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*On changes in the course of the Kusi River, and the probable dangers arising from them.*¹—By F. A. SHILLINGFORD.

With a Map.

[Read, February, 1895.]

For several years past the Kusi, or Kōsi, river has been attracting much attention owing to the sudden shift of its main channel on the borders of Nepal whereby a considerable volume of its flood

Introduction.

waters has been thrown eastwards, over tracts of country in the District of Purneah and Dinajpur, not previously subjected to its floods, in recent years, and it seems not improbable that some unusual change in the course of this erratic river is likely to occur in the immediate future. The writer having lived nearly all his life in Purneah, visiting the banks of the Kusi, from the Nepal mountains to its junction with the Ganges, constantly, for work, or in search of sport, has had exceptional opportunities of watching the lesser as well as the more general changes of that river occurring within the last 25 years. During the rainy season of 1893, when severe floods were occurring up in the north of the District,

¹ [With reference to this paper, readers are referred to the discussion recorded in the Proceedings of the Society for February 1895, in which the propriety of certain of the author's conclusions as regards the physical aspect of the case are seriously impugned. Ed.]

the author deemed it his duty to place the crude notes he had made, during a series of years, regarding the movements of the Kusi, and upon which this paper is chiefly founded, before Government, so as to help as a guide in case of danger, and if his efforts are now successful in drawing attention to this important and interesting subject, his labors will be amply rewarded. The theories that this paper is intended to elucidate are:—

(1) That the main channel of the Kusi river oscillates (in its general sense) over a vast tract of country, from the Brahmaputra to the Gaṇḍak rivers, having practically Catrā Gaddi (Chatra Gaddi of the maps), in Nepal, as its centre, or pivot of oscillation, and that these oscillations are repeated at long intervals of time.

(2) That the westward movement of each oscillation is slow, and in a series of steps, each of which is attended with damage to property, but of a temporary nature.

(3) That the eastward movement of any given oscillation will probably be accomplished in one great swing, and will be accompanied with loss of life and property, with remoter dangers of a serious nature.

(4) That the detritus, resulting from the sub-aerial denudation of the Himālayas, brought down by the rivers, and thrown upon the Indo-Gangetic Plain can be held accountable for these movements of the Kusi and other rivers similarly situated.

The Kusi, or Kōsi, called in old Sanskrit works Kauçikā, is probably the river Cos Soanas (Sankōs, in Nepal) mentioned by Arrian in his *De Indiciis* (*Chap. IV.*) on the authority of Megasthenes, as being one of the navigable tributaries of the Ganges.

The Kusi debouches, or rather leaps, into the Indo-Gangetic Plain in about Lat. 87° E. Long. 27° N. at Barāh Chatra, below which the magnificent falls occur, where, as is usual with all large rivers

held sacred in India, there are numerous Hindū shrines, one of the most celebrated being that devoted to Mahāmāyā, situated just above the falls, which occur between Catrā Gaddi, to which boats can go up, and Barāh Chatra, about 5 miles higher up, the latter named after the Varāha, or Boar *Avatār* of Viṣṇu, to whose shrine here pilgrimages are made. For some miles below Catrā Gaddi, undulating country, interspersed with alluvial tracts, is to be met with, until the Belkar Range of hills (marked incorrectly the Sooroongah Hills in Survey Maps of 1840–47) is passed, about 20 miles below the falls, and then the wide alluvial plains may be said to begin.

Above Barāh Chatra the main stream of the Kusi is called the

San Kusi, or Sankōs, *i.e.*, united Kusi, which runs nearly East and West, and into this the other six rivers consti-

The Sapta Kauçikā. tuting the *Sapta Kauçikā* of Sanskrit works, flow in as tributaries from the North. These are, beginning from the East (1) the Tambar, or Tamrā; (2) the Aran, or Eran; (3) the Dūdh Kusi; (4) the Likhu Kōsi; (5) the Tambā Kusi; (6) the Bhotiā Kōsi. According to the most recent maps, the Tambar, called in its higher reaches the Kambachen, drains the western slopes of the snow-covered portion of the Kanchinjinga (28,176 ft.) spur, containing the high peaks of Janu, 25,304 ft., and Kabru 24,015 ft., and has its source in the snowy peaks of Chutangla, in the main ridge of the Himālayas, whose southern drainage it also receives from the Kanglachin, and the neighbourhood of the Tipta-la Passes. The Aran drains the eastern and northern slopes of Everest, 29,002 ft., and its attendant snowy peaks, and piercing the main chain of the mountains takes its rise in the further snows of Tibet; both these tributaries meet the San Kusi just above Barāh Chatra. The Dūdh, Likhu, and Tambā Kusis carry down the drainage of the southern face of the Everest and Chumlang (24,020 ft.) blocks of snows, whilst the Bhotiā Kusi penetrates the main range, and rises in Tibet, draining the eastern slopes of the Gosainthan, 26,305 ft., and Dyabang, 23,762 ft. The San Kusi itself has its source on the southern face of Dyabang, beyond Katmāṇḍu. Standing near any one of the rest-houses on the great Singalila range, the most elevated spur thrown out southward from the main range, in this portion of the Himālayas, the crest of which forms a portion of the western boundary of British Sikhim, and looking westwards and northwards, one cannot help being struck with the vast extent of the work of denudation performed by the Sapta Kusi, in carving out the huge valleys and rugged gorges which stretch in a series of stupendous waves as far as the eye can reach, over a region of mountainous country, extending from Kanchinjinga to beyond Katmāṇḍu, and from the alluvial plains of Bengal to the further chain of the Himālayas, forming the southern watershed of the Brahmaputra,—a tract of country 200 miles long by 150 miles wide, containing the two highest mountain peaks in the world, with their attendant masses of perpetual snow. Thus the Kusi drains a larger tract of the Himālayas and delivers a greater volume of water as it debouches into the plains than any other stream on the southern slopes of the Himālayas, between the Brahmaputra and the Panjāb rivers.

The Singalila spur, as continued from the main range through Kanchinjinga, Kabru, Singalila, Phalut, Tonglu, Goom, Senchal, Mahalderam, and ending at Sivok, on the Tistā, forms in Bengal,

Watershed between the Ganges and Brahmaputra, in Bengal.

at the present time the watershed between the Ganges and the Brahmaputra, and Mr. Mallet in his Memoir, "On the Geology of the Darjeeling District,"¹ remarks, "the Mahanuddy and the Teesta flow into the plains in the debateable ground where, under sub-deltaic conditions, a constant struggle is going on between the Ganges and the Brahmaputra as they approach each other from the West and from the East, across the great plain to the south of the mountains, early in the century the Teesta was a tributary of the Ganges."²

Before proceeding further it is necessary to preface future remarks by rather long extracts from the writings of previous observers, so far as they can be ascertained, on the changes in the course of the Kusī.

Dr. Buchanan Hamilton, who visited Purneah (1807-11) says,³ "I

Dr. B. Hamilton's have already mentioned a tradition which states views. that the Kusī, on reaching the plains instead of running almost directly south to join the Ganges, as it does at present, formerly proceeded from Catrā to the eastward, and joined the Ganges far below, and many old channels are still shewn by the populace as having been formerly occupied by its immense stream, and are still called *Būrhi*, the old, or *Marā*, the dead *Kōsi*. The change seems to have been very gradual and to be in a measure still going on." Further on he says, that "the Pandits inhabiting its banks allege that in times of remote antiquity the Kusī passed southward by where Tājpur is now situated, and from thence towards the east until it joined the Brahmaputra, having no communication with the Ganges;" and lower down he states, "the opinion seems highly probable, I think it not unlikely, that the great lakes North and East from Māldah are remains of the Kusī united to the Mahananda, and that on the junction of the former river with the Ganges the united mass of water opened up the passage now called the Padma, and the old channel of the Bhāgirathī from Songti to Nadiyā was then left comparatively dry."

Mr. James Fergusson, F. R. S.⁴ says, "The first river to feel the

Mr. Fergusson's effect of the tilting backward of the plane of views. the Ganges by the elevation of the land at Rajmehal was the Coosy, as the nearest to the delta, the consequence is that when Rennell surveyed Purneah, he saw and recorded in his

¹ Memoir Geo. Survey India, Vol. XI, Part 1. 1874.

² This is a mistake, the Tistā deserted the Ganges and joined the Brahmaputra, as is well known, in August 1787.

³ Eastern India (from MSS. of Dr. Buchanan Hamilton): by R. Montgomery Martin, Vol. III, page 15.

⁴ On recent changes in the Delta of the Ganges. Quar. Jour. Geo. Soc., London, Vol. XIX, 1863.

Memoir in the Philosophical Transactions (Vol. LXXI, p. 87) as well as in his letters that, the Coosy had at no distant date flowed past the station of Purneah and joined the Ganges 45 miles further down than its present junction." Then he quotes the extract from Buchanan Hamilton given above, about its being highly probable that the Kusi went away eastward to join the Brahmaputra, and adds, "Indeed an attentive study of the successive changes that have taken place renders this almost certain, and it is probable that the Oorasagar is the mouth by which the combined waters of the Coosy, the Mahanuddee and the Atree were originally discharged into the Assam river," *i.e.*, the present Brahmaputra.

Dr. W. W. Hunter in his statistical account of Bengal¹ writes:

Dr. W. Hunter's views. "The Kusi is remarkable for the rapidity of its stream, the dangerous and uncertain nature of its bed, and chiefly for its constant westerly movement;" and further on he explains this westerly movement by saying, "Within historical times, that is, from the beginning of the eighteenth century, we have evidence that this river (the Kusi) passed below the town of Purneah and then due south to the Ganges. It has since then worked across 25 miles of country till at present it forms the western boundary of the District * * * where the original bed of the Kōsi was, it is impossible to state." Then referring to Dr. Buchanan Hamilton's theory of the eastward channel of the Kusi quoted above, he says, "Dr. Buchanan's suggestion of the union with the Brahmaputra seems less improbable than other parts of his theory. The course of the Brahmaputra appears in early days to have run far to the East of the District of Maimansingh. The Kusi also in its eastward course would first meet the Karatōyā, then a vast river having the

Karatōyā, a large river in early Hindu times.

Atrai and Tistā for its affluents. In my account of the district of Bogra, I have mentioned the very great importance of this river during early Hindū times, both on account of its great volume and its sanctity, and I have stated that it marks an ethnical frontier clearly defined to the present day. If we assume that the Kusi and the Mahananda formerly joined the Karatōyā, we have at once an explanation of the great size the latter river once undoubtedly had, and we shall also be able to account for the process by which the great sandy plain was built up between the Barendra of Rajshahi and the Madhupur jungle of Maimansingh, through which the Brahmaputra made its way at the beginning of this century. The ethnical frontier

¹ Statistical account of Bengal, Purneah, 1877.

which begins to be uncertain in Dinajpur District will be completed

Marks an ethnical frontier. by adopting the above course for the Kusi. On the left bank we shall have the Koch

peoples still found in such numbers in the Kissengunge Subdivision of Purneah District and in the North of Dinajpur, on the same side of the river would be the kingdoms of Kirāt, Kichak, and Kāmṛp. The presence of a great river in the South of Dinajpur would also

Probably formed a barrier to Muham-madan conquest. account for the success with which the Ruler or Hākim, as he was called, of that country resisted the arms of the Musalmān sovereigns

of Gaur. The ancient name of the Kusi and the one by which it is still known in Sanscrit books is Kauçikā. It is interesting to

Probable direction of the Kusi, about A. D. 1600. observe that a river nymph of this name is known if not worshipped on the banks of the Karatōyā. The bed of the river about

three or four centuries ago seems to be marked by the line which divides the parganas which down to the present day, preserve their agricultural records under the Bengali or Façli or Bihāri eras. It is well known that these systems of computation of time are founded on the Musalmān Calendar, and like it date from the Hijra or flight of Muḥammad from Mecca. These systems came generally in use into the present District of Purneah about A. D. 1600. If the supposition be correct that the Kusi formed the boundary between the tracts in which they were in use then, the course of that river passed East of the town of Purneah and through the Police division of Manihāri, before it fell into the Ganges."

In addition to the above supposed (though highly probable) courses of the Kusi indicated by Drs. Buchanan Hamilton and W. W. Hunter, we have the follow-

Various beds of the Kusi.

ing authentic channels of former Kusis known in history or in modern times, viz., beginning from the easternmost.

(1.) The KĀLI or KĀĪ Kusi known in its upper reaches as the Kamlā and in Nepal as the Kajli or Kajri flowing

The Kāli Kusi.

about a mile to the west of the Civil Station of Purneah. The name *Kāli* (black or dark) as applied to this river is from the curious fact that this is the only one of the abandoned channels of the Kusi which carried dark limpid waters until 1889, when an inrush of muddy water came into it and gave rise to enquiries being made as to its cause, which has led up to the recent orders of Government to have the country surveyed. The clearness of its waters is also in Nepal causing moss-like water weeds (*Kajli*) to grow

in the rocks and boulders in its stream, hence its name Kajli or Kajri in the North, the natives, as noticed by Dr. B. Hamilton, being unable to distinguish between the sound of the letters *l* and *r*. This was the main Kusi in 1731, forming at that time the western boundary of the district and in that year, according to Hunter, Nawāb Saif Khān, of Purneah, crossed the Kusi and by gaining the battle of Birnagar over Bir Shāh of that place, acquired the parganas of Dharampur, Gorāri, Nathpur and Dhapahar and added them to Purneah, and it is along the eastern boundaries of these very parganas that, this river at present flows. This Kusi probably joined the Ganges near Manihāri at that time, to the East of Bhawānipur, the last village in the south-east corner of Dharampur, though an older bed still existing joined the Kalindri at Hayatpur in Māldah.

(2.) The DHĀMDĀHĀ Kusi known higher up as the Pheriāni and

The Dhāmdāhā a branch of it as the Binaniā, this is described and shown in his map as the main Kusi, 1807-11.

by Dr. B. Hamilton in 1807-11. It flowed between Dēbigaṅj station on the A. B. S. R. and Nāthpur, and to the East of Dhāmdāhā Thānā and joined the Ganges near Kārāgōlā. Between the Kāli and Dhāmdāhā Kusis there is another well defined channel called in its upper reaches the Livari, and lower down the Barāṅḍi, which must have been occupied by the main Kusi waters between the years 1731 and 1807, but no records can be found of the exact years.

(3.) The HIRAN main Kusi of the Revenue Survey Maps of 1840-47

The Hiran Kusi, flowed to the West of Dhāmdāhā Thānā, 1840-47.

and about the year 1870 began to throw off branches into the Ḍaus swamps which became the main Kusi in 1873, and flowed into the Ganges opposite Patharghaṭṭā.

(4.) The ḌAUS the main Kusi from 1873 to 1893. In the Survey

The Ḍaus Kusi, Maps of 1840-47 the Ḍaus swamps in places 1873-93.

show an outline similar to the abandoned bed of the Dhāmdāhā Kusi shown to the eastward, and marked the "old bed of the Kusi." This Kusi flowed into the Ghagrī river.

(5.) The LORAN, into which the Kusi began to throw in offshoots

The Loran Kusi in 1891, has become the main Kusi since 1893 since 1893. (inclusive), and still carries the bulk of its waters.

It is important to bear in mind that the name "Kusi" is applied generally to any river that may carry the bulk of its waters for the time being; but locally, the original river, which it has adopted as its course, still retains its name, such as Hiran, Ḍaus, Loran, &c.

Other Rivers in North Bhagalpur, which show signs of having been

large rivers formerly, and which have their sources (except Talābā)

Other Rivers in N. Bhagalpur, probably former beds of the Kusi. in the neighbourhood of the detrital talus, at the debouchure of the Kusi into the plains, and whose courses, in their upper reaches

have a westerly direction away from the banks of the Kusi, are, beginning from the East :—

- (1.) The Parmān, or Parwān.
- (2.) The Talābā.
- (3.) The Dīmrā.
- (4.) The Tiljugā.

All of these rivers have probably been, at one time or another, the bed of the main Kusi, but whether they will be occupied again it is difficult to form an opinion. The detritus brought down by other rivers tends to raise the country by degrees, and each successive oscillation of the Kusi, if not controlled by artificial means, would probably have a limit farther to the Eastward.

Thus, we have the main waters of the Kusi, moving from the Kālī Kusi into the Dhāmdāhā Kusi, between the years 1731 to 1807, and then into the Hiran—an adjoining stream—between 1811 and 1840, and further, we have the Kusi waters occupying the Hiran for over 33 years, and the Daus for exactly 20 years. As the Kusi, in its march westward, is traversing a higher lay of country in each successive shift, it appears probable that the duration of the occupation of each new channel to the west, will go on diminishing, and that, from analogy, we may infer that when the Easternmost Channel is re-opened, or re-occupied, it will hold the Kusi waters for some considerable length of time.

With regard to historical allusions to a probable Eastern Channel

Probable Historical allusions to the Kusi, an Eastward Channel.

of the Kusi we have the Chinese pilgrim, Hiuen Tsiang, on his way to Kāmarūpa (about A. D., 638), crossing a great river, which General Cunningham (Ancient Geography of India, I. 1871, page 501) infers was the Tistā, which is hardly a great river, nor is it likely to have been such in past times, looking at its restricted mountain drainage. Then the early Muḥammadan Sultāns of Bengal encountered a large river in their expeditions against Kāmarūp and Bhūtān, in the first half of the 13th Century,¹ and Ḥusain Shāh (1499-1520) also had to cross a large river on his way from Gaur to Kāmrūp. Dr. Hunter in his statistical account of Bogra, says, "Tradition, and the present condition of this District, and of Pabna and Rangpur, to the south and north, show that a great river did once flow

¹ Stewart's History of Bengal, 1813. Pages 46-66, Etc.

in or near the present bed of the Karatōyā, a river of such size that it gained a reputation for holiness, as we learn from the *Purānas*, scarcely second to the Ganges. To this day, the natives who live on the banks of the Karatōyā, say that their river is the old Brahmaputra. In M. Van den Brouck's Map of Bengal, which dates from about 1660, the Karatōyā is distinctly marked as a very great river, and as connected with the Brahmaputra." The theory about the Karatōyā being an old bed of the Brahmaputra could only apply to its lower reaches, and the evidence about its great sanctity, in ancient times, is not borne out by the present reputation of the latter river. The Kusi, or Kauçikā, is, on the other hand, invoked and worshipped by all Hindūs, especially those of Central Bengal, to this day.

In support of the theory advanced by Dr. Hunter, that the Kusi of remote times broke away eastward, in part, along the present bed of the Parwān, or by areas of iron slag. Panār (this river has a variety of names in different parts of its course), through the marshes of South Dinājpur to join the Brahmaputra, we have the occurrence of large quantities of iron slag lying in patches, mostly along banks of rivers, all to the northward of this very ideal line the river is surmised to have taken, as far, at all events, as Tājpur Pargana. Near Forbesgañj Station, of the A.-B. S. R., several miles of the line is ballasted with iron slag obtained from near the banks of the Parwān. Again; from a point (43rd mile-post) a little north of where this river crosses the Ganges and Darjiling road, for about 50 miles north-ward, that road is metalled with iron slag found locally; and again, where the Dinājpur section of the A.-B. S. R. passes through Pargana Tājpur, we find the line ballasted with the same iron slag from Raigañj to Rādhikāpur. This iron slag abounds in many localities in the District, forming mounds in places, and being covered up with earth in others, but occurring only to the north of this ideal line. No indigenous iron ore being found in the District, it seems tolerably certain that it was brought down from the Nepal mountains along such rivers as were convenient for the purpose, and appearances indicate that, probably, there was a barrier beyond which the traffic did not extend, or else all traces of slag from these regions have been swept away or covered up. It seems not unnatural to suppose that such a barrier was a large river into which flowed the streams which brought down the iron-stone, in addition to that carried down its own channel, and that the hill men, who were probably the smelters, confined their operations to the safer side of the river. Then, when the Kusi flowed here, it would be in the palmy days of Gauṛ, whose demands for arms and ironware might have originated

and maintained these iron-works, which, there is evidence to show, were carried on, on an extensive scale.

As far as I can follow Dr. Hunter, the original course of the River as suggested by him, agrees in the main with that indicated by Dr. Hamilton as far as Tājpur Pargana, but from this point the former takes it along a more northerly course into the Karatōyā, whilst the latter takes it farther south into the marshes north and east of Māldah Station (the District did not exist in those days), and thence away to the Brahmaputra. Dr. Hunter's theory seems the more likely of the two, as being based on some evidence and it will be shown lower that these "great lakes, north and east of Māldah," were probably formed by a subsequent movement of the Kusī.

Mr. Fergusson, as we have seen, considers the ancient Eastern Kusī to have discharged its waters through the rivers Atrai and Urasāgar, into the Brahmaputra.

Mr. Ferguson's Eastern Kusī. The next bed of the Kusī, and probably there were other channels occupied between this and the hypothetical course just described, suggested by Dr. Hunter, is supported by the evidence of the distinctive

Dr. Hunter's Kusī of about A. D. 1600. Bengali and Bihāri eras, whose line of division at the time of introduction would most probably be carried along a natural boundary such as a large river. There are numerous large and deep *Jhils*, or extensive pools along this tract of country which seem the work of a large river. This hypothetical course of the Kusī would also throw light on a point on which there has been much speculation and controversy, *viz.*, the causes of the abandonment of Gauṛ to which here I can only casually refer. This Kusī would pass through the Kalindri, a deep and wide channel still known as the Marā Kusī, and would strike direct against the northern suburbs of Gauṛ, and we see numerous embankments to the north and east of this ancient city meant to keep off the floods. Abū-l-Faẓl, in his *Ain-i-Akbari*, alluding to the vast swamp to the East of the city says, "Were the dam that confines it to break, the city would be under water." The flourishing capital of a large kingdom could not originally have been built in a swamp. As a matter of fact it is built on a ridge of yellow clays, with *Kajkar* here and there, which probably forms the outcrop of some of the infra-trappean beds of the Rājmahāl hills, and can be traced from Manihāri, through Gauṛ, and thence through the Borine of Rājshāhī towards Maimansingh. With the Kusī flowing to the north and east,

Deflection of Kusī probable cause of insalubrity of Gauṛ. and the Ganges washing its western walls, it is easy to understand how the city became

pestilential and uninhabitable. Gauṛ was finally abandoned in favor of Rājmahāl as the seat of Government in 1592, or about the time the Kusi is supposed to have flowed along this channel and the numerous marshes near Māldah would form a necessary concomitant to the Kusi in this position.

Returning now to where the Kusi leaves the Mountains, we see that, as a result of its extensive mountain drainage, a vast quantity of detritus is thrown out into the plains below Catrā and keeps constantly increasing and raising the detrital talus, or miniature plateau, formed round its debouchure from the mountains, and along this plateau the Kusi waters run with great velocity and at a high level, as compared with the surrounding plains. The Railway Surveys of the Assam-Bihar section of the E. B. S. R., and the Bengal North-Western Railway, which are connected by a ferry across the Kusi, about 5 miles below the Nepal frontier, show that from Acrā (*vulgo* Achra) Ghāt, on the east bank of the Kusi to Forbesgañj Station, a distance of 14 miles by the line in a South-Easterly direction, there is a fall in the surface of the ground of 29 feet and from Khanwā Ghāt, on the right bank of the Kusi, to Nirmāli—across the Bir Bandh—a distance by rail of 32 miles in a slight South-Westerly direction there is a fall in the surface of the ground of 46 feet. A careful survey, with levels recorded, made by the P. W. D. in 1890-91, shows (1) that the fall along the left bank of the Kusi from Acrā Ghāt to the village of Piṭhoriā, a distance in a straight line of about 10 miles, is 29-33 feet; (2) that the high banks of the Kajri, or Kālī Kusi, or main Kusi of 1731, which flows about 10 miles to the east of Acrā Ghāt is some 10 feet below the level of the bottom or bed of the present Kusi; and (3) that Dēbigañj Station, on the left bank of the Kusi of 1807-10 is about 5 feet below the level of the bed of the present Kusi, lower ground intervening between these two rivers.

Captain Jeffreys, in his report on the Gaṇḍak Canal, remarks "In Bihār it is characteristic of all rivers north of the Ganges that they run on ridges of high ground." The Kusi is so conspicuous in this respect, at

the present time, that it admits of no affluents in the plains, in fact, its banks form, as it were a water-shed between the rivers of the Districts of Purneah and North Bhagalpur near whose line of division the Kusi at present flows during a good portion of its course in the plains. All the rivers in the South-Western half of Purneah, taking their rise from the eastern slopes, and those in North Bhagalpur, mostly from the western slopes of the main Kusi banks; and it is worthy of notice that all the mountain water the Ganges receives through the various tributaries

flowing into it within the limits of Purneah District has previously passed through the Kusi. It seems extremely probable that all the rivers in both the above districts having their sources in the Kusi slopes have at one time or another formed the main stream of that river. We have seen that it has occupied all the Purneah rivers as above restricted, save the easternmost, *i.e.*, the Panār or Parwān, as it is called in the north and it is significant that this river also in its short course in Nepalese territory is called the Būṛhī Kusi *i.e.*, the old or mother Kusi, and it is through this channel that Dr. Buchanan Hamilton conjectures that the Kusi broke away eastwards towards the Brahma-putra; but he also mentions, as being told by a gentleman, who had

A possible Eastern Channel of the Kusi at the foot of the hills. repeatedly visited the spot, that a dry stony bedded stream flowed away eastward from below the third Cataract at Catrā, and

“alleged by the people of the vicinity to be the original channel of the river.” This stream might be the one referred to by Dr. W. Hunter as entering the District where the Bakrā now does break away eastwards. If such a former channel still exists it may possibly be found, if search were made, in the sandy plains containing antelope (*antelope cervicapra*) occurring to the North-east of Simrāhā, in Nepal, or the channel might be only a partial deflection of the stream as, indeed, Dr. Hamilton’s description would lead one to infer that the “original channel” alluded to, had, in his opinion, its exit from Nepalese territory through the Būṛhī or Panār river. The bed of the Kusi, from its high bank to high bank near the Belkār Hills, is some 8 miles wide, containing numerous islands which have been formed by running and abandoned streams intersecting one another, and the maximum rise of the river

Width and maximum rise of Kusi near Nepal frontier. in these parts is only about 8 feet during the rains; whilst the Ganges rises 30 feet where the Kusi joins it. The distance from the Belkār Hills to the Ganges in a straight line is about 100 miles, and the fall in level along the river (Kusi) about 200 feet in this distance.

Probable solution of Westward advance. Here then, I think, we have a probable solution to the problem of this westward advance of the Kusi. Rivers do not originate along “ridges of high ground” but by annual deposits on their shores during flood-time, and blown sand, raise their banks, and their beds keep rising in unison, the accumulations of sand in their beds first beginning in their lower reaches where, owing to distribution, their currents get slack. The Kusi in its most eastward course would be controlled by the detrital slope along the foot of the Himālayas which would give the initial direction to the course of the river in its endeavour to reach

the ocean by the shortest route, and then each affluent from the northern mountains would tend to deflect her course farther and farther to the south. In this position the usual detrital accumulations would go on lifting the river above the surrounding country, until the ever increasing force of the current of overflow of its spill-waters, due to its constant elevation, would ultimately break—during heavy rain or unusually high freshets—a new channel for the river into the lower country which would naturally be in a direction away from the mountains whose own detrital slopes are ever on the increase. This new channel would undergo the same filling up process, and when the next shift took place the raised banks of the channel just previously deserted, would form a sort of barrier against the immediate return of the river in that direction, and a farther deflection away from the mountains would take place, and this “constant westerly movement” would go on until the limit was reached and further westward movement checked by the general slope seaward of the great Gangetic Plain. The Kusi has never been known to return eastwards to any of its deserted channels, but has been steadily advancing westward, the successive leaps forming as it were a series of terraces with the slope facing East. Denudations and the products of denudation have tended towards levelling off the former “ridges” along which the main waters of the river were carried along. That the Kusi must again come eastwards will be apparent to any one who gives the matter a moment’s consideration. We know the Kusi has moved westward through a space of about 60 miles, measured along the Ganges, since 1731, and that it cannot go up country much further. The summer level of the Ganges at Monghyr,

**Gradient of the
Ganges surface**

to the North of which the Kusi flows at present, is 101·83 feet above mean sea level, whilst at Sāhibgañj opposite to which the Kusi of 1731 discharged its waters the summer level of the surface of the Ganges is only 68 feet above mean sea level. It is apparent that this “constant westerly movement” is not taking place for the special benefit of our Government, but must have been repeated over and over again in past geological ages since the upheaval of the Himālayas and the gradual formation of the Indo-gangetic Plain, and when the eastward movement is again accomplished, it may be in the power of distant generations to repeat that the Kusi is remarkable for its “constant westerly movement.” As to the time and manner of its going eastward again, it is difficult and hazardous to form an opinion. Fergusson, referring to the period when he considers the combined Kusi, Mahānanda, and Atrai flowed through the Urasāgar, says,¹ “Were it possible, it

¹ Quar. Jour. Geo. Soc., page 245.

would be extremely interesting to know when this was the case *** that this should have occurred within the very limited range of the traditions of Lower Bengal induces me to suppose that the beginning of the Christian era is the highest antiquity that can be ascribed to such a state of things. It may be much later." If the Bir Bandh, to be next described, is the limit of a former westward advance of the Kusi, then another limit has again been nearly reached, as we have only the rivers Parmān and Talābā in Bhagalpur as possible future streams, the sources of the Dimrā and Tiljugā being cut off from the Kusi by the Bir Bandh. It is, however, possible for this embankment to be cut away by erosion of the right bank of the Kusi, north of where the B. N. W. R. line passes through it, but the current would have to cut through several miles of forest country before accomplishing this. The Kusi floods already find their way into the lower reaches of the Parmān.

In North Bhagalpur there is an extensive embankment of earth in places some 20 to 30 feet high, called the **Bir Bandh**. Belkār or outer range of hills in Nepal southwards into Bhagalpur District, about 50 miles in length, it runs nearly parallel with the present course of the Kusi which approaches it towards its southern end. Dr. Buchanan Hamilton and others considered it to be a fortification, a theory shown by Dr. Hunter to be highly improbable, but it may possibly be a dyke to prevent Kusi overflows from flooding the lower country to the west and carving out fresh channels. It shows signs of having been cut up and partly washed away in its lower course by river action, which may have been done by the Kusi during a former westward advance. Dr. Buchanan Hamilton conjectures that this earth-work was constructed by Lakṣmaṇa II, about the close of the 12th century, the only reasons assigned for the supposition being that tradition stated it to have been built by a Lakṣmaṇa and "as the works were never completed and have the appearance of having been suddenly deserted, it is probable that they were erected by Lakṣmaṇa the second, who in the year 1207, was subdued and expelled from Nadiya by the Moslems." Probably he refers to the detached portions at its southern end, cut away by river action, when alluding to its incomplete and abandoned appearance. This extensive embankment cuts off the sources of the Dimrā and Tiljugā rivers from the Kusi, and intercepts all flood-waters of the latter river from entering the channels.

As to the manner in which the change will take place we have the analogy of the behaviour of the Tistā river, under apparently similar conditions, to be next described. From the general aspects of the

Probable return of the Kusi to its easternmost alignment.

From the general aspects of the

gradients in the Kusi sub-delta, and the inference to be drawn from the straightening of the Tistā, it would appear probable that the Kusi, after reaching its westernmost limit, will go back to near the easternmost of its abandoned channels, and then begin the work of moving westwards all over again. In fact since these notes were taken, the Kusi, during the rains of 1893, made a great demonstration of going eastwards and threw such a considerable volume of water from below the village of Babbia into the Būṛhi river, that a considerable tract of country on both its sides was flooded and covered up in places with 6 to 8 feet of sand, and the large villages of Harinagrā, and Diwāngañj, in Nepal, on the right bank of the Būṛhi stream, were silted up and had to be deserted.

The Tistā river is known to have flowed through the Karatōyā, and to the East of this latter river there are other beds known as the *marā* or dead Tistā. In **Return of the Tistā to its easternmost abandoned channel.** Major Rennel's Bengal Atlas, published in 1781, the Tistā is shown running far to the west of the Karatōyā, *i. e.*, in the Atrai river, and flowing into the Padma or Ganges. This seems to have been the westernmost limit of the Tistā, though in remoter times it may have flowed through the Dhīpā and Purnabahā in Dinajpur, for in 1787, quoting from the Rangpur Collectorate records, Dr. Hunter in his account of that District says, "The Tistā, at all times an erratic river, had for long rolled its main stream through the western part of Rangpur and through Dinajpur till it mingled its waters with the Atrai and other streams, and finally made its way into the Padma or Ganges. At the same time it threw off a small branch in the northern part of Rangpur which found its way by a circuitous course past Ulipur to the main stream of the Brahmaputra, a little farther north than the place where the waters of the Ghaghat found an exit into the same river. Suddenly the main branch of the Tistā swelled by incessant rains, swept down from the hills such vast masses of sand as to form a bar in its course, and bursting its banks the Tistā forced its way into the Ghaghat. The channel of this latter stream was utterly inadequate to carry off this vast accession to its waters; the waters of the Tistā accordingly spread itself over the whole District causing immense destruction to life and property, until it succeeded in cutting for itself a new and capacious channel through which the river now flows. This great inundation occurred on the 27th August 1787, and on the 2nd September, the Collector reported to the Board of Revenue that, "Multitudes of men, women, children and cattle have perished in the floods, and in many places whole villages have been so completely swept away as not to leave the smallest trace whereby to determine that the ground had been occupied." These calamities culminated in a famine. Collections of

revenue were suspended for a period of two months, and provision was made for feeding the starving poor who were daily flocking into the town. "Upwards of 6,000 poor were, at this time, in receipt of daily rations of rice at the Civil Station *** It was estimated that in the course of this disastrous year, Rangpur District lost one-sixth of its inhabitants. In pargana Pangā, half the population were gone."

Fergusson, alluding to this new course adopted by the Tistā, says, "The curious part of the matter is that looking into Rennel's original M. S. Surveys, a chain of ponds is marked in this direction as the old bed of the Tistā," too insignificant to be marked in his Atlas, but at their junction with the Brahmaputra he does mark 'Teesta Creek.' To those who know how permanent the names of rivers are, this is proof positive that the river once before flowed in this direction, but unfortunately we have no knowledge when it deserted this bed and became a confluent of the Atrai."

Thus a comparatively small river, whose mountain drainage is confined to a portion of Sikhim, has proved capable of dealing destruction over a large tract of country in its eastward return; and the Tistā is not singular in this respect, there being rivers in other countries which are reported to carry destruction with their movements. Thus Mr. Woodville Rockhill, the American Central Asian traveller, writing in the *Century Magazine* says, "On the banks of the Huang-ho, a little to the west of where I crossed it, comes yearly an official to sacrifice in the name of the Emperor to the river god, that he may spare the country through which it flows and not visit it with death-dealing floods * * * Evidently little faith is placed in this mode of restraining the fury and vagaries of the great river which within the historical period has four times changed its lower course and yearly breaks through the immense levees along its banks. The most recent change was in 1887, when it swept over more than a hundred thousand square miles of country in the Provinces of Honan and An-hui, obliterating innumerable towns and villages, and dealing death to hundreds of thousands (report says millions) of people."

Now if we return to the Kusi and examine all its abandoned channels lying to the east of its present course, we can see that not one of them, except perhaps the one last deserted, is capable of containing a fraction of the waters brought down by the main river, and extensive and severe floods are sure to occur along whichever channel it adopts in its retreat back towards the sea. With an eastward direction of flow, as indicated by Drs. Hamilton and Hunter, it would intercept and absorb

Changes in the Course of the Huang-ho.

Channels inadequate for carrying main Kusi waters.

the waters of all hill streams that at present drain into the Mahānanda which river itself when it came to deal with the raised banks of the new Kusī would probably break away and join the latter river farther to the south-eastward, through one of those rivers starting from the neighbourhood of its left bank which have in former times, probably, formed the bed of its main stream. In this connection Mr. Fergusson, alluding to the westward advance of the Kusī, remarks :¹ "It shows a great tendency to go farther in this direction, in fact, to imitate the example of its old confluent the Mahanuddee, which forms a circle extending 35 miles to the westward of the straight line in which we may reasonably suppose it reached the Ganges at no very distant date." The Mahānadi appears to have now reached its farthest westward limit and with minor local deflections has been practically stationary in its present course within the memory of the present generation, and the eastward movement will probably be into its easternmost supposed channel, the Tanghan river, or possibly further east. Thus the Kusī in its new course would go on increasing in dimensions and in force and would form in the neighbourhood of the Brahmaputra an immense river.

On approaching the banks of a newly-adopted channel of the Kusī,

Effects caused by movements westward.

when it has been established for a few years, its vicinity can at once be suspected by seeing forests of large trees, which had formerly been growing on the highest class of lands, their stems silted up to their forking branches, gradually dying off, and the whole country covered with sand or clay deposits as the current has been swift or slack, and most of the higher arable lands converted into jungles of tall saccharum grasses and tamarisk (*Tamarisk indica*). On the other hand, a broad belt on either side of a recently deserted channel is rendered conspicuous by the absence of all large trees except occurring as an oasis, spared here and there, dotting the prairie of waving grasses. When Dr. Buchanan Hamilton visited Purneah in 1807, Dhāmdāhā Thanā was one of the most populous and prosperous divisions of the District to the west of, and almost untouched by, the Kusī, whilst Gōndwārā Thanā to the east, recently overrun by its ravages, had wild elephants roaming in its jungles. At the present time the former is just recovering from the state of being more or less a treeless tiger jungle, and the latter is the most cultivated and wooded of the three parganas of the Mahārāja of Darbhanga's zamīndāri of Dharampur, the exploiting ground of the Kusī in Purneah for the past century. Captain Jeffreys in his report on the Gaṇḍak canals, referring to rivers in Bihār north of the Ganges as quoted in Dr. Hunter's "Bhagulpur," says, "Between two adjacent rivers there will be found a shallow

depression consisting of a series of *caurs*, or low lands, leading into one another." This is the case with all the abandoned courses of the Kusi and it is these very shallow depressions, or *caurs*, which the Kusi works into and carves out new channels on a return to the locality. In the case

Rate of silt accu-
mulation.

of the Hiran, or main Kusi, of the surveys of 1840–47 its channel is now nearly obliterated; its former course in places being marked by a high ridge, and when the Kusi next re-visits this locality it will flow along the *chaurs* flanking the original course of the river of 1840, and the present low lands will become in part the high banks of the future river, and *vice versa*. To give an instance, Nipania, situated between beds of the Hiran and Dhāmdāhā Kusi about 30 miles above where these rivers fall into the Ganges, was a working indigo factory belonging to a brother of mine, and obtained its water supply from an artificial tank upon the raised banks of which stood the dwelling-house and masonry outworks. I saw it in working condition in 1869, and on my re-visiting the spot in 1877 no trace of the tank or indigo vats could be seen, but the upper portion of the boiler building with chimney stood out from the sands, marking the spot round which the factory compound and works formerly stood, the place having been covered up with about 10 feet of sand by a turn in the flow of the Hiran, just previous to the Kusi abandoning this river and going into the Daus swamps.

The great changes that have occurred in the courses of the Indus and other Pañjāb rivers in the western half of the Indo-Gangetic Plain are well known, though I believe they have never been system-

Changes in the
Panjāb Rivers.

matically worked out.¹

It is well known that the Ganges or Bhāgirathī in former times flowed past Suti or Sontī in the Murshidābād District into the sea through Diamond Harbour, or along the direction in which the Hugli now flows, and this is the river up to the present day regarded by the Hindūs as their sacred Ganges, or Bhāgirathī; and the portion of the Ganges called the Padda or Padma, between Sontī and its junction with the Brahmaputra, at Jāfirgāñj, is not held sacred. It is important to bear in mind that the real name of the Ganges from Gaṅgōtrī near its source in the western Himālayas to Sāgar on the sea is the Bhāgirathī, and the word Gaṅgā simply signifies *river*, and as applied to the Bhāgirathī means *the river par excellence* of the Hindūs.

¹ [See, however, Major Raverty's Article on the Mihrān of Sindh, appearing as an Extra number of the *Journal* of the Society for 1898. Ed.]

Fergusson¹ alluding to this says "Poddah or Padma (Lotus) is the stream running nearly east and west by which the Bhāgirathi, or true Ganges, above Bauleah at some recent time connected itself with the Brahmaputra somewhere above Jāfirgāñj. The tradition of this junction taking place is quite distinct in the minds of the natives inhabiting its banks, who do not consequently look on the Poddah as a sacred stream."

The Padma. Now if we examine the Sea-board of the Gangetic Delta at the head of the Bay of Bengal, we find three indentations or arms of the sea larger, and running deeper into the seaward face of the Sunderbans than the rest of the creeks. These are, beginning from the west: (1) The mouth of the Hugli, or Ganges proper; (2) The Harinaghattā Estuary; and (3) The Megnā Channel, at present the outlet of the Ganges, Kusi, and Brahmaputra combined.

At about the time the main Ganges flowed into the sea by the first of these channels, and the Brahmaputra, flowing past Maimansingh, joined the Megnā, (as it is well known that the Brahmaputra came into the portion of its present channel lying between Diwāngāñj and Jāfirgāñj, about the beginning of the present century), and found an exit into the sea through the third channel, we have the Kusi probably flowing eastwards towards Pabna, and it seems not unlikely that the Harinaghattā is the channel by which the Kusi waters, swelled by many of the tributaries at present flowing into the Brahmaputra, found their way into the ocean. This would account for the great depth and size of the Madhumati river, and the extent of the Harinaghattā Estuary.

Describing the seaboard, Fergusson says,² "From the Hugly to the Harinaghata, the seaward face of the Sunderbans is tolerably level and fixed, at all events it has undergone no sensible change within any period to which our knowledge extends, and so far as can be ascertained, it shows no tendency to go forward. In that portion of the Delta, however, allotted to the Brahmaputra a great deal of work has yet to be done, everything there is so new and in such a constant state of change." At the present time all the three great rivers have combined their labours, and are using their united efforts in building up the backward—hence comparatively lower—portions of the Delta in the eastern part of the Bay, by depositing the greater portion of their

¹ *Quar. Jour. Geo. Soc., London, Vol. XIX., 1862.*

² *Quar. Jour. Geo. Soc., page 334.*

silt along the Megnā outlets; but a time must surely come when it will be the turn of the Hugli and Harinaghāṭṭā to work on their own portions of the Delta already advanced so far into the sea, and now enjoying a period of rest, and what combination of physical events may bring this about, it is our province to enquire into.

Now, referring to my allusion in the introduction, to remoter dangers of a serious nature, we have Dr. Buchanan Hamilton's opinion that when, in its westward advance, the Kusi came across and joined the Bhāgīrathī, "the united mass of water opened up the passage now called the Padma and the old channel of the Bhāgīrathī from Sonti to Nadiyā was then left comparatively dry." This seems likely enough, but the converse appears still more probable, that is, upon the Kusi breaking away eastward again and deserting the Bhāgīrathī, the latter river will return to and resume its old course and flow into the sea through Diamond Harbour. To quote Fergusson again, he says,¹ "The first result of the invasion of the Gangetic territory by the Brahmaputra was that it should seek to re-enact the part which had just been performed on the other side of the Madhoopur jungles, and should threaten to shut up the Ganges and send it back through its own distributaries. It was so nearly successful that in 1838 the great Ganges was fordable at several places above the junction." Now, if the detritus brought down by the new channel of the Brahmaputra nearly closed up the bed of the Ganges in 1838, it appears more than probable that that event may actually occur upon the Kusi joining it through, probably, the Urasāgar River after over half a century of silting up and raising of the country round the junction of the three rivers.

With the main stream of the Ganges turned into the narrow channel of the Hugli it appears tolerably certain that Calcutta, and many of the towns along the banks of the Bhāgīrathī would be rendered untenable.² Further, the vast increase in its waters would cause its banks to overflow and sand and clay deposits would take place over a wide area, and the silting up and devastation caused by a shift westward of the Kusi, above described, would be re-enacted on a

**Danger to Calcutta
from Hugli becoming
Main Ganges.**

¹ Quar. Jour. Geo. Soc., Page 336.

² [The reader is again referred to the Proceedings for February, 1895, in which this opinion is discussed. It is hardly necessary to point out that the author is dealing with results which may occur if engineering science does not interfere. The discussion above referred to shows that engineering science has interfered. Ed.]

larger scale on the lands flanking the Hugli, which river itself would then—as the Ganges—probably shift about into adjacent channels. Another interesting question now crops up from this state of affairs.

We have all read of the celebrated Calcutta Bore-hole, a boring in search of pure water carried to a depth of **Calcutta Bore-hole.** 481 feet, or about 460 feet below mean sea level, at Fort William, in 1835. At a depth of 25 feet a carbonaceous sandy clay was met with, which gradually passed into a bed of peat at 30 feet, or about 10 feet below mean tide level.¹ This peat bed has since been found in all excavations in and around Calcutta at depths varying from 20 to 30 feet, and it is admitted by Geologists that there is little doubt that this was an ancient land surface, as wood and roots of the *sundri* tree (*heritiera littoralis*) and other vegetable remains occur in the peat. Now it seems not unlikely that the present surface of the ground, in suitable localities, after such a catastrophe as above surmised, would present to future generations such a stratum as the first peat bed encountered in the Calcutta Bore-hole. It might be brought forward as an argument against this theory that the peat occurs at, or a few feet below, mean tide level, but we must remember that the rank vegetation from which the peat had its origin must have grown in soft low-lying grounds, such as the Sundri trees grow in now, and in a flooded state of the country the extra pressure resulting from the higher level of water and silt deposits, with loose semi-fluid quicksands, some 30 feet in thickness, as encountered in the Bore-hole underlying the peat at no great depth, would be sufficient to settle the peat-bed a few feet below water level, especially as the whole country would be saturated with flood waters. In fact it seems probable that a general settling down of all the alluvial strata along the seaboard would be the natural result of such a condition of things. It would be extremely important and

Old Course of the Bhāgirathi. interesting to know when the main Ganges, in past times, last flowed through the Diamond Harbour Estuary. The native tradition is that the original Bhāgirathi formerly flowed into the Estuary through the opening now occupied by the Rūpnarain, and Fergusson² thinks the tradition is right, and as above quoted, he also considers that the main Ganges deflected into the Padma channel “at some recent time.” In the map of Bengal, published in the “*Da Asia*” of the Portuguese historian, De Barros, during the latter half of

¹ Jour. As. Soc. Beng., IX., 686 (1840), also Geology of India, R. O. Oldham, 1898, page 482.

² Quar. Jour. Geo. Soc., London; Vol. XIX., page 340.

the sixteenth century, as given by Wilson,¹ the Padma is already shown as a wide and established stream, but the present Bhāgīrathī is shown as throwing a narrower branch off westward and flowing into the Estuary in the neighbourhood of the outlet of the Rūpnarain, and to this western channel probably the Dāmūdā, alluded to by Wilson,² was an affluent. In the map the name Hugli is not mentioned, but that river is called the Ganges, no town or village is marked where we should expect to find Calcutta, but Sātḡāṣ, spelt Satigam, near the modern Hugli, is shown higher up the river and formed the trading mart of the Portuguese in those times, and there was sufficient water for the larger vessels to come up the river as far, at all events, as the present site of Calcutta and for the smaller vessels to go right up to Sātḡāṣ. Now if tradition is to be trusted in this instance, and De Barros' map has been correctly interpreted by me, then it would appear that the original Bhāgīrathī which flowed into the sea near the Rūpnarain opening, had been then already deserted, and the deeper channel was the present Hugli. That a wide deserted channel can be silted up and obliterated in the short space of twenty years, we have seen in the case of the Hiran, and to those who have watched the process it is easy to understand, and that the old channel of the Bhāgīrathī should have disappeared after a lapse of three centuries is in no way surprising. In the same way that the Ganges probably broke away into the Padma, owing to the accession of the waters of the Kusi, the sluggish Bhāgīrathī after the withdrawal of the bulk of its waters was unable to keep clear the major stream, and to prevent it from silting up, and contented itself with the minor bed of the Hugli. The curious coincidence of the "Da Asia" being published just about the time Gauṛ became unhealthy and pestilential, which I have surmised to have been due to the Kusi coming into the Kalindri, *i. e.*, leaving its eastern courses and coming into the Ganges, which then flowed under the western walls of the old city, may be noted. According to Wilson, the "Da Asia" was published in parts, from 1552 to 1613, and the seat of Government was removed, owing to insalubrity, from Gauṛ to Tandā, by Sulaimān Shāh in 1564-65, and ten years later the great pestilence broke out which depopulated Gauṛ, which was finally abandoned in favour of Rājmahāl in 1592. It was about this time, according to Hunter's *Māldah*, that the Ganges ceased to flow under the walls of Gauṛ, and this would be the natural result of the Kusi deflecting it westward. From

¹ Topography of the Hugli in the 16th Century, by C. E. Wilson, *Jour. As. Soc. Beng.*, Vol. LXI., 1892.

² *Jour. As. Soc. Beng.*, Vol. LXI., 1892, note, page 112.

all these aspects of the case it would appear probable that the Ganges turned away eastwards during the first half of the 16th century, and the probability would amount almost to certainty if we were to admit that the western channel shown in De Barros' Map is the original Bhāgirathi, as it must have been recently vacated to appear so conspicuous.

In conclusion, I would beg to remark that the whole subject is a vast and interesting one, and only the more prominent features have been here touched upon with a view, principally, of pointing out the probability of the Kusi and Ganges changing their courses, and the attendant dangers, and from the evidence adduced I think we are fairly entitled to conclude that both these catastrophes are certain to occur in the not distant future.

Two points of special interest to Geologists crop up from these investigations. The first is that we here see to Sussex Weald, in progress in the Delta. vast fresh-water beds of sand alternating with clay, with here and there thick deposits of fresh-water Shells in the *Cours (vulgo, Chours)* or lagoons forming far inland by the action of rivers; whilst in the newly forming portions of the Delta itself we may expect to find areas of strata containing marine organisms alternating with fresh-water, or estuarine beds, without the aid of general up-heaval or depression of the country. This throws somelight on the probable mode of formation of the fresh water and fluviomarine beds of the Weald of Sussex, a subject of such controversy amongst English geologists.

The second point of interest is that beginning at the Manihāri Hill, High ridge of Country connecting Rāj-mahāl with Assam Hills. in the Purneah District on the left bank of the Ganges, and going eastward and southward, a high ridge of country can be traced, with gaps here and there, right away through Gaur, the Borine of Rajshahi and Bogra through the Madhupur Jungles, away to the Assam Hills, between which and the Rājmahāl Hills it forms a sort of barrier between the Gangetic Plain and the Delta proper. The principal perforations or gaps in this ridge are, (1) the channel of the old Brahmaputra above Diwāngañj; (2) The channel of the present Brahmaputra at Jafirgañj, which probably carried the Kusi at one time, and (3) the channels of the Mahānanda and Ganges which are practically the same between Rājmahāl and the Borine, with the narrow Gaur ridge forming an island in this opening. This ridge is composed of limestone, *kaykar*, and brightly-colored variegated clays in the case of Manihāri Hill, and farther east of yellow and reddish clays with *kaykar* beds uncovered by the newer alluvium. Similar beds occur on the banks of the

Karatōyā and near Dinājpur, where Dr. Buchanan Hamilton¹ mentions the occurrence of *khari*, or the white clay of the Rājmahāl inter-trap-
pean beds in digging a well. In most places these beds are what
are termed in geological works in India, the "older alluvium"
but it is not clear by what process they came to cover the highest tracts
of the country; but the influence of this barrier in checking the drain-
age of the country in the earlier days of the building up of the Gangetic
plain and even probably now must be apparent to all knowing the dis-
tribution of the Ganges alluvium.

These three openings in this high tract of the country corres-
pond to the three larger estuaries in the
Three larger Estua- pond to the three larger estuaries in the
ries correspond with seaboard at the head of the Bay, above
3 gaps in the ridge. described, and knowing as we do that the
flanking estuaries have been occupied separately by the two great
rivers of Bengal, it seems but reasonable to suppose that there
Kusi probably hold- must have been a time when the Kusi,
ing an independent holding an independent course and absorbing
course to the Sea. the southern drainage of the Himālayas up
to the eastern confines of Sikhim, passed through the central opening
and flowed into the sea through the Harinaghāṭṭā Estuary, as a third
great river of Bengal.

A map 50·9 miles to the inch, taken from Messrs. Keith Johnston's
Atlas, published in 1894, with dotted lines indicating the various align-
ments of the Kusi—hypothetical as well as actual—is annexed.

¹ Description of the Dināpur District, Calcutta, 1833.

