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Note on Map of South Peru and North Bolivia

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subsequent to their construction. But maize will not grow in the Andes much beyond 10,000 feet, and Tiahuanako is 12,500 feet or more; and some of the other ruins which I examined, with extensive ancient villages surrounding them, are at 16,000 in some cases. So that the elevation from a supposed original corn-growing level would have had to be very considerable. Further, there would seem to be a point against the theory, in the matter of the snow-cap. There are strong indications that this has been, and is, retiring. I have crossed the Andes repeatedly at points between latitudes 9° and 21° S., and noted this fact. If the Andes had risen so recently, it might be supposed that the edge of the snow-line would be found lower rather than higher, or rather, the diminution would have been balanced by the raising, and the line remained constant. The conclusion that I, personally, have reached, is that there have been changes of climate, rather than elevation, since the time of the prehistoric stone structures, and of their probable Asiatic originators.

The new map of the regions of the Cordillera and Montaña, both, should be of much value to those engaged in opening up those remote places. Gold and rubber are the main products at present of the lower eastern slopes, but there are vast tracts of splendid agricultural lands along the full-flowing rivers of the Peruvian Amazon plain, such as must soon acquire importance. The Montaña is one of the most valuable parts of Peru. These regions are not necessarily unhealthy, and, indeed, in some cases enjoy a delicious climate.

NOTE ON MAP OF SOUTH PERU AND NORTH BOLIVIA.

By E. A. REEVES.

THIS map extends from 8° to 18° S. lat. and from 65° to 74° W. long. The river Madeira is continued, on an inset, about 1° in longitude further to the east, in order to show the railway under construction past the rapids and the port of San Antonio, the position of which has been well determined, and is important for the adjusting of this part of the map. The area included in the map, altogether about 418,000 square miles, is, apart from its present importance in connection with commercial enterprises and boundary questions, one of the most interesting on the surface of the Earth from historical, geomorphological, climatological and other points of view.

The original compilation and drawing has been made on the scale of 1:1,000,000, in four sheets, which will be corrected and added to from time to time as new exploratory and survey work is completed. For the purpose of publication the map has been reduced to one sheet, measuring 22 inches by 19 inches, on the scale 1:2,000,000, or half that of the original, and this, until more complete surveys are made, is large enough for showing all important features. With the exception of a few names and a certain amount of smaller detail, little has been lost by the reduction.

The map is drawn on a conical projection with two standard parallels, which have been computed on the principle that errors on the limiting parallels of the map shall be equal to those on the middle parallel, which, in round numbers, holds good in this case for $9^{\circ} 30' S.$ and $16^{\circ} 40' S.$

No regular surveys exist of this region as a whole, nor are any likely to be undertaken for years to come; consequently, for the greater part of it, any mapping must depend upon rough sketches and route traverses, either overland or by boat. These naturally vary considerably in merit, and in some cases where astronomical observations have been taken, are doubtless fairly good. The compilation and drawing of this map has taken the greater part of two years, and has necessitated comparing and determining the value of a large amount of cartographical material, and many observations.

In the first place, it was necessary to decide as to what parts had been most accurately surveyed, and positions determined with sufficient reliability to form a basis for the map to which the more approximate work could be adjusted. The coast-line was laid down from the latest Admiralty charts, and probably leaves little to be desired. Then, as regards the interior regions, latitude and longitude observations taken at various places were fully considered, and in the end the results given on the following table were accepted. Many observations had to be rejected as unreliable, and in a great number of cases the latitudes only were used, the longitudes being rejected altogether, or, where there was reason to believe that the chronometric differences between places were fairly correct although the absolute longitudes as regards Greenwich might be in error, these differences were utilized, and the work adjusted accordingly. As an example of this may be mentioned the case of Pto. Maldonado, at the junction of the Tambo-pata with the Rio Madre de Dios. Here an occultation of a star was observed in 1904 by Captain Juan M. Ontaneda, of the Peruvian Fluvial Commission, to determine the longitude, the computation of which he gives in his report. This has been recomputed with little difference in result; so the longitude assigned to this place is probably but a few miles in error at most. This has been accepted, and the remaining work in the region, including chronometric differences of longitude by Don Jorge von Hassel and other Peruvian officers, adjusted to it. The course of the Rio Purus and lower Aquiry has been plotted, without alteration, from the excellent surveys of those rivers made in 1866 and 1867 by the late W. Chandless, published in the *Journals* of this Society. Careful astronomical observations were taken to correct the surveys, and as examples of pioneer river exploration, nothing could be better than the work of this explorer. The upper course of the Aquiry was also mapped by Chandless, but it has lately been re-surveyed in greater detail by Major P. H. Fawcett, R.A., the present Commissioner for the Bolivian Boundary Surveys. The agreement between the river as laid down by these two surveyors is, on the whole, very good.

Major Fawcett's recent surveys include the lower course of the Beni, the Rio Abuna, and upper Aquiry, and he has been good enough to place his original documents at the disposal of the Society. In addition to his

route traverses, he has taken numerous observations for latitude and longitude in this region, including occultations at Cobija Capatara on the Aquiry or Acre, Riberalta on the Beni, and Bon Futuro on the Abuna, and his work has been utilized, without alteration, in the compilation of a great part of the north-eastern section of this map.

As regards the high plateau region, the available cartographical material that may be considered most reliable, and which has been utilised as the basis of this part of the map, are the following: surveys for proposed railways, with distances and levels along traverse lines, specially those published in Vol. 3 of the 'Intercontinental Railway Commission Report,' 1891-92, from which the country from Arequipa to Puna, and Juliaca to Cuzco, have been taken. The 'Triangulation of the Cordillera Real,' by Sir Martin Conway, 1898; 'Route Surveys in Caupolicán,' by Dr. J. Evans and Mr. Watney, 1902, adjusted by bearings to Conway's triangulation, and by astronomical observations for latitude; 'Bathymetrical Survey of Lake Titicaca,' by Dr. Neveu-Lemaire, 1903.

In the southern part of this area a portion of the Tacna Province of Chile is included, and for this the new surveys of the Chilean Boundary Commission have been utilized. This contains a large amount of detail, and is probably more correct than almost any other part of the map. The positions determined by Mr. J. B. Pentland in Bolivia and Peru from astronomical observations and triangulation, so long ago as 1827-38 are still the most reliable for the plateau regions in many instances, and those adopted in the map are given, with others, in the list at the end of this memorandum. In addition to those already mentioned, there are at least three other positions that call for special notice, the first of these is Arequipa, the latitude and longitude of which has been accurately fixed by Winslow Upton, the latter ($71^{\circ} 32' 55''$ W.) being determined by telegraph from Arica. This value, in conjunction with that of La Paz (the latest value of which is $68^{\circ} 9' 25''$ W.) serves as a basis of adjustment in longitude for all this part of the map, and has necessitated moving the longitudes of Conway's triangulation and other maps depending upon it about $9' 00''$ to the west of the position previously given. Then there is the position of Cuzco, which has been fixed by several travellers at different dates, including Sir Clements Markham in 1853. The mean of the results of Gibbon, Markham, Squier, and Pentland have been accepted, as given in the table. It is interesting to note that in no case do their values differ more than $41''$ in lat. and $2' 10''$ in long. The longitude of this place was in every instance obtained by chronometer.

In addition to the above, which are the more important surveys of special districts used in the compilation of this map, many others, principally rough route traverses, or compilations from route traverses, have been utilized in filling in detail and gaps where nothing better exists. All of these will be found in the list at the end, but among the

most important are several manuscript and printed compilations of recent work, kindly supplied by the Lima Geographical Society and others, and the map of Peru, on the scale of 1 : 500,000 by Dr. A. Raimondi. Except for the few special maps mentioned in the annexed list, this latter has been extensively used in the Peruvian section, as in many parts nothing better so far exists. For the plateau of Bolivia the surveys of J. Minchin, in 1881, and others, combined with the 1 : 750,000 general French map of the Mission G. de Créqui Montfort and E. Sénéchal de la Grange of 1903, form the basis of the compilation when no later or more detailed material has been available.

The heights on the map vary considerably in degree of reliability. Along the lines of railways and traverses these are doubtless fairly correct, as they depend on levelling. In the neighbourhood of Lake Titicaca and to the south-east in the Illimani district they should not be greatly in error, as they are chiefly from theodolite vertical angles. Then, again, to the south, in the district covered by the Chilian Boundary Surveys, they may be depended upon. But apart from these regions they must be considered as only approximate, since they are chiefly based upon aneroid and boiling-point readings, or are merely estimations.

MATERIAL USED IN THE CONSTRUCTION OF THE MAP.

1. Admiralty Charts Nos. 1279 and 1283.
2. Surveys of the Northern Boundary of Bolivia by Major P. H. Fawcett. 1907.
3. The Cordillera Real, Bolivia. From a Triangulation and Plane Table Survey by Sir Martin Conway. 1898.
4. Surveys of the Comision Chilena de Límites, 1908.
5. Mapa del Peru. A. Raimondi. Scale 1 : 500,000.
6. Caupolican and adjoining portions of Northern Bolivia. Compiled from the Surveys of G. N. Watney, c.e., J. W. Evans, d.sc., and others. 1903.
7. International Railway Commission. Vol. 3. Reports of Surveys and Explorations made by Corps No. 3. 1891 and 1892.
8. Vías del Pacífico al Madre de Dios. Vías del Pacífico al Marañón. El Istmo de Fitzcarrald. Publicación de la Junta de Vías Fluviales. Lima, 1902-3.
9. Nuevas Exploraciones en la Hoya del Madre de Dios. El Istmo de Fitzcarrald. Publicación de la Junta de Vías Fluviales. Lima, 1904.
10. Últimas exploraciones ordenadas por la Junta de Vías Fluviales. Lima, 1907.
These are three important reports, with maps, comprising surveys of the rivers Tambopata, Madre de Dios, Inambari, Mishagua, Serjali, Manu, Cashpajali, Tacuatimanu, Tavara, Sepahua, Urubamba, and the Istmo de Fitzcarrald, by the following members of the Commission: Captain J. M. Ontaneda, Don J. S. Villalta, Don Fernando Carbajal, Don Germán Stiglich, Don C. A. Cipriani, Don J. von Hassel, Colonel D. E. de la Combe, Don J. M. Torres, Don J. M. Olivera.
11. Carte Bathymétrique du Lac Titicaca par le Dr. Neveu-Lemaire, 1903.
12. Mission G. de Créqui Montfort et E. Sénéchal de la Grange. 1903.
Régions des Hauts Plateaux de l'Amérique du Sud (Bolivie, Argentine, Chili, Pérou). Carte dressée par V. Huot d'après les Travaux des Membres de la Mission, les sources originales inédites, et les Documents les plus récents. Scale 1 : 750,000.

13. The Rio Purus, by Wm. Chandless. 1867.
14. The Rio Aquiry or Acre, by Wm. Chandless. 1866.
15. Mapa de los Rios Beni y Yacuma segun las exploraciones del Dor. Eduardo R. Heath. 1879, 1880, 1881.
16. Route Surveys by C. R. Markham. 1853 and 1860.
17. Plano General del Rio Desaguadero por Juan Bergelund. 1892.
18. Surveys of parts of Bolivia by J. B. Minchin. 1882.
19. Mappa topographico da Valle de Rio Madeira levantado pelos engenheiros José e Francº. Keller. 1868.
20. Croquis de la Region fluvial Peruana del Yurua, Purus, Madre de Dios i Beni. Trabajado bajo la direccion del jefe de la Oficina Dr. Carlos Larrabure y Correa. Lima, 1906.
21. Mapa indicando el Resultado de las ultimas Exploraciones en los rios Paucartambo y Madre de Dios. Lima, 1904.
22. Mapa Historico Geográfico de los Valles de Paucartambo. Scipion E. Llona. Lima, 1904.
23. Croquis de la Frontera Peruana-Brasileña. Archivo Especial de Limites. 1909.
24. Region Oriental del Peru. Estudiada por los SS. Mavila, Stiglich, Donaire, la Comision Peru-Brasileña y el Sr. F. Gabrielli. Trazada por encargo y según los datos proporcionados por el Coronel Don Pedro Portillo. Lima, 1906.
25. Departamento de Apurimac. Provincias de Antabamba, Cotabambas y Aymaraes. Croquis de Ingº. Alberto Jochamovitz. Cuerpo de Ingenieros de Minas del Perú. Boletin N. 58.
26. Plano de las Secciones y Afuentes del R. Urubamba levantado por Luis M. Robledo. Lima, 1902-1904.
27. Vallée de Santa-Ana. Depuis le col de la Cordillère Orientale jusqu' aux Cerros de Ichitariato, dressé et dessiné par Ch. Wiener. Paris, 1880.
28. Camino de Herradura de La Paz à Puerto Pando. Segun estudios comparativos hechos por las vias de Coroico y Chulumani por Julio Knaudt. La Paz, 1907.
29. Exploration de la Vallée du Marcapata, relevé par A. Plane. Paris, 1903.
30. Portion of the Rio Inambari. Sketched from a rough survey made November, 1907, by J. C. Quinn.
31. Mapa de los nuevos límites de Bolivia con el Peru en la región litigiosa Madre de Dios-Aquiry Conforme al nuevo Tratado de Setiembre de 1909.
32. La Laguna de Titicaca and the valleys of Yucay, Collao, and Desaguadero in Peru and Bolivia. From Geodesic and Astronomic Observations made in the years of 1827, 1828, 1837, and 1838, by J. B. Pentland, Esq.
33. The Surveys of the Concessions of the Inambari Pará Rubber Estates, by J. G. V. Bonvales. 1909.

NOTE.—Many other maps and sketches were examined with a view to their being used, but were afterwards rejected, or were only serviceable to a small extent.

LIST OF POSITIONS.

Place.	Latitude.	Longitude.	Observer.	Authority, Remarks, etc.
Ancoraimes ...	15 54 0 S.	—	La Puente	'Les Lacs des Hauts Plateaux de l'Amerique du Sud,' p. 50.
Avayiri ...	14 52 50	—	Pentland	

Place.	Latitude.	Longitude.	Observer.	Authority, Remarks, etc.
	° ' "	° ' "		
Arequipa ...	16 22 28	71 32 55 W.	Winslow Upton	Long. by Telegraph from Arica.
Azangaro ...	14 55 10	—	Pentland	
Bahia ...	11 1 0	68 46 47	Major Fawcett	Long. by Occultation.
Bon Futuro ...	9 47 20	66 8 15	Major Fawcett	Long. by Occultation.
Caracoto ...	15 34 20	—	Pentland	
Capatara ...	10 15 47	67 53 2	Major Fawcett	Long. by Occultation.
Copacabana ...	16 19 56	—	Pentland	
Pto. Candamo	13 29 30	69 53 3	Ontaneda	Publicación de la Junta de Vías Fluviales.
Chililaya ...	16 17 4	—	Bergelund	'Les Lacs des Hauts Plateaux de l'Amerique du Sud,' p. 50.
Cuzco ...	13 30 41	72 4 30	{Gibbon, Markham} {Squier, Pentland }	Mean result as taken by Raimondi.
Desaguadero } R. (mouth)	16 33 10	69 2 31	Pentland }	Mean taken.
Desaguadero } R. (mouth)	16 33 52	69 2 23	Bergelund }	'Les Lacs des Hauts Plateaux de l'Amerique du Sud,' p. 15.
Escoma ...	15 40 1	—	Pentland	
Atuncolla ...	15 42 0	—	Pentland	
Huancane ...	15 12 3	—	Pentland	
Huaqui ...	16 35 27	—	Bergelund	'Les Lacs des Hauts Plateaux de l'Amerique du Sud,' p. 50.
Juli ...	16 11 50	—	Pentland	
Juliaca ...	15 29 20	—	Pentland	
Pto. Markham	13 20 50	69 50 33	Ontaneda	Publicación de la Junta de Vías Fluviales.
Pto. Maldonado	12 35 40	69 15 40	Ontaneda	Long. by Occultation.
Nao R. (mouth)	12 55 30	69 41 59	Ontaneda	" "
Puno ...	15 50 35	—	Bergelund	'Les Lacs des Hauts Plateaux de l'Amerique du Sud.'
Riberalta ...	10 59 50	66 5 26	Major Fawcett	Long. by Occultation.
Rames ...	15 19 0	—	Pentland	
Pomata ...	16 19 0	—	Pentland	
Pucara ...	15 2 10	—	Pentland	
San Antonio	8 48 13.4	63 56 7	Com. Davis and Lieut. Norris	U.S. Navy, 1882; United States Hydrog. Office, Chart No. 897.
Sandia ...	14 23 1	—	Stiglich	Publicación de la Junta de Vías Fluviales.
La Torre R. (mouth)	12 48 50	69 27 33	Ontaneda	" "
Pto. Seco ...	13 31 30	69 25 15	Ontaneda	" "
La Union ...	13 31 20	69 47 27	Ontaneda	" "
La Paz ...	16 29 57	68 9 25	—	'Geografia de la Republica de Bolivia' (La Paz, 1905).
Oruro ...	17 53 52	67 19 17	—	
Urubamba ...	13 18 30	72 11 22	Pentland	" "
R. Sepahua and Urubamba junction	11 3 5	—	Olivera	Publicación de la Junta de Vías Fluviales.
R. Mishagua and Urubamba junction	11 10 33	—	Olivera	" "
R. Manu mouth	12 16 22	—	Stiglich	" "
R. Inambari mouth	12 42 21	—	Stiglich	" "
Puerto Oriental del Istmo de Fitchcarrald	11 49 10	—	Stiglich	" "

Place.	Latitude.	Longitude.	Observer.	Authority, Remarks, etc.
	° ' "			
R. Heath ...	12 31 14	—	Torres	Publicación de la Junta de Vías Fluviales.
R. Purus ...	The positions on these rivers, from observations by Wm. Chandless, so far as they come within the limits of the map, have been retained. A list of the latitudes and longitudes, including several occultations, is given in the <i>London Geographical Journal</i> , vol. 36, 1866, pp. 115, 126.			
R. Aquiry or Acre				
Ixiamas ...	13 45 0	—	Watney	
San Rafael ...	14 1 0	—	"	
San Martín ...	14 6 0	—	"	
San Juan ...	14 10 0	—	"	
Buturo ...	14 17 0	—	"	
Asilla ...	14 27 6	—	"	
San José ...	14 13 0	—	"	
Tumupasa ...	14 9 0	—	"	
San Buena Ventura	14 26 0	—	"	
Apolo ...	14 43 0	—	"	
Aten ...	14 55 0	—	"	
Pelechuco ...	14 49 0	—	"	
Mariara ...	15 15 0	—	"	
Maqnique ...	15 23 0	—	"	
Isapuri ...	15 26 0	—	"	
Charapampa ...	15 15 0	—	"	

NOTE.—Where not otherwise stated, the longitudes are by chronometer. In addition to the above longitudes, in several instances chronometric differences were used after being adjusted to fixed points.

MR. CARRUTHERS' EXPEDITION TO NORTH-WEST MONGOLIA.

MR. DOUGLAS CARRUTHERS has sent us a short report on the first stage of this expedition, which, it will be remembered (see *Journal*, vol. 35, p. 333), set out early in the present year for scientific exploration in the extreme upper basin of the Yenesei and other parts of Mongolia. Some excellent work seems to have been already accomplished, from the point of view both of geography and of natural history. At the time of writing (July 25), the expedition was at Cha-kul on the upper Yenesei, having left Minusinsk in May and traversed the Saiansk and Bei-kem districts of that region, drifting in rafts for 300 miles after reaching the Bei-kem river. As a result of the journey it had been ascertained that the supposed main range of the Saiansk mountains (shown on the maps) has no existence, its place being taken by isolated groups of very rough, rugged mountains. These seem to owe their origin to a series of disconnected uplifts, which have taken place in different directions and at different periods. The river systems are divided from each other by almost imperceptible water-partings. Many glacial lakes not marked on existing maps—some of large size—were met with. A striking fact is the close affinity which this country possesses with Siberia, not with Mongolia. The climate,