



The Tana River

C. W. Hobley

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In some districts the Government's communications have to run across the rivers, and not up and down on the commerce routes. As regards the trade, I do not think there is any possibility whatsoever of the aeroplane competing with any other form of transport, though it might be able to relieve the lack of supplies at certain times. When I visited the Rio Acre in 1912 there were aground there three steamers which had come up in the first rains; after the short period of the mid-rain dry weather, the rains not having continued, these steamers had to remain there nearly a year. Meanwhile the price of provisions had gone up enormously. The prices at the headquarters of the district were about half as much, but there was no equalization because there was no good communication between the two places, separated only by 60 miles from each other.

The PRESIDENT: There is no time for any more discussion, and it only remains for me to thank the lecturer on your behalf, as I am sure you will wish me to do, for his lecture and the splendid illustrations which at very great cost he has brought before us. I think we can realize the difficulties he has gone through. At any rate, those of us who have had to go through something of the same kind ourselves can realize them. He has been doing the pioneering work. Somebody has to make a start in these things. We do not suppose that flying across the Andes for trading is going to be a business proposition, because it is evident from what he said (and he has had great experience of aviation), and from what Colonel Beatty and Major Nanson said, that the cost would be too great. But it may be quite possible for those on the spot to make use of aeroplanes and hydroplanes and amphibious machines for exploring the rivers, for visiting outposts, and for going about from one river across to another. Anyhow, Mr. Dyott has done most valuable pioneering work in that direction which cannot fail to be of the greatest value, and we are extremely grateful to him for having given us this address, for having delivered it in such an admirable manner, and for having illustrated it with those wonderful pictures and cinematograph films which he was able at such grave personal risk to take during the course of his journey.

THE TANA RIVER

C. W. Hobley, C.M.G.

Map following page 328.

THE general physiography of the Tana river is fairly well known, and I feel some diffidence in approaching what may be considered a threadbare subject. I will, however, venture to crave indulgence on the score of being one of the earlier travellers who followed its course. Dr. Krapf knew but little of its geography, and only reached its banks somewhere west of Mumoni; Teleki and Höhnel only crossed the river. The first people to map its course were the brothers Gustav and Clemens Denhardt, who settled as merchants in Lamu, and ascended a considerable distance from the sea in 1878. They were probably briefed to obtain information for the official expedition of the infamous Dr. Peters, who ascended the river a little later with the avowed intention of hoisting

the German flag wherever advisable, and who left an unsavoury reputation which lasted for a number of years, and from which other Europeans who followed him had to suffer.

In 1889 J. R. W. Pigott of the I.B.E.A. Co. took an expedition up the Tana, and from Korokoro he struck west through the waterless region towards Mumoni and came to grief, barely escaping with his life, and losing a number of men from thirst.

In 1891 I formed part of what was, for those days, a well-equipped expedition which proceeded up the river in a stern-wheel steamer, the *Kenya*, and I mapped its course from the mouth to Hameye, where we established a station which was afterwards abandoned. An account of the journey was published in the Royal Geographical Society's *Proceedings*, 1892, p. 513. This is my excuse for the interest I have always maintained in this river; the reflections which follow are the result of that interest in its history, and the main excuse for embarking on a second paper.

The river is generally said to rise on Mount Kenya, and its principal branch, the Sagana, obtains its water from the west side of that mountain, the other tributaries of importance rising in Kenya being the Thika, Mutanga, and Kazita.

A considerable amount of water comes, however, from tributaries rising on what is generally known as the Aberdare range, the northern part of which is called Settima, and the southern Nandarua.* The main tributaries from these mountains are the Northern Chania, Southern Chania, Thika, Gura, and Mathioya. The proportion of the water supplied from Kenya and the Aberdare mountains respectively has never been accurately assessed, but it is believed that Kenya contributes the greater share. The tributaries of the river all rise in volcanic rocks, and have carved out deep valleys on their descent to the lower country. The main river, which is called the Kiluluma by the Kamba and Embe people, may be said to commence below the junction of the Thika and the portion locally called the Tana or Thana. This former name has been adopted by geographers for many years past as the accepted designation for the whole river. The river thenceforward flows in a north-easterly direction over metamorphic gneisses and schists. The valley is narrow and rocky, and is stepped down at intervals, these points being marked by waterfalls or rapids, and at many of these places granite dykes cross the valley.

The general direction of this portion of its course is dictated by the Mumoni range and the complicated ridge of metamorphic rocks to the south of that range; the river has cut a narrow valley round the north-west slopes of Mumoni, and once clear of the range it flows approximately due east until the metamorphic rocks disappear from view at the Hargazo

* These names, or variants of them, are sometimes given, as in W.O. map 1/250,000, to the culminating peaks of the groups. (See also *Journal*, Vol. 14, p. 283; 25, pp. 294-5; 26, pp. 466-7; 33, p. 91.)—ED. G. J.

falls (named Hoffman by Dr. Peters); the river then begins to turn southward towards the sea.

The last tributary entering the river is a small stream about 36 miles west of the above falls, and known as the Salt river on account of the brackish nature of its water in the dry season. Flood water from the Thua or Thowa river in Kitui and probably the Tiva river is said to find its way to the Tana in periods of very heavy rainfall, but by no marked water-course, great flats west of the river being under water during such seasons.

From the Hargazo falls to the sea the river can be compared to the lower course of the Nile; it flows through a vast alluvial plain, and although its general course is fairly straight, its minor bends vie with those of classical Meander, and its course is continually changing by a process of erosion during flood-time, the concave sides of the bends being carved away, and sandbanks piled up on the opposite side. Moreover, nearly every year the river succeeds in cutting through the neck of some of the more pronounced horseshoe bends, leaving a stagnant lagoon which soon becomes a reedy swamp, and eventually silts up altogether; if not cultivated it in time becomes covered with a patch of forest.

In the upper part of the river's course the rocky banks are not as a rule well wooded, although large acacias, dom palms, wild figs, and other trees are not uncommon; when Korokoro is reached, however, a belt of good forest is found on each bank varying from a mile or so to a few hundred yards in thickness. The trees composing this forest have not been systematically examined, but many species are known, and among them is one of the few soft and light timbers in the country, *Populus Denhardtiorum*, a very graceful tree with the typical poplar appearance. Below Malululu the amount of forest rapidly increases, and in the lower portion of the river it is usually entirely absent with the exception of an occasional group of borassus palms. When the tidal waters are reached one meets however with the usual mangrove forest.

This brings us to the mouth of the river, and there many problems of interest arise. In 1891 when I first visited the river it discharged at about lat. 2° 40' S., at the spot generally marked on the maps as Mto Tana, and as far as one could judge the position of this mouth was gradually moving in a southerly direction owing to the piling up of sand by the north-east monsoon. About 16 miles to the north-east there was a wide tidal creek called the Ozi, which was navigable by dhows as far as a village called Kau and possibly a few miles further; thenceforward the Ozi becomes a very insignificant affair.

Some years previously the then Sultan of Witu, one Fumo Omari, cut a small canal in order to afford communication between Charra and Kau; it was a mere ditch only sufficient for a canoe to pass. In about 1895, however, the District Officer at Kipini, as a famine relief work, consider-

ably widened the ditch, which is called Belezoni (Swahili, *Belezo*, a canal). Shortly after the construction of this work a big flood came down, and the flood water, finding it an easier outlet to the sea, carved a great wide channel in a single season, and henceforth the Tana river permanently discharged its waters by the Ozi mouth, and the old Tana mouth, or the Sheriko, only discharged a small amount during the highest floods; whereas when I last saw it in 1891 we steamed up it in a stern-wheel steamer 75 feet long.

Since the date when the river annexed the Ozi as its main channel it has worked its way north for some 200 yards, and unless it is checked it will, in a comparatively short time, demolish the present village of Kipini. A grove of palm trees formerly on the north bank has been entirely swept away and its position is only marked by a sandbank in the river. It is evident that the north-east monsoon was the determining factor with regard to the gradual southern movements of the old Tana mouth, and that the south-west monsoon is the factor which causes the Ozi mouth to gradually eat its way northwards.

I will now venture a few remarks upon the history of this river in more remote times. If we examine the coast to the south of the river we find a creek of considerable size, the Kilifi river, some 16 miles south of the old Tana mouth, and again 10 miles south of that another creek called Pamamba. Now it is believed that both these creeks were old mouths of the Tana river; it is not suggested that either carried the whole of the water discharged, but it is more than probable that they formed part of a great delta. The Kilifi river can to this day be clearly traced northwards through the swamp known as Lake Kurawa to near Golbanti on the Tana, and in periods of high flood still discharges to the sea.

Proceeding also north-east we find a number of creeks commencing with the Ozi, Mkonumbi creek, Mto Unga creek, and Mongoni creek, the outlet of the Pokomoni river. Although some of these are of considerable size, they now normally discharge insignificant amounts of fresh water, except the Ozi, which, as explained before, now carries the whole of the discharge of the Tana of to-day. But before the river became so diverted the Ozi creek was an estuary of very considerable size, to above the village of Kau. The Mkonumbi creek, however, still discharges Tana water in seasons of high flood.

After careful consideration of the data available, I feel convinced that the whole of the creeks from Pamamba to Mongoni composed the delta of the Tana river in past times and probably throughout the whole of the latter portion of the Tertiary period. Whether they were all in commission at one time is not certain, and the following point is worth consideration. It has been laid down by some of our greatest geologists that the course of rivers flowing north and south through horizontal strata or through alluvium is affected by the revolution of the Earth. The Earth revolves from west to east, and this movement is believed to cause

greater water pressure and consequently a greater amount of erosion on the west bank of rivers from N. to S. Now, not counting bends, during the last 120 miles of its course the Tana runs practically north and south through a plain covered with a layer of soft alluvium, and we have a case in which the Earth's rotation has probably exercised an effect uninterruptedly during a long period. This being so, from an examination of the charts we may premise that the original delta consisted of the creeks from Mkonumbi to Mongoni, the three main outlets of discharge being the Siyu channel, Manda bay, and Mkonumbi channel. The great beds of sand forming Lamu island and parts of Siyu or Patta island are relics of the alluvial deposits brought down by the river and piled up by it against reefs of coral growing up out of the sea.

As the course of the river gradually moved westward these channels carried less and less water and went out of action as mouths of the Tana. It is, however, very unlikely that the flood discharge of the river would have become confined to a single opening or mouth unless the volume of water had been greatly reduced, for we must not overlook the fact that the southern arms of the delta have fallen into disuse as well as the northern members. This will be referred to later.

An important fact must here be mentioned:—opposite the ancient sandbank which is now Lamu Island we have Manda Island, which is an old coral reef; this latter island now stands some 12 to 15 feet above high-water level, which is evidence of the latest elevation of the coast-line hereabouts. Similar elevation is to be observed farther south and also to the north. At Wasin Island (near the old Anglo-German frontier) it is about 20 feet, at Mombasa and Kilifi it is about 70 feet, at Malindi about 50–60 feet. This elevation probably occurred as far back as Pliocene times, and was probably an important factor in changing the points of discharge of the water brought down by the river.

Attention is also invited to the fact that opposite what I propose to call the old Tana delta, the edge of the continental shelf runs out to sea abnormally far as compared with the coast-line in general, the 200-metre line being some 23 miles out to sea, and this, coupled with the existence of the creeks, is quite good evidence to a geologist of great deposits of alluvium formerly brought down by those said creeks. Opposite the Mto Tana mouth, although the 200-metre contour cuts across the chord of Ungama Bay, the bulge to seaward is not so pronounced as farther north.

The coral of Manda and Patta reefs began to be formed during the last phase of the history of this delta, for it is unlikely that a great growth of coral reef would take place during the period in which the fan of alluvium was being deposited out at sea; and further, during the period of deposition the weight of the deposits would tend to check the general rate of elevation of the coast-line at this point. Another river some 250 miles to the south, the Rūfiji, is in the same stage as the Tana was during its delta period. The Rūfiji annually discharges a vast amount of alluvium

by its many mouths, and this forms a great deposit out to sea, the weight of which is very great, and the Earth's crust appears to be sinking in the vicinity of the south end of Mafia Island, as evidenced by mediæval ruins now to be traced below sea-level.

I have above mentioned that the former existence of a delta is almost certainly connected with an increased discharge, particularly in flood-time. In this connection I would ask the reader to examine a map of the area south of Kenya and east of the Aberdare range, and on southward to Ngong or Lamwia mountain. We here find a large number of streams which rise on the east flanks of the great ridge which extends from Settima to Lamwia; the majority of these streams have courses practically parallel with each other, and the depth of most of their valleys are so identical that they are evidently all of the same age, and the early travellers quite reasonably assumed that these streams belonged to one river system.

The more early explorers had varied views as to the upper course of the Thika, Tana, and Athi, and the three sketches in Gregory's "Great Rift Valley," p. 200, show the different opinions. Ravenstein never visited the country, but he had a profound knowledge of maps, and it is of interest to note that, taking his Theuka as the combined Athi and Thika, we get a rough idea of how the rivers ran before the suggested change of channel occurred. Von Hohnel, who was usually a very careful observer, showed the Thika running into the Athi; and Gregory was the first explorer to show the correct arrangement of this curious piece of river alignment, that the streams south of the Chania flowed into the Athi, and that the Athi and Thika at one point were only about 2 miles apart, being separated by a ridge composed of a sheet of lava (phonolite) overlying the old metamorphic rocks.

There is, I consider, a strong presumption that at one time the rivers south of the Chania, including what is known as the Mbagathi, were tributaries of the Tana, and that towards the end of this period of volcanic activity the group of streams mentioned above became diverted from the Tana basin to the Athi by volcanic action. Only an explanation on these lines will, I consider, solve the mystery of such an unusual drainage line. Further detailed survey needs to be done to provide complete evidence of this change of course, but we have here a reasonable explanation which will account for a decrease of the flood discharge of the Tana by at least one-third.

In a previous paper on the "Desiccation of East Africa," which appeared in the *Geographical Journal* of November 1914, I summarized the evidence for decrease of rainfall, and I am convinced that much of this is unassailable, and that, speaking in general terms, there is but little doubt that since the middle of the Tertiary period the rainfall, and consequently the discharge of water to the sea, has decreased.

To revert to the beheading of the Athi; the sheet of lava above referred to is very persistent, for it follows the left bank of the river for a

vast distance in a southerly direction, and is throughout called the Yatta by the A-Kamba. At the north and about lat. 1° S. it covers a wide extent, but as we follow it southwards it becomes narrower and narrower and also considerably thinner; opposite the Tsavo junction, for instance, it is under a mile wide and only about 50-60 feet thick. It is said to finally disappear near Loga Hill about 3° S. lat. and $39\frac{1}{4}^{\circ}$ E. long.

Various theories have been propounded on the formation of this curious sheet of lava, but none is entirely satisfying, and the focus or foci of eruption of the Yatta lavas are still to seek. Prof. Gregory has, I believe, essayed the opinion that the persistent tongue of lava known as the Yatta may be due to the discharge of the phonolite down an old river valley which formed the old course of the Athi and Sabaki rivers; the premiss is ingenious, and I regret that since the suggestion was made no opportunity has offered of testing it on the spot. There is one place where a V-shaped gorge has been cut through the lava belt, and an examination at this spot should be of value, for it should demonstrate or disprove the existence of the old river gravels deposited in the valley before the filling up of the river-bed.

If this theory holds, one difficulty is the great distance the lava must have flowed, for the narrow strip forms a continuous mass for a distance of no less than 180 miles, and it is not easy to see how it can have remained hot enough to flow so far, especially if the original stream was anything like its present width. I am inclined to look upon it as the survival of a much wider tongue of lava which has been denuded away on the east side by the present Tiva and its tributaries. On the west side probably the metamorphic series rose much higher than to-day, and the Athi cut its channel along the western edge of the lava-flow and gradually eroded its present deep valley. Even then the difficulty regarding the distance over which the flow extends still remains.

I would ask readers to refer again to the map of the country east of the Athi. In Kitui district, some 30 miles east of the Athi, there is a broken range of old metamorphic rocks, and numerous small streams rise in this ridge and flow south-west towards the Athi; they are, however, all absorbed by a small intermittent river called the Tiva, which for a long distance runs parallel to the east flank of the Yatta plateau.

Assuming that the Yatta is the relic of a wide tongue of lava, of say Cretaceous age, which welled out of a series of foci of eruption south of the Tana valley, we may well consider in this connection the former history of the Tiva, and my proposal is that the original Tiva drained the surface of this great lava-flow and during that time flowed into the Athi valley. Later on in Tertiary times the eastern edge of the lava-sheet was gradually cut into by streams which ran into the Tana; this action eventually captured the Tiva system, and henceforward its waters flowed eastward to the Tana, the point at which the waters were diverted east being roughly S. lat. $2^{\circ} 30'$, E. long. $38^{\circ} 20'$.

For the reasons above stated the Tiva river in the hypothetical map is shown as a tributary of the Athi river. This river during the rains carries a large amount of water, for it drains a very considerable area ; at other times it is dry. Beyond E. long. 39° its course becomes very indefinite ; the late Captain Aylmer made an attempt to discover whether it does actually discharge into the Tana as supposed, but he failed to solve the problem. Recently some Sania hunters informed me that the Koromi river, which enters the Sabaki near its mouth, was named the Tiva in its upper course. It is doubtful if this is the northern Tiva, but if opportunity offers another attempt should be made to solve this small geographical problem. At any rate, whether it is connected with the Tana or Sabaki, its course is so long and its flow so intermittent that it would not materially affect the volume of discharge of either river.

In 1917 I made a journey for some distance through the dry country due west of Fundi Isa, to visit some outlying native settlements in a dry watercourse which had cut a shallow valley through some lowlying ridges. About 7 miles west of Fundi Isa I located a bed of fossil shells of Tertiary age, which are of some interest in connection with the present inquiry. The ridges rose to about 200 feet, and the level of the shell beds was probably about 75 feet. These beds extend over a considerable area, and from their first occurrence to the last one seen was about 8 miles. The shells are of marine origin, and the deposits evidently mark the position of the beaches at the mouth of a great estuary into which the Tana debouched. There appeared to be two beds of fossils, but the bush was thick, and there was no water to be had, so it was impossible to stop and work out the succession in detail. The formation of these beaches was probably prior to the existence of the old delta referred to earlier in this paper.

A careful search was made for traces of coral, but only one water-worn coral pebble was seen, and the scarcity of coral may be evidence of a much greater flow of fresh water than exists to-day, for marine shells can adjust themselves to a large amount of fresh water, periodically discharged, but coral cannot do so ; one flood of even brackish water kills it. Or possibly the fact that the flood waters of a river bring down a large amount of mud may be the actual point that tells, the fine river mud causing functional disorders which the coral cannot struggle against.

Slight traces of similar beds of fossil marine shells have also been found along the flank of Gaji hill some 10 miles up the Sabaki valley, and evidently mark a similar epoch.

Mr. Newton classes the mollusca from the beds nearer the sea as Miocene and those from the beds farther inland as Eocene, and Prof. Gregory also describes the solitary coral as Eocene. This determination therefore puts back the age of the ancient shoreline farther than was anticipated, and it will be interesting to trace its extent and map its original outline. Similar beds should be found to the north in the Juba

valley. I am indebted to Mr. J. G. Elliot, who first drew my attention to these deposits.

Proceeding inland westerly from Fundi Isa, after the shell beds were lost sight of I found thick beds of pure white sand, and these probably mark a still earlier epoch in the history of the coast, but no traces of fossils could be found. At one place called Hadu this soft sand was carved out by water into a steep-sided pit some 40 feet deep, and several acres in extent; a small dry stream bed emerged from its eastern edge. As however I have ventured to remark elsewhere, the discussion of problems like these demonstrate more than ever the necessity of detailed survey with the aid of large-scale accurate maps, and until this is possible certainty can in no way be reached.

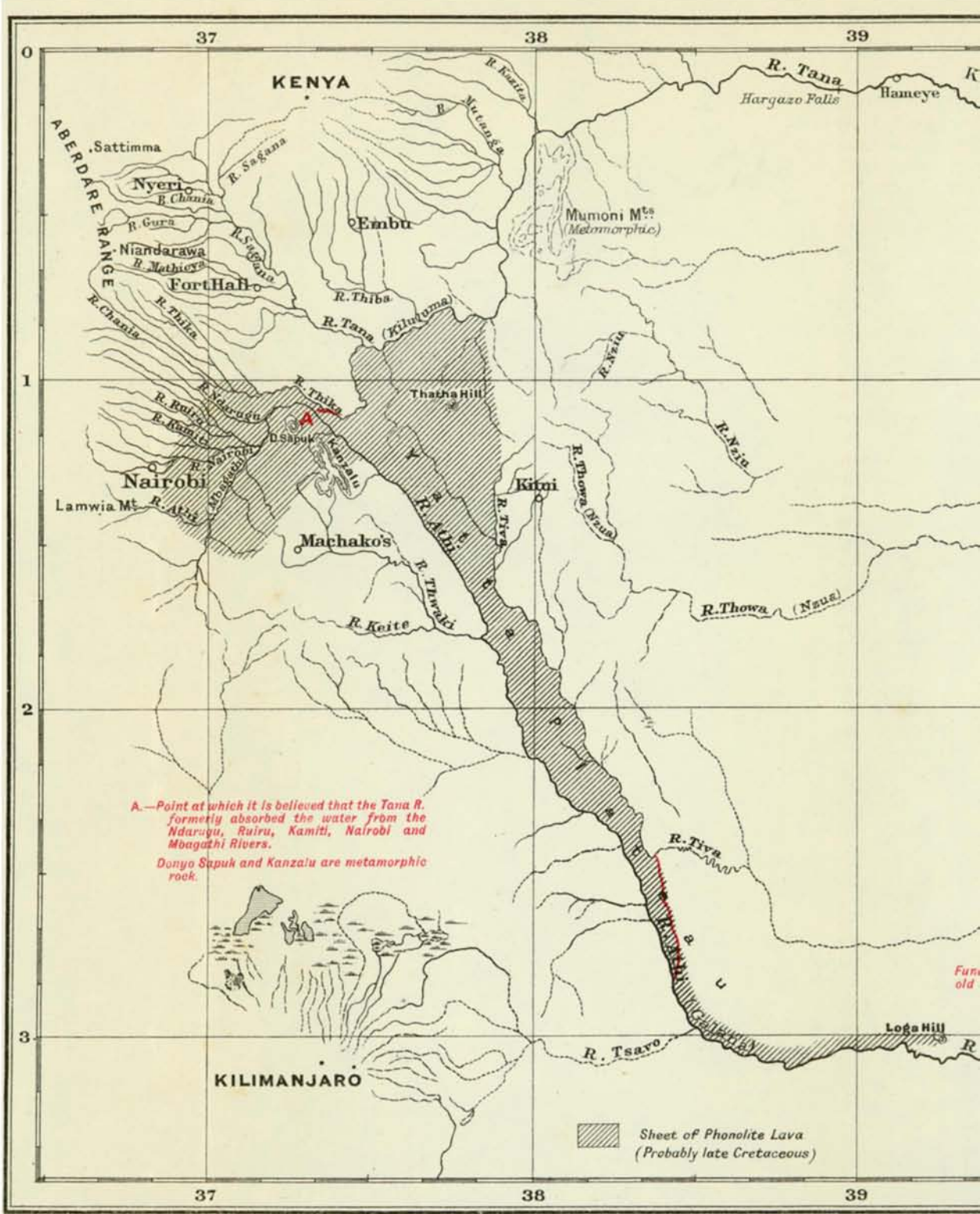
THE PALACE OF KHOSRAU II. AT DASTAGERD

Major H. C. Agnew, R.E.

SOME 50 miles north-east of Baghdad two names are shown on the War Office Maps, "Eski Baghdad" and "Zindan" (ruins). Eski Baghdad, or Old Baghdad, is a name given by the Arabs to the ruins of more than one ancient city, and there is nothing on the map to show that either of these places is of more than usual interest.

In the *Journal* of the R.G.S. for 1840, Rawlinson writes that of the identity of Dastagerd with the Sassanian ruins of Eski Baghdad there can hardly be any question. At Eski Baghdad there is now nothing noteworthy to be seen. Its destruction must have been completed in recent times by the local Arabs carrying off the bricks for building modern villages, a fate which has befallen many ancient ruins in Mesopotamia. Rawlinson, however, also refers to a palace called Bebdareh on the outskirts of Dastagerd, and says it may perhaps be identified with the remarkable ruins of Zindan.

I think there is no doubt that Rawlinson is right, or anyhow that these are the ruins of Khosrau's palace. The tradition of the local Arabs connects it with Khosrau, though the legend runs that he built it as a prison for his numerous captives. Zindan is Persian for a prison, and the ruin might possibly have been used as a prison at some later date. Certainly nobody who studied the ruin could imagine that it was originally built for a prison. Comparing it with Ctesiphon, it was easy to guess at first sight that this too was the ruin of another great Sassanian palace. Built of the same large bricks and hard mortar, it is planned on a scale which marks it as likely to have been one of the most magnificent buildings of the age. This corresponds with the account given in the 'Decline and Fall of the Roman Empire' of the palace of Khosrau II. at Dastagerd. The city of Dastagerd is said to have been founded by his father Hormuz; the palace



A.—Point at which it is believed that the Tana R. formerly absorbed the water from the Ndaru, Ruiru, Kamiti, Nairobi and Moagazi Rivers.
 Donyo Sapuk and Kanzalu are metamorphic rock.

Sheet of Phonolite Lava
 (Probably late Cretaceous)

