

CHAPTER I

PHYSICAL ASPECTS

GENERAL DESCRIPTION

THE district of Nadia forms the north-eastern portion of the Presidency Division, and lies between north latitude $24^{\circ} 11'$ and $22^{\circ} 53'$, and east longitude $89^{\circ} 22'$ and $88^{\circ} 9'$. It extends over an area of 2,793 square miles, and has a population, according to the Census of 1901, of 1,667,491 persons. It takes its name from the town of Nadia or Nabadwip, situated at present on the west bank of the Bhagirathi, but the administrative head-quarters and chief city of the district (although not the most populous) is Krishnagar, on the Jalangi river, in latitude $23^{\circ} 24'$ N. and longitude $88^{\circ} 31'$ E.

BOUNDARIES

The district is separated on the north from the districts of Pabna and Rajshahi by the Padma or Ganges; on the north-west, from the district of Murshidabad, for about three-quarters of this boundary, by the Jalangi or Kharia; and on the west from the districts of Bardwan and Hooghly by the Bhagirathi or Hooghly. On the remaining sides of the district there are no natural boundaries, but it is bounded on the south by the 24-Pargannahs district, on the south-east by Jessore, and on the east by Faridpur. On the western boundary there were two strips of land included in the district, though they lie, at present, on the west bank of the Bhagirathi. On the southernmost of these, which has an area of about 11 square miles, lies the town of Nadia, or Nabadwip; it is probable that this strip would have been transferred to the district of Bardwan, within the natural boundary of which it now falls, had it

not been for the previous history of the river and the anomaly which would have been caused by including within another district the town from which the Nadia district derives its name: indeed the order for transfer was actually passed by Sir George Campbell, but was rescinded in the following year by his successor, Sir Richard Temple. The other strip is the island of Agradwip, which lies about 15 miles north of Nadia: this, however, was transferred to the district of Bardwan with effect from 1st April 1888. There seems no doubt that at one period the main channel of the Bhagirathi passed to the west of both these strips.

NATURAL CONFIGURATION

The Nadia district is a large alluvial plain stretching southwards from near the head of the delta formed by the successive rivers into which the Ganges has from time to time distributed itself. As to the formation of this delta, the following remarks of Dr. Thomas Oldham recorded in the proceedings of the Asiatic Society of Bengal, 1870, page 47, may be quoted :-

"I suppose no one will hesitate to acknowledge that the whole of the country, including the Sunderban proper, lying between the Hooghly on the west and the Meghna on the east, is only the delta caused by the deposition of the debris carried down by the rivers Ganges and Brahmaputra, and their tributaries. It is also equally well known that in such flats the streams are constantly altering their courses, eating away on one bank and depositing on the other, until the channel in which they formerly flowed becomes choked up, and the water is compelled to seek another course. It is also certain that in this peculiar delta the general course of the main waters of the Ganges has gradually tracked from the west towards the east, until of late years the larger body of the waters of the Ganges have united with those of the Brahmaputra and have together proceeded to the sea as the Meghna. Every stream, whether large or small,

flowing through such a flat, tends to raise its own bed or channel by the deposition of the silt and sand it holds suspended in its waters, and by this gradual deposition the channel bed of the streams is raised above the actual level of the adjoining flats. It is impossible to suppose a river continuing to flow along the top of a raised bank, if not compelled to do so by artificial means, and the consequence of this filling in and raising of its bed is that, at the first opportunity, the stream necessarily abandons its original course, and seeks a new channel in the lower ground adjoining, until after successive changes it has gradually wandered over the whole flat and raised the entire surface to the same general level. The same process is then repeated, new channels are cut out, and new deposits formed.

"Bearing these admitted principles in mind, look to the delta of the Ganges and Brahmaputra. The Ganges river emerging from its upper levels round the Rajmahal Hills, and prevented by their solid rocky barrier from cutting further to the west, sought its channel in the lower ground adjoining, and originally the main body of its waters flowed along the general course now indicated by the Bhagirathi and Hooghly. But gradually filling up this channel, it was again compelled to seek a new course in the lower, because as yet comparatively unfilled-in, ground lying to the east. And the same process being repeated, it wandered successively from the rocky western limit of the delta-flat towards the eastern. If this progress eastwards was allowed to be sufficiently slow to admit of the gradual filling in of the country adjoining, the delta was formed continuously up to the same general level, and the larger streams or channels passing through this flat to the sea became unavoidably diminished in size, and in the quantity and force of the water they carried, the main body passing around further to the east, and having its course in the channels successively formed there. I need not here point out the successive stages in the formation of the delta, or show how these have been

exactly paralleled by similar change in the course and deposits of the Brahmaputra and the other river which unite with the Ganges."

Revd. J. Long, in an article entitled "The Banks of the Bhagirathi," and published in volume VI, December 1846, of the *Calcutta Review*, writes thus: "We name this article the banks of the Bhagirathi, though some Europeans call the river as far as Nudiya the Hugly; but Hugly is a modern name given to it since the town of Hugly rose into importance; the natives call it Bhagirathi, because they say it was the channel Bhagirath cut in bringing the Ganges from the Himalaya to Ganga Sagar. This name recalls, what is believed to be a fact, that the Ganges itself formerly ran by Katwa, Tribeni, and not as it does now into the Padma; our reasons are, the natives attribute no sanctity to the waters of the Padma, thinking the Bhagirathi to be the true bed of the river; hence the water flowing by Bishop's College is not esteemed holy, as they say that the site of Tolly's Nala was the ancient bed; there are no places of pilgrimage along the banks of the Padma, while on the Bhagirathi are Tribeni, Sagar, Nudiya and Agardip. Dr. Buchanan states on that subject: 'I think it not unlikely that on the junction of the Kosi with the Ganges, the united mass of water opened the passage now called Padma, and the old channel of the Bhagirathi from Songti (Suti) to Nudiya was then left comparatively dry. In this way we may account for the natives considering that insignificant channel as the proper continuation of their sacred river, as they universally do, a manner of thinking that, unless some such extraordinary change had taken place, would have been highly absurd.' The names of places near the Bhagirathi ending in *dwip* island, *danga* upland, *daha* abyss, *sagar* sea, seem to indicate that a large body of water formerly flowed near them."

The country is flat and the general aspect is that of a vast level alluvial plain, dotted with villages and clusters

of trees and intersected by numerous rivers, back-waters, minor streams and swamps. The soil is agriculturally classed as high land, and bears cold weather crops as well as rice. In the west of the district is the Kalantar, a low lying tract of black clay soil which stretches from the Murshidabad district through the gap in the north-western boundary between the Jalangi and Bhagirathi, down into the Kaliganj and Tehata thanas. This tract bears only winter rice and is specially liable to famine when the monsoon fails: it is also liable to serious injury from inundations from the Bhagirathi when the Laltakuri embankment in the Murshidabad district gives way.

RIVER SYSTEM

At present all the Nadia rivers may be described as off-shoots of the Padma, or main channel of the Ganges, but it seems clear that at one time the Ganges found its way to the sea along the course of the Bhagirathi, and in those days, before the Padma broke its way to the eastward and intersected the drainage of the Darjeeling Himalayas, there must have been some earlier streams to carry that drainage to the sea, of which the Bhairab is said to have been one. Now-a-days, however, all the drainage of Northern Bengal is intercepted by the Padma before it reaches Nadia.

PADMA

The Padma impinges on the district at its most northerly corner, at the point where it throws off the Jalangi, and flows along the northern border in a direction slightly south of east, until it leaves the district some miles to the east of Kushtia. It carries an immense volume of water and is very wide at places. Except where it is confined by high banks, the main channel is constantly shifting, whereby many disputes are caused as to the possession of the *chars* and islands which are thrown up.

JALANGI

The Jalangi leaves the Padma at the extreme north of the district, and after forming the greater part of the north-western boundary, passes within the district at a point some miles north of Tehata. Thence it pursues a tortuous course in a southerly direction until it reaches Krishnagar, from which point it proceeds due west until it falls into the Bhagirathi opposite the town of Nabadwip.

BHAIRAB

The Bhairab, which is by some thought to be of older origin than the Jalangi, its generally reputed parent, takes off from that river at a point a few miles north of Karimpur, and after a most tortuous course across the district, the general trend of which is to the south, loses itself in the Matabhanga not far from Kapasdanga. During the greater part of the last century there was very little current in this river, owing to its intake from the Jalangi having silted up; in 1874 a high flood cleared away the obstruction and widened the channel, but, for many years past, it has been practically dead, and the unhealthiness of Meherpur, which lies upon its banks, is in great measure attributed to the stagnancy of its waters.

BHAGIRATHI

The Bhagirathi impinges upon the district near Plassey, and for some distance, forms its western boundary. It takes the name of the Hooghly from its junction with the Jalangi opposite Nabadwip town. In its upper reaches it is at present a comparatively insignificant stream, but the surrounding country gives evidence of the vast size which it attained, when it formed the main bed of the Ganges, the name of which is still applied to it by the villagers along its banks.

MATABHANGA

The Matabhanga or Hauli leaves the Padma about ten miles below the point where the Jalangi diverges from

it. It flows first in a south-easterly direction as far as Hat Boalia, where it bifurcates, and one branch, which is thereafter known as the Kumar or Pangasi, proceeds, in the same direction past Alamdanga up to the boundary of the district which it forms for a few miles until it passes into Jessore, while the other branch pursues a very tortuous course, the general trend of which is to the south, until, after passing Chuadanga, it reaches Kissengunge, east of Krishnagar, where a second bifurcation takes place, the two resulting streams being known as the Churni and Ichhamati, and the name of the parent river being lost.

CHURNI

The Churni passes in a direction slightly west of south, past Hanskhali and Ranaghat and falls into the Hooghly between Santipur and Chakdaha.

ICHHAMATI

The Ichhamati flows in a south-easterly direction and after forming the boundary of the district for a few miles passes into the Bangaon Subdivision of the Jessore district.

KABADAK

The Kabadak takes off from the left bank of the Matabhanga a few miles below its junction with the Bhairab, and takes an almost straight south-easterly course to the boundary of the district where it passes into Jessore. Its offtake is silted up, and, within this district, it is now nothing but a *khal*.

GARAI

The Garai takes off from the Ganges not far from Kushtia, and after flowing in a south-easterly direction past Kumarkhali and Khoksa, passes over the border into the Goalunda Subdivision of the Faridpur district. It throws out two unimportant distributaries from its right bank,

named the Kaliganga and Daoko. The Garai is gradually silting up, and is now navigable only during the rainy season.

NADIA RIVERS

The whole district is a net work of moribund rivers and streams, but the Bhagirathi, the Jalangi and the Matabhanga are the three which have been for more than a century, and still are distinctively known as the "Nadia Rivers." Until the advent of the railways, these watercourses afforded the regular means of communication between the upper valley of the Ganges and the seaboard. Ever since the British occupation of the country much difficulty has been experienced in keeping them open for navigation throughout the year. They have, when left to themselves, a very sluggish current which fails to carry off the large quantities of silt which they receive from the Ganges. In 1781 Major Rennel Recorded that they were not usually navigable in the dry season. Captain Colebrook, in a memoir on the course of the Ganges (1797), writes thus:—"The Bhagirathi and Jalangi are not navigable throughout during the dry season. There have been instances of all these rivers continuing open in their turn during the dry season. The Jalangi used formerly to be navigable during the whole or greater part of the year. The Bhagirathi was navigable in the dry season of 1796. The Matabhanga, when surveyed in 1795, was navigable throughout in the dry season for boats of a moderate burden. This year (1797), however, I was informed that the passage was no longer practicable for boats proceeding to Calcutta. Experience has shown that none of these rivers are to be depended on." Early in the nineteenth century the Matabhanga appears to have been more easily navigable than either the Jalangi or the Bhagirathi, and it is said to have continued open every year from 1809 to 1818. In 1813 measures were taken towards improving its channel, and a toll was established to defray the expense of the work. Very little

good, however, appears to have resulted from the effort then made, for in 1818 "the obstructions had become so many and dangerous, as to cause the wreck of innumerable boats, and to entail heavy losses on account of demurrage paid for detention of ships waiting expected cargoes. The merchants of Calcutta in that year urgently petitioned Government that steps should be taken for remedying an evil from which the commercial interest suffered too severely."

In order to allow the ordinary large traffic-boat of 250 to 300 maunds to pass by this route, there must be a minimum depth of not less than $2\frac{1}{2}$ or 3 feet. This amount of water can of course always be obtained during the rains from the middle of June to October. But during the other seven months of the year, obstructions and shoals form, which render navigation always uncertain, and often impossible, by the beginning of February. In 1819-20, Mr. C. K. Robison was appointed Superintendent and Collector of the Matabhanga, and he succeeded in clearing the mouth of the river, where it leaves the Ganges in the north of the district, from the sand banks which had formed over sunken boats and timber. The channel was also narrowed by means of *bandhals* described below, and the river rendered navigable from its head to the point where the Kumar branches off to the east. This river carried away five-sixths of the supply of water from the Matabhanga, and an attempt to divert a portion of its current into the Matabhanga proved unsuccessful. Shortly afterwards, Mr. Robison was succeeded in his office by Mr. May, who conducted the duties over twenty years, and first directed his attention to the damage caused by the numerous trees which were allowed to grow on the river side, and which fell into the stream wherever the waters cut into the banks. Many wrecks took place every year from boats running against these fallen trees, and Captain Lang states that in 1820 the number of sunken *sal* timber logs was incredible. In a single year timber rafts to the value of a lakh of rupees are said to have

been lost. During 1820 and the following year, three hundred sunken timbers and many boats and trees were removed from the bed of the river, some of them being buried to a depth of twelve feet in the sand. During 1920-21, the upper channel of the Matabhanga was deepened by means of *bandhals*, constructed as follows:— At the shoals, to be operated on, a line of bamboo stakes is run out from each bank of the river. These stakes gradually converge so as to force and concentrate the current into a narrow channel. They are well driven into the bed of the river, supported by struts, and fastened at the top by longitudinal ties. Large mat screens (*jhamps*) are then let down as far as possible, and well secured to the bamboo frame-work. The first result from the *bandhal* is a great velocity within the channel it is intended to create, and a diminished current on both sides. Owing to the increased pressure below, the mat screens (*jhamps*) can never be sunk quite to the bottom of the river, and through the space left there the water rushes with immense force in a circular direction, cutting away the sand, and carrying it under the matting and behind the line of bamboos, where the stream being sluggish, constant deposit takes place. The force of the current in the centre of the channel is at the same time gradually cutting and bearing down stream the sand in its course, so that by these two actions the depth is increased in the channel enclosed by the *bandhal*, while on each side of it towards the bank, large collections of sand take place, materially narrowing and deepening the stream. The depth of the channel within the *bandhal* scarcely varies more than an inch or two, which is remarkable: and although the rivers may fall two or three feet after the *bandhals* are constructed, and shoal proportionately at other points, the uniform depth, be it three, four or five feet, is generally maintained within their channels till the next rainy season. All that is necessary is to drive the bamboo piling further down as the water cuts away the sand, and to sink the *jhamps* from time to time to suit the fall of the river. It sometimes happens that the weight of gravel and sand

swept away by the current within the *bandhal* sinks immediately on getting beyond it, thus forming another shoal which requires the construction of another *bandhal* to remove it.

These works, carried on in the upper channel of the Matabhanga during the dry season of 1820-21, rendered the river navigable till the end of March, from its mouth to the entrance of the Kumar, at which point further measures were undertaken to divert a portion of its current into the Matabhanga. A cut, 1,540 yards in length, was made to shorten one of the bends of the latter river, and to increase the fall; a caisson was also sunk, together with a number of old boats, across the mouth of the Kumar. These operations involved an expenditure of Rs. 14,000. When the river fell again to its usual dry season level, it was ascertained that the works had not been without effect, that the entrance of the Kumar had shoaled considerably, and that the depth of the Matabhanga had increased in proportion. Throughout 1821-22, a depth of three feet of water was always to be found at the worst shoals, and boats of three hundred maunds burden passed without difficulty. In the beginning of 1823, a dredging machine worked by oxen was supplied at a cost of Rs. 10,400. In the meantime, however, the condition of the river had altogether changed, and although the dredge only drew 2 feet 4 inches of water, it was conveyed up the river with difficulty, and the entrance was found so shallow from the masses of sand which had been thrown up across the mouth by the Ganges, that the machine could not be used. Having found the Matabhanga so obstructed, and seeing no prospect of improving it, Mr. May proceeded in 1823, by order of Government, to inspect the Bhagirathi and Jalangi. The channel of the former was discovered to be greatly obstructed by trees which had fallen into its bed during the two preceding inundations. At the Jalangi head, a little to the west of the Matabhanga entrance, sufficient water was found for boats of three hundred maunds burden, there being a

depth of ten feet at the entrance, and only one shoal of three feet in its course. Here a *bandhal* was erected, and a depth of four feet secured. The Bhagirathi head, which turns off from the Ganges in Murshidabad district, had shifted about half a mile to the east of its former position before the rains, and in the month of December was even more favourable than the Jalangi; for, although there was less water at the entrance, yet it lay so well open to the stream of the Ganges, with no detached sand-banks near, that there was every prospect of its being kept open for large boats throughout the season. The dredging boat was therefore despatched to this river. During 1824, Mr. May was appointed to the additional charge of the Bhagirathi and Jalangi, and a regular establishment was sanctioned for the three rivers. A great change, however, took place soon afterwards in the Bhagirathi. At the end of the year it was found that the entrance of the river had shifted five miles further westward. Its new head lay quite open to the direct current down the Ganges which forced itself with such violence down it, that its breadth rapidly enlarged from two hundred and fifty feet to half a mile. Across this entrance there was a depth in January 1825 of twenty-two feet, the shoals down the river were easily removed by means of *bandhals*, and a depth of three feet was maintained throughout the dry season from the Ganges to Nadia.

The favourable condition of the Bhagirathi head did not last long. In 1825 the Ganges altered its course, and the entrance to the Bhagirathi shifted eight miles to the south-east. The river became wholly unnavigable as early as November, and it was found that it would be a useless expenditure to attempt to improve it. In spite of a second dredging boat, which was supplied at a cost of Rs. 15,000, all the rivers became closed at the beginning of March 1826.

During the following five years, 1826-27—1830-31, all the rivers, with the exception of the Jalangi, continued in an unsatisfactory state as regards navigation, although

the usual operations were vigorously carried on. In 1826-27, the sand-bank at the mouth of the Bhagirathi was found to have increased in breadth and length. After the rains of 1826 it extended far below the entrance, and the river became impassable, except by small boats, before the end of December. During the inundations of 1829, however, another change took place at the head of the Bhagirathi, by which the entrance was removed three and a half miles from its position of the previous year, and the old channel of 1823 re-opened; but its course for some miles being through a loose sandy soil, shoals soon began to appear, and before January 1830 it again became impassable.

The Jalangi, however, was in a much more favourable state. In 1826-27 it was closed for a portion of the year. In 1827-28 it continued navigable for boats of two feet draught during the greater part of the dry season, and in the two following years, by constant attention to the usual works for removing obstacles, it remained navigable for small boats throughout the dry season. In 1830-31 the river continued navigable for large boats to the end of December, and for boats drawing two feet throughout the year.

The Matabhanga continued in a bad state throughout the five years 1825-30. In 1828-29 a steam dredger received from England was sent to work on this river, but the machinery did not answer well, and the draught of the boat, six feet, rendered her very ill adapted for the river.

During the next few years, very little improvement appears to have been effected, and, in the case of the Jalangi, greater difficulties were experienced in navigation than during the previous five years. In the early part of 1831-32 an unusual flood occurred in the Bhagirathi, caused by heavy rain in the Rajmahal Hills swelling the tributary streams. The force of the current cleared away the shoals below Berhampore, and reopened the communication for small boats, which had been entirely closed since January.

During the inundation of 1832 an unfavourable change took place at the entrance of the Jalangi, the head having shifted five miles to the north.

In 1835 doubts seem to have arisen whether the benefits that accrued from the works were commensurate with the expense incurred. Orders were given in February to stop operations and the establishment was discharged. Mr. May's report on the work done during the previous three years showed that 359 *bandhals* had been constructed on the different rivers, 118 sunken boats raised, 219 sunken trees and timbers removed, 12 masonry buildings pulled down, and 1,731 trees cut down on the banks to prevent them falling into the stream. He explained that the extraordinary deviations annually occurring in the course of the Ganges, affecting as they did all the streams that flowed from it, rendered it impossible to lay down any fixed rule of guidance or plan of operations by which the navigation of the Nadia rivers could be permanently maintained. An experience of thirteen years had convinced him that the changes which took place in the great river during one inundation afforded no data to determine what the next would bring forth, and therefore there was no assurance that the measures adopted for mitigating or repairing the evils of one season would be of the least avail in the ensuing one. Dredging machinery could only be usefully employed where the stream was rapid. Its use was to stir up the sand, so that the current might carry it away, rather than to lift the sand itself out of the bed. In sluggish water, where a bucketful was raised it was instantly replaced by the falling in of the surrounding mass.

During two years (1835-37) the operations were stopped, but in February 1837, Mr. May proceeded, by order of the Government, to again inspect and report upon the state of the rivers. He found that obstacles to navigation had much increased since the suspension of the works, and in June 1837, he was reappointed Superintendent. For the next three years the Bhagirathi was the most favourable of the three rivers for navigation.

In August 1840, Mr. May resigned his office, and was succeeded in November of the same year by Captain Smyth. The operations carried on by this officer during the next seven years were the same as those previously adopted by Mr. May. The rivers continued in much the same state as before, the Bhagirathi being the most favourable for navigation. In 1840-41 this stream was kept open for large boats throughout the dry season, and in 1841-42 for boats of $2\frac{1}{2}$ feet draught. In 1842-43, however, it was found to be in a worse state than at any time during the previous five years, and many complaints came up of the obstructions to navigation. Strenuous efforts were made to clear it of its shoals, and with much difficulty a passage was maintained throughout the season for boats of from 250 to 350 mounds burden. In 1845-46 the river was kept navigable throughout the dry season for boats drawing two feet, but in the following year, 1846-47, it shoaled at the entrance to such an extent as to close altogether in February 1847. A fresh opening was made from the Ganges to the Bhagirathi, and in May, when the rains set in, this cut rapidly enlarged itself, and gave a depth of from five to ten feet of water, whereas at the old entrance there was only a depth of one foot. The cost of the excavation was soon repaid by the increase of the toll collections.

The Jalangi remained in a very bad state throughout the whole seven years (1840-47), and the Matabhanga was never navigable in the dry season below the point where the Pangasi branches off from it.

In December 1847, Captain Lang was appointed Officiating Superintendent of the Nadia rivers, and, in support of further remedial operations, he brought to the notice of Government that, during the eight previous years, the total toll collections on the rivers had yielded an average annual surplus of Rs. 1,65,090 over the amount expended in keeping open the navigation, including the cost of collecting the tolls, and of all establishments. During the year 1847-48 the amount of tolls realised from each

of the rivers was as follows:—Bhagirathi, Rs. 1,51,482; Jalangi, Rs. 63,222; Matabhanga, Rs. 24,028; total toll collections, Rs. 2,38,733. On the expenditure side the charges for facilitating the navigation were Rs. 36,122; for collection of tolls, Rs. 22,360; total expenditure, Rs. 58,482. Surplus of receipts over expenditure, Rs. 1,80,250.

The same system of operations without much variation was carried on in the succeeding years. In 1859 a further attempt was made to improve the current down the Matabhanga, at the expense of the Kumar, by cutting channels across a few of the bends in the former. The following year some experiments were made by towing a rake or harrow over the entrance shoals by a steamer when the Ganges began to fall in the autumn, but no success was obtained.

In 1881, Mr. Vertannes, Superintending Engineer, submitted a memorandum on the state of the rivers. At that period the Matabhanga had the best entrance. It was said, however, that this was the first year for nearly 20 years that that river had been navigable for large boats. Alluding to the cuts on the Matabhanga made in 1859, Mr. Vertannes said:—"Of the five cuts-off made in the river by the late Mr. J. W. Armstrong, four have already deepened out, and are only a little narrower than the normal width of the river. These cuts, now that they have been worked out, seem to have benefited the river, as far as navigation is concerned, but I fear that they must have tended to raise considerably the flood level of the river lower down, and the damages recently caused to the Eastern Bengal State Railway, are, I think, more due to this than to any breaching of the embankments above Murshidabad."

In 1888, the revenue administration of the Nadia Rivers, which had up til then been controlled by the Board of Revenue, was transferred to the Public Works Department, and a separate division, called the "Nadia Rivers Division," was constituted, and placed in charge of an Executive Engineer. Since that year an average

sum of about $1\frac{1}{4}$ lakhs of rupees has been spent annually, chiefly on training works, to increase the depth in the dry season over the many shoals which form every year as soon as the rivers begin to fall. From December 1906 to March 1907 two small dredgers were hired and worked on the head shoal of the Jalangi river. The experiment cost nearly Rs. 38,000; it was temporarily successful, but no permanent improvement was effected. Two dredgers were again employed, at a cost of Rs. 12,000, during the following cold weather, in dredging $6\frac{1}{4}$ miles of the Jalangi river. The result was—in two miles, less depth than before dredging; in two miles, depth slightly increased; and in $2\frac{1}{4}$ miles, maintenance of full depth dredged.

The possibility of maintaining a navigable entrance to the Bhagirathi was discussed in 1906, 1907 and 1909. In 1909 the Steamer Companies submitted a representation strongly urging that the river be made fit for steamer traffic throughout the year, as the water-route from Calcutta to up-country would thereby be shortened by 425 miles. In September 1906 the Chief Engineer estimated that the initial cost of the plant necessary for dredging the off-take of the river from the Ganges would be 126 lakhs of rupees, and that, if the scheme were undertaken, the yearly recurring charge for maintenance would be very heavy, and such as could not possibly be met by any tollage which the steamer companies could afford to pay: he also pointed out the necessity of caution in the execution of any works in these rivers, as it was possible that any channels which might be made might become larger and deeper, and that this might eventually lead the main Ganges into the Hooghly and thereby ruin the port and city of Calcutta. A further point to be remembered was that any increase in the volume of water passed down these rivers must mean a decrease in the volume passing down the Ganges below their off-takes, and that such decrease would produce a deterioration in the present navigable channels of the Ganges.

According to the figures given in Hunter's Statistical Account of Nadia and Jessore, the net revenue from the Nadia rivers in the year 1847-48 was Rs. 1,80,250, and during the ten years ending with 1870-71, Rs. 1,04,538, the average annual expenditure during this same decade being Rs. 1,45,094. The following table shows the average income, expenditure and financial result since then :—

PERIOD	Average annual income	Average annual expenditure	Average annual net surplus or deficit
	Rs.	Rs.	Rs.
1871-72 to 1880-81 ...	2,32,938	87,019	+ 1,45,918
1881-82 to 1890-91 ...	1,95,632	1,18,136	+ 77,495
1891-92 to 1900-01 ...	1,27,479	1,25,864	+ 1,645
1901-02 to 1907-08 ...	76,629	1,23,689	- 47,060

Since 1871, there has been a steady decline in the average income, while the average expenditure has maintained an almost steady increase : from 1895-96, there has been a deficit every year ranging from Rs. 2,657 in 1899-1900 to Rs. 1,07,804 in 1906-07. In 1907-08 the total receipts amounted to only Rs. 35,229. The falling off in the receipts is, of course, mainly due to the extension of the railway systems, which now carry off a very large portion of the traffic, which used to find its way down the rivers, but a further cause is to be found in the reduction of the tolls which was introduced in 1906. The last two revised schedules of tolls, sanctioned in 1879 and 1906, are reproduced below :—

Schedule of tolls to be levied on the Nadia Rivers under Act V of 1864, whatever the distance travelled.

No. Notification No. 175, dated 30th July 1879—vide Calcutta Gazette of 30th July 1879, Part I, page 789

	Rs.	A.
1. Pinnaces of 10 oars and under that number, each ...	3	12
Ditto exceeding 10 oars ...	6	0
2. Budgerows of 10 oars and under that number ...	2	4
Ditto exceeding 10 oars ...	4	8

No. Notification No. 175, dated 30th July 1870—vide Calcutta Gazette of 30th July 1879, Part I, page 789

	Rs.	A.
3. Bholeahs and boats for personal accommodation, cutters not being of the description specially defined, and bulwars, pansways and baggage boats, per oar	0	4
4. Empty boats and boats laden with bricks, tiles or other earthen substances, baked or otherwise, per 100 maunds tonnage ...	0	2
5. Boats laden with quick-lime, chunam, straw, fire wood, gurran-sticks, thatching grass or such like, per 100 maunds tonnage ...	0	8
6. Boats laden with grain, pulse, seed or vegetables of whatever description and indigo seed, per 100 maunds tonnage ...	0	12
7. Boats of burthen freighted with timbers and bamboos or with any article not included in the above enumeration, per 100 maunds tonnage	1	0
8. Timbers with chowkars and dowkars, if floated on rafts or otherwise, not being boats, each timber	0	6
9. Unwrought timbers called ghole or floated as above, each	0	3
Rafts floating 200 bamboos or less, each raft	0	3
Rafts floating more than 200 but not more than 400	0	6
Rafts floating more than 400 but not more than 1,000 ...	0	12
Rafts floating more than 1,000, each raft	1	8

Schedule of tolls to be levied on the Nadia Rivers under Act V of 1884, whatever the distance travelled

No. Calcutta Gazette, Notification No. 6, dated 31st July 1906

	Rs.	A.
1. Passenger boats, accommodation boats, bholeahs, budgerows, pinnaces, bulwars, pansways and baggage boats, per oar ...	0	4
2. Empty vessels, except steamers, per 100 maunds of measured tonnage ...	0	4
3. Vessels laden with cargo of any description per 100 maunds of measured tonnage	1	0
4. Cargo carried in flats or steamers and charged on the manifest per 100 maunds of cargo	1	0
5. Steamers that have been surveyed under Act VI of 1884, whose tonnage is determined by measurement, whether laden or empty, per 100 maunds of measured tonnage ...	1	0

No.		Calcutta Gazette, Notification No. 6, dated 31st July 1996	
		Rs.	A.
6.	Floats or rafts of roughly squared timbers, each timber	0	6
7.	Floats or rafts of unwrought timbers, each timber ...	0	3
8.	Rafts of bamboos, each 100 bamboos	0	2
9.	Reeds, for each hundred bundles of reeds ..	0	4
10.	All boats the tollage of which does not exceed 4 annas will be allowed to pass <i>free</i> .		

N.B.—During the flood season (June to October, both inclusive) half the above schedule rates will be charged.

This account of the Nadia Rivers may fitly be closed with two extracts from an article by Sir William Hunter entitled 'A River of Ruined Capitals,' which appeared in the Nineteenth Century of January 1888 :—

"The Hugli is the most westerly of the net-work of channels by which the Ganges pours into the sea. Its length under its distinctive name is less than 150 miles, a length altogether insignificant compared with the great waterways of India. But even its short course exhibits in full work the twofold task of the Bengal rivers as creators and destroyers. The delta through which it flows was built up in times primæval a thousand miles off. Their inundations still add a yearly coating of slime to vast low-lying tracts, and we can stand by each autumn and see the ancient secrets of land making laid bare. Each autumn, too, the network of currents rend away square miles from their banks, and deposit their plunder as new alluvial formations further down. Or a broad river writhes like a monster snake across the country, leaving dry its old bed and covering with deep water what was lately solid land.

"Most of the channels do their work in solitude in drowned wastes where the rhinoceros and crocodile wallow in the slush, and whither the wood-cutter only comes in the dry months, after the rivers have spent their fury for the year. But the Hugli carries on its ancient task in a thickly-people country, destroying and reproducing with

an equal balance amid the homesteads and cities of men. Since the dawn of history it has formed the great high road from Bengal to the sea. One Indian race after another built their capitals, one European nation after another founded their settlements on its banks. Buddhists, Hindus, Musalmans, Portuguese, Dutch, Danes, French, Germans and English have lined with ports and fortresses that magnificent waterway.

"The insatiable river has dealt impartially with all. Some it has left high and dry, others it has buried under mud, one it has cleft in twain and covered with its waters : but all it has attacked, or deserted, or destroyed. With a single exception, whatever it has touched it has defaced. One city only has completely resisted its assaults. Calcutta alone has escaped unharmed to tell of that appalling series of catastrophes. The others lie entombed in the silt, or moulder like wrecks on the bank. The river flows on relentless and majestic as of old, ceaselessly preaching with its still small ripple, the ripple that has sapped the palaces of kings and brought low the temples of the gods, that here we have no abiding city. It is a vision of the world's vanities such as the world has not seen since Spenser mourned the 'Ruins of Rome' :—

Ne ought save Tyber hastning to his fall
Remains of all : O world's inconstancie !
That which is firme doth flit and fall away,
And that is flitting doth abide and stay."

"Of all the cities and capitals that man has built upon the Hugli only one can now be reached by sea-going ships. The sole survival is Calcutta. The long story of ruins compels us to ask whether the same fate hangs over the capital of British India. Above Calcutta, the head-waters of the Hugli still silt up and are essentially decaying rivers. Below Calcutta, the present channel of the Damodar enters the Hugli, and at so acute an angle, that it has thrown up the James and Mary sands, the most dangerous river-shoal known to navigation. The combined discharges of the Damodar and Rupnarayan

rivers join the Hugli, close to each other from the same bank. Their intrusive mass of water arrests the flow of the Hugli current, and so causes it to deposit its silt, thus forming the James and Mary. In 1854 a committee of experts reported by a majority that, while modern ships required a greater depth of water, the Hugli channels had deteriorated, and that their deterioration would under existing conditions go on. The capital of British India was brought face to face with the question whether it would succumb, as every previous capital on the river had succumbed, to the forces of nature, or whether it would fight them. In 1793 a similar question had arisen in regard to a project for re-opening the old mouth of the Damodar above Calcutta. In the last century the Government decided, and, with its then meagre resources of engineering, wisely decided, not to fight nature. In the present century the Government has decided, and, with the enlarged resources of modern engineering, has wisely decided, to take up the gage of battle.

"It is one of the most marvellous struggles between science and nature which the world has ever seen. In this article I have had to exhibit man as beaten at every point; on another opportunity I may perhaps present the new aspects of the conflict. On the one side nature is the stronger, on the other side science is more intelligent. It is a war between brute force and human strategy, carried on not by mere isolated fights, but by perennial campaigns spread over wide territories. Science finds that although she cannot control nature, yet that she can outwit and circumvent her. As regards the head waters above Calcutta, it is not possible to coerce the spill-streams of the Ganges, but it is possible to coax and train them along the desired channels. As regards the Hugli below Calcutta, all that can be effected by vigilance in watching the shoals and by skill in evading them is accomplished. The deterioration of the channels seems for the time to be arrested. But Calcutta has deliberately faced the fact that the forces of tropical nature may any year overwhelm and wreck the delicate contrivances of man. She has,

therefore, thrown out two advanced works in the form of railways towards the coast. One of these railways taps the Hugli where it expands into an estuary below the perilous James and Mary shoal. The other runs south-east to a deep river, the Matla. Calcutta now sits calmly, although with no false sense of security, in her state of seige, fighting for her ancient waterway to the last, but provided with alternative routes from the sea, even if the Hugli should perish. *Sedet aeternumque sedebit.*"

EMBANKMENTS

The Embankment Act is not, and never has been, in force in the Nadia district, and there are no embankments which are maintained from Government or public funds. In 1868 the Collector urged the necessity of action by Government in the way of repairing existing, and constructing new, bunds, as the zemindars could not be relied on to do anything, and the cultivators had no ability for combination. An enquiry was made by the Executive Engineer, and estimates amounting to Rs. 3,494 were sanctioned by Government for repairs to embankments on the Jalangi and Matabhanga rivers. It was, however, made clear that this was a concession to meet an emergency, and was not to be regarded as a precedent. In 1880 a report was submitted by the District Engineer detailing the embankments which existed on the various rivers by which the district is bounded or intersected. There are many isolated embankments which were apparently nearly all submerged by the flood of 1879. In the case of a few of the embankments it was said that they were repaired by the Public Works Department; for the rest, they were repaired to a small extent by the zemindars or cultivators. The only continuous line of embankment was that on the left bank of the Jalangi, and the District Engineer estimated that it would cost Rs. 18,000 to put it into efficient condition. The Commissioner recommended some grants in aid for repairing some of the more important of the embankments, but it

does not appear that the proposal received the approval of Government. Two years later the Superintending Engineer reported that in his opinion it was not advisable to retain the Jalangi embankments generally, though portions might be kept up to prevent inundation water from needlessly damaging the crops at every rise of the river. In 1895 the Superintending Engineer was directed to have the embankments which had been scheduled in 1882 inspected, and to ascertain whether they had been added to or altered. A list with notes of the state of repair of each, was accordingly submitted, but no further action was taken. The flood water is, however, not greatly affected by such private works as are still in existence.

LAKES AND MARSHES

The names of the chief lakes and marshes in the district are given in the following list:—

Sadar Subdivisions—Abhangi, Adityapur, Arangsarisa, Aundhari, Bachamari, Bairampur, Bakshi, Baliadaha, Bara Chapra, Barbhanga, Bhajanghat, Bhaluka, Chapra, Charatola, Chingrimari, Chinichora, Digri, Dubli, Dumri, Chidaha, Goaradahs Gurguria Hansadaha, Hansadanga, Haridaha, Jhora, Jhori, Jiddha, Kaichuni, Kalatola, Kalidaha, Kalinagar, Kalinga, Kalma, Kaniadaha, Keturi, Khaira, Khana, Nelor, Nutan, Padma, Pagla, Panighata, Poaldaha, Sajanipur, Sat-tala, Sonajuli, Sukni, Tengra, Tungi, Usidpur.

Ranaghat Subdivision—Amda, Bali, Bara Kachua, Bayeswar, Bhomra, Champta, Chapra, Chinili, Damrail, Dhoktadaha, Dohar, Gangaprasadbaor, Gopaya, Haripur, Jhakri, Kachua, Kulia, Kataganj, Mogra, Mondoura, Morail, Nasta, Nrisinghapur, Panikhali, Pocha, Saguna, Sat Sholaki, Shejdiar, Ukundi.

Chuadanga Subdivision—Baradi, Begampur, Bharbharia, Buichitola, Chakli, Chandmari, Dalka, Dhankholabaor, Dukmari, Ektarpurbaor, Harda, Kamladaha,

Khayerhuda, Kobikhali, Kulbila, Kumridanga, Loknathpur, Medinipurbaor, Mrigamari, Nalbila, Nalgari, Padmabila, Pakar, Pakhi, Purapara, Raipurbaor, Raisa, Sankarchandra, Sankharia, Solmari, Tentulia.

Meherpur Subdivision—Alagari damosh, Asrafpur, Baghadoba, Batkemari, Chakla, Chamu Khandaha, Dubukhola, Elangi, Fatehpur damosh, Gobri, Ichamatidaha, Jalanga, Kishorpur, Kol Kulbila, Mohishkhola, Mohishmari, Nishchintapurbaor, Nona, Padma, Pangasi, Patabuka, Roakul, Ruimari, Sonadaha, Tengramari, Teragharia, Topla.

Kushtia Subdivision—Amla, Baradi, Boalia, Chapalgachi, Choroikhol, Gholdaha, Kachudaha, Mohishkundi damosh, Sagarkhali, Talberia.

The following remarks are taken from the Gazetteer volume of the Khulna district, as they are equally applicable to Nadia:—

“Many (bils) are of small size, but others are practically inland lakes. Some are mere accumulations of water upon low-lying ground, while others are natural drainage basins, the level of which does not admit of drainage. Their formation is due to the configuration of the district, which is divided by the interlacing of the rivers, into what are practically islands. Each of these is bounded by rivers, and the highest level is along their banks, so that the fall from all directions is towards the centre, which again is drained by a creek or *khal* communicating with one of the surrounding rivers. In some places the basin thus formed is on a fairly high level, and the central depression, being sufficiently high to be above water at least during some months of the year, is used for growing crops. Other such depressions are water-logged, but can still be used for growing rice, while others again are inland lakes always under water and cannot be used for cultivation.”

GEOLOGY

The soil of the district is composed of recent alluvium, and the surface consists of sandy clay and sand along

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the course of the rivers, and fine silt consolidating into clay in the flatter portions of the plain, such as the tract known as the Kalantar.

BOTANY

The stretches of low-lying land under rice cultivation afford a foothold for many marsh species, while the numerous ponds and ditches are filled with submerged and floating water plants. Remarkable among these for its rarity, and interesting on account of its distribution to Europe on the one hand, and to Australia on the other, is the floating *Drosera*. The edges of sluggish creeks are lined with large sedges and bulrushes, and the banks of rivers frequently have a hedge-like shrub jungle. The sides of embankments and village sites, where not occupied by human habitations, are densely covered with large growths of semi-spontaneous vegetation, often interspersed with clumps of planted bamboos, and groves of *Areca*, *Moringa*, *Mangifera*, and *Anona*. Waysides and waste places are filled with grasses and weeds, usually of little intrinsic interest, but sometimes striking because of their distribution. A large proportion of the species of this class to be met with in the district have been inadvertently introduced by human agency, and besides weeds that are indigenous in other parts of India, European, African and American species are sometimes found, which can not only hold their own with, but actually spread more plentifully than, similar weeds of truly Indian origin. In many places the soil does not seem to suit mango, jack and other indigenous fruit trees, and consequently the poorer classes are, in times of scarcity and famine, deprived of one resource which they can fall back upon in more favoured districts.

FAUNA

At the beginning of the nineteenth century tigers were common in the more sparsely inhabited portions of the

district near the Bhagirathi. A reference has been made to their depredations in the Gazetteer article on Chakdaha in the last chapter of this volume. It is, however, many years since the last of these animals disappeared, and none are now to be found nearer than in the Sundarbans. Leopards, however, are still fairly common, especially in the Meherpur and Kushtia subdivisions: they do a good deal of damage to goats and young cattle, and are reported to kill two or three human beings yearly. Wild hogs are common, especially where protected for the purpose of pig-sticking: the record bag of boar for the whole of India was made recently on the *chars* of the Padma in the north of the district.

Among lesser fauna are foxes, hares and porcupines. Monkeys (the black-faced Hanuman or langur) are numerous and destructive in the towns, especially Krishnagar, where they cause much damage in gardens, and to the mango crop when it is ripening. Jackals are credited with carrying off about 100 infants yearly, and many cases of hydrophobia are caused by their bites. Crocodiles are fairly common, especially in the Garai and other rivers in the north of the district, and they occasionally kill human beings.

Of game-birds, the florican used to breed on the field of Plassey, but appears to have deserted the district during recent years. Snipe are very common in the south of the district during the latter part of the rains and the beginning of the cold weather. Various kinds of wild duck and other aquatic birds are found in large numbers in the east and north of the district during the cold weather, and wild geese are common in the Padma. A few partridge and quail are occasionally met with. Snakes are common, and account for some 400 deaths annually.

Fish abound in most of the rivers and *bils*, and very large catches of hilsa are made in the Padma during the rainy season, and are exported freely by rail from Damukdia, or Sara, on the opposite bank of the river.

CLIMATE

The seasons in Nadia are substantially the same as in other parts of Lower Bengal. The cold weather may be said to commence in the latter part of November (the first part of this month is frequently very warm), and to last until the middle of February. During these months the prevailing winds are from the north and north-west, and there is a very heavy dew at night. During March and April the weather becomes increasingly hot during the day, though the nights remain fairly cool; the daily range of temperature is frequently very high during these months. The temperature in May is often tempered by severe "nor'-westers", which generally come on in the evening, and last about an hour, during which the rainfall is very heavy, and the thunder and lightning practically incessant. The monsoon as a rule sets in about the middle of June, and causes some diminution in the maximum temperatures. The rains abate in September, when the heat again becomes very trying, and remains so until the cold weather gradually sets in. The mean temperature for the year is 79° , and it ranges between 69° and 89° . The mean minimum varies from 52° in January to 79° in June, and the mean maximum from 77° in December to 97° in May. The average humidity is 79 per cent of saturation, varying from 71 per cent. in March to 87 per cent. in August.

RAINFALL

The rainy season begins about the middle of June and lasts till October. The average annual rainfall for the district is 57 inches, of which 6.5 inches fall in May, 9.7 in June, 10.5 in July, 11.3 in August, 8.1 in September, and 4.1 in October. Kushtia receives rather more rain than the other rain-registering stations in the district, but, with this exception, the variations from the district average are very slight.