NUMBER 30
OCCASIONAL PAPERS
ENGINEER SCHOOL
UNITED STATES ARMY

THE RECONNAISSANCE MAP OF CUBA

1906-7

By

First Lieutenant JULIAN L. SCHLEY
Corps of Engineers

WASHINGTON BARRACKS, D. C.
PRESS OF THE ENGINEER SCHOOL
1908

NUMBER 30
OCCASIONAL PAPERS
U.S. ENGINEER SCHOOL
UNITED STATES ARMY

THE RECONNAISSANCE MAP OF CUBA

1906-7

By

First Lieutenant JULIAN L. SCHLEY
Corps of Engineers

WASHINGTON BARRACKS, D. C.
PRESS OF THE ENGINEER SCHOOL
1908

THE RECONNAISSANCE MAP OF CUBA, 1906-7.

[NOTE.—The information contained herein which relates to the work of the central office was obtained while assistant to Major W. C. Langfitt, Corps of Engineers, Chief Engineer of the Army of Cuban Pacification.

The remarks concerning the fieldwork are the results of personal experience and of conversation with officers of Engineers who were in charge of reconnaissance detachments in the field.]

Soon after the arrival in Cuba of the Army of Cuban Pacification in October, 1906, the Commanding General directed that the existing "Reconnaissance Map of the Island of Cuba" be revised under the direction of the Chief Engineer, Major W. C. Langfitt, Corps of Engineers. The planning and organization of the entire work, the carrying to completion of the fieldwork (except some subsequent corrections) and of a large part of the drafting were completed before his relief, in June, 1907.

PRELIMINARY WORK.

The existing reconnaissance map had been prepared under the direction of then Majors W. M. Black and H. F. Hodges, Corps of Engineers, in 1902–3. It is a compilation of charts, surveys, and geographical maps, all mainly from Spanish sources, and reconnaissances of limited extent by United States troops. The scale is 1:250,000. (This map will be hereafter referred to in this paper as the *old map.*)

The old map was divided into quadrilaterals each one-half degree of longitude by one-half degree of latitude. These quadrilaterals were enlarged by pantograph to the scale of 1:62,500 on vellum paper. From each of these enlargements a brown negative was made on brown process paper. From each of these were made two or more blue prints with blue lines on white ground. At least one of each of these sets of blue prints was cut into thirty-five quadrilaterals and mounted on cardboard cut to fit. (These will be referred to hereafter as *cards.* The uncut blue prints will be referred to as *uncut sheets.* The maps submitted by the field parties to the central office will be referred to as *field sheets.*)

This work of enlargement and preparation of cards and uncut sheets was done by civilian draftsmen in the office of the Chief Engineer, with the exception of a few sheets by the Second Battalion of Engineers.

For purposes of general supervision and co-ordination of work, *general co-ordinating reconnaissance officers* were appointed by the Chief Engineer.

To these officers were assigned portions of the island, in some cases comprising several quadrilaterals. It was the duty of these officers to assign the work to the field parties working in their respective territories, to see that their work did not overlap unnecessarily, that they connected satisfactorily, and to standardize the work.

To each general co-ordinating reconnaissance officer were sent one or more uncut sheets and one or more sets of cards of each quadrilateral in his territory, with the following "Instructions for Reconnaissance Parties:"

Instructions for Reconnaissance Parties.

1. It is desired to obtain as much information as possible which will be permanently of value from a military standpoint of the portion of the island surrounding your station assigned your command for mapping.

2. The accuracy of the data finally sent in is of much greater importance than the quantity, but no unnecessary delay must occur.

3. The work should be done by officers, assisted by such enlisted men as are competent to perform this duty.

4. You will be furnished two or more copies of a map covering an area in the vicinity of your assigned station.

5. This map will be on a scale of 1:62,500, which is so nearly 1 inch to 1 mile that all your plotting may be done on this scale of 1 inch = 1 mile.

6. One copy of the map (previously prepared in this office) will be found to consist of sections of convenient size for the pocket.

7. The method of procedure will be as follows: Each party will take into the field one or more of the cardboard sections and will actually proceed over all roads, railways, public and private (plantation) and important trails. Lines of communication not shown on the map will be followed and drawn in. Lines shown on the map, but no longer existing, will be crossed off over extent not existing and marked "Out."

a. As the party proceeds it will correct when necessary any inaccuracies or omissions on the map, showing in their correct locations all roads, buildings, bridges, important culverts, fords, telegraph or telephone lines, fortifications and other objects of military importance.

b. Contouring will not be attempted on flat or ordinary rolling country, but hill forms, prominent ridges and accessible mountains will be shown by contours, 50 feet intervals, the datum point of contours being noted.

c. The length and character of bridges will be noted on the map.

d. Swamps, woods, cultivated land, etc., will be shown by conventional signs. Villages and towns will be shown in true plan with their names correctly spelled. (See paragraph h.)

e. At night the day's work will be transferred in ink to the large map.

f. If parties are to be out more than one day and there is no copy of the large map for them to carry, they will take with them ink and drawing materials and go over at night with ink each day's work on the cards; as soon as possible thereafter it will be transferred to the large maps. This is *important*, for if notes and hasty field sketching be not transferred at once it will be found, after a short lapse of time, that even the man who made them can not interpret them intelligently. When parties

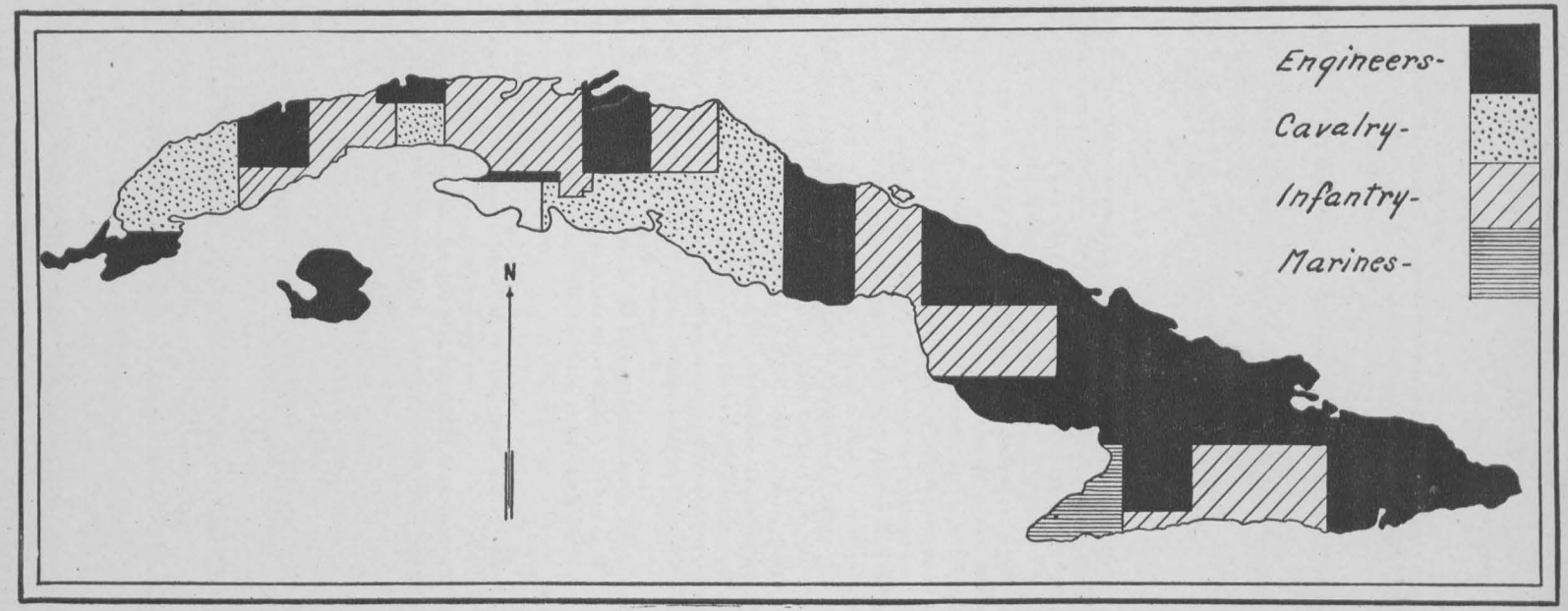


Fig. 1.

are working simultaneously on adjacent areas, care must be taken that when streams, roads, etc., cross the dividing line, the locations check as found by the two parties. This should be carefully done before sending in the maps. If a sheet is sent in before the adjacent sheet is reconnoitered, the roads, streams, etc., should be carried well across the boundary between the two sheets to some well-defined point which can be easily identified by a later party working on this adjacent sheet. Such verbal description as may be necessary for aid in identification of the point should be attached to sheet sent in.

g. Hard pencils will be used for fieldwork on the cards. When gone over on cards or transferred, red will be used for contours, blue for streams, black for roads, buildings, etc.

h. In addition to the above, a notebook will be kept by each party, in which will appear:

h a. Information as to the roads and trails, width, surfacing (metal or earth), the grades, noting especially the length and slope of very steep grades and class of transportation for which road is available.

h b. Sketches to convenient scale of all towns and villages with locations of all public and important buildings, railways, stations, water tanks, yards, tunnels, etc.

h c. The notes will show the number of houses, stores, water supply character, quantity and quality, and any other information of military value.

h d. Notes as to material and animal resources of the country traversed.

h e. Sketches and notes as to important bridges, character, length, width, material, condition.

h f. Notes as to streams, depth, width, quantity and quality of water, fords, and whether or not there is evidence of considerable fluctuation in the water level.

h g. Good camp sites and capacity should be noted, fuel, grass, water supply, etc.

h h. Location, description and condition of existing fortifications and blockhouses.

h i. Plantation or private railroads: Name, address of superintendent, length, gauge, weight of rails used, number and capacity of locomotives, number, kind and capacity of cars, and such other data, such as notes as to bridges, tunnels, coaling stations, as might prove of value.

8. Distances will be determined by pacing, by the ascertained rate of the walk of the horse and time intervals, by odometer, cyclometer.

Directions by compass, noting the compass variations if possible.

Distances to prominent objects off the line of trail will be estimated, checked by compass bearings.

9. Advantage should be taken of all existing sources of information, such as local maps, known elevations along railways, etc.

10. Large sheets should be sent in to this office as soon as completed. The mounted sections should be sent in as soon as work on them is completed and transferred to the larger sheets.

Office, Chief Engineer, Army of Cuban Pacification,
Marianao, Havana, Cuba, October, 1906.

FIELDWORK.

The fieldwork was done by troops of Engineers, Cavalry, Infantry, and Marines. The portions of the island covered by the fieldwork of the several branches of the service are shown in Fig. 1.

In general, the territory adjacent to a post was assigned to the troops stationed at that post. The portions of the island distant from posts garrisoned by troops were assigned to the Engineers.

The composition of the field parties varied considerably, and the instruments used varied according to the preference of the parties and the availability of instruments. The instruments most generally preferred were the prismatic compass or the box compass, Abbot's celluloid protractor, aneroid barometer, notebook, and watch or football timer. By some the sketching case was used. Distances were plotted by time or pace scales. With few exceptions the fieldwork was done mounted. A sufficient number of barometers was not available. Clinometers were used by some parties as a substitute, but many parties were without either, making it necessary to sketch hill forms entirely by eye.

The old map proved to be so incorrect in many parts, especially in those parts compiled from Spanish maps, that the cards, and in many cases the uncut sheets, could not be used in the manner contemplated. Thus the task in those parts of the island became one of making a new reconnaissance map. When this fact was reported to the office of the Chief Engineer, instructions were issued to accept the portions of the main railroads and the large towns as shown on the uncut sheets as a system of control. The field parties in those parts of the island proceeded to make road sketches of all roads and trails and to fit them together and plot them on the assumed points so as to make complete and connected road maps of the sections assigned them. The country between the roads was filled in from the best information obtainable on the ground. Even where the old map was greatly in error, it proved valuable in furnishing names of places and rivers.

The two-man method of reconnaissance with prismatic compass, Abbot's protractor, and notebook proved to be by far the most satisfactory method. The sketcher handles the notebook, does the plotting, puts in the details, and directs the assistant sketcher. The assistant takes the necessary observations for azimuth and distance.

Where it was possible to use the cards, the procedure was simple. By placing a box compass on the card so that the sides of the card and the sides of the box were parallel, the sketcher could travel with the card continuously oriented in front of him. With the aid of his scale he could make minor corrections and could add details as he traversed the roads.

As soon as these maps were finished they were submitted with the plans of towns and notes to the chief engineer officer.

PREPARATION OF POLYCONIC PROJECTIONS AND PLOTTING OF EXISTING INSTRUMENTAL SURVEYS.

While the fieldwork was being done the base of the finished map was being prepared in the Chief Engineer's office.

The degree and half degree meridians of longitude and circles of latitude covering the island were plotted on a polyconic projection to the scale of 1:62,500. The quadrilaterals thus formed correspond to those of the old map—that is, to the uncut sheets. United States Coast and Geodetic Survey Tables for a Polyconic Projection of Maps, second edition, was used in plotting this projection. The plotting was done on rolls of detail paper, each roll receiving two circles of latitude, and thus containing one east and west row of quadrilaterals throughout the length of the island. The intersecting points of the meridians and circles had to be plotted on one side of the center line only, because these points pricked through to the back of the roll gave the symmetrically placed points on the opposite side of the central line. (These rolls will hereafter be referred to as *projection rolls.*)

All existing charts of the Hydrographic Office, Navy Department, of the coast of the island were then transferred to the projection rolls to the proper scale. The large scale charts were used first, and the coast line between these was filled in from a small scale chart of the entire island. Such coast lights as were not given by these charts were plotted from co-ordinates given in Servicio de Faros, Departmento de Obras Publicas. By sextant observations of single altitudes of stars with chronometers and telegraphic signals from the Government observatory at Havana for longitude, and by sextant observations on Polaris for latitude, the positions of four of the principal towns along the east and west railroad line through the island were determined by two officers and a detachment of enlisted men of the Second Battalion of Engineers. Instrumental surveys of the two trochas across the island were made by two officers and detachments of the same organization. All these were plotted on the projection rolls. All railroads of which existing surveys were obtainable were similarly placed on the projection rolls, as were also such instrumental surveys in the office of the Obras Publicas as proved to be of value. This formed the base of the new map.

DRAFTING OF THE FINAL SHEETS.

This work was done in the office of the Chief Engineer.

Tracing linen was cut into sheets of sufficient size for one quadrilateral with a margin of 18 inches on the right. (These sheets will hereafter

be referred to as *final sheets.*) Each was given a number corresponding to the quadrilaterals on the projection rolls. On these final sheets were then traced from the projection rolls the meridians of longitude and parallels of latitude enclosing the corresponding quadrilateral and everything contained therein.

These final sheets were then ready to receive the details as given by the field sheets. The old map being a lithograph, the enlargements from it and the blue prints from the enlargements to a still greater extent were in error as to scale. This, and the fact that the fieldwork was done with so little accurate control, made it impossible to trace the field sheets. Each road and stream was consequently adjusted so as to fit the parts of the final sheets traced from the projection rolls. In doing this, care was taken to first adjust those roads of the best class which connected most directly the well defined and positively identified points taken from the projection rolls. The road and stream crossings of these roads were put in at the same time. Next were adjusted the most direct connecting roads, and, finally, the winding roads and unimportant trails. By this means the inaccuracies of the field sheets were so thoroughly distributed that, if the final sheet and its field sheet were placed side by side, the one would appear to be a tracing of the other.

The method of adjusting a road is that in common use, which is as follows: Suppose the distance between the extremities of the road on the field sheet to be less than that on the final sheet as traced from the projection rolls. The latter is placed over the former so that the same amount overlaps at each end and so that a straight line will pass through the four extremities. A very short section of the road halfway between the extremities is traced. Each half of the road is then treated as was the entire road, the middle point and one end being made to overlap an equal amount, and a short section of the road at the middle of the half is traced. This method is continued, the road being further subdivided, until the short sections traced form a continuous road. Adjacent features are traced with the short sections.

As far as it was possible to do so, the conventional signs and abbreviations adopted by the War Department were used. In a legend at the top of the margin at the right were placed those conventional signs and abbreviations whose exact meaning might not be known to all. (See map opposite page 6.) The objects aimed at in adopting these conventional signs, their size, and their spacing were (1), that the information which the map furnished would be conspicuous in proportion to its military importance; (2) that the map would be "open"—that is, that the symbols were well spaced so as to prevent confusion, to facilitate catching names quickly, and

RECONNAISSANCE MAP OF CUBA 1906-7

Sheet No. 54

-LEGEND-

- Public Railroad.
- Private Railroad.
- Metaled Road.
- Road passable for loaded escort wagons.
- Road passable for bull carts
- Horse Trail.
- Town with streets.
- House.
- Group of houses.
- Ruins.
- Block House
- Church.
- Sugar mill in working condition.
- Sugar mill ruined.
- Point known by name. No houses.
- Telegraph line.
- Well.
- Windmill.
- Lighthouse.
- Thick Woods.
- Thin Woods.
- Open Country
- Brush.
- Palms.
- Sugar Cane.
- Tobacco.
- Other Cultivation.

-ABBREVIATIONS-

Ar.	Arch.	I.	Iron or Steel
A.	Arroyo Small Stream.	K.P.	King Post.
B.S.	Blacksmith Shop	N.F.	Not Fordable
B.	Brick.	Pta.	Punta. Point.
Cem.	Cemetery	R.	Rio River
Con.	Concrete	Sta.	Santa. Saint.
Cul.	Culvert.	S.H.	School House.
D.S.	Drug Store	S.	Station, Railroad
Embo.	Embarcadero. Landing Place.	St.	Stone.
Ens^a	Ensenada. Cove.	S.M.	Saw Mill
Est^o	Estuario. Estuary	Tres.	Trestle.
F.	Fordable.	Tr.	Truss.
G.S.	General Store	W.	Wooden

CONTOUR INTERVAL 100 FEET.

Scale of Kilometers

1 ½ 0 1 2 3 4 5 6 7 8 9

Scale of Statute Miles

1 ½ 0 1 2 3 4 5 6

-NOTES-

Communications

All roads show signs of being very muddy in wet weather. There are few bridges; at the fords the banks are generally steep and most of the streams are unfordable at high water. The Bayamo ORQUETA-GUISA-CALABAZAL road is fairly good as far as Güisa; beyond this place it is rough and rocky. The GUISA-STA. BARARA road is rough. The BAYAMO-DATIL-BUERCITO road is very bad in places; just beyond Mabay are two hills with steep slopes. The PASO REAL-BABINEY road is rough.

Towns

BABINEY. Population 350; 60 houses; 6 stores. Very good water from 12 wells.
BARRANCAS. Population 75; 14 houses and 25 scattered within half mile. Plenty of good water from Rio Buey.
BAYAMO. See plan below.
BUERCITO. Population 200; 24 houses; 5 stores. Plenty of good water from Rio Buey.
CALAMBROSIA. Scattered settlement. Population 200; 40 houses; 2 stores. Plenty of good water.
CANABACOA. Scattered settlement. Population 200; 1 store. Good water from Rio Canabacoa.
CASIBOCOA. Population 100; 20 houses; 1 store. Plenty of good water from Rio Bayamo.
GUISA. Population 350; 95 houses; 4 stores; 1 butcher shop. Good water from wells and small spring.
HUMILLADERO. Scattered settlement. Population 600; 100 houses; 5 stores. Good water from wells in bed of Rio Batatuaba.
SANTA RITA. See plan below.
SAN FERNANDO. Population 100; 20 houses; 1 store. Water from river is poor but plentiful.
SOFIA. Population 500; 50 houses. Plenty of good water pumped from Rio Buey.
VEGUITAS. See plan below.
YARA. See plan below.
ZARZAL. Population 100; 25 houses; 7 stores. Plenty of good water from Rio Yara.

Streams

ARROYO BABATUABA. Averages 14 feet wide; ½ foot deep; banks 8 feet high and sloping; bottom hard; water good. Between La Sal and Escondido stream bed is very small. At places may be entirely dry in dry season.

RIO BAJA. Dry at places during dry season. At ford east of Finca Dueña banks 15 feet high and sloping.

RIO BAYAMO. Bottom gravel; water good; 3 feet deep; banks 30 to 40 feet high, and steep except at fords. Above Datil it averages 50 feet wide; banks 30 feet high. Fords at Bayamo, Sta. Ana, and Los Mangas are from 90 to 225 feet wide. Evidence of much fluctuation.

RIO BUEY. Bottom hard; water good; averages 1 ½ feet deep. Above San Antonio fords are 75 to 225 feet wide and rough; banks steep. At Limonar and Canuco fords are 30 feet wide, banks about 30 feet high. Ford near Palmarita has low banks.

RIO CANABACOA. A small stream; bottom sandy; water good.

RIO CAUTILLO. Bottom gravel; water good; 15 to 50 feet wide; 2 feet deep; banks 10 to 20 feet high and generally sloping.

RIO GUAJACABO. Water bad; 20 to 50 feet wide; 2 feet deep; banks generally sloping. Ford at San Fernando has sandy bottom. Fords below this point have muddy bottoms. At Cespedes the banks are very steep.

RIO GUISA. Bottom rocky; water good; 15 to 60 feet wide; 1 foot deep; banks sloping and generally low.

RIO JICOTEA. Bottom hard; water good; averages 17 feet wide; 1 foot deep; banks 6 feet high at fords at Sta. Rita and El Palo, 10 to 20 fet high at other fords.

RIO JIGUANI. Bottom very muddy; water good; 20 feet wide; 2 feet deep.

ARROYO MABAY. Bottom hard; water good; 15 to 40 feet wide; banks 12 to 30 feet high, steep at fords above Mabay, sloping at other fords. Dry in places during dry season.

RIO YAO. Bottom rocky; water good; banks generally low. Fords at and above Cayo Redondo 50 to 100 feet wide; 1 foot deep; banks sloping. At other fords 100 to 150 feet wide; 2 feet deep; banks steep. At ford at Longostura banks 15 and 30 feet high.

RIO YARA. Bottom sandy and rocky; water good; at fords 50 to 150 feet wide; 1½ feet deep; banks 8 feet high and generally sloping.

Resoures

This is a cattle raising section. Scattered through the open, flat country are approximately 14,000 cattle and 200 bull carts. There is excellent grazing but the grass is much withered during the latter part of the dry season.

Sugar Mills

INGENIO SOFIA. A small mill in bad repair. Accommodations for 500 men. Water pumped from river.

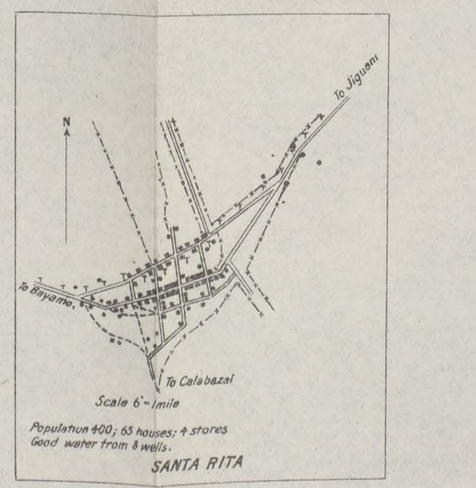
Camp Sites

During the dry season a camp site can be found anywhere in the flat section, where there is water. The wells at the houses generally furnish very good water but the amount is limited. During very dry weather water is very scarce. There is no grass in the mountains. Along any one of the following rivers there are plenty of grass and water: Bayamo, Buey, Cautillo, Jicotea, Yao, Yara. In very wet weather these sites would be muddy. This territory is healthy except perhaps the northwest corner.

Miscellaneous.

There are many barbed wire fences. The only blacksmith shops which shoe animals are at Bayamo and Sta. Rita.

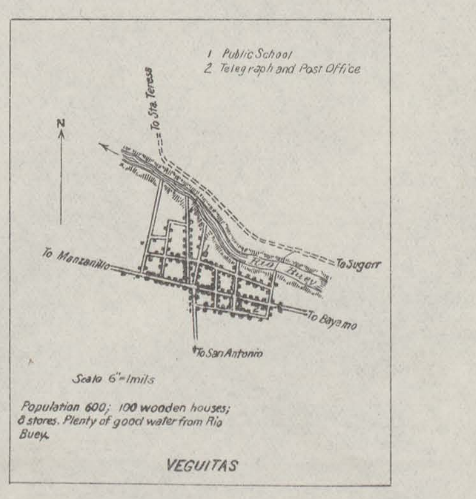
All field work was done in dry season



Scale 6" = 1 mile

Population 400; 65 houses; 4 stores
Good water from 8 wells.

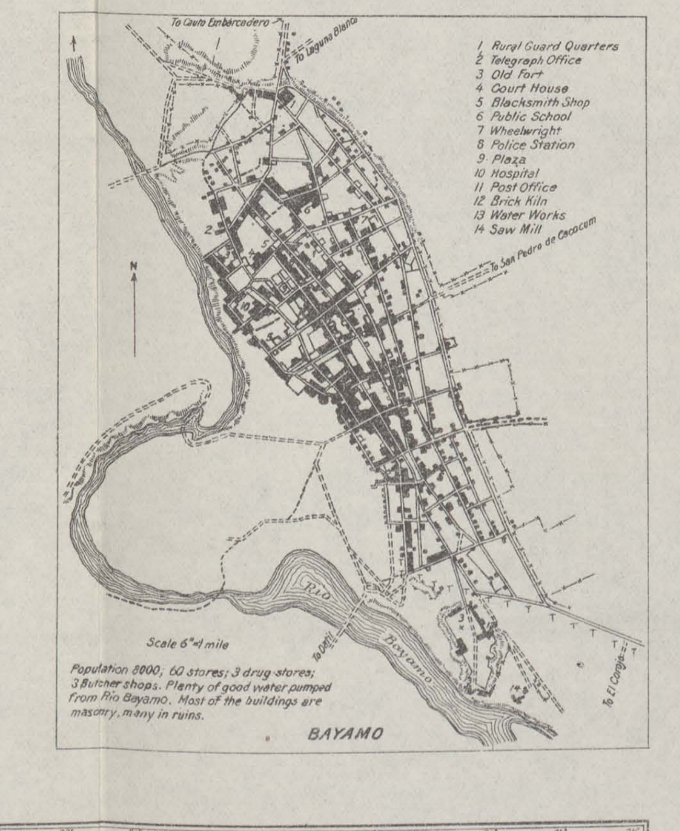
SANTA RITA



Scale 6" = 1 mils

Population 600; 100 wooden houses; 8 stores. Plenty of good water from Rio Buey.

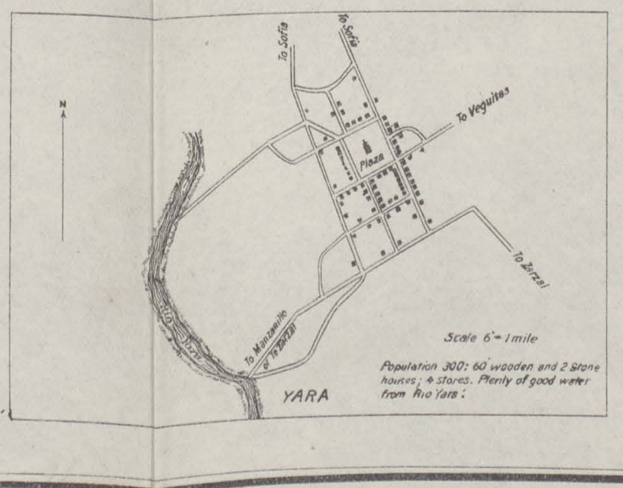
VEGUITAS



Scale 6" = 1 mile

Population 8000; 60 stores; 3 drug stores; 3 Butcher shops. Plenty of good water pumped from Rio Bayamo. Most of the buildings are masonry, many in ruins.

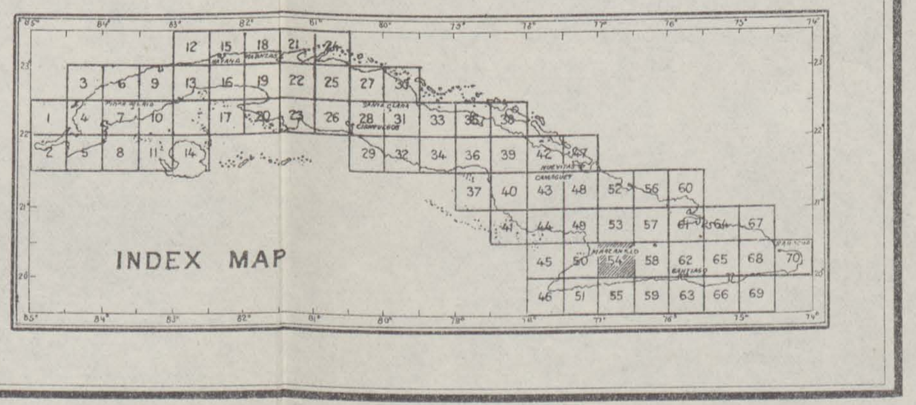
BAYAMO



Scale 6" = 1 mile

Population 300; 60 wooden and 2 Stone houses; 4 stores. Plenty of good water from Rio Yara.

YARA



THE NORRIS PETERS CO., WASHINGTON, D. C.

Office of the Chief Engineer, Army of Cuban Pacification
Completed October 1907

to
mi
ter
de
mi
Th
arr
the

the
und
of F
A
bott

I

In
step
case
the c
know
woul
was f
spere
enoug
Hava
was w
many
Th
Chief
fitting
prising
more c
skelete
of mor
system

The
or appr

to render legible additions or notes which might be made while using the map in the field; (3) that the symbols should suggest what they are intended to express; (4) that the map could be reduced one-half in scale, if desired.

The object of the notes was to furnish some of the information of military importance which could not be placed on a map of this scale. The notes submitted by the reconnaissance parties were condensed and arranged under subheads in the margin on the right immediately under the legend. (See map opposite page 6.)

The plans of the large towns in each quadrilateral were transferred to the scale of 6 inches to the mile and grouped in the margin on the right under the notes. An exception was made to this in the case of the city of Havana, which was placed on a separate sheet.

A key map, 8 inches by 3 inches, was placed on each final sheet in the bottom of the margin on the right.

DIFFICULTIES AND SUGGESTIONS.

Preliminary Work.

In making a map of as large a territory as the island of Cuba, the first step should be to obtain a system of control. This was not done in this case for the following reasons: (a) it was imperative that information of the country should be obtained as soon as possible, because it was not known at what time it might be immediately needed; considerable time would have been required to obtain an accurate system of control, and it was the opinion of the Commanding General that this time could not be spared; (b) at the outset it was thought that the old map was accurate enough to form a satisfactory control. This map was tested around Havana and was found to be satisfactory. It was not until the fieldwork was well under way that it was realized that the old map was inaccurate in many parts of the island.

The control, previously explained, which was used in the office of the Chief Engineer was a makeshift substitute. It was really a control for fitting the quadrilaterals together. This substitute, however, gave surprisingly satisfactory results. If the work could have been approached more deliberately, without such haste to obtain information in detail, the skeleton placed on the projection rolls, added to by astronomical locations of more points and by rough traverses, would have made a satisfactory system of control for the field parties.

Fieldwork.

The task assigned to a field party was, in many cases, one quadrilateral, or approximately 900 square miles. Difficulty was experienced in making

a reconnaissance map of territory this large without some accurate system of field control. In those parts of the island in which the old map showed correctly the large towns and important roads these could be used as a system of control. But such places were not numerous. In the other parts of the island, after trying several schemes, the following organization and procedure were found to give the best results:

ORGANIZATION OF DETACHMENT.

1 officer, mounted.
4 sketchers, mounted.
4 assistant sketchers, mounted.
4 packers (2 of whom are regular civilian packers), mounted.
4 assistant packers (who can also do simple cooking), mounted.
12 pack mules.

BASE CAMP GUARD.

1 non-commissioned officer, mounted.
2 cooks.
4 privates.
1 private, Hospital Corps.

Total,
1 officer.
1 non-commissioned officer.
23 men.
18 mounts.
12 pack animals.

TENTAGE FOR BASE CAMP.

1 "A" tent for officer and for drafting work.
3 conical tents for the men.
1 "A" tent for rations.
1 "A" tent for grain.
1 fly for kitchen.

In addition, each man takes his shelter half and poncho for use away from the base camp.

For evident reasons it is imperative that every member of the detachment be steady and trustworthy.

The sketchers will, in many cases, be non-commissioned officers. At least two of them should be very experienced in road sketching. If possible, the assistant sketchers should be picked by the sketchers themselves.

Two of the packers should be regular civilian packers, because it is not believed that without them can the pack animals be kept in good condition under trying work. And in case the detachment is from a dismounted organization, general supervision of the entire stock will necessarily fall on these men. The other two packers should be well trained in packing and must have had some experience with animals. The

assistant packers should know enough about packing to throw the hitch from one side. They should be able to do simple cooking for four men.

The non-commissioned officer should be thoroughly reliable, so that the officer can leave the base camp in his charge.

The Hospital Corps private should be well instructed in the application of simple remedies. Military posts were so numerous throughout Cuba that a man taken seriously sick could be sent to the nearest post for medical attention.

Unless veterinarians and blacksmiths are available in the territory, some member of the detachment must be familiar with the common diseases of horses and their remedies and must be able to shoe animals.

The officer and the sketchers are armed with the revolver; all other members of the detachment are armed with the rifle (except the Hospital Corps private and the civilian packers).

The trips away from the base camp are often very fatiguing; consequently every comfort in the base camp adds to the rest received between trips.

It was not found advantageous to take with the detachment more than one month's rations and forage. If more than this was required, it was shipped by a quartermaster upon application.

The base camp should fulfil as nearly as possible the following conditions: it should be in a sanitary location, should be near a railroad station or point of entry of a ship line, and should be near the center of the territory to be mapped.

From the base camp sketching parties are sent out composed of the following:

1 sketcher, mounted.
1 assistant sketcher, mounted.
1 packer, mounted.
1 assistant packer, mounted.
3 pack animals.

A party so composed can remain away from the base camp for ten days. Grain alone is taken for the animals, forage being purchased or grazing resorted to on the road. The detachment is capable of furnishing four such parties, leaving the camp guard at the base camp.

For convenience, suppose the sketching parties to be numbered 1, 2, 3, and 4, and the sketchers of parties Nos. 1 and 2 to be experienced road sketchers. The first step is to have parties Nos. 1 and 2 each make a large loop, each beginning and ending at the base camp. The loops should also cross each other at some point, and they should reach near the boundaries of the territories to be mapped. In making these loops a road sketch is

made of the route, showing all details, especially crossroads and information which will make them easily recognizable to other parties. An obscure trail should not form part of a loop, nor should a road of steep grades or through swamp. Great care should be taken in the distances and directions of the courses, but the sketcher should not attempt to force his work to close. When the parties return to the base camp, the officer

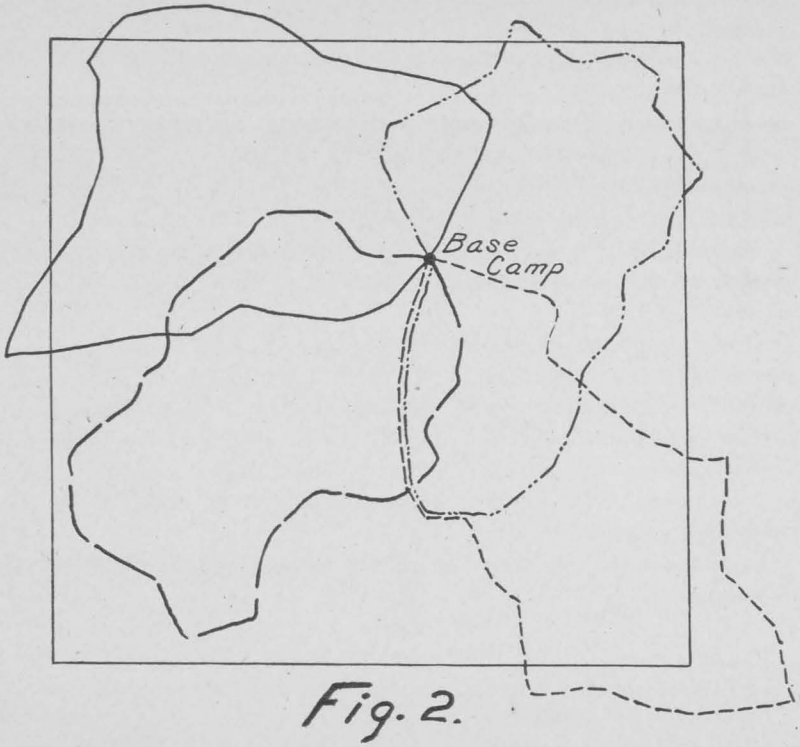


Fig. 2.

adjusts these loops so that they will close on the base camp and on their point or points of crossing, throwing the error of closure of each throughout its entire length. These and as many other loops as seem necessary form the control for the map. In Fig. 2 may be seen four such loops. While parties Nos. 1 and 2 are making these loops, parties Nos. 3 and 4 are mapping the territory in the vicinity of the base camp.

The loops having been adjusted and plotted, four of the sections into which the territory is thus divided are assigned to the four parties. Each sketcher is furnished a tracing of the portions of the control loops surrounding the section assigned to his party, and he is instructed to fill in

the details of that section. After proceeding there with his party, he starts at a crossroad and makes a road sketch through his territory to another crossing of the control loops. If his sketch does not fit between the two crossings, he adjusts it so that it will fit and inks it in on his tracing. He continues in this manner until all the roads and trails in that section are covered, when he returns with his party to the base camp. While the party is resting, the officer transfers the work to his map and compiles whatever information is desired. By continuing this method the territory is completely mapped. When possible, the parties in the field are visited by the officer.

This method is also well adapted to contouring with the aneroid barometer. A barometer is carried by the parties making the control loops, and readings are taken at easily recognizable points. Upon return, these readings are corrected by periodical readings on a barometer kept at the base camp. Using these corrected readings as bench marks, the parties which fill in the sections are able, with the aid of barometers, to do very satisfactory contouring.

By this method, and with a detachment as here described, 900 square miles of average Cuban territory can be carefully mapped in from five to six weeks. If the duties of quartermaster, including the property and money papers, are to be considered, this time must be doubled or the detachment must have an additional officer.

The above plan is believed to be well adapted to the making of a reconnaissance map of a large territory without a system of accurate control. The method with cards, as originally planned, is an excellent one for making minor corrections and filling in details on a map which is, in the main, an accurate one.

A large part of the island of Cuba, especially the fertile part, is divided into tracts of land called "fincas." Some of these are very large, covering many square miles, and all of them are named. It being impracticable to show the boundaries of these fincas on the map, difficulty was experienced in determining the position which their names should occupy. As a rule, the names were placed near the store or the important buildings of the finca. The same difficulty was found with named districts and with political divisions, such as "barrios," which usually have the same names as their principal municipalities.

Many streams were difficult to follow, because they would disappear and continue as subterranean streams for several miles before reappearing. And many streams which in the rainy season carried considerable water were dry in the dry season and could then be easily passed unnoticed.

The season of the year affected greatly the progress of the fieldwork, the best time being the first half of the dry season. The roads of Cuba are, as a rule, extremely bad; consequently, during the rainy season, it

was almost impossible to go any distance from the few macadam roads which exist. During the last of the dry season most of the small streams and many of the wells throughout the country had become dry, and the supply of water for the stock became a serious problem.

Those detachments which remained in the field for a month or longer experienced great difficulty in keeping their animals in good condition. American horses failed rapidly, lost weight, and became very susceptible to sickness. On account of the many swamp roads and mountain trails traversed their feet suffered considerably. It was often found impossible to work the horses more than four days in a week. Blowflies were everywhere present in great numbers, and they never failed to find the slightest break in an animal's skin. The maggots which they produced could be killed with creolin, but it was difficult to keep the wound from being again infected before it was sufficiently healed not to attract these flies. Mules stood the work much better than horses. They proved very satisfactory as mounts, some of the sketchers preferring them to horses. The native pack (seron), when handled by natives on Cuban animals, was fully as satisfactory as the regulation pack and pack mules.

One of the detachments remained in the field continuously for three months. Its experience was that the time scales originally made for the mounts were of no value after a few days' work. The animals' time of traveling a mile changed considerably and, in many cases, irregularly during the first month. During this time it was necessary to change the pairing of the mounts of the sketchers and assistants so as to keep equally rated animals working together. For this reason the animals were periodically timed over a measured distance and new scales made for them. This detachment found it impossible to keep American animals in good shape under this trying work by feeding oats and green forage. Hay was finally procured and substituted for the green forage while in the base camp.

The general co-ordinating reconnaissance officers play a very important part in the mapping of a large territory under such a system as that used on this map. It is in their power to save the central office an immense amount of work or to cause it endless trouble.

Preparation of Polyconic Projections and Plotting of Existing Instrumental Surveys.

The coast chart which furnished the coast line between the harbor charts was of small scale and had to be enlarged about thirteen times. This gave a coast line only approximately correct in detail.

Great difficulty was experienced in using some of the railroad maps. Some of them showed no meridian lines, and the meridian lines on some of them were conflicting. This difficulty was overcome by locating astro-

nomically the principal railroad towns, especially the termini of systems. A few of the railroad surveys were very inaccurate, some being primary location surveys and some being mere reconnaissances. Those which were very inaccurate were easily recognizable when compared with the field sheets after the latter had been turned in. In placing such railroads on the final sheets due weight was given to the field sheets.

Drafting of the Final Sheets.

In many cases the points assumed as correct by the reconnaissance detachments were incorrect. In some of these cases the work had to be warped considerably in tracing. These caused some inaccuracies in details. If these inaccuracies seemed to be of importance, a party was sent into the field to correct the work, having been supplied with a tracing showing the correct positions of the known points taken from the projection rolls.

In some cases it was not possible to connect in the office two quadrilaterals made under the supervision of different co-ordinating reconnaissance officers. This was due to accumulative errors in one or both maps or to a strip of unmapped territory between the two sheets. In such cases, parties furnished with copies of the adjacent edges of the two quadrilaterals were sent out to rectify the discrepancies or to map the intervening territory. This trouble would have been avoided if every road had been reconnoitered well beyond the boundaries of the allotted territory to some easily recognizable feature, as the instructions directed.

On account of the approximate method used in contouring, the contours of the different reconnaissance detachments in many cases could not be connected. This is unavoidable in this class of work.

The coast line as obtained from the large scale harbor charts was accepted. Those parts of the coast line taken from the small scale chart of the island were changed so as to give weight to the coast as found by the reconnaissance detachments only in case these detachments were able to reach the coast by good roads. On account of the swamps which form a large part of the coast of the island, in many districts the detachments were unable to reach the coast.

In the work submitted by several of the detachments there was a lack of uniformity in the symbols and abbreviations used, in the amount of detail attempted, and in the division of the information between the map and the notes. This was eliminated as far as possible in the final sheets by transferring information from the notes to the map and vice versa, and by using throughout the symbols adopted.

As a rule, in making a map such as this, instructions concerning the amount of information and detail to be sought, and concerning symbols and abbreviations to be used, can not be too complete; and, if time does not prevent, a general knowledge of the country should be obtained before these instructions are issued.