ohdaira and Suzuki on the Japanese Side. At the beginning of the meeting, the 15-point inquiry list was presented by the Japanese Side to the Kenyan officials. The replies given by the Kenyan Side were further discussed. Later on the same day, all the conferees joined by the field

survey staff took a field inspection tour as far as Hadu about 60 km north of Malindi to identify the roads, structures and vegetations on the site according to their respective classifications.

At the third meeting on August 2, the minutes of the proceedings were documented and subsequently on August 6, they were executed as an offical agreement by Messrs. Ogutu and Odero for Kenya and Messrs. Buso for Japan. Leader Buso explained to the Survey Team the Minutes of the Proceedings and the findings of the inspection tour to make sure that every team member should conform to the agreed procedures.

In the meantime, Mr. Odero continued to stay in Malindi to survey place names. On August 10, the field survey staff met at the Galana Sub Camp to discuss vegetation identifications.

The questions asked at the meeting by the Japanese Side concerning the Specifications and the replies made by the Kenyan officials were as follows.

[Question 1] What is the base document for symbols to represent classifications of the primary points, secondary

points and other control points?

[Answer] They are in the result table.

[Question 2] What should be the minimum space size for a common cemetery to be represented on the map? Is there any with too small a space to be represented by one symbol?

[Answer] The public cemeteries only should be represented. With respect to application of the symbols for cemeteries, it will be checked and let known at a later date. If it is a cemetery with one grave, as long as it is distinguished, it should be noted therefor.

[Question 3] How do you define the Antiquities? Are there any in this particular survey site?

[Answer] All the listed antiquities have to be represented regardless of their scopes. If any unlisted historic remains are found, they have to be reported and the museum at Mombasa or at Lamu will decide whether or not they should be represented. There are antiquities in the survey area. (The Japanese Side requested that Mr. Odero will provide the information on them to the Survey Team.)

[Question 4] What are the Ruins specifically? Are there any in the survey area?

[Answer] It is difficult to actually distinguish the Ruins from the Antiquities. The Ruins are defined as those listed as such.

[Question 5] What is meant by 'Beacon'? Is there any in the survey area?

[Answer] The difference between light house and beacon will be studied and made clear at a later date.

[Question 6] What is the sea plane base? Is there any in the survey area?

[Answer] It is the water suited for sea plane landing. It has to be checked whether or not such waters exist in the survey area.

[Question 7] What is the Race Track? Is there any in the survey area?

[Answer] The Race Track to be represented on the map are motor racing tracks and horse racing tracks. It is not known immediately whether or not any such tracks exist in the survey area.

[Question 8] From which government agency can the further information pertaining to Questions 3 to 7 be obtained? Is there any need to obtain such further information?

[Answer] Yes, it should be necessary. Whenever there is anything you are not clear about you should check it with the authorities concerned.

[Question 9] How should the submarine cable laid between Lamu and Mokowe be handled?

[Answer] There is no precedent to represent such a feature. There are also underground telephone cables being laid out. We might have to introduce new symbols for such underground cables as well as for undersea cables. We will discuss it among ourselves in the government to make a decision.

[Question 10] What should be the minimum size of bridges to be represented on the map? We would suggest that all bridges should be represented however small they are.

[Answer] The symbol for the bridges over the rivers represented by one line on the map should be 2 mm in length having the width including 0.5 mm from the road line on both sides. The symbol for those on two-line rivers should have the length including 0.5 mm from the water boundary on both sides. Its width should be the same for those over one-line rivers. All the bridges regardless of their sizes should be represented in the map.

[Question 11] Are the symbols for embankment and cutting of land as indicated under railways in the Specifications applicable to roads?

[Answer] The symbols for land embankments and cutting for roads should be printed on the black plate.

[Question 12] How should the fields for such crops as cotton and corn that are not included in the Specifications be handled?

[Answer] Plantations for such perennial plants like coffee, acasia, cashews, tea, sugar canes, sisal, should be represented but annual plants such as corns and cotton are not.

[Question 13] How should the large spaced premises like school grounds be represented?

[Answer] The premises with a large space should be represented by enclosing it with the fencing symbol. Mr. Ogutu will provide to the Japanese the examples of the latest symbols.

[Question 14] What should be the minimum length and width of the rivers of which the direction of river flow is indicated?

[Answer] The rivers having a width of more than 30 m should be indicated by two lines. Such rivers of which the direction of the river flow is not obvious from other map features should have an arrow to indicate the flow direction.

[Question 15] What are the differences between wells, springs, water holes and bore holes? What is the maximum

size of those that should be represented by symbols? We would indicate them, if they are big enough, according to their shapes.

[Answer] There are many of them in this survey area. We would like to study the differences in the field jointly with the Japanese Survey Team.

Others: The Japanese Survey Team decided to stay clear of such military information that would pertain to the security. In this connection, Mr. Ogutu was requested that he will provide to the Japanese a list of such military information. Mr. Ogutu agreed to send such a list to the Japanese Survey Team through Mr. Kasyi as soon as it was obtained.

4 - 3 Preliminary Work

The field party completed the set-up of the Base Camp and the Sub Camp by July 24. From July 25 through 27, the western parts of the survey area were inspected as they performed the pricking of the bench marks. From July 28 through 31, the barometric altimeter was checked in experimental observations and the preliminary photo interpreations performed in Japan were substantiated

on the ground. On July 31 and August 1, all of the field survey staff joined in the review of the Specifications as mentioned in the preceding section. On August 2, the actual survey got underway.

The photos for field identifications and pricking of bench marks, reference maps, maps for road surveys, copies of the original result tables of bench mark observations and elevation observation with a barometric altimeter, were prepared in advance for use in the field work. The various reference materials requested to the S.K. had not been made available by the time the field work got underway.

With respect to the equipment and materials, the barometric altimeter, stereoscopes,levelling equipment, compasses, in addition to the materials for the Base Camp setting, were prepared in advance.

4 - 4 Progress of the Field Identification

The original plan called for the work to begin with the coastal area in the east where it was expected to take a relatively long period of time for surveying. But because the roads could not be used, the work was started

from the western part. From July 25 to 27, the field survey party performed the pricking while they were on the reconnaissance of the area. The six days from August 2 to 4 were devoted to the pricking work by the pricking party.

Sub Camps for the field work were set up at five locations, i.e., Galana, Voi, Asa, Garsen and Mokowe. For outlying areas, the field work was conducted working from a Sub Camp, namely for Dakadima Hill from the Galana Sub Camp, for Kitau, Faza, Pate, Oda, Siyu and Manda from the Mokowe Camp, Witu, Ngao and Kipini from the Malindi Camp. When in such distant areas, they stayed on the individual sites for one to two days by encamping in groups. The average number of days for the actual survey work at each Sub Camp was one week with several intervening days spent for organizing the acquired data. At Mokowe, however, the survey was conducted for 18 consecutive days.

The survey was conducted on the basis of reference maps, field data and information collected from local people and every road accessible by the vehicle was actually run through. Noted with particular importance were routings and classifications of roads, locations and special shapes of villages, structures that require notations

in full or in part, their locations and names, vegetation classifications and historic sites. Vehicles were fully utilized for the field work. But the swampy areas around the villages along the Tana River could not be entered by the vehicle and, therefore, a motor boat was rented for the surveying of such areas.

For ferrying between the islands in the Lamu region, a motor boat was rented also. The interior of each island was not accessible by the vehicle and, therefore, bicycles were rented and the survey was continued by making overnight stops at one village and another.

Those archaeological sites located close to the sea coasts were heavily covered by grasses and mostly inaccessible by the vehicle. Therefore, they had to be reached on foot for surveying.

There were some on-going agricultural developments in the survey area. One was the Magarini Scheme being undertaken by Australia in an area northeast of Malindi, others being in the area along the Tana River and in the vicinity of Lake Kenyatta in the eastern part. In the area covered by the Magarini Scheme, new roads will most likely be built in the future. The data on the control points surrounding

the area were available for use in mapping as reference. In the area along the Tana River, there were no changes as significant as to require representation in the 1:50,000 scale maps. As for the Lake Kenyatta region, the road networks were aerially photographed. Housing increased from the time of aerial photographing.

Observations with the barometric altimeter were conducted at various locations to provide information for mapping. The observations were performed at the Base Camp in Malindi every hour during the eight-day period from August 7 right after the field survey got started. The same observations were simultaneously made at the Galana Sub Camp. When the results were compared, however, the differences in atomospheric pressures were so large between the two locations. So that the observations at the Malindi Camp were terminated and the base observations were shifted to another Sub Camp. As a result, one member had to be diverted to attend to this from the field survey group which was usually formed by two so that the field work was performed by one.

As the plantations that could be represented, there were coconut fields in Lamu Island and small tracts of cashew fields in the Mokowe area. In complicance with the instruction given by the S.K. at the meeting held

in November, the coconut fields were represented according to the specified classification. Water boundaries of the coasts to be represented on the map were based on the full tides in accordance with the agreement. With regard to the classified facilities for security that should not be represented on the map, there was one as such in the survey area. It was deleted from the photo.

4 - 5 Existing Data Collection

The data and information made available by the S.K. in the relatively early stages of the field work included the Gazetteer, road numbers and marine charts, while the archaeological site information and the administrative data were not made available which would have been most helpful to prevent missing of village or other survey elements pertaining to the administration particularly for those areas inaccessible by the vehicle. In paucity of such data, therefore, we had to rely on hearings from local people to fill in the necessary information. As the census was taken as of August 28, the Survey Team made a request for the latest information on the names of villages possibly incorporated in the census data. Then the name list was supplied for the

Lamu District. As for Kipini, Mkununbi and Ngao in the Garsen area, the information was obtained directly from the District Chief.

With respect to archaeological site information, since it would take time if via the S.K., they referred us to the Museums at Mombasa and Lamu for information on the names and locations of archaeological sites.

4 - 6 Organization of Acquired Data

The survey findings were indicated on the contact prints of aerial photos with color inks according to the classifications as specified. For the four areas of Garsen, Lamu, Witu and Ngomeni where the density of the existing structures was high, the portions of aerial photos covering these areas were enlarged to two times for representation of survey findings.

The road routes were not recognized clearly enough on the aerial photos. Therefore, they were identified on the existing 1:100,000 or 1:50,000 maps and colored according to the classifications. The roads with identification numbers were noted as such and connections

with the individual field survey photos were indicated, thus making the road survey maps.

Measurement records of the barometric altimeter were corrected for changes in atomospheric pressures and temperatures before the elevations were determined. The elevations thus determined were indicated on the field survey maps together with point numbers.

With respect to the connections with the existing maps, the first priority was given to the existing maps as long as they were not affected by secular changes. Each sheet of the field survey photos was checked for connection of road and vegetation classifications with adjoining sheets.

4 - 7 Place Name Survey by the Survey of Kenya

On July 31, the place name survey party from the Survey Department of Kenya led by Mr. Odero arrived in Malindi and encamped on the grounds next to the Japanese Base Camp. Starting on August 7 right after the meetings with the Japanese Survey Team which lasted till August 6, Mr. Odero and his party engaged in place name surveying covering wide areas surrounding Malindi. Earlier, one

set of aerial photos had been submitted to the Director of the S.K. for their use in place name surveying but the existing maps instead were used for representation of the survey results. In mid-October, another Kenyan survey party reportedly entered the western part. Mr. Odero on his part moved from Malindi to Garsen to continue the survey in the Mokowe area. Their survey results as they were acquired were sent to the Place Name Committee in Nairobi for approval. We requested that the place name survey results as approved by the Committee be supplied for the whole survey area by October when we were to return to Japan. By that time, however, we could not receive three sheets covering the coastal areas. The survey results received were in the form of the survey maps attached with a list of the place names that had been changed.

4 - 8 Consultations with the Survey of Kenya on Survey Results

Consultation Meetings:

On November 5, just before the field Identification party was to return to Japan, the Japanese Survey Team met with Mr. Obel, Superintendent of Surveys and Mr. Ogutu at the

Field Headquarters of the S.K. to discuss the questions that arose in the later stages of survey with respect to the interpretations of the Specifications.

At this meeting it was made clear that if the survey results on road classifications agreed with the judgment of the Kenyan survey officials, there was no need to submit them to the Ministry of Works responsible for road maintenance and management for approval. Therefore, we had Mr. Odero, who did the field survey for place names, go over the road classifications as we made. He agreed with our results and put his signature on the road survey maps to attest his agreement.

By this time, the maps showing the information on archaeological sites as collected by the S.K. were made available so that our survey results were compared with them. As a result, it was found that there was one site that was missed in a swamp area inaccessible by the vehicle. It was understood that this site would be covered by survey in the next year's supplementary work. On the other hand, there were several archaeological sites that were identified in the Japanese survey but not listed in the Kenyan documents. It was understood that the S.K. would survey such sites for themselves for confirmation. Also, the errors in

the listing of place names as we found on the existing maps were pointed out to the S.K. for their information.

5. Demobilization

Those of the survey equipment used by the pricking party that were to be shipped back to Japan were crated after checking on August 29 and 30 and handed over to Nakuline of Mombasa for forwarding on September 3 as the party moved from Malindi to Nairobi.

The field survey party did the checking and crating of their equipment to be shipped back, dismantling the Base Camp, cleaning and checking out, sorting materials left over, and transporting and storing of the equipment and materials to stay, in the S.K.'s warehouse, during the period from October 29 to November 1. Those of the equipment and materials that were supposed to be used for the next year's work were clearly distinguished from the rest in the warehouse. The equipment of the field Identification party was shipped back to Japan by air cargo.

6. Vehicle Check-up

The replacement parts that had not been obtainable in Kenya in the third year were shipped from Japan by air cargo. They were delivered to a repair plant in Nairobi where the whole fleet of vehicles was checked and repaired. This repair work was finished on July 12. On the following day, the vehicles were inspected by Mr. Okabe, Head of JICA's Nairobi Office. As JICA let us use all of the vehicles, the whole survey team moved to the work site in these vehicles on the same day.

At the Base Camp in Malindi, a tent was set up for storage of repair tools and parts. A check-up garage was also built with steel reinforced concrete blocks by the tool shop. The mechanic explained to all the survey members the check items of vehicles before their use and points to watch while they were in operation. Every member was reminded to be extra watchful to prevent accidents.

The field work called for all the vehicles to be fully operated. During the daily wireless communications with the Sub Camp that were made twice in the morning and evening at seven, it was made sure that the conditions of the vehicles should be reported. When the field party returned to the Base Camp

after demobilizing the Sub Camp, they were required to report the conditions of every vehicle in detail to the mechanic, who took necessary actions according to the levels of troubles. While the field party was back at the Base Camp, there was more time for vehicle check-up. After the pricking party returned to Japan in mid-September, more time was taken for check-up of the vehicles. There were two troubles while the vehicles were in the field for which the mechanic was dispatched, once to the Galana Sub Camp and next to Mokowe.

Many of the troubles with the vehicles this year were ruptures and crackings resulting from heavy vibrations. Therefore, the oxygen welding equipment was a must throughout the work period. As mentioned earlier in the section dealing with the site conditions, the grasses were grown particularly heavily this year. These grasses got stuck into the radiator grill impairing its cooling efficiency. The stuck grass had to be removed from time to time by pulling the vehicle to a stop. At the same time, a wire net was mounted over the front. Tree twigs also caused troubles. They got stuck into the radiator to damage it causing leaks of water. This type of trouble occurred twice.

Since the fuel tanks were replaced in all Land Cruisers this year, there was no trouble resulting from rusting of the inside of a tank as we experienced in the previous years. On the other hand, the rusts from the drum cans in which gasoline was transported from the Base Camp to the Sub Camp where the gasoline supply was usually short could clog the filters. Particular attention was paid so that the wheel nuts should not get loose from vibration because this could lead to a serious accident.

The replacement parts were still difficult to obtain locally. When it took too long for orders placed in Malindi to come through, we often went to Mombasa and Nairobi for them not always with success. In the final days of the work when the field survey party stayed at the Base Camp, there was enough time to check up the vehicles. After we moved to Nairobi, the vehicles were checked in at the repair garage where they were overhauled starting on November 4 to complete on November 20. After inspection by Messrs. Yamamoto and Murayama of JICA, the vehicles were officially returned to JICA and turned in at the warehouse.

C. Site Inspection of Work Progress

Mr. Absaloms, Assistant Director of the Survey of Kenya, accompanied by Mr. Kasyi, Provincial Surveyor of Mombasa, arrived in Malindi from Nairobi on the afternoon of August 9 for a visit at the Japanese Base Camp. Leader Buso briefed them on the progress of work up to that date and the plan for ensuing work. They did not have enough time to go on a field tour of inspection. After visiting the neighboring S.K.'s base for place name surveying, the officials returned to Nairobi on the following day.

On October 24 and 25, Mr. Obel, Superintendent of Surveys, accompanied by Mr. Kasyi, was visiting at the Base Camp. They brought with them some of the information requested earlier. They discussed the questions raised by Mr. Buso. After inspecting the site, they returned to Nairobi on October 26. It was learned that the Director of the S.K. also wished to take a field tour of inspection this year but he could not take time out to do it.

As mentioned earlier in the report, Mr. Yukio Kitani, and Mr. Murayama, arrived at Nairobi on July 12. After meeting with the Director of the S.K. and consultations with

the survey team members at the Nairobi Office of JICA on July 13, they took an inspection tour of the survey area on their way from Nairobi to Malindi via Tsavo Mombasa, arriving at Malindi on July 19.
They also inspected the Galana and Malindi areas and advised the Survey Team. They returned to Nairobi by air on July 23 accompanied by Messrs. Buso and Suzuki of the Survey Team. They met with the Assistant Director of the S.K. at the Field Headquarters on July 24 and they left Nairobi for Japan on July 26.

Mr. T. Hirai, Chief, Planning and Coordination Division, the Geographical Survey Institute of Japan, who also served as Technical Advisor arrived on November 8. He met with the Director of the S.K. on November 9.
On November 10, Leader Buso briefed him on the progress of the work. Taking two days, Mr. Hirai took an inspection tour of the survey area at Tsavo with Leader Buso serving as a guide. After returning to Nairobi on November 14, he consulted with Mr. Murayama of JICA about matters to be discussed with the S.K. Also, he advised the Survey Team on the future work plan. He had meetings with the S.K.'s officials on November 19 and 20. After visiting the Field Headquarters, Mr. Hirai left Nairobi for Japan on November 22, accompanied by Messrs. Buso, Suziki and

Asami.

From the Nairobi Office of JICA, Mr. Okabe, Head of the Office, came to stay at the Base Camp in Malindi for two days from October 24 and Mr. Yamamoto for three days from August 21, for inspection of the work progress.

D. Meetings with the Survey of Kenya

The following are the proceedings of the meetings.

1) Date : July 13, Friday

Place : Office of the Director of Survey in Nairobi

Attended by :

For Kenya - Mr. Omondi, Director
Mr. Absaloms, Assistant Director

For Japan - Mr. Kumagaya, 1st Secretary, Japanese Embassy
Mr. Kitani, Technical advisor
Mr. Yamamoto, JICA
Mr. Murayama, JICA
Mr. Buso and all Survey Team members

The following were discussed at the meeting.

a. Agreement was reached on the actions to be taken relating to the density of elevation points as indicated in the Specifications for the Fifth Year Work and irregularities in connection.

b. It was agreed that the contour line interval should be 20 m and 10 m intermediate contour lines should be drawn only for the Tana River area.

c. The extended portions in the northeastern part should be represented in the inset on Map Sheet 180E.

d. Monumented bench marks should be indicated with B.M. written after the elevation figure at each point in the map.

e. It was requested by the Japanese Side that the map name be decided by the S.K.

f. Procedures for joint work with S.K.'s officials dispatched to the site to obtain agreement on the interpretations of the Specificationa were discussed.

The Japanese Side requested that these officials arrive on site July 30 or 31.

g. It was understood that the place name survey team from the S.K. would work independently from the Japanese and that the vehicles to be used by the Kenyan team would be provided by the S.K.

h. Cooperation of the Kenyan Side was requested for hiring of auxiliary workers and dispatching of game scouts.

i. The Japanese Side requested that the local administrative offices be informed by the S.K.

j. It was requested that the identification cards and official passes to the National Parks be issued to the Japanese Survey Team members.

k. Application for the permit for the use of the wireless would be made by the Japanese Survey Team.

l. A request was made for 21-item information materials.

It was referred to Mr. Obel, Superintendent of Surveys.

m. The Japanese Side requested information for map connections.

n. The Japanese Side requested that the data on 177-ST5 be provided.

o. The Japanese Side requested that the data on magnetic declinations as of 1981 be compiled.

p. Revision of the Scope of Work as a result of extention of the completion date was discussed and agreed to.

2) Date : July 24, Tuesday

Place : Office of the Director of the survey of Kenya

Attended by:

For Kenya - Mr. Absaloms, Assistant Director
Mr. Obel, Superintendent of Surveys

For Japan - Mr. Kitani, Technical Advisor
Mr. Yamamoto, JICA

Mr. Murayama, JICA

Messrs. Buso and Suzuki,

Survey Team

The meeting discussed the following.

a. Copies of the notification to the local government agencies were requested. (They were received on the following day by the Japanese Side.)

b. Mr. Odero was introduced as responsible for the place name survey to be conducted by the S.K. He will arrive in Malindi on July 31. The S.K. will send Mr. Ogutu for consultations on the Specifications. Mr. Ogutu is authorized to act on behalf of the Survey of Kenya.

c. As information for the field survey, the Gazetteer, the list of map names, 1:50,000 maps with road numbers, Route Map, Marine Chart, maps for field work, etc. were received by the Japanese Team.

d. Since five sheets of aerial photos taken by the Japanese had cloud covers, the contact prints and

positive films of the old photos covering the clouded areas were requested for loan.

e. The specific areas and the number of map sheets to be covered by 10 m intermediate contour lines for the Tana River area were decided. The S.K. needs the maps for this area for immediate use and the Japanese Side agreed to provide the compiled maps in two sets of positive prints and one set of polyester base.

f. The data on 177-ST5 are necesaary for aerial triangulation and it was requested that they be made available by the end of August.

g. A sample of the inset was requested.

h. It was agreed that the Scope of Work would be revised in November.

3) Date : September 5, Wednesday

Place : S.K.'s Field Headquarters

Attended by:

For Kenya - Mr. Absaloms, Assistant Director

Mr. Ndonda, Chief Cartographer

Mr. Gitao, Cartographer Grade 1
Mr. Kinele, Officer in charge for 1:50,000 maps

For Japan - Messrs. Buso and Suzuki and Pricking Party members

The meeting discussed the following.

a. The Japanese Side thanked Mr. Absaloms for his field inspection trip. The Pricking Party members made farewell as they were leaving for home.

b. The M.O.W.'s latest records pertaining to the road maintenance were requested for reference by the Japanese Survey Team. In paucity of such data, it was agreed that if the survey results by the Japanese meet with the judgment of the S.K.'s place name survey party, the M.O.W. inspection will not be required.

c. Those matters that were left unanswered in the previous meetings on the Specfications were discussed as follows.

(1) The 'beacon' and the 'light house' are both

for maritime navigation. While the light house is equipped to send out the light reaching farther out on the sea, the beacon is smaller in capacity covering shorter distances.

(2) The information on the seaplane bases is not ready yet. It is presumed that there is no such base in the survey area. If any, it was requested, they will be point out.

(3) Submarine or underground cables are to be represented by the symbol for telephone lines with 0.75 mm ticks at their both ends noting submarine or underground respectively at one end and for longer ones, at both ends. The type and size of letters to be used for this purpose should be the same for pipe lines.

(4) The latest version of legend is in printing now. As soon as they are out of the press, they will be delivered to the Japanese Side.

(5) The list of the classified security facilities also will be delivered as soon as it is ready. Those of such facilities that exist in the survey area

include the General Service Unit Camp at Mokowe and the Navy's V.H.F. facilities along the coast.

d. It was reported that the survey results revealed that there are differences in vegetation classifications from those in the existing maps. The Kenyan Side requested in reply that they should match those of the existing maps at least in the connecting areas.

e. The Japanese Side requested that the recent census data be made available, at least the names of villages. The Kenyan Side replied that they would be forwarded in as much as possible.

f. The ten sheets as completed to date are currently under inspection. After the inspection, they will be delivered.

g. The data on 177-ST5 are not presently available at the Survey of Kenya. The Kenyan Side was asked to check it with the D.O.S. of Britain. The S.K. replied that Mr. Ogutu currently in London will be contacted to check it.

h. It was requested to check the dates of the magnetic declination data received by the Japanese Side. (The data were re-edited for March 1981 and delivered to the Japanese Side.)

i. Since it was learned that the S.K. has the levelling data acquired by the Australian office in Malindi, their copies were requested. (The Japanese Side went to Malindi to obtain them directly from the said office.)

4) Date : October 25, Thursday

Place : Base Camp at Malindi

Attended by:

For Kenya - Mr. Obel, Superintendent of Surveys

Mr. Kasyi, Provincial Surveyor of Coast Province

For Japan - Messrs. Buso and Suzuki, Survey Team

The meeting discussed the following.

a. The old aerial photos previously requested to supplement the cloud covered areas of the photos

taken by the Japanese were provided to be used as reference for ruins survey. The adjoining photo sheets were also requested in case and it was agreed that they will be delivered on November 5.

b. It was requested that the name place survey will be completed before the end of October.

c. The results of old aerial triangulation for connecting areas were requested. But it was apparently difficult to obtain and it was agreed, therefore, that they will not be considered in the aerial triangulation to be conducted by the Japanese.

d. The Tide Tables for 1977 and 1979 were requested for use as reference for sea levels as taken in the aerial photos.

e. It was requested that the administrative boundaries as shown in the existing maps be checked at the S.K. and check results be made known to the Japanese Side.

f. The Kenyan Side was requested to find the development

plan maps for the Lake Kenyatta area.

g. The magnetic declinations to be applied should be for 1981 (scheduled date for completion of map printing) and they will be prepared by the Survey of Kenya.

h. The items and manner of notation for the symbols for principal points of aerial photos to be indicated in the maps were determined.

i. The islands in the extended portions of the north-eastern part would involve three sheets. It was suggested, therefore, that they will be shown in the insets.

j. The latest sample of marginal information was requested. It was agreed that it will be delivered to the Japanese Side in Nairobi.

5) Date : November 6 and 7, Tuesday and Wednesday

Place : S.K.'a Field Headquarters

Attended by:

For Kenya - Messrs. Obel, Ogutu and Odero.

For Japan - Messrs. Buso, Ohdaira and Suzuki

The meeting discussed the following.

a. Those place names not covered by the S.K. data can be indicated in the original maps to be produced by the Japanese. Such names should be determined by the next year's survey by the S.K.

b. Questions were asked about the manner in which to represent dams as provided for in the Specifications.

c. Coconut plantations should be indicated with 'CCN' without using the palm symbol except when they were mixed for which both should be indicated.

d. The palm symbol can be used with other symbols for thicket vegetations.

e. The palm symbol can be used in combination with those for 'scattered trees' and 'scrubs with scattered trees'.

f. Standard stick-up strip films should be used for vegetation sysbols as appropriate to their density.

For sparce distributions, symbols will be deleted appropriately. When they are mixed, they should be arranged as appropriate.

g. Thickets and Scrubs can be represented within Forest.

h. It was agreed that indefinite water boundaries are difficult to identify on the photo. They are not seasonal.

i. In such cases where the annotations are many and dense as in a town and difficult to to be placed at the right place, they can be placed outside of the town. In such instances, however, the administrative annotations should have the priority to stay at their original places. The others are left to the judgment of the Japanese Side.

j. Road numbers can be given to foot paths.

k. The difference between Ruin and Antiquity is based on whether or not it is recorded. Those recorded in the S.K. data are defined as Antiquity and indicated with the symbol thereof. This will be further dis-

cussed at the time of map compilation scheduled for next year.

l. Letter spacing should be according to the photo printing machine specifications. Shapes and sizes of other symbols should be determined individually for respective features and no standard procedure is given.

m. Some of the lettering classifications were clarified.

6) Date : November 9, Friday

Place : Office of the Director of the Survey of Kenya

Attended by:

For Kenya - Messrs. Omondi and Absaloms.

For Japan - Messrs. Kumagai (Japanese Embassy) Hirai (Technical Advisor), Yamamoto (JICA), Buso and Suzuki (Survey Team)

The meeting discussed the following.

a. The draft of the revised Scope of Work was delivered

for review by the S.K. Its handling was discussed.

b. The proposed plan to invite Kenyan trainees to Japan for aerial triangulation and map compilation, one for each, was explained by the Japanese Side. Selection of trainees and necessary arrangements were requested.

6) Date : November 19, Monday

Place : Office of the Director of the Survey of Kenya

Attended by:

For Kenya - Messrs. Omondi, Absaloms and Obel.

For Japan - Messrs. Hirai, Yamamoto, Murayama, Buso and Suzuki.

The meeting discussed the following.

a. The 180/2 map sheet with 10 m intermediate contour lines contains islands. It was agreed that the intermediate contour lines should be at an interval of 20 m for the interiors of the islands.

b. For the map sheets with 10 m intermediate contour lines are supposed to be drawn, positive prints and polyester bases for duplication of positive prints are expected to be delivered next year. Positive prints are not needed for other map sheets except for inspection.

c. Three sets of positive prints will be needed for inspection of the compilation maps scheduled for next year. It should hopefully be delivered to the S.K. two weeks before the arrival in Kenya of the Japanese Survey Team.

d. It was confirmed that the cadaster should be represented on the 1:50,000 maps. Then, the data will be required by January 1981 and the S.K. agreed to deliver them.

e. The boundaries of various kinds should be delineated on the positive prints of compilation maps. The positive prints should be completed by mid-August 1981.

f. Destination annotations should be entered on the neat line portions of the positive prints on which

the boundaries are shown. It was requested that necessary data should be prepared in advance.

g. It was asked if the stick-up strip films for vegetation symbols and others can be purchased and, if so, how. The S.K. agreed to check it.

h. "BM" should be indicated only for the monumented bench marks. The elevations should be expressed in the unit of meter with fractions of more than .5 inclusive counted and the rest disregarded. The F.B.M. bench marks should be represented by the elevation of the monument top.

i. The S.K. place name data list almost none of village names. They are covered mostly by area names. As the Japanese Side considers it important to have the individual names of village and the Gazetteer includes many such names, they are being confirmed on site by the Japanese Team. Of those not included in the name list, some are not on the existing maps while there are others that are still on them. A question was raised as to how to handle those still on the maps. The Kenyan Side said in reply that those village names are necessary and should be indicated

on the new maps. Those names as well as the names surveyed by the Japanese will be studied as they are incorporated in the compilation manuscripts which are expected to be submitted next year. It was requested that, in the meantime, the name survey results be reviewed by the Kenyan Side.

j. The applications of trainees will be submitted next week.

k. The Japanese Side asked if the S.K. can dispatch its officials, who are authorized to act on behalf of the S.K., to inspect the drafting and printing around January 1981 when drafting is to be finished and printing to start. If they can, it was conveyed, the Japanese Side will arrange it with JICA. The S.K. agreed to consider it.

l. The official document relating to the revision of the Scope of Work has been delivered by the Japanese Embassy.

m. The Survey of Kenya agreed to deliver to Japan the remaining parts of the name information and the ruins information by the end of January next year.

7) Date : November 20, Tuesday

Place : Office of the Director of the Survey of Kenya

Attended by:

For Kenya - Messrs. Omondi, Absaloms and Obel.

For Japan - Messrs. Hirai, Okabe (Head of JICA Nairobi Office), Yamamoto, Murayama, Buso and Suzuki.

The meeting discussed the following.

a. The proceedings of the meeting held on the previous day, November 19, were confirmed by both sides by signing them.

b. The S.K. has the forms for vegetation symbols in negative films so that if the Japanese Side provides printing papers on which to print them, they will supply the prints.

E. The Sixth Year Work

(1) The work scheduled for the Sixth Year, fiscal 1980, ranges over five work processes, namely, stereo-plotting (remaining 22 sheets with 15 sheets completed in the Fifth Year), editing (all 37 sheets), field completion, colour separation drafting, printing. Each process requires checking and inspection as it is completed. Therefore, every attention should be paid to the work period of each process so that the whole project should be completed on schedule.

(2) In stereo-plotting, the first and foremost attention should be paid, as in all previous years, to the accuracies that must be maintained well in the range of specified tolerances. All the field survey results must be carefully interpreted with particular attention paid to connections. Anything that needs further clarification must be conveyed to those who will take charge of supplementary work scheduled for next year. As for the areas covered with clouds in the new aerial photos, the old photos have been loaned from the S.K. for reference.
Therefore, such features that are clearly identifiable

on both old and new photos will be selected and shown on the plotting base as given points for orientation on the old map. For areas for which 10 m contour lines are drawn, 5 m lines will be drawn as necessary for plotting work. The islands in the northeastern part that are to be shown in the insets must be represented in the whole even when they fall outside of the neat line.

(3) In editing, particular attention should be paid to the applications of the Specifications, shifting in areas where features are densely located and representation of shapes of planimetric features. Data and information should be neatly organized to provide efficient reference during the colour separation drafting work. Also, attention must be paid so that the pencil with the right thickness be used in consideration of printing on the scribe base.

(4) The field completion work should be concerned mainly with confirmation of villages, archaeological sites and roads in the swamp areas and areas not entered because the road was impassable; surveying of such areas that were found at the time of editing as needs

further clarification; and changes taking place in the on-going development areas. With respect to the areas for which the old photos were used because of the cloud covers in the new photos, further field checking is not required since they happen to have no planimetric features such as roads and villages.

Consultations with the S.K. should include confirmation of road classifications, determination of annotations to village names and area names, representation of reefs, for all of which explicit agreement should be obtained. Also, information on boundaries of various kinds and destination names and items to be covered by the marginal information should be obtained.

(5) In colour separation drafting work, care must be taken so that thicknesses of lines, spacing of broken lines, sizes of points, etc. should conform with the Specifications and the formats of the legend and marginal information should meet with those specifically given by the S.K. Attention must be paid to possible shifting and overlapping of coordinate lines. As much checking and correction as possible should be made so as to minimize the need for correction in the printing process.

Approval of Kenyan officials should be obtained for annotations.

(6) In printing, the type of paper as approved by the S.K. should be strictly adhered to. Care must be taken to prevent shifting between the different color plates. Color tones should be uniform respectively and as approved by Kenyan officials.

(7) The vehicles have been checked up and parts have been replaced as necessary at the end of each project year. So they are in operative conditions but in view of the long mileages already covered and bad conditions of the site, there is a possibility of damages to be caused by ruptures and wears of parts. Therefore, added care must be taken in the maintenance of the vehicles.

(8) This will be the last project year. Those who will take over the project next year are urged to make efforts for good communications with the S.K., local government agencies and local people in the interests of good relations with Kenya.

PART II DOMESTIC WORK

Aerial Triangulation
Stereo Plotting

II. Domestic Work

A. Outline of Domestic Work

1. Purpose

Based on the results achieved by the end of the Fifth Year, which covered the field work, of the Project being undertaken as part of the International Cooperation Program for Kenya, the domestic work was conducted.

2. Types and Volumes of Work

(a)	Aerial triangulation:	860 models.
(b)	Stereo-plotting :	Of the total of 37 sheets nominal, 15 sheets actual (15 sheets nominal) for the Fifth Year, each sheet being 15' x 15' in size.

3. Work Period

From September 3, 1979
to March 10, 1980

B. Aerial Triangulation

1. Specifications and Equipment Employed

(a)	Photo scale	:	1:60,000
(b)	Camera	:	RC-10 Superwide
(c)	Focal length	:	88.86 mm (For 1977 photographing) 87.76 mm (For 1979 photographing)
(d)	Number of courses for aerial trinagulation	:	74
(e)	Number of aerial triangulation models	:	860
(f)	Reference control points	:	Aerial signalized control points, pricked points, pricked bench marks
(g)	Equipment	:	Pricking device, stereo comparator, electronic computer (TOSBAC 3400/M41, IBM 370/158)
(h)	Materials	:	Contact prints of aerial photos, positive films

2. Planning and Methodology

Considering the layout of the control points, the whole area was initially divided into three blocks based on the analytical method. Those blocks were made so as to overlap at the location of the main course. The numbers of models comprising the respective blocks and the numbers of control points used are given in the table below.

Block Name	Number of Models	Number of Control Points	
		Horizontal	Vertical
I	391	27	102
II	298	27	129
III	233	34	112

Adjustment computations were performed for each block by the independent model method. Based on the residuals of control points and discrepancies of tie points including pass points obtained from computations, the points to be excluded from adjustment computations were determined. These residuals and discrepancies were due to the photographing conditions and natures of control points so that the irrational errors were eliminated from each

block by deleting these points. This process was repeated until the results met with the Specifications. Adjustment computations were performed for all blocks to obtain the results which met the Specifications.

All control points were considered for adjustment computations. Considering the photographing conditions and the natures of individual control points, the following four points were ultimately used for their horizontal and elevation values as reference values.

a. 170-UT-1 Elevation adopted. X,Y used as reference.

b. 180-ST-1 Both elevation and X,Y used as reference.

c. 180-UT-26 Elevation adopted. X,Y used as reference.

d. BP-ST-3 X,Y adopted. Elevation used as reference.

BP-ST-3 is a pricked point and the other points are signalized points. The total number of models comprising all the blocks was 860. The numbers of control points used were 73 for X,Y and 284 for elevation.

3. Point Selection

Two pass points were selected for the principal point of photo and one each in the vicinity of the principal point at the both ends on the line orthogonal to the base line of the principal point. Tie points were selected from those plainly recognizable on the photo located in the central portion of the overlapping area of upside and downside courses at a rate of more than one point for every two models at the same intervals. Parituclarly for such areas where courses are connected or crossed by the main course, tie points were located more densely.

The above pass points and tie points were initially determind on the contact photo prints and then pricked on the positive films using the pricking device. On the contact prints, the pricked points were marked by a circle written in red ink and the points numbers were entered. On the positive films, the pricked points were marked by a circle written with a red pencil.

The pass points located in the vicinity of the principal point were named "b" points, those on the upside of the base line of the principal point "a" points, those below

the line "c" points and those below the line and close to "b" points as "d" points. In addition, for incomplete models such as for coasts and islands, "e" points were made between "a" and "b" points and "f" points between "b" and "c" points. As for the tie points, the courses in one direction were given the serial numbers as course numbers and "T"'s were noted thereafter.

4. Measurement of Photo Coordinates

By using the stereocomparator, two-time independent measurements were taken of photo indice, signalized or pricked control points, selected pricked bench marks, pass points and tie points contained in each block. When the discrepancies of the measured values were less than 20 μ, their average value was adopted. And when they exceeded the limit, another series of measurements were taken and the average of all measured values was adopted.

5. Computations for Converstion to Geodetic Coordinates

Computations for this purpose were performed by the computer giving code numbers to the control points, course numbers, pass points, tie points and blocks.

The program used for block adjustments was PAT-M43 based on the independent method developed by Stuttgart University of West Germany. In adjustment computations, each point was given a weight according to the purposes of the individual points.

a. Model point

X, Y : 1.000

Z : 1.000

b. Center point of projection

X, Y : 0.250

Z : 1.000

c. Control points used for horizontal adjustment computations

Z : 100.000

d. Control points used for vertical adjustment computations

Z : 100.000

e. Control points for reference but not used for adjustment computations

X, Y : 0.0

Z : 0.0

The weight matrix for the above is given in the computations records. Since the weights were given

to the control points with a measurement accuracy of less than 20 μ on the photo, its actual distance is 1.2 m. If the accuracy of a control point is given in the unit of centimeter, it should be made less than 1/100 in the aerial photogrammetric computations. Therefore, it was assumed to require to give a weight of 100 to be given to the measured value of the control point.

The code numbers given to each model and control point are shown in the point layout chart. The manner in which the numbers were given to the tie points was explained at the beginning of the computation records.

6. Results and Accuracy of Adjustment Computations

Adjustment computations were performed in the order of horizontal, vertical, horizontal, vertical, earth curvature correction and horizontal. Convergences in each of the above steps of adjustment computations are shown in the records of repeat computations. The final accuracies are given in terms of average square errors for results of weighted model points, projection center and control points. With respect to the control points not used for adjustment computations, they were

expressed in terms of the average square differences between the computed values and the input data values.

In order to facilitate identification of such points with a large residual and time points (including pass points) with a large discrepancy based on the results of computations for conversion to geodetic coordinates, the values three times the average square errors of the model points and the projection center were applied as calibration values. Those which exceeded these values were indicatd by I as noted. After conversion computations, all the values relative to the same point were tabulated for each model and further the determined values were printed out in the order of point numbers as the final result table. The orientation elements for each model are given at the end of the computation records.

The average square errors computed to represent the accuracy of adjustment computations are as shonw in the following table.

Block Name	No. of Models	No. of control points		Horizontal Residuals of control points		Vertical Residuals of control points		Tie point max. horizontal discrepancy	Tie point max. vertical discrepany
		Horizontal	Vertical	Average sqaure errors	Max. values	Average square errors	Max. values		
				m	m	m	m	m	m
I	391	27	102	0.013	0.02	0.018	0.05	1.575	1.431
II	298	27	129	0.013	0.04	0.022	0.05	1.927	1.565
III	233	34	112	0.019	0.05	0.028	0.08	2.311	3.525
All Blocks	860	73	284	0.017	0.036	0.024	0.071	2.718	3.525

C. Stereo plotting

(1) Preparations and Equipment Employed

The preparatory work performed prior to the plotting involved collection of necessary data including the results of control point survey, field surveys, results of aerial triangulation, the Specifications and other data obtained locally in Kenya, and computations by computer for conversion of longitudes and latitudes to the UTM cooridnates and for neat line lengths and diagonal line lengths.

For the base material for plotting, micro-traced NSW #500 was used. On this polyester base were plotted corners of neat lines, control points and their eccentric points, pass points, tie points and coordinate lines at 5 m interval.

The equipment used included Planimat, Planicat, Autograph A10 in addition to the coordinate plotting machine.

(2) Orientation

Orientation was performed by aerial triangulation on

the basis of the pass points, tie points, signalized points, pricked points and pricked bench marks as marked on the positive films. The results of absolute orientation were entered in the orientation records. Tolerances for absolute orientation were less than 0.5 mm on map for horizontal locations and less than 5 m for elevations. The results for each model fell in the range of these tolerances.

(3) Measurement of Elevation Points

The elevation points as well as control points and bench marks were spaced about 5 cm apart on map. They were located mainly at the tops of elevations, valleys, branching points of roads, etc. After performing two-time independent measurements in the unit of meter by the plotting machine, the measured values were recorded on the overlay and their mean values were applied as determined values.

(4) Detail Plotting

Using the field survey photos as reference, roads, rivers, transmission lines, buildings, vegetation, other planimetric features requiring representation

and lastly contour lines, in that order, were delineated in colors according to the Specifications.

The work for this year accomplished the mapping of 15 map sheets nominal (15 actual), specifically, 176-1, 176-2, 176-3, 176-4, 177-1, 177-2, 177-3, 177-4, 184-2, 184-3, 184-4, 185-1, 185-2 and 185-3 covering the western part of the survey area. Contour lines were mostly at 20 m intervals while some 10 m lines were also entered as necessary. For where the interpretations by the plotting machine differed from the field survey photos, they were marked with a colored pencil on the reverse sides of the manuscpripts so that they can be chekced in the supplementary field completion

(5) Connection

Connections were made with the existing maps for the areas adjoining the survey area which were loaned from the Survey of Kenya in the film base. Since the existing maps covering the southern part had contour lines in the unit of feet, the connections could not be made. In the existing maps for the northern part provided in the form of the restitution manuscripts was found one location where contour lines did not match.

For the western part, there was no problem except for secular changes and this part was generally well covered. The connections between the map.sheets covering the survey area were made directly without making copies.

(6) Final Results

Checking was performed for plotted points, neat line lengths, absolute orientation errors in the orientation records, discrepancies of measured values for elevation points and their mean values, control points, bench marks, elevation points, quality of contour lines, verifications with the field survey photos, connections, etc.

The final results of this work phase were:

a. Restitution Manuscripts.
b. Control Point Data Maps.
c. Orientation Records.