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The River Aruwimi

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area in the north-east, now almost unoccupied, is also valuable. This country has a good climate and excellent rainfall, and would grow almost any sub-tropical plants successfully.

Much help was obtained from the natives, who proved generally friendly and ready to disclose the positions of their wells, and the places where feed was best. They were scattered in families throughout the area, and though not in large numbers in the drier parts, towards Sturt creek they were found in parties of two hundred and over. They wear no clothing, have no habitations, and depend absolutely on natural sources of food-supply. They apparently have no religion, and seem generally to be cannibals. Their language changes rapidly from south to north, but their marriage customs, etc., seem practically the same throughout. Physically, they are clean limbed and active, and possess a marvellous instinct of bushmanship, and a capacity for tracking which will make them useful on occasion as stockmen.

THE RIVER ARUWIMI.*

By ROBERT L. REID.

IN considering the economic value of a great waterway, a question of first importance is its capacity for transport. The Aruwimi (or, to give it its proper name, Luwari, or Luari †), between Basoko and Avakubi, carries on its waters a constant stream of traffic, furnishing a safe and cheap means of transport over 350 miles, for this most important service. Provisions and other necessities for the governing body of whites, and merchandise and articles of exchange for the native population, pass daily up its course, and the fleets of canoes necessary for the transport make the return journey loaded with rubber and ivory. This in turn is discharged at Basoko into large river steamers, taken down the Congo to Leopoldville, and thence by rail and ocean steamers to the markets in Europe.

During the wet season the Aruwimi is navigable as far as Yambuya for steamers up to 30 tons burden, drawing about 3 feet when loaded. They make the journey against the current in something under two days, including stops, and return to Basoko in about half that time. At low water, however, encounters with obstructions are liable to considerably extend the run. New sandbanks form at every flood, while old ones are displaced or washed away, making it impossible to lay down a permanent fairway on any chart; the downstream end of an island is in general a

* Map, p. 112.

† Stanley probably added -imi to the name given him, not knowing that the latter word merely stood for "it is" in Kingalima. Example: "Imi Kwakwara," "it is hard," or "you are strong." A natural answer to the question, "What is the name of the river?" would be "Luari it is." For the sake of euphony, the final *i* in Luari would naturally change to *u*, and the answer would probably be "Luaruimi."

place to be avoided; while deep water may be looked for quite close to the banks or alongside the larger islands. The river commences to rise about August, reaching its maximum usually in November, and then gradually falling till April, when the light rains will keep it about medium height until the following August. Varying seasons alter these dates slightly; 1909 was a very wet year, the river rising in November to an exceptional height (about 22 feet at Panga above the lowest, April 1908, reading). Between Basoko and Yambuya the river is not marked by any great alterations to the usual trend of its channel, but flows placidly along between low banks for the most part, varied occasionally by steep clay sides and at Baonde by white sand cliffs. Many islands, some of considerable size, mark this stretch; all are heavily wooded. No rapids occur here, but the battered appearance of some of the plates in the steamers testify to the existence of occasional rock. The rapids begin at Yambuya, and, continuing, make a dangerous and rough bit of water up to Ilungo, necessitating at Yambuya a portage of about a mile. From here all goods are transferred to dug-out canoes, and commence their long journey towards the head of navigation at Avakubi. Receiving stations are placed at Yambuya, Banalia, Panga, Bomili, and Avakubi; each has its own transport fleet of dugouts and permanent canoe-men, the latter supplemented from the native villages along the river as occasion arises. Most of the larger villages contain a good rest-house, built and maintained by the natives, for the use of white passengers, and, unless exceptional circumstances occur, these can always be reached by the traveller from day to day.

Rapids are met with at intervals throughout the whole course of the river; some of these may be shot safely at high water, but many necessitate unloading and portering all the cargo round the dangerous stretches (averaging about a mile at a time), the canoes being taken through empty. A village is always established at or near these spots, on the inhabitants of which devolves the duty of portering and taking over the canoes, the regular crew loading up and resuming the voyage when quieter water is reached. The worst place is at Panga, where a great earth-fold crosses the country in a north-west to south-east direction, through which the river has torn a way into the jagged masses of upturned rock, over which it dashes with terrific force, and a booming sound that can be heard some miles on a still night. These falls are the only complete bar to canoes on the river, and on occasion even they can be surmounted by special crews of the villagers whose home is situated on the high bank overlooking the cataract.

The Aruwimi follows generally an east and west course; it reaches its northern limit at Mokupi about $10^{\circ} 58' 20''$ N. lat., whence it gradually works back southerly to Avakubi to within $6''$ of its latitude at the mouth at Basoko. Its middle and upper stretches are marked at intervals by sharp bends, where hard country has turned the



TYPICAL SANDBANKS, KASAI RIVER.



PANGA RAPID.



WANGILIMA OF PANGA. TYPE OF CANOE-MEN.



WANGILIMA WOMEN, ARUWIMI RIVER.

original course into softer formations. No affluents of great size occur until Bomili is reached, at which place the Nepoko joins on the north bank. This great branch (second only in size to the Aruwimi itself), with its tributary the Nava, drains the country nearly up to the third degree of north latitude, and extends its heads easterly to the Nile-Congo watershed, north and west of Lake Albert. Only a few miles above the Nepoko another large branch, the N'Gayu, comes in, also on the north bank, its course lying between the Nepoko and Aruwimi, and its heads rising in the granite ranges between Nepoko and the Epulu. Minor tributaries occur in the lower and middle parts of the Aruwimi; those on the north bank running back 20 miles or so. No great branches come in on the south, but countless small creeks drain the country on both sides, their mouths for the most part hidden by the dense vegetation which clothes the river-banks.

Above the junction of the Nepoko and N'Gayu a noticeable diminution takes place, the river contracting to about 200 to 300 yards, and reducing in places to under 100 yards in width. The densely wooded banks shut out all view from the river; but ridges or low hills occur on the right bank between Mogandjo and Yambuya; thence no high country can be seen until approaching Panga, when hills come in view on the north bank, rising to some 300 to 400 feet. This low range crosses the river and causes the cataracts at Panga, the rapids at Jambe, and much broken water up to Karagba. Sights to hills lying near the river can be taken above Bomili, at Mombatili, and Yenga; low ranges can also be seen from Avakubi, but none appear to rise more than 200 to 300 feet. Openings in the forest of a few acres in extent occur from time to time on either bank, marking the sites of old villages, and low scrub and an absence of heavy timber indicate where clearings still older have existed, but are now being quickly grown over by the encroaching forest. In some cases lines of old mussel-shells and village *débris* can be seen at these spots, the remains of kitchen middens. With these exceptions the banks are heavily wooded throughout. The river itself is remarkably clear of swamp, grass, or sudd of any description.

Fish abound, and are taken by the natives in baskets and weirs, generally at the rapids and the mouths of small creeks. Game animals are not plentiful, elephants being the principal and most numerous; crocodiles are sometimes seen sunning themselves on the sandbanks; an odd hippopotamus and a few buffalo tracks are occasionally met with; and the natives get small antelopes by placing nets across the runs in the forest. These are principally a grey and a red duiker, and the water chevrotain. The okapi and bongo both exist in the forest, but are seldom taken, and an otter is known. The forest, however, is full of monkeys, and these may be seen every day from the canoes. Two or three varieties were noted, the most plentiful being a dark brownish-grey, with rufous tail and a white nose; large baboons are seen coming

down to drink, and the chimpanzee is heard at night, but as they inhabit the gloomiest parts of the forest are seldom seen. Water-birds are scarce ; a few flocks of ducks, an occasional goose, and two or three varieties of cranes or herons. Forest birds are more plentiful ; unwieldy-looking hornbills are seen flying across the river ; many pigeons, a few partridges, and guinea-fowl can be shot, and I found what appeared to be a black variety of the latter.

If animal and bird life is not so plentiful as might be expected, the same cannot be said of the insect world. Butterflies at certain seasons arrive in their millions, all apparently travelling in one direction ; they are filthy in their habits, and almost as great a nuisance as flies. Bees great and small, the former with a formidable sting which they do not hesitate to use if removed too roughly from bare arm or neck. The small black bee is, however, without a sting. Both kinds pitch on one where any moisture of perspiration shows. A favourite place of the small bee is the interior of one's helmet, the ventilating holes forming a convenient tunnel through which they creep. Flies of every variety abound, from the hippo fly over an inch in size, down to sand-flies so small that muslin will not keep them out. All seem to have but one object in life, viz. to make a meal off the unfortunate human being they pitch on. Tsetse fly are numerous ; they love to fly quietly to the back of one's chair, out of sight, and from there walk to a bare elbow or neck, or from some dark spot on the floor make their way slowly up one's leg, where they fill themselves with blood. Sitting cramped in a canoe, the traveller is certainly bitten by them every day.

Sleeping sickness has not yet made its appearance on the river proper ; but it probably is expected, as the authorities are preparing in a way by having the villages and portages brushed. Just below Basoko there is a lazaret of sleeping-sickness patients, with a white doctor in charge, and if the Aruwimi tsetse get infected a bad time will result, as there is no break in the range of the fly as far up the river as I have been.

The native villages are located close to the water, generally on a high clay bank. From about Yambuya up, they build the high cone hut something like huge extinguishers. Some are round in shape, others square, but none larger than 7 to 8 feet across. The walls are made of small sticks, driven closely together into the ground and plastered with clay ; the floor is raised a foot or 18 inches of well-beaten earth ; the roof rises to a point some 12 to 15 feet above the walls, and is covered with three or four thicknesses of large leaves laid like the scales of a fish and sewn on with cane ; the apex is generally finished off with an old pot, or perhaps a bit of basketwork plaited round and stuck through with a few skewers like Japanese hatpins.

Bananas and manioc are grown, and with fish form the staple food of the natives. Maize and ground-nuts are also cultivated in a lesser



CONE HUTS OF THE WANGILIMA, ARUWIMI RIVER.



AVENUE OF MANGO TREES, FLANKED WITH OIL PALMS, AVAKUBI STATION.



CHEF DE SECTEUR'S HOUSE, BANALIA.

degree. Rice is being introduced with some success, especially where colonies of time-expired soldiers and workmen have been installed. These people are also expert in growing and curing the native tobacco, which is much sought after.

The riverine people may be divided roughly into three groups—Basoko near the mouth, Mongalima in the middle, and Mobali towards Avakubi. Subdivisions are met, probably caused by overlapping and fusion with the forest people.

The Popoie occupy a large tract back from the river on the southern bank, and on the northern side various small tribes of Babua, Mombuli, Makeri, Medje, etc., are passed before one comes to the larger tribal divisions of Mangbetu and Azandi. The Mangbetu language seems to influence most of the dialects spoken among the above tribes, but for trade purposes Bangala is used on the lower river and Swahili from Panga up, and both these languages are understood everywhere. Arabs and their mixtures are first encountered at Mongalulu, and at Avakubi there is a very large settlement of them. These people (called Mongwana) are established principally along the larger main tracks, and they extend east to the English borders; they cultivate rice largely, and own goats and a few sheep and cattle. There is a *poste restante* at Basoko and at Avakubi; a system of mails by canoes serve the intermediate stations at intervals of a fortnight or three weeks, the state of one's correspondence at times indicating that part of the journey has been made under water.

Transport labour is cheap and plentiful on the river as yet, but if it failed at any time, there are stretches of many miles right up to Avakubi where a small launch could tow strings of laden canoes, and a few charges of dynamite at the rapids would enable many of them to be passed; so that the river Aruwimi will ever remain a most valuable asset to the state and the rich country through which it passes.

FORMATION OF THE MAP.

Starting from Basoko in the early part of 1908, a compass traverse from canoes was made as far as Panga, and during the same year various short traverses were made on different parts of the river.

In November a traverse was made from Basobangi to Panga. During 1909 two journeys between Dima and Basoko, and in the beginning of 1910 a voyage from Dima to Avakubi, and from Avakubi a return right down to Basoko. All these were canoe voyages. Observations were taken at night on stars for time and latitude, and during the day attention was paid to traversing with 5-inch prismatic compass and watch; bearings being taken to bends, islands, prominent trees, etc., and the times noted. Widths of the river were measured at intervals with the instruments, but mainly depend on estimate and plotting from cross-bearings. Magnetic plottings of the traverses were made on the spot for the use of the expedition, but since my return to Europe I have worked up all the astronomical data and corrected the traverses to the positions so found. Where different traverses are of equal value, I have adopted a mean, but in some cases

No. I.—JULY, 1911.]

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single traverses are known to be better than others, and I have either kept to these, or given them a weighted value.

Latitudes were obtained by circummeridian altitudes of north and south stars, or, when this was not possible, by the sun. The results obtained by the north and south stars agreed with each other, in all cases, within a few seconds of arc.

For absolute longitude, occultations of stars by the moon were observed at the base camp, Dima island, and one occultation was observed at Mokopi camp, mostly under unfavourable conditions. The observation of η Leonis, on June 22, 1909, at Dima island, was particularly good as regards weather conditions, preparation for observing, etc., and, being on a large star, is believed to be of much the best value. I have adopted the resulting longitude from this observation as a basis (one of the others, marked indifferent in my notes, only differs from this by 11''4). All other longitudes are chronometric differences, starting from this point. Basoko is placed 3' 16''4 further west than the position on Grenfell's map, assigned to Delporte.

Captain George's mercurial barometer was filled at Yambuya, Banalia, and Avakubi, and was kept set up at Dima for about a year, and midday readings taken fairly regularly, together with the height of the thermometer. The height of water in the river was also noted daily. Variation of the compass was ascertained at intervals, by observations on stars or the sun compared with their astronomically determined azimuths. For the shapes and sizes of some of the islands between Mogandjo and Basoko I have made use of an existing chart.

The instruments used were as follows :—

5-inch transit theodolite by Casella, fitted with Reeves' micrometers to both circles.

Half chronometer watch, R.G.S. pattern by Blockley.

Split seconds stop-watch.

5-inch prismatic compass.

Astronomical telescope 2½-inch object glass, by Cary.

George's mercurial barometer, by Cary.

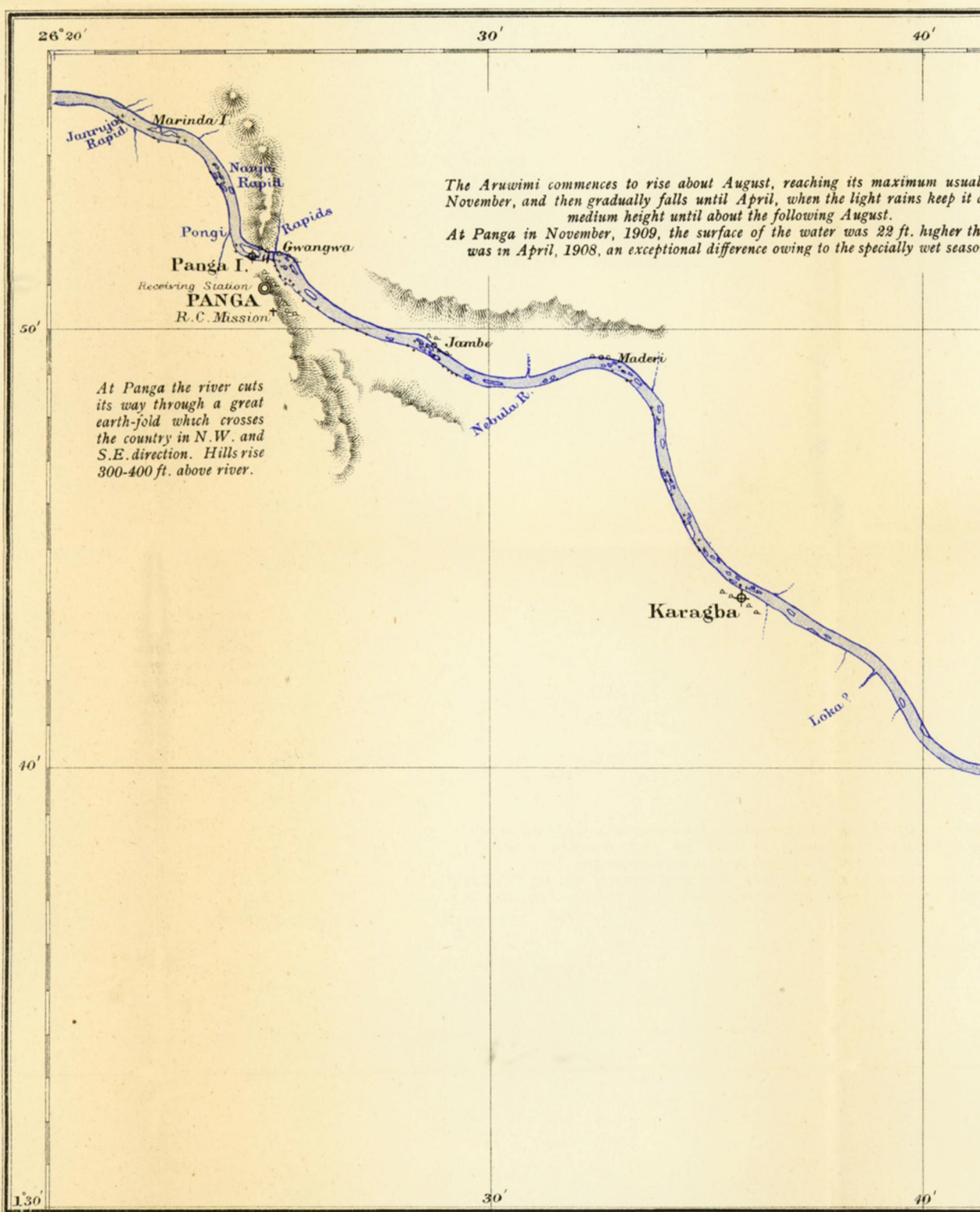
3-inch surveying aneroid.

Swing and ordinary thermometer.

THE FLOWING WELLS OF CENTRAL AUSTRALIA.

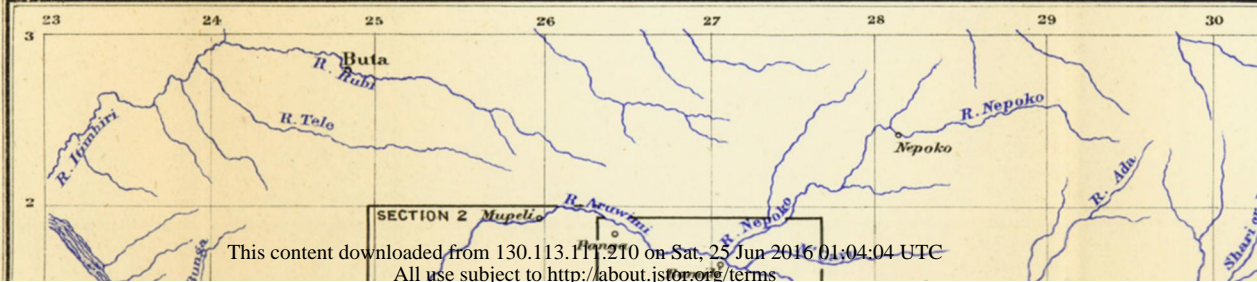
By Prof. J. W. GREGORY, D.Sc., F.R.S.

- I. Introduction.
- II. The Term Artesian.
- III. The Run-off of the Darling and Murray rivers.
- IV. The Loss by Percolation :
 - (a) The Blythesdale Braystone.
 - (b) Other Possible Intake Beds.
- V. The Sources of the Subterranean Water :
 - (a) The Diminishing Yield.
 - (b) Meteoric Water due to Ancient Infiltration.
 - (c) Residual Water.
 - (d) Plutonic Water.
- VI. Difficulties of the Water Pressure Theory.
 - (a) The Limitation of Water Pressure.
 - (b) Irregularities in Potential Level.
 - (c) The Toowoomba Sandstones as a High-pressure Reservoir.
 - (d) Oscillating Wells.



The Aruwimi commences to rise about August, reaching its maximum usual November, and then gradually falls until April, when the light rains keep it at a medium height until about the following August.
 At Panga in November, 1909, the surface of the water was 22 ft. higher than was in April, 1908, an exceptional difference owing to the specially wet season.

At Panga the river cuts its way through a great earth-fold which crosses the country in N.W. and S.E. direction. Hills rise 300-400 ft. above river.



40'

50'

27°

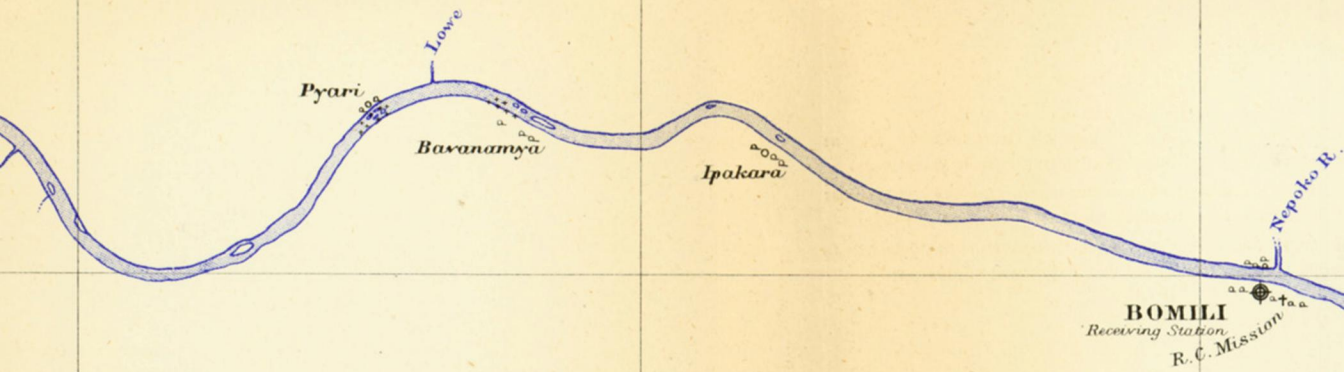
SECTION 3.

maximum usually in
ght rains keep it about
gust.
s 22 ft. higher than it
specially wet season.

This Chart is based chiefly on a compass traverse, adjusted by astronomical observations, taken with a 5 in. micrometer transit.

Heights are computed from mercurial barometer and aneroid, several cases extended over a considerable interval of time.

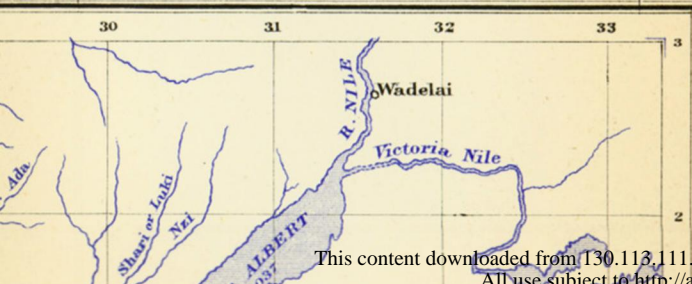
For further information concerning the construction, see the "Geographical Journal" for July, 1911.



*Above the Nepoko and N
200-300 yds., and i*

40'

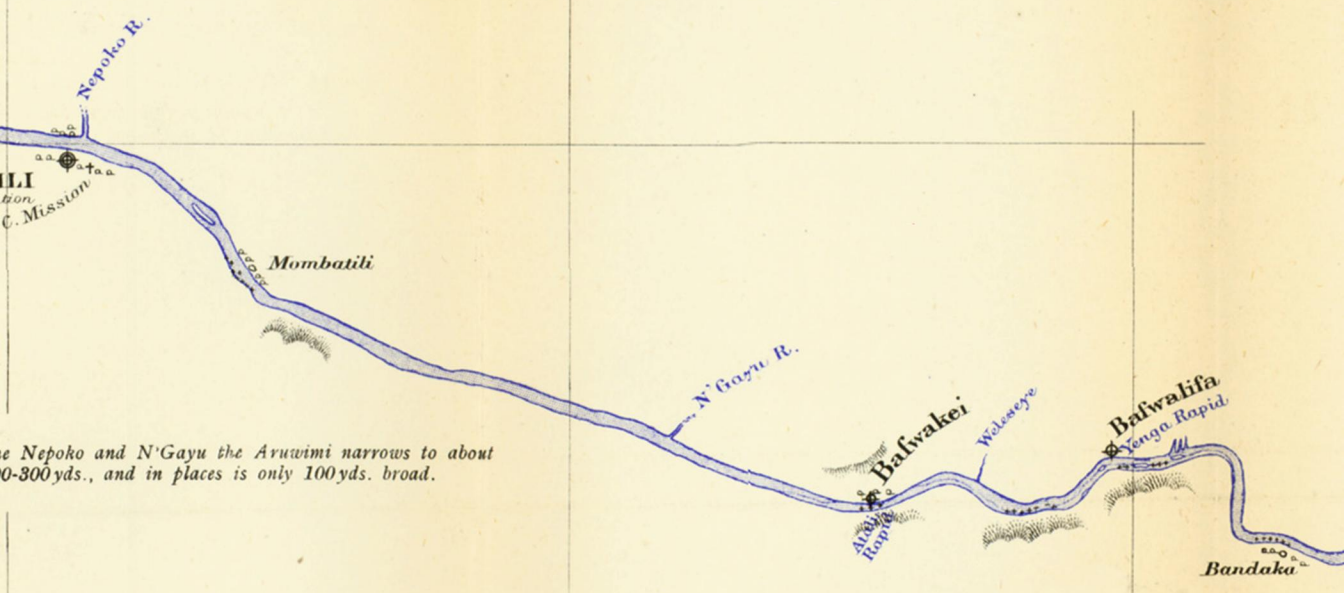
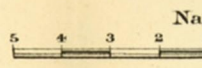
50'



DN 3.

ss traverse, adjusted to positions determined
 5 in. micrometer transit theodolite.
 barometer and aneroid readings, which in
 interval of time.
 the construction, see Mr. R. L. Reid's Note
 , 1911.

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the Nepoko and N'Gayu the Aruwimi narrows to about
 10-300yds., and in places is only 100yds. broad.

30'

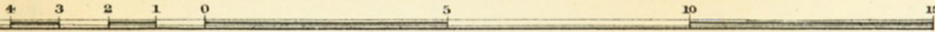
40'

BELGIAN CONGO

Chart of the RIVER ARUWIMI

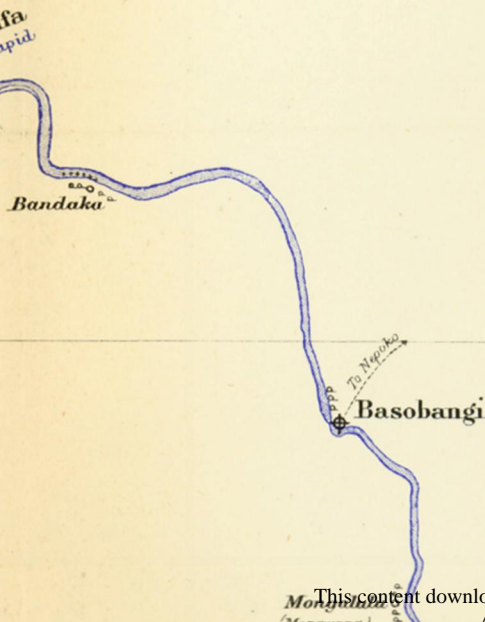
From a survey by
ROBT. L. REID.
1908-10.

Nat. Scale 1: 250,000 or 1 Inch = 3.945 Stat. Miles.



Reference .—

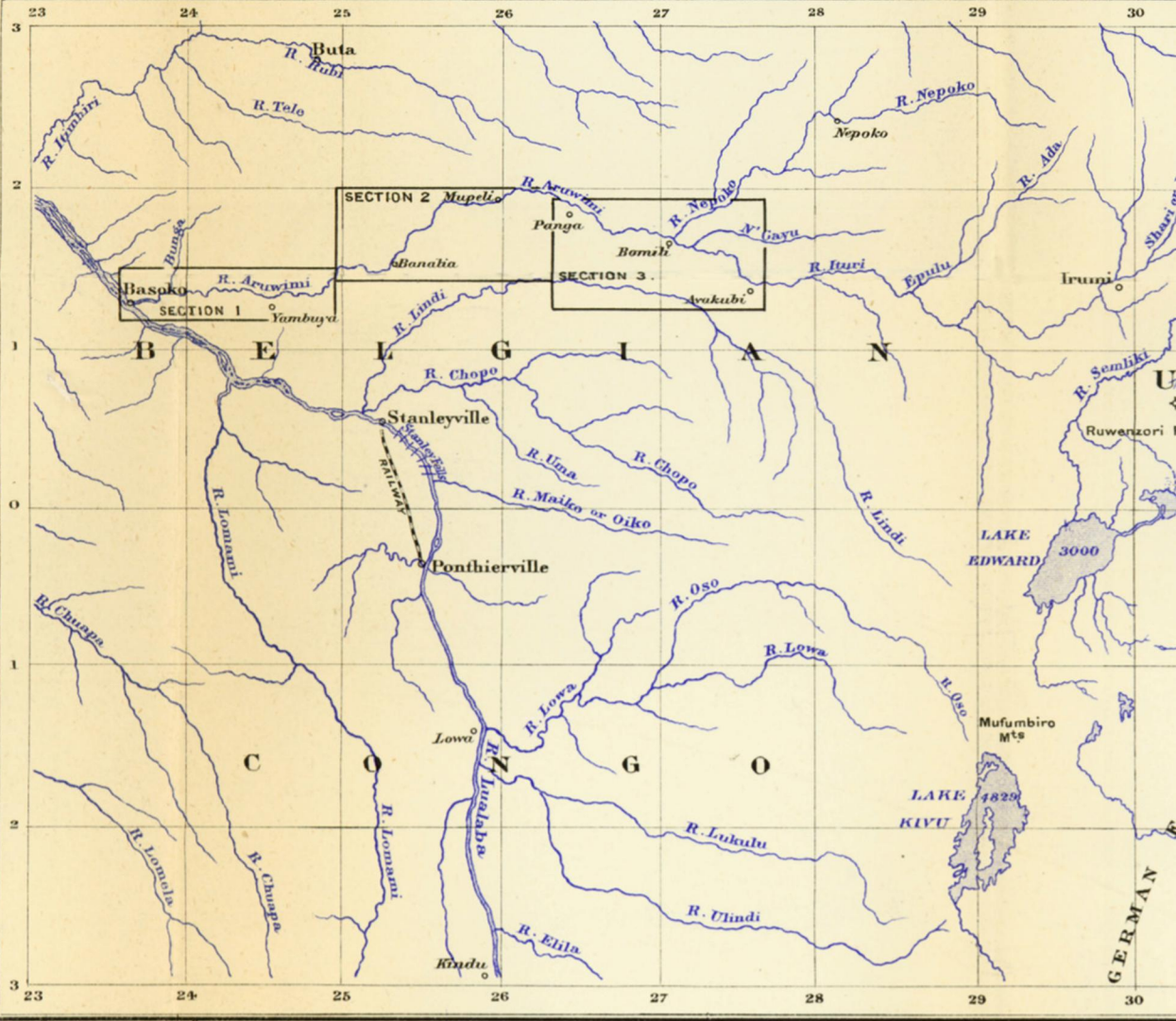
- State Posts ○
- Positions fixed ⊕
- Villages ○○○
- Roman Catholic Mission †
- Rocks



50'

40'

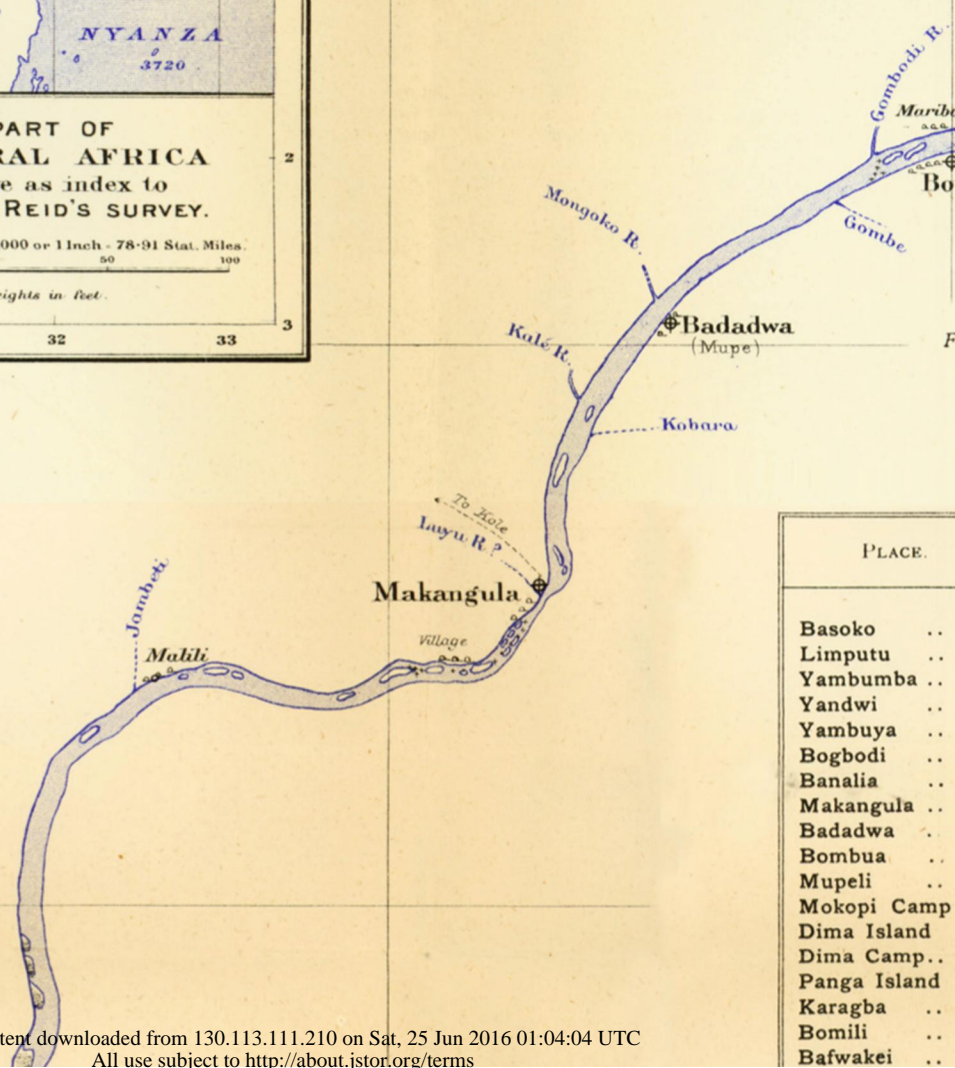
30'



The Riverine people may be divided roughly into three groups: BASOKO north, MONGALIMA in the centre, and MOBALI towards AVAKUBI. Sub-divisions probably caused by over-lapping and fusion with the joint people. The a large tract back from the river on the southern bank, and on the northern small tribes of BABUA, MOMBALI, MAKERI, MEDJE, &c., are passed by tribal divisions of MANGBETU and AZANDI are reached.



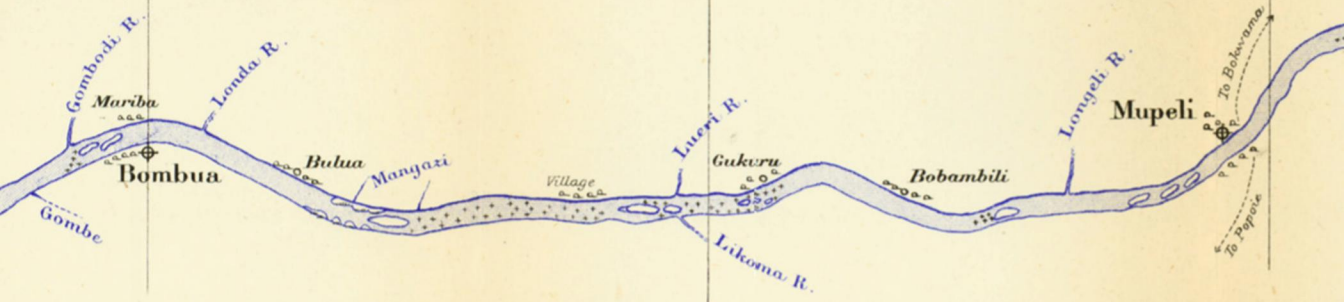
s: BASOKO near the mouth,
Sub-divisions are met with,
people. The POPOIE occupy
on the northern side various
are passed before the larger
are reached.



PLACE.	
Basoko	..
Limputu	..
Yambumba	..
Yandwi	..
Yambuya	..
Bogbodi	..
Banalia	..
Makangula	..
Badadwa	..
Bombua	..
Mupeli	..
Mokopi Camp	..
Dima Island	..
Dima Camp	..
Panga Island	..
Karagba	..
Bomili	..
Bafwakei	..

27° 10' 20' 25°

SECTION 2

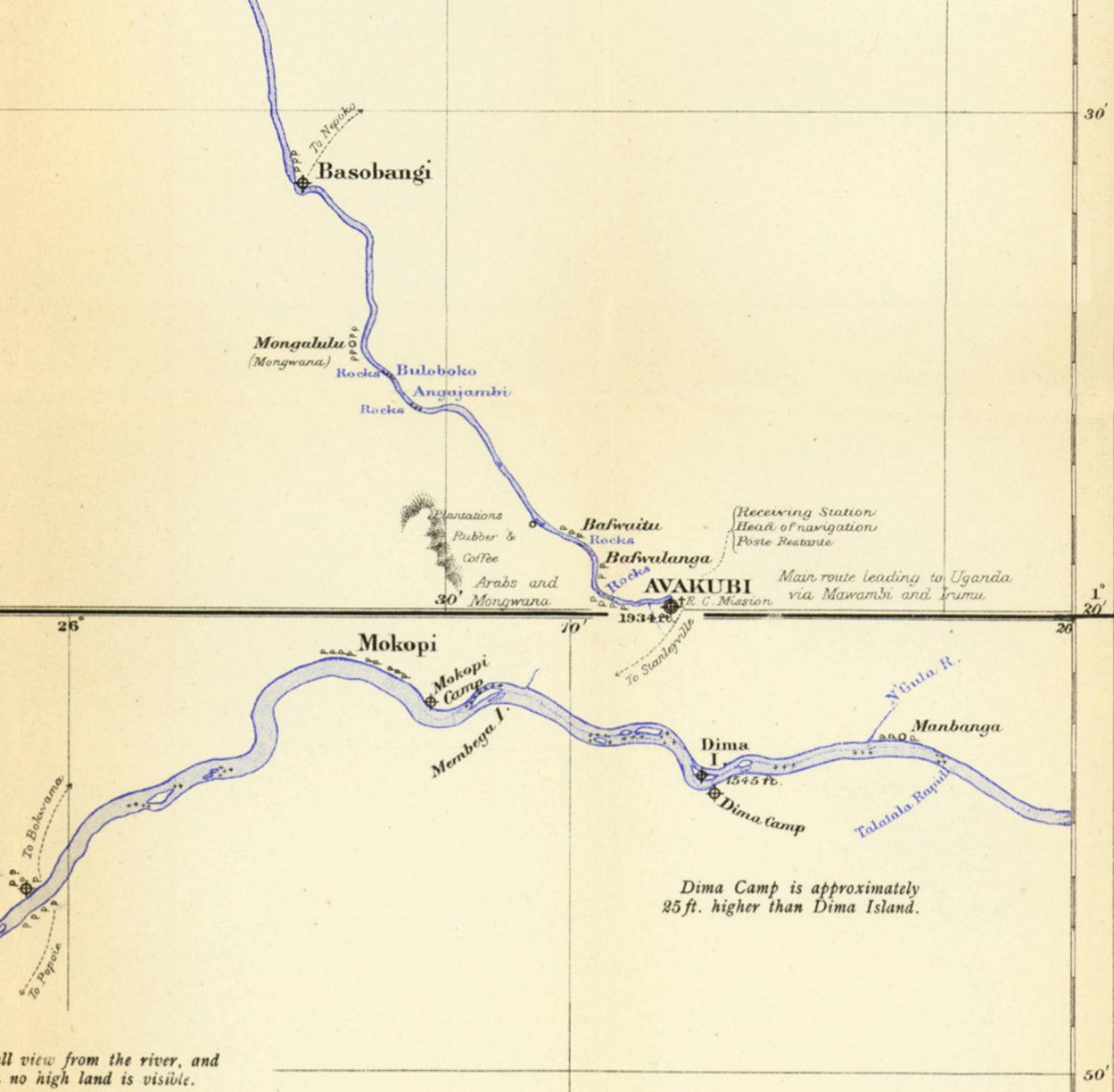


From rapids above Yambuya to Avakubi the river is only navigable for dug-out canoes

Densely-wooded banks shut out all view from the between Yambuya and Panga no high land is

TABLE OF POSITIONS

PLACE.	Latitude, North.	Longitude, East.	Mag. Var., West.	How Latitude and Variation of Co
Basoko	1 14 11	23 36 25	.....	Circ. Mer. Alts. of N. Star
Limputu	1 14 27	23 36 51	8 30 21	" " of N. and S. Stars. Az. by Sun and Star
Yambumba	1 19 36	24 02 32	.....	" " " " .. .. .
Yandwi	1 19 30	24 19 19	.....	" " of N. Star
Yambuya	1 15 26	24 32 37	8 17 58	" " of the Sun. Az. by Sun, compared with
Bogbodi	1 29 38	25 04 25	8 15 19	" " " "
Banalia	1 33 00	25 19 59	8 14 41	" " of N. and S. Stars and Sun. Az. by Sun
Makangula	1 45 34	25 32 40	.....	" " " " .. .. .
Badadwa	1 50 30	25 34 53	.....	" " of Sun and Double Alt.
Bombua	1 53 23	25 39 59	.....	" " of N. and S. Stars
Mupeli	1 53 34	25 59 14	8 13 06	" " " " Az. by Sun, compared
Mokopi Camp	1 57 17	26 07 17	.....	" " " " .. .. .
Dima Island	1 55 51	26 12 49	7 40 36	" " " "
Dima Camp	1 55 35	26 12 58	.....	" " " " .. .. .
Panga Island	1 51 36	26 24 37	7 36 16	" " " " Az. by Sun, compared
Karagba	1 43 52	26 35 50	.....	" " " " .. .. .
Bomili	1 39	27 .. ..	.....	" " " " .. .. .
Bafwakei	1 33 37	27 .. ..	.....	" " " " .. .. .



all view from the river, and no high land is visible.

SITATIONS, &c.

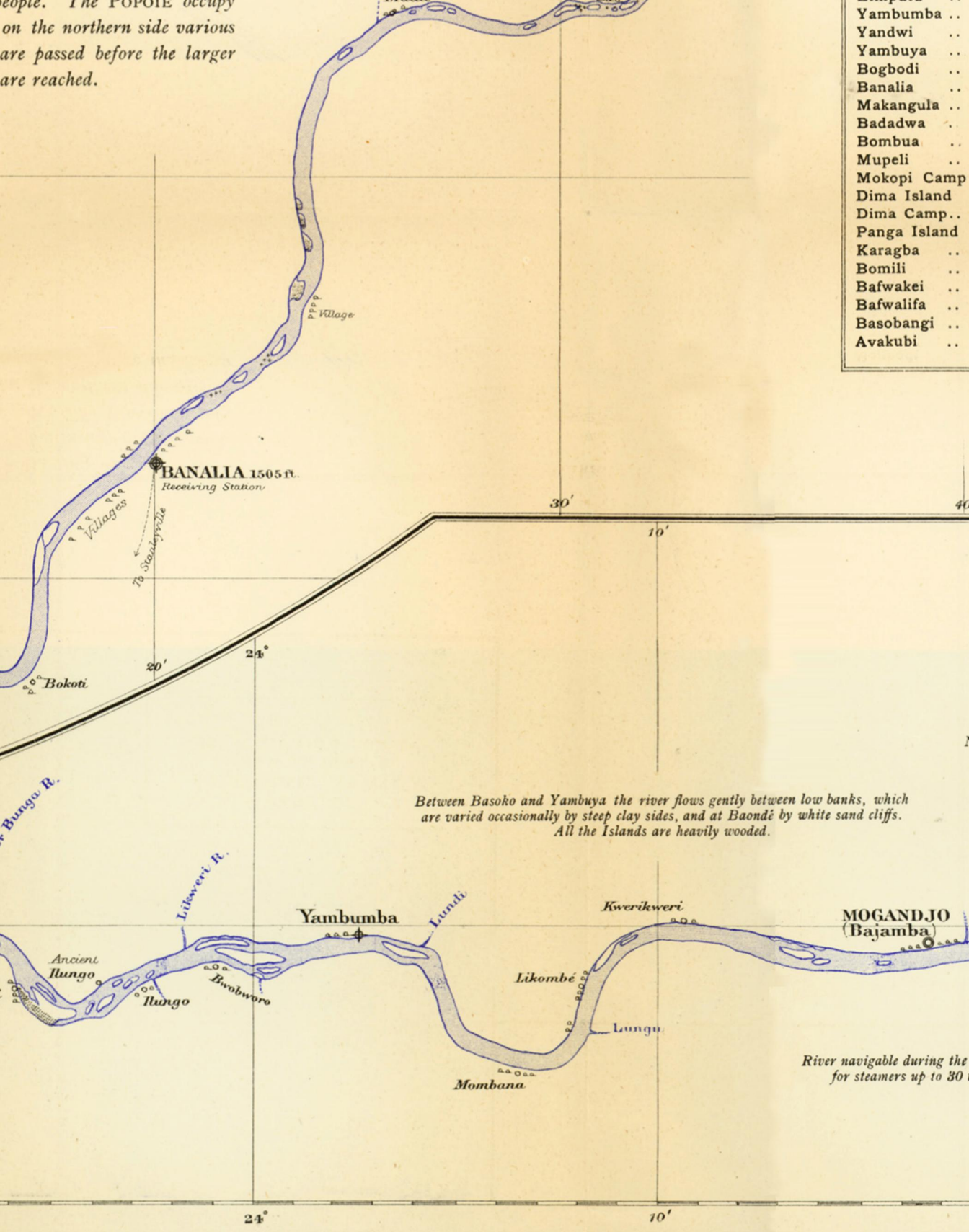
Variation of Compass were determined.	REMARKS.
by Sun and Star, compared with Compass bearing	Taken between Commandant's Residence and Post at Magazine. [Office.
.. .. .	" " Rest House.
.. .. .	" " Village.
.. .. .	" " Passengers' Quarters.
.. .. .	" " Rest House.
.. .. .	" " Passengers' Quarters.
.. .. .	" " Rest House.
.. .. .	" " Village. Bad fixing.
.. .. .	" " Rest House.
.. .. .	" " Old House (Chemin de fer).
.. .. .	" " Camp (R.L.R.)
.. .. .	" " Tree & Instrument Platform. Longitude by Occultation.
.. .. .	" " Rest House.
.. .. .	" " " "
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probably caused by over-lapping and fusion with the joint people. In a large tract back from the river on the southern bank, and on the north small tribes of BABUA, MOMBULI, MAKERI, MEDJE, &c., are passed by tribal divisions of MANGBETU and AZANDI are reached.



... on the northern side various
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Yambumba ..
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Bogbodi ..
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Badadwa ..
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Mupeli ..
Mokopi Camp
Dima Island
Dima Camp..
Panga Island
Karagba ..
Bomili ..
Bafwakei ..
Bafwalifa ..
Basobangi ..
Avakubi ..

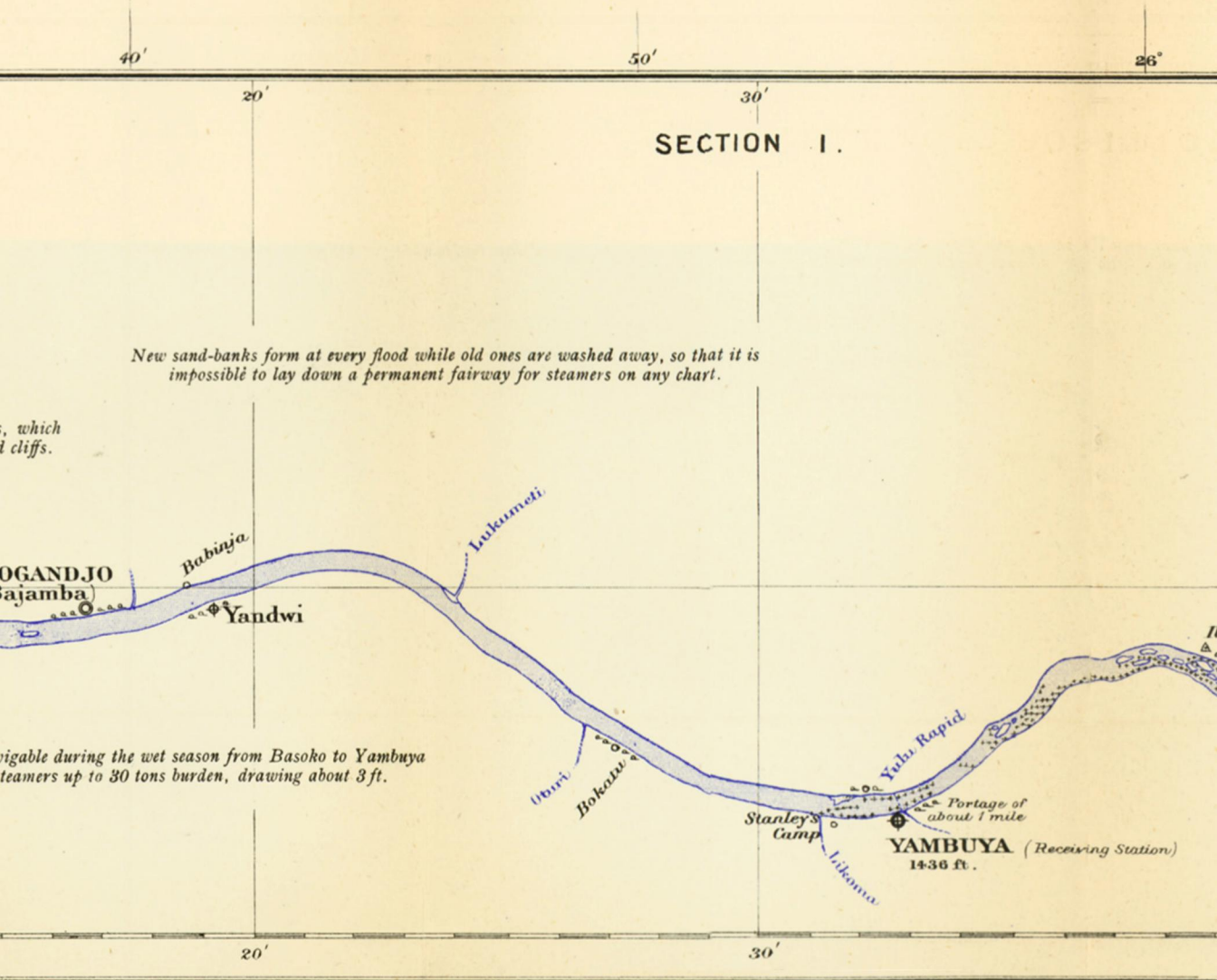


Between Basoko and Yambuya the river flows gently between low banks, which are varied occasionally by steep clay sides, and at Baondé by white sand cliffs. All the Islands are heavily wooded.

River navigable during the
for steamers up to 30'

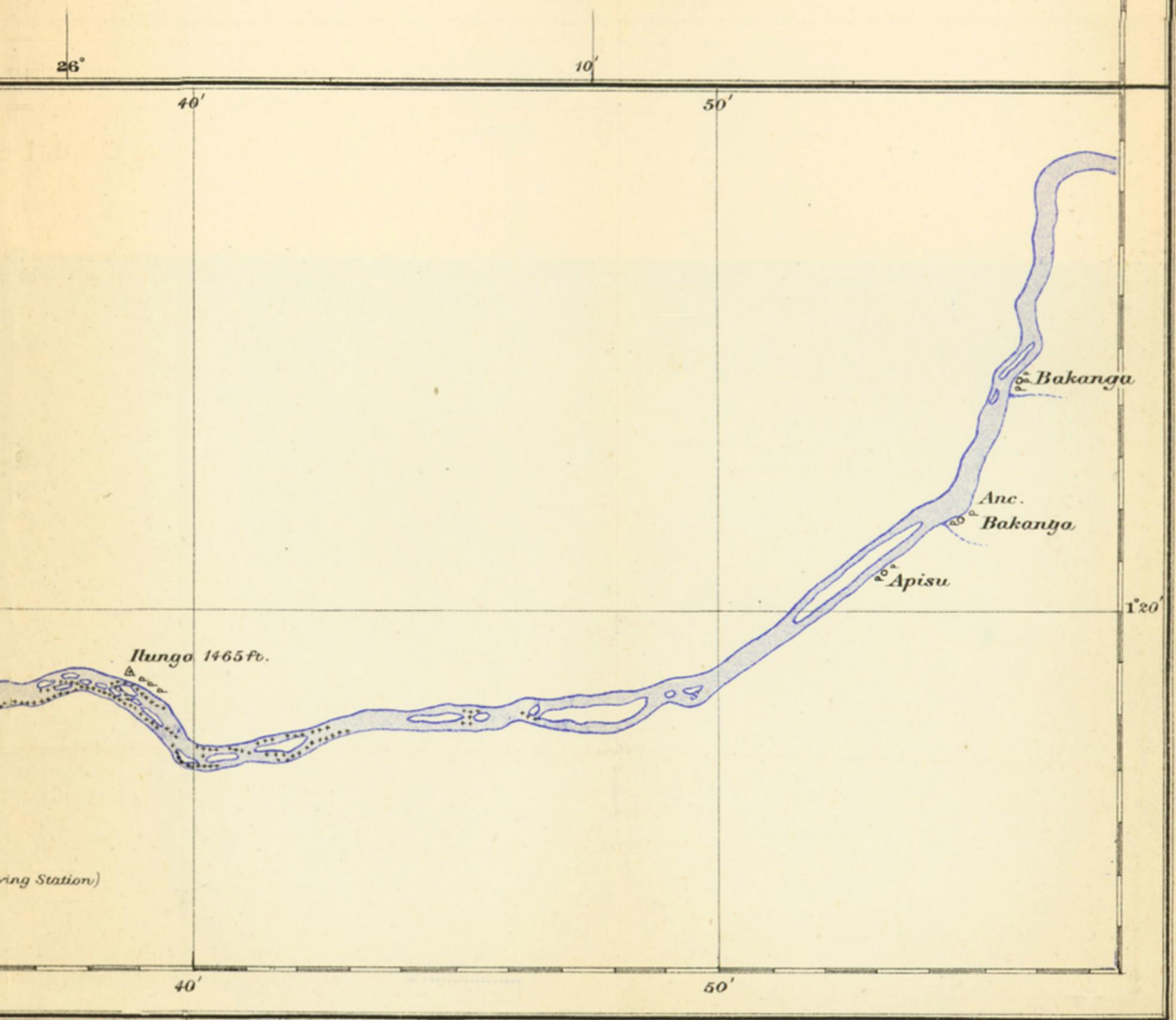
Yambumba	I 19 36	24 02 32	.....	" " " " " " " " " " " "
Yandwi	I 19 30	24 19 19	.....	" " " " " " " " " " " "
Yambuya	I 15 26	24 32 37	8 17 58	" " " " " " " " " " " "
Bogbodi	I 29 38	25 04 25	8 15 19	" " " " " " " " " " " "
Banalia	I 33 00	25 19 59	8 14 41	" " " " " " " " " " " "
Makangula	I 45 34	25 32 40	.....	" " " " " " " " " " " "
Badadwa	I 50 30	25 34 53	.....	" " " " " " " " " " " "
Bombua	I 53 23	25 39 59	.....	" " " " " " " " " " " "
Mupeli	I 53 34	25 59 14	8 13 06	" " " " " " " " " " " "
Mokopi Camp	I 57 17	26 07 17	.....	" " " " " " " " " " " "
Dima Island	I 55 51	26 12 49	7 40 36	" " " " " " " " " " " "
Dima Camp.. ..	I 55 35	26 12 58	.....	" " " " " " " " " " " "
Panga Island	I 51 36	26 24 37	7 36 16	" " " " " " " " " " " "
Karagba	I 43 52	26 35 50	.....	" " " " " " " " " " " "
Bomili	I 39 44	27 01 13	.....	" " " " " " " " " " " "
Bafwakei	I 33 37	27 15 19	.....	" " " " " " " " " " " "
Bafwalifa	I 34 30	27 19 40	.....	" " " " " " " " " " " "
Basobangi	I 28 34	27 27 02	.....	" " " " " " " " " " " "
Avakubi	I 20 05	27 34 31	.....	" " " " " " " " " " " "

Longitude of Dima Island determined by Occultation (Immersion)
 All other Longitudes depend upon Chronometric Difference



at Magazine.	at Magazine.
.. .. .	.. .. . Rest House.
.. .. .	.. .. . Village.
.. .. .	.. .. . Passengers' Quarters.
.. .. .	.. .. . Rest House.
.. .. .	.. .. . Passengers' Quarters.
.. .. .	.. .. . Rest House.
.. .. .	.. .. . Village. Bad fixing.
.. .. .	.. .. . Rest House.
.. .. .	.. .. . Old House (Chemin de fer).
.. .. .	.. .. . Camp (R.L.R.)
.. .. .	.. .. . Tree & Instrument Platform. Longi- [tude by Occultation.
..
.. .. .	.. .. . Rest House.
.. .. .	.. .. . Passengers' Quarters. Indifferent fixing.
.. .. .	.. .. . Rest House.
.. "
.. "
.. "
.. .. .	.. .. . Chef de Secteur's Residence.

Occultation (Immersion of η Leonis).
 Azimuth Differences from Dima Island.



RIVER ARUWIMI

REID