



Through the Great Cañon of the Euphrates River

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Reviewed work(s):

Source: *The Geographical Journal*, Vol. 20, No. 2 (Aug., 1902), pp. 175-200

Published by: [Wiley-Blackwell](#) on behalf of [The Royal Geographical Society \(with the Institute of British Geographers\)](#)

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other room some of his photographs, which were examples of the way in which, by a knowledge of the formation of ripples in sand, one would be able to tell the direction of currents in mouths of rivers and estuaries. So I think we can congratulate Dr. Vaughan Cornish, not only on the great scientific value of his investigations, but also on the practical use to which many of them may be turned. I now ask the meeting to pass a unanimous vote of thanks to Dr. Vaughan Cornish for his valuable paper and for the beautiful way in which he has illustrated it by his photographs.

THROUGH THE GREAT CAÑON OF THE EUPHRATES RIVER.*

By ELLSWORTH HUNTINGTON.

A REFERENCE to the map of Asia Minor shows that the Euphrates river is formed by the union of two great branches. These for several hundred miles flow west-south-west in nearly parallel longitudinal valleys bounded by high ridges of mountains. The north-western branch, or Kara Su, although it is smaller than the other, is generally called the Frat, or Euphrates. Near Egin the mountains that bound its valley come together, and it is obliged to turn abruptly at right angles toward the south through a tremendous gorge, which it has cut directly across the southern range of the anti-Taurus mountains. Twenty miles below the gorge it empties into the larger branch, the Murad Su. The latter flows from north of Van nearly straight west-south-west to this point, part of the way through an unexplored cañon, said to be longitudinal and impassable. Below the junction of the Murad Su and Kara Su the Euphrates river makes a great bend to the south, and later to the east, and then, again turning south, zigzags through the Taurus mountains in a deep gorge. It is this great bend and the lower part of the two branches which I propose to describe.

Before proceeding to that, however, it will be well to get a general idea of the physical features of the surrounding country. We will examine these in geographical order, beginning on the south with the Taurus range. This rises here to an average height of 7000 feet, the lowest passes, except where the Euphrates and Tigris rivers cut through the range, having an elevation of about 5000 feet. The core of the mountains consists of a very old trap, the oldest formation of the region. This is broken in many places by eruptive granites and porphyries, which are older than the oldest stratified deposits. These crystallines are especially abundant on the north side of the mountains. On the weathered surface of these igneous formations are the remnants of a complex series of strata with several unconformities marking intervals of erosion so extensive that

* Map, p. 177.

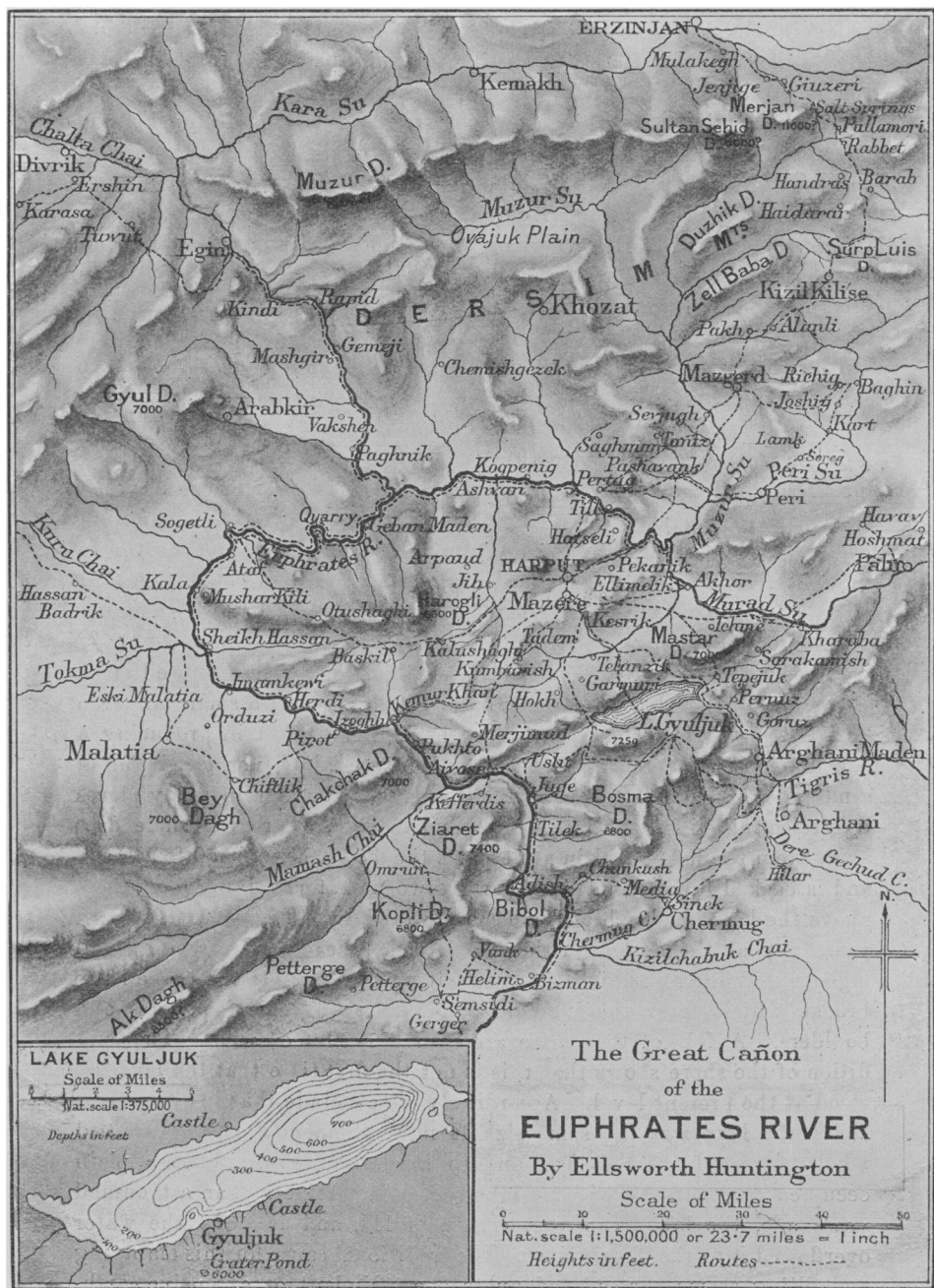
only the upper series of strata remain in large quantities. These are Cretaceous shale and limestone containing, among other fossils, numerous hippurites and nummulites. In post-Cretaceous times extensive elevation and mountain-building took place accompanied by considerable faulting. Probably it was at this time that the shale was locally much metamorphosed. The Cretaceous strata, rarely exceeding 1000 feet in thickness, form the tops of the majority of the mountains. Overlying the uplifted and highly eroded surface of this formation are numerous recent lava-flows, chiefly basaltic, which evidently took place after the country had assumed approximately its present topography. In several places there are cones of ash, and south of Lake Gyuljuk there is a crater enclosing a pond.

This lake lies in a longitudinal valley between the northern ridges of the Taurus, in the neck of the great bend of the Euphrates river. Its position in respect to the latter is so remarkable that it deserves notice. The map shows that below Palu the river flows south-west directly toward the lake and in the same longitudinal valley. Fifteen miles from Gyuljuk it is turned west and north around the great bend already mentioned. After a course of 160 miles, it again enters the same great valley on the opposite side of the lake, toward which it once more flows, this time in a north-easterly direction, to a point 15 miles from the lake, where it turns south. The valley, which is everywhere a prominent feature in the topography, is occupied by six small streams beside the lake and the river, three flowing west and three east, two to the lake and four to the river; and in it, moreover, is the service of the main branch of the Tigris river.

The name Gyuljuk means "little lake," but the sheet of water is 12 miles long and from 2 to 3 miles wide. Previous to 1878 or 1879 it had no visible outlet.* For many years its borax-bearing waters had been steadily rising, and at that time overflowed to the Tigris. The older villagers, who live along the shores of the lake, say that they can remember a time when the water was 20 or 30 feet lower than it now is. Their fathers told them that in their young days it was possible to wade to an island which is now separated from the shore by water 75 feet deep. They had heard that still earlier the island was connected with the mainland, and was the site of the village which now lies on the mainland opposite. This is incontestably corroborated by the fact that on the island are the remains of an old monastery,† all around which may be seen the ruins of houses submerged in the lake to a depth of 25 or 30 feet. Part of the stones of the monastery are of a kind not now found

* H. F. Tozer, 'Turkish Armenia and Eastern Asia Minor,' London, 1881, pp. 239-246.

† *Verhandlungen der Berliner anthropologischen Gesellschaft*, February 17, 1900, pp. 144, 150-152.



in the vicinity, but probably cropping out under the lake. Some villagers who know how to read say that in their church was an old book, unfortunately destroyed during the events of 1895, in which it was recorded that six hundred years ago the site of the lake was a plain, through the middle of which flowed a stream emptying into a hole at the lower end. This hole was later filled with silt, and the stream was thus dammed so as to form a lake. In 1899 I mapped the lake and took a number of soundings, from which the contour of the bottom was roughly determined. It is perhaps worth noting that at the east end, just where the villagers locate the ancient outlet, there is a very precipitous slope with a descent of 400 feet in 1100 feet. Another corroborative piece of evidence is furnished by two castles which were built between one and two thousand years ago, and stand on opposite sides of the lake, near the middle. Such castles are always built with a definite purpose, but under the present circumstances it is hard to imagine what use they could serve, as there is nothing for them to defend. If there were no lake, the shortest and easiest road from Harput to Diarbeker, as determined by the location of passes, would go directly across the lake-basin from one castle to the other. Hence they lend additional certainty to our conclusion that no lake, or only a very small lake, existed here one or two thousand years ago.

Accepting this conclusion, it is clear that the present shore-line is along an old beach. In twenty or twenty-five years a small lake like Gyuljuk would be utterly unable to have much effect in producing a bench along its margin. The beach as now seen, however, consisting of sand and pebbles, is fairly continuous, although broken in many places by projecting cliffs, especially on the north side, where the shale dips away from the lake; and in some parts the beach is 40 or 50 feet wide, and is backed by a second line of wave-worn material lying 6 or 8 feet above the lake-level, which has been lowered by a trench dug twenty years ago at the outlet. Behind this upper beach are several small lagoons. While discussing the beach, it may be said that all the little brooks which enter the lake have fan deltas of coarse pebbles and boulders. A few of the deltas are nearly 1000 feet wide. The condition of the shore shows that this is not the first time that the lake has stood at the present level. Accordingly we conclude that in prehistoric times the lake was the same size as now. Somehow it was drained wholly, or in large measure, and so in early historic times a plain occupied most of the present lake-bed. At last, less than a thousand years ago, the lake-basin began to be filled, and in 1878 the water overflowed into the Tigris river. The traditional cause for this emptying and filling seems the only adequate one. Violent or extensive earth-movements are utterly out of the question, because there is not the slightest sign of them, the present shore-line agreeing exactly with the

old one. Changes in climate are impossible as an explanation, because a reduction in rainfall sufficient to cause the lake to shrink to the size which it must have assumed, would have made the surrounding country a desert at the beginning of our era, which, as every one knows, is contrary to the facts of history. Therefore we seem to be justified in assuming that somehow a passage was opened in the bottom of the lake; most of the water was drained off; later the hole was filled, probably by the deposition of silt, and so the lake was restored to its former condition.

North of the Taurus mountains is a great lozenge-shaped basin, from the two ends of which flow the Murad Su and Tokma Su in opposite



A RUINED BRIDGE OVER THE MUZUR SU, NEAR MAZZERD.

directions towards the centre. This is floored with a series of plains formed of a fine alluvial deposit and broken by a number of small mountain ridges. Cretaceous strata are abundant in these ridges, but their lower layers contain more sandstone and conglomerate than do the corresponding strata further south. North of the plains lies the southern half of the anti-Taurus mountains, in which may be included the great Dersim range. The old trap, the Cretaceous strata, and the later lava-flows are well represented, and there is a large development of limestone, seemingly older than the Cretaceous, although its age has not been determined. This is especially abundant among the highest mountains, those around which the Kara Su flows, where it turns from

a westerly to a southerly course, and in the lower mountains farther west. It reaches its maximum development in Muzur Dagħ, where the thickness from the river at Egin to the top of the mountain appears to be 8000 feet. Between the two great divisions of the anti-Taurus mountains lies another series of alluvial plains at an elevation of from 4000 to 6000 feet. They are to Asia Minor what Tibet is to Asia Major. Through them flow the Kara Su from the east and the Chalta Su from the west, meeting a few miles above Egin. The former flows on the surface of the larger plains, but on the sides of the latter river the plains lie at a much higher elevation, and have been cut by the river to a depth of 2000 feet.

Such, in brief, is the country where the Euphrates is formed by the junction of two large streams, and changes its course from eastward to southward. The main roads have been often traversed and described by travellers, but most of the region is very imperfectly known. The great general Von Moltke was the first to investigate the course of the Euphrates river, as it zigzags through the mountains.* In July, 1838, when the water was at its lowest, he floated down on a raft from Palu to Birejik, finding the first 125 miles to Kemur Khan easy, but farther down, in the gorge through the Taurus mountains, meeting with the greatest difficulty because of rapids. A second attempt in the spring of the next year, when the water was high and the rapids more dangerous, had to be abandoned at Tilek near the beginning of the greatest cañon. Since that time no one, so far as I can learn, either native or foreigner, had attempted the journey through the lower gorge until in the spring of 1901 it was my good fortune to accomplish it in company with Prof. Thomas H. Norton, U.S. Consul at Harput.

Starting from that place, we rode to Akhor, on the bank of the Euphrates, at the eastern end of the Harput plain. The people of this village, Armenians, make a business during the winter of floating down the river to Kemur Khan on rafts of skins, fishing as they go. These rafts are known as kelleks, and the raftsmen as kellekjis. As there are no equivalent English words, I shall employ the Turkish terms. At Kemur Khan the kelleks are taken to pieces, and together with the fish loaded on donkeys sent by land across the neck of the river's bend to meet them. The fish are sold at Harput, and the rafts are taken back to the village, whence they start again. We had engaged two of these fishermen to take us down the river as far as we should choose to go, with the condition, imposed by them, that they should be allowed to make a portage around one dangerous rapid, of which they had heard, in the lower gorge below Kemur Khan. We

* See Moltke, H. von, 'Briefe über Zustände und Begebenheiten in der Türkei au den Jahren 1835 bis 1839.' Berlin, 1876, pp. 289-291, 360-363.

sent our horses by land across the narrowest part of the bend of the river to Chunkush, and thence to Gerger, and on the morning of Friday, April 12, were ready to begin our voyage.

The making of the kellek took some time, although in the evening a number of entire sheepskins had been well soaked and left wet so that they might be pliable and ready for immediate use. In the morning they were inflated by blowing through the necks, the legs being securely tied so that no air could escape. At first the mouths of the blowers were at a distance of 8 or 10 inches from the necks of the skins, but as the latter became fuller and more difficult to inflate, the men's mouths were brought nearer until they touched the skins. When a hole was



KELLEK ON THE MURAD SU, NEAR ASHVAN.

discovered, it was quickly mended by putting a piece of wood like a checker against the inside of the hole and tying the skin firmly around it. A light frame of saplings was tied together with ropes, and under this were tied the skins, about thirty in number, with the legs up. They were packed together so closely as to make the kellek watertight. Thirty skins seemed to us very few for five people, but the fishermen's rafts consist of only six, and two men sit on one such kellek. The kelleks always go in pairs on long fishing-trips.

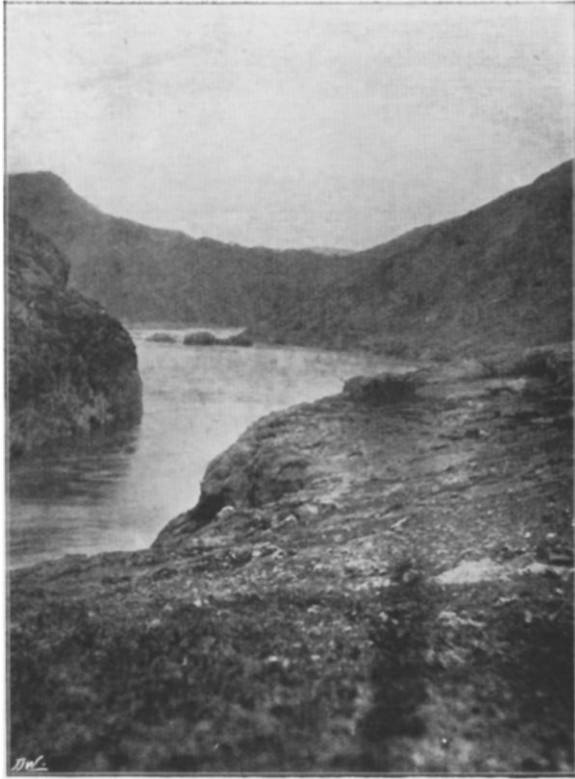
As the spring of 1901 in Turkey was unusually dry, the river was comparatively low, being about halfway between the extremes of flood and low water. As it was, the current seemed very swift even in the

plain at Akhor. As soon as we began to float, we concluded that a kellek moves in the easiest, most delightful way that can be imagined. There is no jar or shake. The buoyant skins and pliant saplings adapt themselves to every movement of the waves. Half an hour after starting, we stopped for some time while the kellekjis gathered a great quantity of weeds, which they spread over the raft, partly to protect the skins from injury by our feet, but still more to prevent them from drying in the hot sun and cracking. Every hour or two they threw water over all exposed portions of the skins.

On the plain half a mile from this place, near the village of Elimellik, is one of the many artificial mounds which dot the plains of this region in large numbers, and which contain polished stone hammers, bone knives, and other implements. This mound is small, only 200 or 300 feet in diameter, and insignificant except for one thing. Close beside it flows a mill-race, which has undermined one side so that a perpendicular section is exposed about 30 feet high. About 12 feet above the level of the plain is a horizontal stratum of water-rolled gravel, 2 or 3 inches thick. Above and below this the mound is composed of loam filled with bits of pottery. Clearly this mound was built to a height of 12 feet, and then submerged under some body of water long enough for the layer of gravel, and probably for some layers of finer material, to be deposited. The water then retired, and men again occupied the mound. The cause of this submergence is not clear. The first thought is that it was due to a river flood of unusual height, but under present conditions this would be impossible, for the highest level of the water is now 30 feet below the mound, and the range from high to low water is not more than 15 feet. Moreover, if a flood reached to the mound it would not deposit gravel, but sand or finer material.

A short distance below this mound the river enters a gorge, and a series of small rapids is formed. It here turns north by west, and passes transversely through the small Harput range of mountains. The gorge, cut almost wholly in basalt, has walls 1500 feet high on the south side, and 2500 feet on the north, the distance between the two summits being but little more than 3 miles. Halfway between the entrance to the gorge and the mouth of the Muzur Su, an imposing basaltic rock rises in the middle of the river to a height of 60 feet. On the side down-stream, where alone it is possible to land, is an artificial platform, from which a flight of rock-hewn steps leads to the levelled top. A few other places where ascent might be possible have been protected by walls. On the right bank of the river close by is a cliff, in which has been cut a cave about 20 feet deep. From the back of this ascends a flight of seventeen steep steps, leading to an opening which commands a fine view up the river. The style of work shows that this was a fortress of the Haldis, or Näiri, those

unconquerable enemies of the Assyrians of whom we have lately learned so much through the labours of Drs. Belk and Lehmann, especially the latter. The location of a castle here, where there could be no bridge, and where the road along the river-bank is very difficult and much longer than over the mountains, and the fact that the watch-cave faces up, not down, the river, indicate that it was built to guard against enemies who came down the river itself. Probably they used to float down the river on kelleks 3000 years ago just as they do now.



LOOKING DOWN THE EUPHRATES FROM THE OLD MARBLE QUARRY NEAR KEBAN MADEN.

The next point of interest below the castle is the mouth of the Muzur river, a large and very swift stream with remarkably clear and cool water. Rising in the mountain-girt plain of Ovajuk, and fed by the springs of the great Dersim mountains, from the north side of which the snow never disappears, it always has a full stream navigable for kelleks from the plain to its mouth. Its largest branch, the Peri Su, 150 miles long, rises near Bingyul Dagħ, south of Erzerum, and in spring is larger than the main stream. Thirty miles

above its mouth, near the old ruined town of Baghin,* with its Haldi fortress and two cuneiform inscriptions, it passes through a gorge on the two sides of which hot springs gush out in numerous places. For a quarter of a mile the river is confined between perpendicular walls covered with stalactites 40 or 50 feet long, the deposit of the springs.

Passing the mouth of the Muzur Su, we soon came to a ferry owned by one of the few beys, or feudal lords, whose power is still absolute. His Kizilbash retainers, a few days before our visit, had stolen the ferry-boat from Akhor, our raftsmen's village, in order to use it in ferrying wood to be sold in Harput. The mountains south of the river are wholly deforested and the Kurds are rapidly cutting the small growth that remains in Dersim. The men at the ferry got out their old flintlock guns and tried to force us to pay for floating past the place where they had the ferry rights, but our hats overawed them.

Below this the river leaves the mountains, but the valley is still hemmed in on the south for some miles by a wall from 500 to 800 feet high, capped with from 50 to 100 feet of basalt, the edge of a lava-flow which came from the mountains north-east of Harput and reached the edge of the river-valley, but apparently did not fill it. From here the river flows for 30 miles through low hills and plains broken only at Pertag. The first village passed on the right is Till, which must once have been an ecclesiastical centre of some importance, since there are the remains of seven Syrian churches, beside those of baths and houses. Indeed, the whole of Dersim is full of relics of the Christian population, Armenian and Syrian, that once filled it. At Pertag, close to Till on the same side, ruins of other kinds are found. From far up the river the picturesque castle is seen on its high pointed rocks. It was first built by the Haldi and last rebuilt by the Seljuk Turks, but no one knows by how many races it has been occupied between these extremes. At the base of the castle are the ruins of several mosques, churches, and baths, and of hundreds of houses. At the beginning of this century Pertag seems to have been a large and flourishing town, but in 1839-40 troops were brought here and quartered in the houses of the people, who promptly moved to their beautiful well-watered gardens, an hour away to the north-east at the base of the mountains. When the soldiers finally departed, the people did not care to return to their injured houses. Some ferrymen and a few zaptiehs, gens d'armes, are the only inhabitants of the old town. A fair is held here every Friday morning, and is attended by Christians and Mohammedans from all sides.

The river here cuts through a great boss of granite porphyry which rises in the sharp castle rock on one side and in a magnificent dark

* *Verhandlungen der Berliner anthropologischen Gesellschaft*, November 18, 1901, pp. 174-180.

cone, 1000 feet high, on the other. Along the river the rock forms fine though small columnar palisades. Just west of the castle, where the river leaves the palisades and enters a region of black basalt, we discovered the ruins of an old Roman bridge, which formed part of the road from Harput, through Kuttu Dere, in the midst of Dersim, to Erzinjan. This route *viâ* Erzinjan is the shortest from Harput to the Black Sea at Trebizond, but it is not now used, because the Kurds in the mountains through which it passes make travelling very unsafe. The makers of the bridge utilized as piers two islands, on the larger of which massive limestone blocks still remain in place. The rest of the way to the Kara Su the scenery is uninteresting, the open valley being cut through limestone, which forms low rounded hills a few miles back from the river. On the right bank one of the villages is Kogpenig, where many of the inhabitants live in caves. At Ashvan a model farm is being conducted on American principles under the direction of Prof. Norton.

The mouth of the Kara Su is disappointing because its appearance is not equal to its geographical importance. Both rivers flow slowly here, and approach each other from nearly opposite directions—a most peculiar configuration for well-established rivers of such size. In the summer of 1901, I floated down the Kara Su from Egin to the Malatia plain. The cañon at Egin is one of the finest in Turkey. Two miles above the town the narrow stream flows between solid walls of hard limestone 400 feet high, which even, when looked at from a distance, appear to be really perpendicular. Above these perpendicular walls the steep rough limestone rises 4000 feet on the west side in a distance of only 4 miles, and on the east side 8000 feet in scarcely 8 miles. Trees and vegetation are almost lacking, and the landscape is all brown and grey; yet, in spite of the bareness, it is grand. Egin itself, thanks to the great springs, is completely hidden in trees, so that the contrast between the green city and the bare mountains is most striking. In floating down the stream, the mountains are soon left behind, and the old limestone falls lower and lower, until at last it forms a wall but 10 feet high. Over this lie sandstone and much rough conglomerate, which seem to be a part of the great Cretaceous deposits. On both sides of the river the land rises 1000 feet or more in broad irregular terraces to a partly dissected plain covered with alluvium. Near the mouth of the Kara Su, the old limestone rises again in rounded hills from 400 to 1000 feet high. On the Kara Su below Erzinjan only one dangerous rapid occurs, 15 miles below Egin, and it is dangerous only because of the great number of stones in the middle of the channel. It is worthy of note, as an indication of the age of these streams, that, although the grade is in some parts steep, it is rarely broken by ledges and sudden descents. Except in the cañon between Kemur Khan and Chunkush, the rapids of both the Kara Su

and Murad Su are usually due to accumulations of gravel brought in by side streams.

The mouth of the Kara Su lies at the head of a second winding transverse gorge cut through limestone except at Geban Maden, where there is an outcrop of trap in which are silver mines. The raftsmen told us that 2 miles above Maden there were traces of another bridge, which, however, proved to be a quarry with a series of flat steps full of drill-holes, and cut into the face of the steep cliff in such a way that blocks of the beautiful variegated marble could be loaded on to rafts with the greatest ease. Where the marble was carried is not evident, as none of it has been noted in neighbouring ruins. The passage through the real gorge, beginning at Maden, occupies four hours with a swift current, and in spring some good rapids, which are scarcely noticeable in the lower water of summer. The limestone walls tower very steeply 1000 feet or more, and above that height the mountains rise another 1000 or 2000 feet. Hundreds of pinnacles and peaks rise like countless castles separated by gigantic clefts. Here a little tributary comes at the same level through a cañon with perpendicular walls; there a sheer cliff rises 500 feet; close by, the massive strata are crumpled like paper or are set at various angles by great faults. Where the strata are horizontal, the wall is benched with terraces from 20 to 60 feet high, each bearing on its top a strip of beautiful green grass in delightful contrast to the prevailing buff grey of the mountains and intense blue of the sky. Almost the only inhabitants are big-horned ibex and wild blue pigeons, which make their home in the numberless inaccessible caves which honeycomb the limestone from top to bottom. In the intense heat of summer, when everything dries up and the cañon is like a furnace, even these are not seen. Near the lower or south-west end of the gorge the walls grow steeper as they decrease in height, until the river passes out into the Malatia plain from between perpendicular limestone walls, here only 40 or 50 feet high.

The Euphrates, now turning south, skirts the base of the western extension of the Harput mountains, entering but slightly the great Malatia plain which stretches 20 miles to the west. The inhabitants on both sides are for the most part Kurds, those on the left of the river being largely *Zaza*, those on the right, north of the Kuru Chai (*Chai*=brook), being Kizilbash, and those on the right, south of the Tokma Su, Kurman; while the area between the Kuru Chai and the Tokma Su, very fertile, but not easily irrigated, is practically uninhabited. The Kizilbash are the most interesting of these three divisions of the Kurds. They are a mixed race, the foundation being some tribes of a stock allied to the Persians, who advanced into Turkey along the central highlands. These mountains were inhabited by Armenian Christians, who under stress of persecution became nominal Mohammedans and intermarried with the invaders. The

Kizilbash in the district near Malatia, unlike their brethren in Dersim, are peaceable, well-behaved agriculturalists, most of whom have entirely given up nomadic life. In general the Kizilbash are a frank, good-natured people, eager to be amused, very ready to ask and answer questions, hospitable, easy to deal with, industrious when work is necessary, and faithful when they have given their word, although very ready to rob and even to kill those to whom they are not under obligation. Morally they are superior to their neighbours. They deteriorate rapidly under new or adverse conditions, becoming more suspicious and treacherous. When among the Turks, they swear that they are good Sunni Mohammedans, although in reality their religion is a mixture of



IN THE CAÑON BELOW KEBAN MADEN.

Shiite Mohammedanism and Christianity, with perhaps a trace of primitive paganism. Accurate information is hard to obtain, because in talking with a Christian they try to make their religion appear like Christianity. For instance, a prominent agha, or village chief, said to me, "We have four great prophets, Adam, Moses, David, and Jesus, of whom Jesus is the greatest. We have four holy books, the Gospels. All religions are but different roads to the same end—one long, one short—one easy, one hard. You go yours, and we go ours." When I tried to talk about Mohammed, he avoided the subject as though it were unpleasant, so that I could learn nothing. The Kizilbash never pray in private, but only when led by one of their sehids, or religious chiefs,

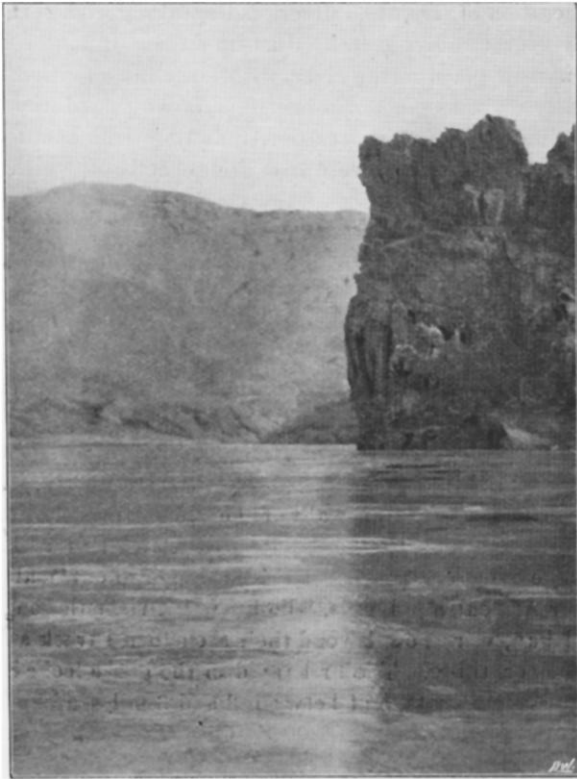
who have great influence among them, and who go freely and safely from tribe to tribe even during times of feud. So common are feuds, and so respected are the sehids, that the business of conducting travellers or of carrying freight is wholly in their hands. At certain times they observe a sort of sacrament, which closely resembles the Christian Communion Service. No competent observer seems to have witnessed this, and it is known only by report. The Kizilbash reverence all Christian sanctuaries and churches, and will even go into a church where service is being conducted, and take part, kneeling and bowing with the people. To be sure, they will do the same thing in a Sunni mosque, but in the latter case it is for fear of persecution, while in the former it is a matter of their own inclinations.

The Euphrates, as it winds through the Malatia plain, flows slowly and divides into a network of channels, enclosing islands of sand or gravel nearly level with the flood-plain. The latter, often half a mile wide, is bounded by bluffs from 30 to 50 feet high, cut in the alluvial deposit which forms the Malatia plain. Villages, especially on the left side, are numerous and prosperous, being usually beyond the flood-plain, although some lie at its edge.

At Kala, close to the most western point of the great bend, there is, on the left side of the river, a large rock, which the Haldis, or Naïri, long ago fashioned into a castle by excavating platforms and steps, and building walls. Behind the village, on the steep slope of Mushar mountain, are situated several famous holy places. The first, 400 feet above the river, is a raised platform of stone and mud, said to be the grave of an Armenian girl who cared for the great church on the top of the mountain. The Kizilbash aghas of the village are honoured by being buried here, although the common people must be content to lay their dead by the river. Five hundred and fifty feet higher is found a Turkish holy place, the grave of a man called Hassan, in a small cave, which has been walled in and furnished with many gaudy and some valuable offerings. Outside is a great square altar of rough stones, all covered with the gore of the scores of sheep and goats, which are brought as sacrifices by both Christians and Mohammedans, and which are cooked in huge copper caldrons hung from great beams. The horns of the offerings are piled on another altar, and the meat is often eaten in the holy place itself, the bones being thrown into a little cave back of the main cave. The shrine has no guardian, but it is regarded with such veneration by men of all religions that the most valuable of the offerings are perfectly safe from pilferers. The third, and least visited, holy place is an old well-built church with massive buttresses and arches, located on the bleak mountain-top 2400 feet above the river. A more unpromising or inaccessible site for a church can hardly be imagined. The view from Surp Aharon, as the Armenians call the church, or Mushar Kilise, as the Turks call it, is very extensive, including the

snow-capped Dersim and Anti-Taurus mountains on the north, the western extension of the Harput mountains on the east, the Taurus mountains on the south, and on the west the broad brown expanse of the Malatia plain, bounded on the east by the blue network of the Euphrates, and on the west by the range of Aghaja Dagħ, cut by the V-shaped cleft of the Tokma gorge.

Returning to the river, the reedy, bushy islands, or the banks of shingle between the branches of the river, are the resort of all kinds



TRIPLE ROCK, IN THE GORGE AN HOUR BELOW KEBAN MADEN.

of water-birds—ibis, black divers, storks, bustards, herons, cranes, and many smaller birds. The current was slow and the voyage monotonous as we floated past the mouth of the Kuru Chai, whose valley the Malatia-Sivas road follows for two days' journey, and past the large Tokma Su from Gurun and Derende, until we reach Pirot, where the road crosses the Euphrates. Here the mountains again approach the river, leaving on either side a strip of smooth green fields dotted with trees and houses. Behind this on the right rises the first ridge of

the Taurus, from 4000 to 5000 feet above the river, and green clear to the snow-line, where verdant wheatfields lie close to snow-filled valleys from which shining little brooks tumble down the steep slope. Although the view is not wild or grand, it is most attractive, because of its quiet strength joined with real verdure—a rare element in the landscape of Eastern Turkey.

For 6 miles we skirted the base of the mountains, which, approaching gradually nearer the river, cause it to become more narrow and swift. Near Kemur Khan, on the left side, is a cuneiform inscription recounting an expedition of Tiglath Pileser, and speaking of a certain bridge, presumably over the Euphrates. Just up-stream from the inscription is a fairly narrow place in the river, with low cliffs on either side which might readily serve as piers of a bridge. As we passed this point, our kellekjis volunteered the information that they had heard from their fathers that in old times there was a bridge here, of which they—the fathers—had in their youth seen a few stones.

At Kemur Khan the river turns at right angles and goes south by east through a remarkably straight gorge 12 miles long and nearly 4000 feet deep. The scenery is even finer than in the preceding gorges. The dark, steep, gloomy walls of basalt and metamorphic shale are terraced at an elevation a few hundred feet above the river, and on each terrace or nestled in each tiny valley are one or two houses and a patch of bright green fields. In some cases the fields are on slopes so steep that it seems as though the sower could scarcely find a footing. Far above the fields white patches of snow contrast strongly, in spring at least, with the black and green walls of the cañon, and send little streams cascading down through rough gashes in the resistant rock, amidst a chaos of huge boulders and trees. In this gorge our real difficulties began. Our Armenian kellekjis, who knew the river thoroughly, as far as Kemur Khan, were now beyond their accustomed track and ready to be afraid of everything. The first rapid in the gorge looked to them so bad that we made a portage of between 2 and 3 miles around both that and the next rapid, climbing 1200 feet up the steep slope over the roughest kind of road. If the kellekjis had not been so timorous, the rapids might easily have been shot, and we should have been saved twenty hours.

As we were about to embark below the portage, after a night spent on the river-bank, a raft of logs passed us manned by two almost naked Kurds, with wooden tridents in their hands, and strings of gourds around their waists for life-preservers. They carry wood from Izoghlu through the Kemur Khan gorge to Kefferdis. We followed the men, and after a few minutes shot a fairly large rapid, at the bottom of which was a big whirlpool. Our men, with their spoon-shaped walnut paddles, were able to pull us out of it, but the Kurds could do nothing with their tridents, and were carried far up-stream. Finally

they had to land and haul their raft down to a point below the whirlpool.

Through the whole length of the gorge we went at an average rate of 5 miles an hour, between walls of solid rock which come down sheer to the narrow stream, and are broken only by precipitous gullies entering at grade and bounded by jagged cliffs with needle-like points. The mouths of these gullies are footed by fan deltas, which have been pushed out into the river, forming dams, over the outer ends of which



FAULT IN THE GORGE BELOW KEBAN MADEN.

the water pours in foaming rapids. We shot into these over smooth rounded waves, like the long swells of the ocean, but in a moment were among the breakers, which tossed the light raft up and down like a cork, and often came over us, breaking up-stream, as is usual in rapids. The kellekjis paddled with all their might. The raft spun round and round, so that we saw the wild mountains on every side without turning our heads.

Near the end of the gorge, where the mountains become lower, a

good-sized brook from Merjimud, coming in on the left through a fine cañon, has built a large fan. The size of the rapid thus formed frightened our kellekjis so much that we could not persuade them to shoot it, and were obliged to spend two hours in letting the kellek down past it by ropes. While we were doing this, the Kurds on the wood-raft overtook us. Lying flat on the logs, they shot through, not over the rapid, going into wave after wave with 4 or 5 feet of water over them, and coming out at the bottom with a triumphant yell.

At the mouth of Mamash Chai we left the transverse cañon, and turned at right angles to the east by north into the broad longitudinal valley in line with Lake Gyuljuk. On looking into the valley from any of the surrounding mountains, it appears so broad and well matured that one feels certain at first that the Euphrates must come down its whole length from the west-south-west, the actual cañon of the river seeming to be merely the bed of a short tributary. The part of the main stream in the open longitudinal valley and the tributary, Mamash Chai, lying directly in line with one another and at right angles to the transverse cañon, have incised in the valley-floor a steep-sided trench from 150 to 250 feet deep, and wholly filled at the bottom by the streams, which flow between rock walls without a flood-plain. Most of the valleys in this immediate region show the same feature of a flat-bottomed old valley with a small trench-like new valley, without a flood-plain, incised in the floor. Thirty miles north in the Harput mountains such newly incised valleys are not found. They occur on a small scale 30 miles north-west, in the western extension of the Harput mountains, around which flows the Euphrates river, and again 20 miles further east, in the valley of the Tigris river. Probably this conformation is due to an uplift of the region at a comparatively recent date, affecting most strongly the Taurus mountains where they are traversed by the Euphrates river. The minimum elevation seems to have been at least 500 feet. The immediate vicinity of Harput may have been unaffected, or, as is equally probable, the cutting down of the bed of the Euphrates has not yet proceeded far enough up-stream to affect these mountains, although they may have been uplifted. In the Tigris basin the very small dimensions of the newly incised valleys may be due to slight uplift or to the comparative slowness with which the small stream of the upper Tigris scours out its bed. The 8 miles of the course of the Euphrates, along the open longitudinal valley in line with Lake Gyuljuk, are over numerous rapids, caused not by fans but by inequalities in the bed-rock, and thus indicating that the revival of the river by uplift of the surrounding country is very recent.

Near Aivose, just below the ferry where the road from Harput to Shiro crosses the river at the head of a dangerous rapid, which, unlike those just above it, is caused by a detrital fan, thirty or forty of the villagers tried to prevent us by force from going further, but were soon

persuaded to take up our craft and carry it a quarter of a mile around the rapid. They could not understand why any one should make such a dangerous journey, and especially why any one should take notes all the time, and so, with oriental logic, they concluded that we had some secret purpose which must be opposed to their interests. Our own servants were equally unable to understand our purpose, although I tried to explain. Often I heard them answering the questions of inquisitive villagers, "What are these men doing?" "We don't know. Perhaps they are going to make a bridge, or a wagon-road, or a railroad. More likely they have a secret commission from the king. They say they are not paid for making this journey, but we know better; they are not such fools as all that. They know everything: they see a stone or a plant, a brook or a mountain, and they know it. They even know what is in a place before they have visited it. They write everything. If you want to know any more, ask them. What do we know?"

The villagers at Aivose feared not only that we should harm them, but also that we should be drowned, in which case the Government might hold them responsible for the foreigners, the "men with hats." The people here, as well as many others with whom we talked, both above and below this point, asserted that no one ever had navigated or could navigate the river from Aivose to Chunkush. Von Moltke's journey seems to have been forgotten.

Leaving the villagers, who had become quite friendly as they carried our goods around the rapid, we boarded the kellek once more, and in less than ten minutes were at the angle where the river, turning once more to the south from the longitudinal valley, enters an immense crooked transverse cañon, the last and longest of the great gorges, 30 miles long and 5000 feet deep. Before we knew it we were at the head of a rapid worse than any that we had yet shot, or around which we had made portages. It seems to be due partly to the structure of the bed-rock and partly to the fan of the Uslu brook, which flows into the river just in the middle of the rapid over a series of small cascades, which, as seen from the river, appear to be caused by the brook's own fan. The kellekjis wanted to make another portage, but we insisted on shooting the rapid. Although we made the passage safely, the men's nerves were so completely unstrung that when we landed soon after at



KUZZLEBASH KURD CROSSING THE EUPHRATES
ON INFLATED SHEEPSKIN.

the head of another large bed-rock rapid, they absolutely refused to go on. One was sent to find a village and get men and animals to help in making a portage. He found a village after a hard climb of an hour or more, but instead of going to it he hid till after dark, and then returned to us, because, as he said, if the Kurds knew that we were encamped beside the river, they would come and rob or even kill us during the night. The other Armenian, when told to take some baggage off the safely moored kellek, said, "If I ever set foot on that kellek again I know that I shall die. Then who will take care of my wife and children? You haven't any hearts. The mountains are savage, the river is savage, the people are savage, but you don't fear them. Don't you even fear God?"

He was full of superstition and was in terror, partly because he had dreamed the night before that some of his friends were dying. This night he dreamed that we Americans were shooting pistols, which, curiously enough, seemed to encourage him greatly.

In the morning we made our portage, a long hard one involving a climb of 900 feet up out of the steepest parts of the cañon, and at twenty minutes past five in the afternoon were ready to embark, 2 miles from our camp of the previous night. Floating very rapidly for nearly an hour, we passed the sulphurous hot springs of Tilek, which rise on both sides of the river below high-water mark. They contain chiefly hydrogen sulphide and calcite. In July, 1900, I visited them and found the temperature to be 114° Fahr., while that of the surrounding air was 103° Fahr. at 4.30 p.m. On account of the inaccessibility of the springs, they are but little visited, although reputed very beneficial for skin and rheumatic diseases. The favourite method of treatment is to bathe the patient half an hour, and then bury him up to the neck in the hot river sand for two hours, repeating this process four or five times in a day.

Near Tilek the river turns more directly south and passes through magnificent scenery. At the bottom, schist, formed by the metamorphism of shale, forms almost perpendicular walls, which we estimated as nearly 400 feet high. Above is a terrace, from which green wooded upper walls rise less steeply to the mountain-tops a mile above our heads. The larger tributaries cut through the apparently perpendicular lower wall in steep-sided narrow cañons, entering the main stream at grade, while several small streams have not yet cut down to grade, and cascade over the cliffs in a series of white falls.

These hanging valleys and many other characteristic features of the Euphrates cañon correspond closely to what is described in the Grand cañon of the Colorado river, showing that the two rivers are of nearly the same age. The Colorado cañon is much longer than that of the Euphrates, and is cut through a plateau of nearly horizontal strata instead of through a range of mountains formed of much distorted

strata; but in both cases the depth of the cañon and the inclination of the walls, very steep at the bottom and more gentle above, are approximately the same. Both rivers are so young that they have not yet established thoroughly graded channels, but no waterfalls are found such as we should expect in extremely young streams.* There are, however, the two kinds of rapids which I have already mentioned, viz. those due to outcrops of hard rock which have been worn back so far as to present a regular but nevertheless very rapid descent, and those due to the damming of the stream by fans of detritus brought in by tributaries. It was by these that the famous journey of Powell down



ENTRANCE TO THE GREAT CAÑON AT KEMUR KUAN, LOOKING SOUTH.

the Colorado was made so dangerous.† We found that as a rule the bed-rock rapids are longer, but the fan rapids are more steep and dangerous. They indicate that the rivers are approaching, but have not yet reached, the stage of maturity, when the whole channel assumes a graded character.

The junction of the side streams with the main river is another interesting indication of youth. The majority, as has been said, enter

* See Gilbert, G. K., Engineer Dept. U.S. Army, 'Report upon Geog. and Geol. Expl. West of 100th Meridian,' vol. iii. (Washington, 1875) part i. pp. 70-75.

† See Powell, J. W., 'Exploration of the Colorado River of the West and its Tributaries,' Washington: 1875.

at grade through narrow steep-sided cañons, but some of the smaller tributaries and a number of wet-weather torrents have not been able to carve valleys as rapidly as the main stream has incised its cañon, and so have been left hanging at various levels on the cañon wall. They are in marked contrast to the hanging valleys described in glaciated countries such as Switzerland and Norway. The latter enter main valleys far broader than the streams that occupy them—so broad, indeed, that the main rivers have room to wander over wide flood-plains, bordered often by narrow strips of plain which graduate into the steep valley wall without any sudden angle. The others, on the contrary, send their streams cascading over the precipice directly into the Euphrates river, whose valley is so narrow that not only is there no flood-plain, but the water washes the rocky base of the almost perpendicular cliffs. The Colorado river, it will be remembered, has just such hanging valleys where it passes through the harder crystalline rocks. These two cases, where the discordance of side valleys seems to be incontestably due wholly to river-erosion, are in such marked contrast to the discordance of valleys of glaciated countries, that it is very hard to believe that the latter could have been due to river-erosion. If we regard them as the product of glacial erosion, we have what seems to be an adequate explanation of their difference from those that are certainly of river origin.*

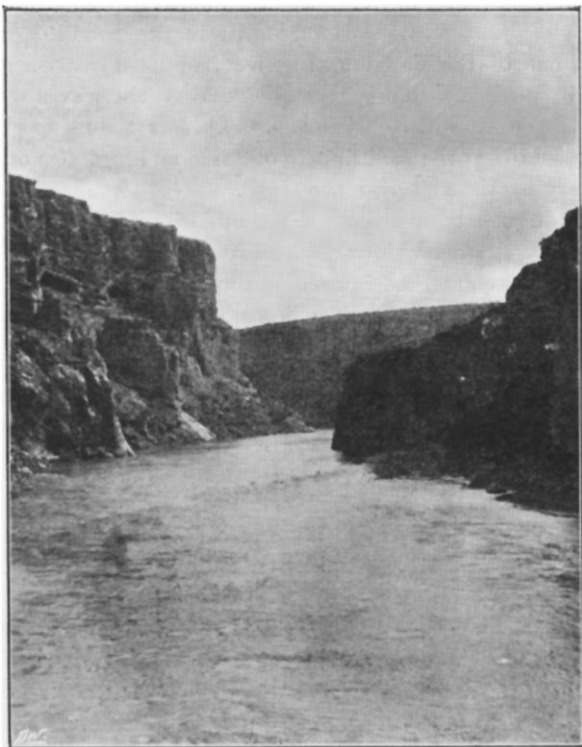
In the middle of the fan delta of Haloge Chai, a small tributary of the Euphrates which enters the main stream at grade, lies an immense white boulder, 30 feet in diameter, on the top of which are perched a number of boulders of other kinds, small only in comparison with the monster on which they rest. Probably the surface of the delta was formerly high enough to cover completely the large boulder above which the others were laid down. As the delta was worn away, the latter were left resting on the former. That water could transport and smooth a boulder of such enormous size seems incredible, but the stone is there at a considerable distance from its point of origin, and must have been carried down the slope to its present position by floods.†

A mile below this we stopped at the head of the biggest rapid yet seen, and of course the men wanted to make a portage. As our time was growing short, and a portage would take nearly a day, we decided to leave the light baggage for the men to carry over the quarter-mile chord of the great boulder-strewn fan which caused the rapid, and ourselves take the raft down. They expected that we should be drowned, and they would be left alone without a kellek in the bottom of that almost inaccessible gorge; but in spite of their entreaties we pushed off, and

* See Davis, W. M., "An Excursion to the Grand Cañon of the Colorado," *Bulletin of the Museum of Comp. Zoology at Harvard College*, vol. xxxviii. (Cambridge, 1901) p. 169.

† See Gilbert, G. K., *op. cit.*, p. 71.

although we paddled hard were in the rapid before we had reached mid-stream. There was a long swift exhilarating shoot over a tilting stretch of water, and we were among dashing waves which seemed to be 10 feet high. As the kellek rose on the first one, we stopped paddling and seized the ropes. We whirled round and round more swiftly than ever before, this time not looking at the grandeur of the mountains, but only at the waves, which broke over us again and again, wetting us to the skin. The kellek stood the passage perfectly, and below the rapids



LOOKING UP-STREAM IN THE CAÑON OF THE EUPHRATES AT MORFA, JUST SOUTH OF THE GERGER RIDGE.

we brought it safely ashore. When at last the men overtook us, they seemed to feel that our preservation was miraculous.

"You're not men; you're jinner (spirits)!" one of them exclaimed.

From here to Chunkush the gorge is cut almost entirely through limestone. Travelling at the rate of 8 miles an hour, we passed for 18 miles through a continuous succession of bed-rock rapids, many of them larger than those around which we had made portages. We spent the night on a tiny ledge, where the precipice overhung us and partly

protected us from the light rain that fell toward morning. Although neither the river, the mountains, nor the Kurds had harmed us, the men seemed determined to find something of which to be afraid.

"If we sleep here, the bears will come to the top of the precipice and throw stones on us," they said, when we proposed to land on the narrow ledge.

The next to the worst rapid is 2 miles above Chunkush, where the one of our kellekjis whose sleep had been disturbed by dreams was washed overboard by the waves. Most fortunately his companion seized his arm, and we all pulled him on to the raft at the imminent risk of upsetting it. A few minutes later, while we were still in the same long rapid, we encountered one of the dangers that we had most feared. The raft stuck on a hidden rock in such a position that the waves would soon have battered the skins till they leaked and the raft went to pieces; but we got off by shifting the load first to one side and then the other, thus, as it were, prying the raft over the stone.

From Chunkush to Gerger, where our river journey ended, the mountains grew gradually lower. The river presents no special obstacles and no points of marked interest, although the scenery is still fine. The large Chermug Chai, a brook which enters on the left, has two main branches: one, the Kizilchabuk, is a wet-weather stream from the south-east, where it drains part of the plain north-west of Diarbekir; the other has always a large stream. Its main source is halfway between Chunkush and Chermug, where there is in the limestone a great sink-hole over 400 feet deep, with an aperture scarcely 50 feet by 20. The water from this reaches the surface $2\frac{1}{2}$ miles farther east, near the village of Sinek, from which the stream takes its name. A smaller branch comes from the locally famous sulphur hot springs of Chermug.

At Gerger, where the Euphrates passes through the last outlying ridge of the Taurus mountains, we find one of the narrowest gorges. The hard limestone mountains rise over 2000 feet above the river, the north side of the ridge being bounded by a long line of cliffs 400 or 500 feet high, from the base of which there is a much more gentle slope to Petterge Chai. The south side slopes off gradually in well-rounded gentle hills which can be traversed with great difficulty because of the rough pits and sharp edges into which the limestone weathers, and which have been denuded of soil because of the deforesting which has taken place. As one stands on the top of the ridge, a long broad depression is here visible—the old valley of the Euphrates stretching to the south-west nearly parallel to the mountains—but there is no sign of the river, whose present course is marked only by a slight line of cliffs. An observer who did not know that the river intervened would think that he could easily walk to the hills on the opposite side. The river now flows in a narrow cañon with perpendicular walls 450 feet high.

This journey of 190 miles by water from Akhor to Gerger occupied

seven days, including the unnecessary portages, although the time actually required for floating down the river was only thirty-seven hours. The 50 miles from Akhor to the Kara Su occupied ten hours, the 35 miles to the beginning of the Malatia Plain six hours, the 45 miles to Kemur Khan ten and a half hours, and the remaining 60 miles to Gerger ten and a half hours. The total descent as measured by aneroid is 1250 feet, the steepest part being near the big rapid just below Tilek, 100 feet in 6 miles, and the gentlest descent being in the Malatia plain, 100 feet in 55 miles. We found that the map as given by Von Moltke needs considerable correction.

At present the roads avoid the gorges of the river and climb over the high mountains. As soon as railroads are introduced, there can be no doubt but that, as usual, one of the main lines will follow the easy grade of the river.

Although the utilization of the Euphrates river for industrial purposes may be far in the future, it is, nevertheless, a problem which will some day be of great importance. The most valuable part of the river's basin is Mesopotamia, which begins south of our journey's limit, and of which I cannot speak from personal knowledge. A comparison of the accounts of ancient and modern travellers shows, however, that its present poverty is almost as remarkable as was its ancient fertility and wealth. That region is described as being so rapidly and completely ruined by the invasion of the sand of the desert on the south-west side, and by the constant shifting of the channel of the Euphrates river in the centre, that the future will be even more desolate than the present unless measures are taken to resist these encroachments. Against both the river and the desert the means of protection lies in controlling the river itself. In ancient times the control of the water was effected by a great system of canals, embankments, and reservoirs in Lower Mesopotamia. These were in constant need of expensive repairs, and their breaking was the cause of frequent disaster. England has found that the only way to control the Nile is to control its sources, and, having finished the work of cutting the sudd, she is now making the huge dam at Assuan, and considering the far greater task of regulating the outflow of the great African lakes. It is a work of great magnitude, involving an immense outlay of capital, but there is no doubt that it will prove permanently successful. The problem presented by the Nile is similar to that presented by the Euphrates, and the two must be similarly dealt with, although there is one important difference. In the former case, the chief problem is to conduct the water to the sea by the right channels, in the right quantities, and at the right time. In the Euphrates river, the problem is to use the water before it reaches the sea.

When the Euphrates river is properly controlled, it will serve two great uses: it will be a great producer of power, and it will accomplish the vastly more important work of irrigating Mesopotamia. More than

three-fourths of the rainfall of the upper Euphrates basin falls in the seven months from October to April. If the precipitation of this period could be retained among the mountains, and allowed to escape during the late spring and summer, it would not only save Mesopotamia from the annual floods which carry away great sections of land along the banks and convert other large areas into disease-germinating swamps, but would also accomplish the far more important result of enabling vast tracts of the best kind of land to be irrigated and reclaimed from the desert. The extent of the entire region that can be reclaimed by means of the river seems to be as great as that of England. Although Mesopotamia can produce two crops a year, its population is scarcely a million; yet it might support ten times as many people, and still export in great quantities all sorts of food-stuffs. It is destined to be one of the richest parts of the world if its development is unhindered. The great need, so far as merely physical matters are concerned, is the controlling of the Euphrates river.

The best means of accomplishing this seems to be by building reservoirs in the great depression of the upper Euphrates valley between the Taurus and anti-Taurus ranges. This contains a series of small parallel mountain ridges enclosing many plains, generally, although on slight ground, called lake-basins. In the middle of each is a stream, which passes out at the lower end through a steep narrow valley. The plains can easily be converted into reservoirs by the construction of simple dams. The expense, which would not be excessive, would certainly be met, in part at least, by the water-power thus rendered available, while the storing of the surplus water of the winter would be of incalculable value in irrigating Mesopotamia. Of course, the value of the land covered by the reservoirs must be considered. Fortunately it is slight, for although the larger plains are very valuable, the smaller ones are often so cut up by small watercourses that they have little value for agriculture, and might readily be converted into lakes. It is the work of the engineer to determine the best sites for dams, but the possibility of building them seems patent to any one who has seen the plains and gorges. The progress of civilization will necessitate the building of such reservoirs, and the only place where they can be profitably built is north of the Taurus mountains.

What has been said of the Euphrates river is, with certain modifications, true of the Tigris also. Reservoirs can probably be built east of or among the Zagros mountains, just as they certainly can be built north of the Taurus mountains. From the earliest times until now the history of the Mesopotamian plain has been sharply separated from that of the mountains to the north and north-east. In the future the history of the two regions must be one, because the development of Mesopotamia depends absolutely on the great rivers which flow from the mountains, and must there be controlled.