

Papers on the subject of the Bengal cyclone and storm-wave of the 31st October - 1st November 1876 ; and the subsequent cholera epidemic.

Contributors

Cotton, H. J. S.
Great Britain. Parliament. House of Commons.
London School of Hygiene and Tropical Medicine

Publication/Creation

London : Printed by Eyre and Spottiswoode, for H.M.S.O., 1877.

Persistent URL

<https://wellcomecollection.org/works/cj9q9fmm>

Provider

London School of Hygiene and Tropical Medicine

License and attribution

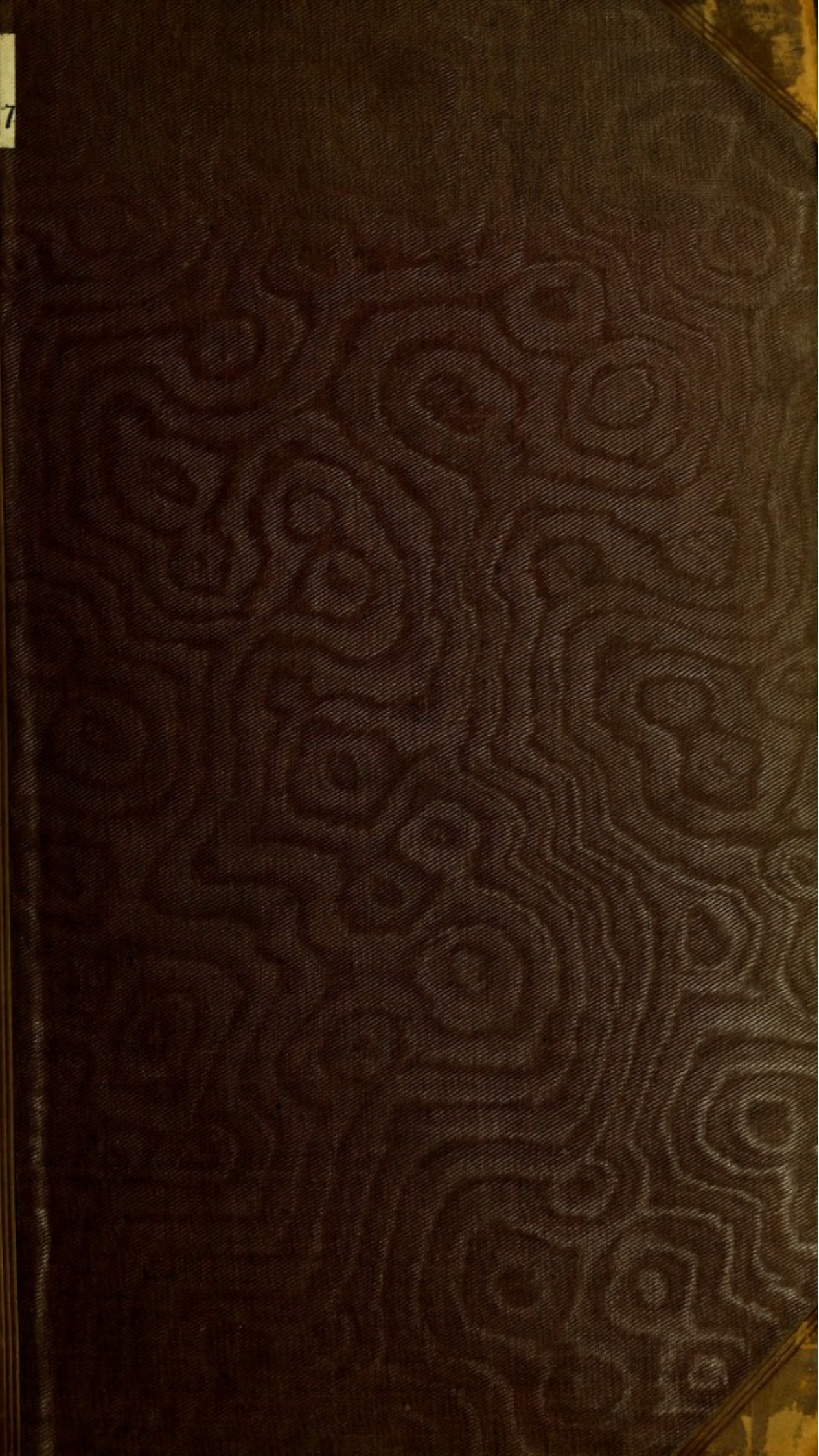
This material has been provided by This material has been provided by London School of Hygiene & Tropical Medicine Library & Archives Service. The original may be consulted at London School of Hygiene & Tropical Medicine Library & Archives Service. where the originals may be consulted. This work has been identified as being free of known restrictions under copyright law, including all related and neighbouring rights and is being made available under the Creative Commons, Public Domain Mark.

You can copy, modify, distribute and perform the work, even for commercial purposes, without asking permission.



Wellcome Collection
183 Euston Road
London NW1 2BE UK
T +44 (0)20 7611 8722
E library@wellcomecollection.org
<https://wellcomecollection.org>

3
A7



Ex Libris



ACQUIRED BY
Purchase

To be returned to :

UNIVERSITY OF LONDON LIBRARY DEPOSITORY,
SPRING RISE,
EGHAM,
SURREY.

From
THE LONDON SCHOOL OF HYGIENE
AND TROPICAL MEDICINE,
KEPPEL STREET,
LONDON, W.C.1

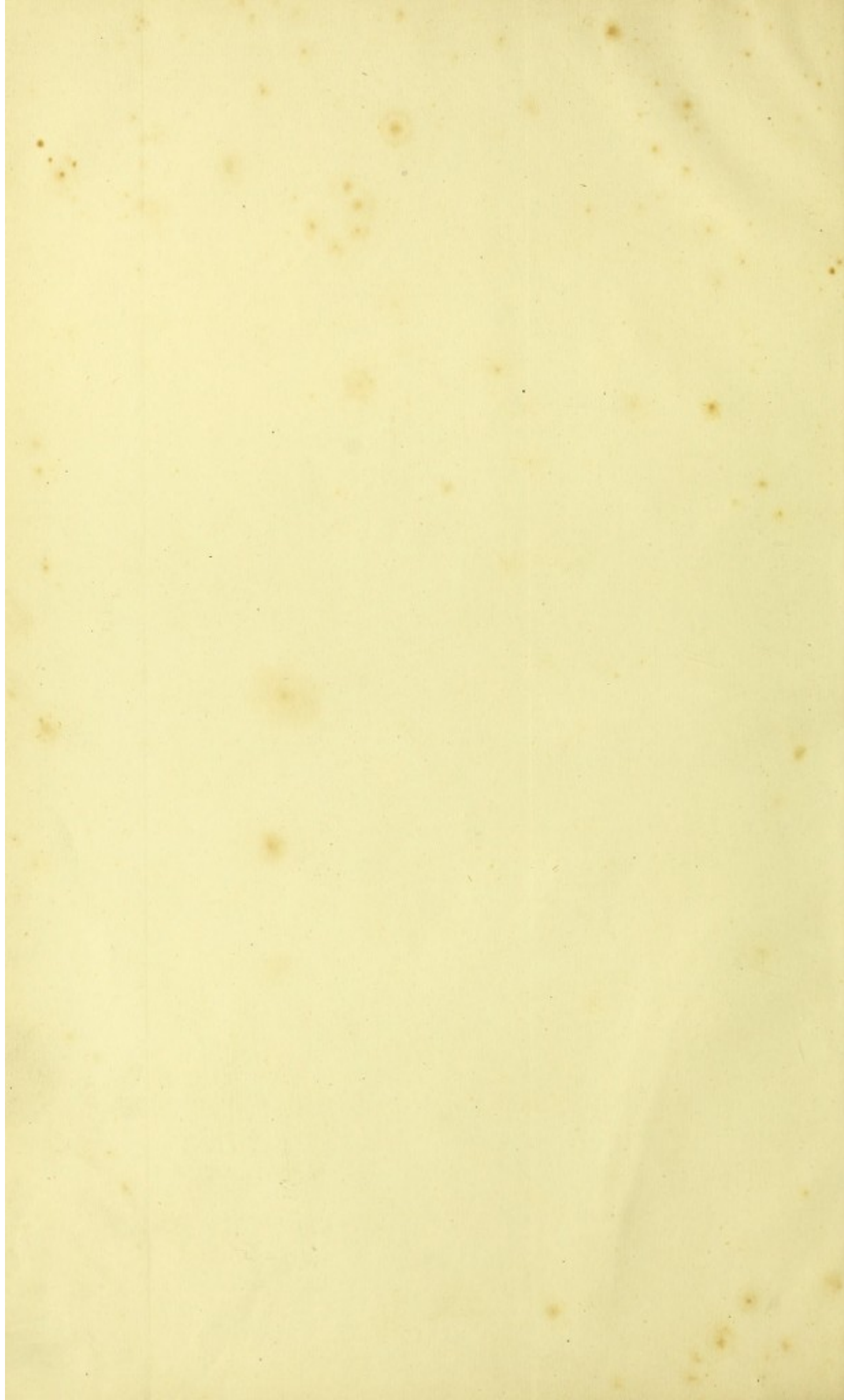
691

7
7



Digitized by the Internet Archive
in 2015

<https://archive.org/details/b24915002>



~~2-19438~~
29



CHART OF THE
STORM WAVE INUNDATION.
NOV^r 1st 1876.

DACCA



Area of Fresh-water Inundation colored Green.
Do Salt Do Blue.
Track of Vertice marked by Parallel lines
Depth of Inundation given in feet.

Cris Bazar

Original in the possession of the Government of India

PAPERS

ON THE SUBJECT OF

THE BENGAL CYCLONE AND STORM-WAVE

OF THE

31st October — 1st November 1876;

AND

THE SUBSEQUENT CHOLERA EPIDEMIC.

Presented to both Houses of Parliament by Command of Her Majesty.



LONDON:

PRINTED BY GEORGE EDWARD EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

1877.

24530

PAPERS

OF THE

THE BENGAL GOVERNMENT AND STORM-WAVE

OF THE

31st October - 1st November 1817

AND

THE SUBSEQUENT CHOLERA EPIDEMIC

Assembled to this House of Parliament by command of His Majesty



LONDON:

PRINTED BY GEORGE EDWARD RICE AND WILLIAM COOPER, STATIONERS

AND TO BE HAD OF THE BOND STREET BOOKSELLERS

AND THE NEWSPAPER VENDORS

1817

[G-1817] Price 1s. 6d.

CONTENTS.

Date.	From.	To.	Subject.	Page.
1876.				
24th November	Government of India	Secretary of State -	Transmitting copy of telegram regarding mortality from storm-wave.	1
17th November	President in Council -	- - -	Telegram referred to - - -	1
24th November	Government of India	Secretary of State -	Transmitting copy of Sir R. Temple's minute on his visit to affected districts	1
22nd November	Government of Bengal	Government of India	Ditto ditto - - -	2
21st November	Lieutenant-Governor of Bengal.	- - -	Minute referred to - - -	2
			Estimate of number of persons drowned.	7
24th November	Government of India	Government of Bengal	Acknowledging minute and conveying thanks to the various authorities for their relief of sufferers.	7
1st December -	Ditto - -	Secretary of State -	Report of Dacca Commissioner on the District of Backergunge.	9
27th November -	Government of Bengal	Government of India	Transmission of above report -	9
19th November -	Officiating Commissioner Dacca Division.	Government of Bengal	Report on visit to Backergunge district.	9
8th December -	Government of India	Secretary of State -	Chittagong Commissioner's report on his visit to Chittagong district.	14
4th December -	Government of Bengal	Government of India	Transmitting above report - -	15
23rd November -	Officiating Commissioner of Chittagong Division.	Government of Bengal	Submitting report referred to -	15
15th December -	Government of India	Secretary of State -	Further report by Chittagong Commissioner on Noakholly district.	19
7th December -	Government of Bengal	Government of India	Ditto ditto - - -	20
23rd November -	Officiating Commissioner of Chittagong Division.	Government of Bengal	Submitting report referred to -	20
1877.				
12th January -	Government of India	Secretary of State -	Further minute by Lieut.-Governor of Bengal on effects of cyclone in Sundeep group of islands.	22
18th December - (1876).	Government of Bengal	Government of India	Ditto ditto - - -	22
15th December - (1876).	Lieutenant-Governor of Bengal.	- - -	Minute referred to - - -	22
12th April -	Government of India	Secretary of State -	Report of Bengal Government Meteorological Reporter on cyclone and storm-wave.	24
	J. Elliott, Esq., Meteorological Reporter to the Government of Bombay.	- - -	Report on the cyclone and storm-wave.	25
			Introductory chapter—Cyclone Theories. Chapter I. (Not printed.)	26
			" II. Meteorology of N. India and Bay of Bengal, from 10th to 31st October.	28
			" III. Path of cyclone in Bay of Bengal.	35
			" IV. Progress of cyclone over Eastern Bengal.	44
			" V. The storm-wave - - -	55
			" VI. The causes of the Backergunge cyclone.	66
19th April -	Government of India	Secretary of State -	Mortality from drowning and from cholera in Chittagong division.	70
27th March -	Government of Bengal	Government of India	Ditto ditto - - -	70

Date.	From.	To.	Subject.	Page.
1877.				
27th March	Resolution of Government of Bengal.	- -	Mortality from drowning and from cholera in Chittagong division.	70
24th May	Government of India	Secretary of State	Cholera epidemic in Backergunge, Noakholly, and Chittagong districts.	71
5th May	Government of Bengal	Government of India	Ditto ditto - -	72
24th March	Officiating Commissioner of Dacca Division.	Government of Bengal	Ditto ditto - -	72
16th March	Officiating Magistrate of Backergunge.	Commissioner of Dacca Division.	Ditto ditto - -	73
14th March	Civil Surgeon of Backergunge.	Magistrate of Backergunge.	Cholera epidemic in Backergunge -	76
2nd April	Government of Bengal	Dacca Commissioner-	Ditto ditto - -	80
27th April	Chittagong Commissioner.	Government of Bengal	Cholera outbreak in Chittagong division.	81
4th May	Government of Bengal	Chittagong Commissioner.	Ditto ditto - -	85
2nd August	Secretary of State	Government of India	Review of general subject of cyclone and storm-wave, and ensuing cholera.	86

P A P E R S

ON

The subject of the Bengal Cyclone and Storm-wave of the 31st October—1st November 1876, and the subsequent Cholera Epidemic.

DESPATCH from the GOVERNMENT OF INDIA to the SECRETARY OF STATE FOR INDIA.
No. 75. Home Department (Public).

MY LORD MARQUIS,

Fort William, the 24th November 1876.

WE have the honour to transmit a copy of a telegram sent to your Lordship on the 17th instant regarding the effects of the storm wave which recently passed over the Chittagong, Backergunge, and Noacolly Districts in the Lower Provinces of Bengal.

We have, &c.

(Signed) H. W. NORMAN.
A. HOBHOUSE.
E. C. BAYLEY.
A. J. ARBUTHNOT.

Telegram No. 1,799, dated the 17th November 1876.

FROM PRESIDENT IN COUNCIL, Calcutta, to SECRETARY OF STATE FOR INDIA, London.

SIR RICHARD TEMPLE returned from the cyclone-stricken districts yesterday. He reports that the storm-wave in the Chittagong, Backergunge, and Noacolly Districts on thirty-first October, according to careful estimates, destroyed about 215,000 persons, with numerous cattle. All that is possible is being done for the survivors, and happily there is much less suffering among these from sickness, want of food or fresh water than could have been anticipated.

No. 1. of 1876.

DESPATCH from the GOVERNMENT OF INDIA to the SECRETARY OF STATE FOR INDIA,
Department of Revenue, Agriculture, and Commerce, Meteorology.

MY LORD MARQUIS,

Calcutta, the 24th November 1876.

YOU have been already informed by a demi-official letter from our President of the terrible calamity which has occurred in the districts of Backergunge and Noacolly, which, on the night of the 23rd October last, were visited by a cyclone and storm-wave, resulting in a loss of human life estimated at not less than 215,000 souls.

2. We now submit for your Lordship's information copies of a letter from the Government of Bengal enclosing the Lieutenant-Governor's report, and of our reply. The facts are so fully and clearly stated in Sir Richard Temple's minute that we do not deem it necessary to make any observations on them, in addition to those which are contained in our Secretary's letter of this date to the Government of Bengal, further than to repeat the expression of the high sense which we entertain of Sir Richard Temple's promptitude in repairing in person to the scene of the disaster so immediately after it occurred, and thus furnishing himself with the best means of forming an estimate of its extent, and of the measures requisite for the relief of the distressed survivors.

3. On the 21st instant we communicated to the Government of Bengal the expression of the deep concern which Her Majesty the Queen was graciously pleased to signify on being informed of this lamentable occurrence. A copy of a letter from that Government, in which the Lieutenant-Governor gratefully acknowledges on behalf of the people of the province the sympathy expressed by Her Majesty, is enclosed.

4. We shall forward for your Lordship's information any further reports that may reach us on the subject.

We have, &c.

(Signed) H. W. NORMAN.
A. HOBHOUSE.
E. C. BAYLEY.
A. J. ARBUTHNOT.

From the JUNIOR SECRETARY TO THE GOVERNMENT OF BENGAL to the SECRETARY TO THE GOVERNMENT OF INDIA, Department of Revenue, Agriculture, and Commerce.

SIR,

Calcutta, dated the 22nd November 1876.

IN reply to your letter No. 517C, dated 15th November 1876, calling for a full and early report on the late cyclone, I am directed to submit, for the information of the Government of India, a copy of a minute recorded by the Lieutenant-Governor on the cyclone and storm-wave in the districts of Backergunge and Noacolly.

2. Sir Richard Temple's account furnishes the latest information available up to the 12th of this month. Reports on the progress of events are still being received from the local officers, and as soon as these have all been received, they will be collated and a final report submitted. A special report by the Meteorological Reporter to the Government of Bengal is also under preparation, and will be submitted to the Government of India as soon as it is ready.

I have, &c.

(Signed) H. J. S. COTTON,

Junior Secretary to the Government of Bengal.

CYCLONE AND STORM-WAVE IN BACKERGUNGE AND NOACOLLY, 31st OCTOBER 1876.

MINUTE by the LIEUTENANT-GOVERNOR OF BENGAL, dated 21st November 1876.

HAVING recently returned from the cyclone-stricken districts, I proceed to record a brief narrative of my expedition, and a sketch of the case as it appeared to me and my party on the spot a week after the occurrence.

I was proceeding to Noacolly on an ordinary tour, having received reports only of a cyclone having occurred at Chittagong and Noacolly. Approaching Noacolly I heard of the disaster which had happened in the highly cultivated and thickly inhabited islands at the mouth of the Megna, known as the groups of Sundeep, Hattea, and Dukhin Shahbazzpore, and on both the coasts of that great river; so I cut short my visit to Noacolly, after inspecting some of the ruined villages in that quarter, and hastened to the points where it seemed probable that the worst stress of the storm must have been.

Thus, besides the coast near Noacolly and the interior as far as that station, I visited the islands of Hattea and Dukhin Shahbazzpore in the Megna, near its mouth, and the western coast of the great river within the district of Backergunge. In each of these localities I visited a number of villages, and had the precise mortality in each house ascertained in my own presence on the spot, so as to prevent any possibility of deception. From the authentic data thus obtained I am able to check the local estimates, and to measure the mischief as it actually was. With me there was Mr. Reynolds (Secretary to Government) and Mr. Beverley, whose statistical ability is so well known; also Dr. Weir (temporarily on my staff), and some of the local officers.

Enclosed is an estimate of the probable number of lives lost (all, or nearly all, by drowning), prepared by Mr. Beverley and myself from our own data, compared with local reports, oral and written, and based on the returns of the last census. It will be seen that we apprehend that in an area of some 3,000 square miles, out of 1,062,000 persons, suddenly thrown into more or less of danger, 215,000 must have perished. This, of course is only an estimate; the exact number cannot be known yet a while, perhaps never will be known. We found in some villages 30 per cent. of the inhabitants lost, in others 50 per cent., in some even 70 per cent. The total seems very high; I earnestly hope that it may be found to exceed the truth, and that the facts may not prove to be quite so dreadful. Still such is the estimate at present. At the least there must have been a most shocking loss of human life. And even the urgency of our duty towards the surviving cannot drive from our minds the sorrow for so great a multitude of dead.

There was a severe cyclone in the Bay of Bengal on the night of the 31st October. But it was not the wind which proved so destructive, though that was bad enough; it was the storm-wave, sweeping along to a height from 10 to 20 feet, according to different localities; in some places, where it met with any resistance, it mounted even higher than that. I will endeavour to have meteorological inquiry made as to how and from what direction this inundation came. The Noacolly people think it came from the sea right up the great river (Megna) with salt water; that then the cyclone turned round and rolled the fresh water from the river downwards; that with this reflux there was a piling up, as it were, of fresh and salt water, venting itself by a rush all over the surrounding tracts.

I am not sure that this is the true explanation. It is understood that the eastern coast of the Megna and the Sundeep Island, adjacent thereto, caught the inundation from the south-west. But the almost unvarying direction of the rent deflected and up-rooted trees in the islands of Hattea and Dukhin Shahbazzpore, and the western coast of the Megna, convinced us that there the storm broke from the north and north-east.

In the evening the weather was a little windy and hazy and had been somewhat hot; but the people, a million or thereabouts of souls, retired to rest, apprehending nothing. But before eleven o'clock the wind suddenly freshened, and about midnight there arose a cry of "the water is on us," and a great wave burst over the country several feet high; it was followed by another wave, and again by a third, all three rushing rapidly southwards, the air and wind being chilly cold. The people were thus caught up before they had time even to climb on to their roofs, and were lifted to the surface of the water, together with the beams and thatches of their cottages. But the homesteads are surrounded by trees—palms, bamboos, and a large thorny species called Madârs. The people were then borne by the water on to the tops and branches of these trees. Those who were thus stopped were saved, those who were not must have been swept away and were lost. Doubtless there must have been variation in detail in this struggle for life with death. But there is an extraordinary sameness in the general manner in which people were saved or lost. In most cases they would show us the particular tree on which they stuck, and generally the survivors pointed to the severe scratches they received from the prickly branches of the Madâr trees; in reality these thorns and prickles held them tight, as if with natural grappling-hooks, and prevented them from being borne away.

The mode of habitation is in this wise. Each hamlet consists of four to six houses (to each house a family); these are built (thatch and matting) on a slightly raised platform, composed of earth thrown up from the surrounding ditch; they are surrounded by a wall of trees, high and dense. It was this formation, unvarying in kind, though varying in degree, that prevented the loss of life from being universal. Indeed, the trees, in their long stretching arms, held up the poor drowning souls. In those hamlets where the trees grew thickly many lives were saved; in those hamlets where there happened to be gaps or breaks in the environment of trees most of the inhabitants were carried off.

The bodies of the lost were carried to considerable distances, where they could not be identified. Most homesteads have dead strangers lying about, washed in from distant villages. The corpses began to putrify before the water cleared off the grounds, so they are left unburied in numbers all over the country (in a Mahomedan population there is no cremation). They are indeed masses of corruption which no one can bear to approach, and they present a sickening spectacle. Mixed with human bodies are the bodies of cattle, all heaped up together. The smell in many places was distressing, to us as we walked through the fields from village to village. Weather-tossed seamen in the Bay of Bengal saw many corpses floated out from land with the waves. Corpses from the Sundeep Island were flung on to the seashore at Chittagong; and living persons were borne thither across an arm of the sea, clinging to the roofs or beams of the own houses, as if upon rafts.

As an authenticated instance (as described to me by the witness) of the suddenness of the onset of the storm-wave, I may mention that Mr. Higgins, an inspecting postmaster, was in his travelling barge that night, moored in the creek near Noacolly, about 10 miles inland from the Megna; he had gone to bed that night at eleven o'clock, without any fear or anxiety whatever; the boatmen were ashore, but his four native servants were on board with him; shortly before midnight he was awakened by a cry of "the waters are up:" jumping up he looked out and saw a high wave, with its crest and curling top gleaming in the starlight, it seemed like a flash; in an instant his boat seemed rising up on high; he fastened on a life-belt; in a few moments another wave came rolling on, and the barge capsized; he paddled about in the water all the rest of that night with the help of the life-belt; the native servants clung to spars—three were saved, one was lost; the water felt warm to the body, but the air was bitterly cold to the head or hands above the surface; of some natives lodged on the branches of a tree, one was seen to relax his hold from cold and numbness and sink into the flood.

If this happened at Noacolly, what must have been the emergency in the islands still more exposed to the fury of the storm?

The force of the inundation appears to have lasted in most places from about midnight to 2 a.m., that is, for two hours; by daybreak there was much subsidence of flood, and by noon next day the survivors had come down from the trees, and regained *terra firma*. But they must have been foodless and shelterless for the rest of that day and all the next day. After that, however, they began to re-assemble, not indeed at the ruins

of their homesteads, which had been carried away entirely, but at the sites and foundations. They took out their stores of grain buried in pits, dried those which were wet—the sun having come out in the cleared sky—and cooked such as were undamaged. At every homestead which I visited I found the people engaged in drying their grain. They also made frameworks with broken branches, over which they threw sheets and cloths, such as they had about them at the moment, and so made little tent-like habitations. Plantain trees abounded, but the fruit was mostly destroyed. The cocoanuts, however, very frequently stood through the storm, and must have afforded some sustenance. There must have been much trouble about water at first. But either the drinking tanks speedily recovered from the brackishness left by the salt wave, or else the storm-wave must have mainly consisted of fresh water; for the drinking tanks were not brackish when we tasted them a few days afterwards. It was a great relief to find that such was the case. Some tanks, and some swamps, indeed, are full of human corpses and dead cattle, and all manner of fœtid matters, and cannot be approached; the streamlets which carry off the accumulated water were flowing black and thick with putrid substances.

No estimate can be made of the number of cattle drowned. They are chiefly bullocks and cows, some few are buffaloes, but the buffaloes are mostly saved, being excellent swimmers. The loss of cows is bad for the people, and the loss of oxen is still worse for agriculture. Fortunately there is no immediate demand for ploughing in the fields, so the loss will not make itself severely felt for some months.

In some places, and for the first two or three days, the people seem to have been often in want of food; they could not get at their stores. In some places they suffered severe hunger, assailing with entreaties for food the Rev. Mr. George Kerry, who was one of the first to appear among them. But this difficulty must have gradually subsided, for when I saw them there was no clamour for food particularly, though there was naturally loud lamentation for their sorrows generally; nor were there any signs of hunger; on the contrary, the noticeable circumstance was the trouble the people were taking to dry their grain. The demeanour of those who really bore the brunt of the storm was marked by that enduring fortitude under suffering which distinguishes the native character.

Nor was there at the time of my visit any sign of epidemic sickness anywhere, save around Noacolly. How long this immunity will be vouchsafed to the poor survivors may be a question anxiously asked. We have since learned that cholera has broken out on the Chittagong coast and on the east side of the Megna.

For the first day or two after the catastrophe there were some attempts at plundering, and some lawlessness broke out; but all this was promptly suppressed. Gang robbery used to prevail formerly in these tracts, and the robber spirit still survives among the instincts of the people; the fear was that, unless authority could be quickly vindicated, many persons would be tempted to take advantage of the sudden disruption of all social bonds to superadd crime to the many evils already inflicted on the land by a physical visitation. I trust, however, that the difficulty will be found to have been encountered and subdued.

Most of the local native officials were drowned, deputy magistrates, police inspectors, native civil judges, notaries, and others. Of those who escaped, some stood by their posts and did their duty well. Some few deserted and fled for their own safety, forgetting their charges; these, however, belonged chiefly to the lowest grade of the police, and will be duly punished. Among the police, some behaved so well as to merit reward. There were few resident landlords and few land agents on the spot. The villagers mostly consisted of cultivators with various kinds and degrees of tenures, and of sub-proprietors—a substantial yeomanry in fact—and they were the richest peasantry in all Bengal.

When the storm burst there was an abundant rice crop ripening for the harvest—the well-known deltaic rice crop, which is much beyond the needs of local consumption, and affords quantities (measured by thousands of tons annually) for exportation to distant districts. A part is lost, that in which the plant had not advanced beyond the stage of flowering, and a part is safe still, that in which the grain had formed or begun to form. If even one third is saved that would suffice for the population now on the land.

The boats, great and small, which constitute the only carriage in these tracts, and which fill the place of carts, were all lost on the night of the storm, jammed and smashed together, or wrecked or disabled, or carried inland and left high and dry. The Noacolly authorities were thus bereft of all resources for moving across the floods. In the case of the Hattea Island this was very hard; by reason of the loss of all boats there was no means of crossing the Megna to reach the island, and for three days at least it was

succourless. The people on the mainland knew its danger, but could not cross over to it. The Backergunge authorities were more fortunate; their boats escaped destruction, and they were able to move with all the promptitude that could be desired. The Chittagong authorities had most of their boats temporarily disabled, but, despite their own pressing needs, they managed to send succour to the devastated islands of Sundeeep.

Most of the trees, fruit bearers or others, will recover; except the Areca or betelnut palms. These exist in great numbers, of which very many are broken, snapped off as it were, and much of the betel crop just being gathered was destroyed, though some part was saved. The country here is well wooded, but at present it has lost all verdure and sylvan appearance; it seems to be stricken by a withering winter, and wears a drab colour, with bare branches or dead leaves, or trunks contorted, as if torn by some super-human destructive agency. Many trees, torn up by the roots, were carried away with the flood into the great river, and there remained as sunken trees, known to sailors as "snags," so dangerous to navigation. They virtually barricaded the passage out to sea by the western branch of the Megna, so that we were barred from approaching by water the seaface of the devastated tracts. The "snags," extending over an expanse of water, looked as if they had been set up by an enemy.

The wealth lost was almost entirely agricultural—crops or cattle. To this, however, there is one notable exception, namely, Dowlutkhan, a rich trading town, clean destroyed, with loss of miscellaneous property and valuable records. It had 8,000 inhabitants, one fourth of whom perished, perhaps more. Approaching the place, we steamed for two miles through a creek, the banks of which all the way were strewn with human bodies, floated up and down by the tide.

I give this outline of the case judging by what I saw of it, and from what I heard from those who were in it. The local authorities did instantly all they possibly could, and some of them managed to do a great deal. The immediate obstacle was of course the difficulty of communication. Still, day after day, sometimes hour after hour, officials, non-officials, messengers, guards, supply boats, arrived at some point or other of the wide and scattered scenes of disaster. Since the first few hours of inevitable destruction, not a life, so far as I could learn, had been lost from any preventable cause, nor had anyone been in extreme danger. Those who perished in that fatal instant of time passed suddenly beyond aid; but those who escaped then are still sustained, or are sustaining themselves sufficiently well. The disaster, big though it be, has yet happened in the midst of plenty, and of rural wealth. All around the fated and wasted area there are excellent crops and abundant stores. Those who have lost their agricultural wealth have still some left, and doubtless possess considerable credit. Soon, therefore, will boats come pouring in by the numerous channels from districts teaming with water-carriage; soon will fresh cattle be swum or ferried across the rivers from the overstocked districts of Eastern Bengal; soon will the grain bazars be reopened, and the rustic marts be filled with the surplus produce of neighbouring tracts.

The local authorities have indeed opened "relief centres," dotted all over the distressed tracts, and they afford relief in some cases; but this is done very sparingly; and though any case or cases of real danger or sickness will be watched for, so that no life can be lost (as we hope), save from incurable sickness, still we trust that very little relief will be really needed. The relief centres are as much for guard as for relief; are established for the purpose of restoring order, of preventing confusion, of keeping rustic society together, of making every responsible person stick to his work, and of ensuring that public confidence, without which trade of all sorts cannot quickly be restored. All this is being done with the utmost energy that the local officers can command, and all the staff, both European and Native, that can reasonably be required has been or is being despatched to the spot. Our object is to let the poor people see that the authorities are thinking, caring, feeling for them in their misery. This knowledge will brace their nerves, raise their spirits, and induce them to return promptly to all their accustomed industries.

There will be some extra police for a month or two, but that will not be much; also some relief expenses. There probably will be hereafter some advances to cultivators for purchasing plough-cattle (to replace the cattle drowned), but these advances will be recoverable, and will be made only on security. Altogether the expenses will probably not be beyond the means of local or provincial funds, and I hope to be spared the necessity of asking the Government of India for any financial aid.

We are prepared, so far as medical aid goes, for the contingency of epidemic sickness. Two parties of native doctors have been already despatched, and more will be kept in readiness.

I hope also that there will be no appreciable loss of revenue. The land revenue forms a small part of the profits of the land in these heretofore flourishing tracts, and is paid by very well-to-do persons. We got in all our land revenue during the infinitely worse case of the famine of 1874 in every district of Bengal and Behar, and I fully intend to enforce the same rule now, if possible. Nor is there any considerable loss to be feared under the other heads of revenue.

But, although I hope for the best regarding the surviving population, I still remember that things might take a turn for the worse, and that there may be distress of which information has not yet reached us. In that case the numerous temporary stations which have been established, and the many responsible persons who are moving about, have instructions to act with all necessary effectiveness. Sickness and pestilence are the things uppermost in our fears.

The following is the *resumé* of the instructions which I gave on the spot to the local authorities:—

- 1st. Throughout the devastated tracts to establish posts of observation at points sufficiently numerous to ensure the condition of the people in every village being thoroughly watched, so that if there are any cases, or even a single case, of dangerous distress they or it may be surely discovered.
- 2nd. To afford relief in any cases where it is necessary to save life; but in all cases short of this extremity to be very cautious in affording direct assistance of this sort.
- 3rd. To stop those attempts at plundering or lawlessness which are to be apprehended after a physical catastrophe such as that which has occurred.
- 4th. To preserve social order; to urge the people to rebuild their cottages quickly; to induce shopkeepers to re-open their shops; to re-establish local bazars and markets; to assure all persons, especially those who bring supplies or livestock from without by river, that their boats and property are safe against any sort of attack or interference.
- 5th. To encourage and induce all landed proprietors of any grade, superior or inferior, and their agents, to stay in or return to their respective properties, to help their tenants and dependants.
- 6th. To see that the regular police set a good example, and that the village watchmen stand by their posts.
- 7th. To ascertain whether any cash advances will probably be necessary to enable cultivators to purchase cattle for agriculture.
- 8th. To investigate numerically the casualties which actually occurred on the fatal night of the 31st October.
- 9th. To be prepared to establish medical stations and dispensaries in event of epidemic sickness breaking out.
- 10th. To incur such expenditure as may be absolutely necessary under the above instructions, but with this reservation, to be very economical in spending money.
- 11th. To arrange for the taking of a new census, on some date during December next, of the people remaining in the local divisions (*thanas*) which have suffered from the storm-wave.
- 12th. To discourage or refuse any applications for remission of land revenue.
- 13th. To act promptly in any emergency which may arise, not provided for in these instructions.

The Commissioner of Dacca, Mr. F. B. Peacock, proceeded immediately by steamer with assistance to Backergunge, and supervised the local arrangements. The Acting Commissioner of Chittagong, Mr. A. Smith, despatched with excellent promptitude assistance to the Sundeep Islands, under Mr. Badcock, which we trust arrived in time to prevent disaster. He and a non-official landholder, Mr. Macalpin, joined my party at Hattea Island. The Magistrate of Backergunge, Mr. E. Barton, was as prompt as possible in sending every sort of help to the scene of distress; his conduct in that trying moment has received my high commendation. The District Superintendent of Police, Mr. H. N. Harris, proceeded at once to Dowlutkhan, the spot of all others where his presence was most needed, and was personally very active and resourceful. The Reverend Mr. G. Kerry (of the Baptist Mission) volunteered to visit some of the tracts where hunger was most feared, and distributed supplies from Government among those who were most in need; he was among the first to appear on the scene of destruction. Mr. R. Porch, the Magistrate of Noacolly, speedily organised relief establishments along the coast line of his district. Mr. R. Harvey, manager of the Paikpara estate, proceeded to the islands to assist the distressed tenantry. The Nawab Abdool Ghunnee, of Dacca, sent his steamer and some large boats, which will be very useful for

the conveyance of men and of supplies. Most of the zemindars were non-resident; but on hearing of the disaster they hurried off agents, or went in person, to their estates. I am sure that they will be found doing their duty as landlords.

It may be asked, in conclusion, whether any protective means against such calamities in future can be devised—any embankments or the like? This question will be duly considered; but at present I know not how to devise such safeguard, nor have I seen anyone who can suggest anything. The area to be protected would be too great to be encompassed with protective works. If embankments became breached in such a storm, they would afterwards do more harm than good, for they would prevent or retard the running off and the subsidence of the waters. Perhaps the people might build perches for themselves on platforms, on stilts, and the like; but the trees which invariably surround the homesteads serve this purpose admirably, and it is to them that the survivors mainly owe their escape.

There is always this consideration, too, that these disasters, though not unfrequent somewhere or other in a less severe form, do not visit the same locality in such intensity, save at long intervals of time. Without specifying the exact date when the last event of such gravity befell the delta of the Megna—one case of this kind happened in 1822—most people say that there has been nothing like the recent cataclysm since the middle of the last century.

(Signed) RICHARD TEMPLE.

ESTIMATE of the NUMBER of PERSONS DROWNED in the CYCLONE of 31st October 1876.

In the Backergunge District.

	Population.	Probable number drowned.
Dukhin Shahbazzpore Island - - -	221,000	70,000
Bowful thannah - - -	118,000	15,000
Golachipa ditto - - -	98,000	20,000
	<u>437,000</u>	<u>105,000</u>

In the Noacolly District.

Sundeeep Island - - -	87,000	40,000
Hattia ditto - - -	54,000	30,000
Sudharam thannah - - -	96,000	5,000
Boumnee ditto - - -	33,000	5,000
Ameergaon ditto - - -	133,000	10,000
	<u>403,000</u>	<u>90,000</u>

In the Chittagong District.

Meerkaserai thannah - - -	120,000	10,000
Koomeria ditto - - -	26,000	5,000
Chittagong ditto - - -	76,000	5,000
	<u>222,000</u>	<u>20,000</u>
Total - - -	<u>1,062,000</u>	<u>215,000</u>

AREA.

In the Backergunge District.

Dukhin Shahbazzpore Island - - -	818 square miles.
Bowful thannah - - -	194 ditto.
Golachipa ditto - - -	804 ditto.

Total - 1,816 square miles.

In the Noacolly District.

Sundeeep Island	-	-	-	} Exact area cannot be given; may be roughly stated at about 900 square miles.
Hattia ditto	-	-	-	
Sudharam thannah	-	-	-	
Boumnee ditto	-	-	-	
Ameergaon ditto	-	-	-	

In the Chittagong District.

Meerkaserai thannah	-	-	-	} Exact area cannot be stated; may be roughly stated at about 380 square miles.
Koomeria ditto	-	-	-	
Chittagong ditto	-	-	-	

From the OFFICIATING SECRETARY TO THE GOVERNMENT OF INDIA to the SECRETARY TO THE GOVERNMENT OF BENGAL.

SIR,

Calcutta, the 24th November 1876.

I AM directed to acknowledge the receipt of Mr. Cotton's letter of the 22nd instant, No. 3,705, forwarding copy of a minute recorded by the Lieutenant-Governor on the cyclone and storm-wave which have recently devastated portions of the districts of Backergunge and Noacolly. The President in Council has read with painful interest the account of this terrible calamity which is contained in Sir Richard Temple's minute, a calamity which, as regards the number of human lives lost, to say nothing of the destruction of cattle and other animals, is scarcely paralleled in the annals of history. The Lieutenant-Governor estimates that in an area of some 3,000 square miles, out of a population of about a million, some 215,000 persons have perished. The loss of property, and especially of cattle, a very serious matter in an agricultural district, has been of course considerable. The local authorities appear to have done everything that was in their power to afford relief to the survivors in the devastated tract. The Lieutenant-Governor makes special mention of the Commissioner of Dacca, Mr. F. B. Peacock; of the Acting Commissioner of Chittagong, Mr. A. Smith; of the Magistrate of Backergunge, Mr. E. Barton; of the Magistrate of Noacolly, Mr. E. Porch; and of the District Superintendent of Police, Mr. H. N. Harris. The exertions of the Reverend G. Kerry, of the Baptist Mission, and of Mr. R. Harvey, manager of the Paikpara Estate, are also specially mentioned, as well as those of Nawab Abdool Ghunnee, of Dacca, who sent his steamer and some large boats to the scene of the disaster. The President in Council requests that the thanks of the Government of India may be conveyed to all these gentlemen for their services.

2. To his Honour the Lieutenant-Governor, who, with his characteristic energy, visited the locality within a week after the occurrence of the cyclone, the Government of India and the public are much indebted for his clear and interesting narrative of the results of his inspection, and for his judicious directions to the local authorities. Sir Richard Temple's presence on the spot so immediately after the catastrophe must have been invaluable as an encouragement to the officials, and as an assurance of the sympathy of the Government with the survivors of the population in the sufferings to which they have been exposed. The Government of India will be glad to receive any further reports and more detailed information that may reach the Government of Bengal.

3. The Government of Bengal have been already informed that Her Majesty the Queen, immediately on hearing what had occurred, was graciously pleased to signify by telegraph her deep concern at the terrible calamity which has thus overwhelmed a large body of Her Majesty's subjects. A similar expression of concern and sympathy has been received from his Excellency the Viceroy.

4. A copy of Mr. Cotton's letter and its enclosure, and of this reply, will be published in the "Gazette of India" for the information of the public.

I have, &c.

(Signed) T. C. HOPE,

Officiating Secretary to the Government of India.

No. 2. of 1876.

DESPATCH from the GOVERNMENT OF INDIA to the SECRETARY OF STATE FOR INDIA,
Department of Revenue, Agriculture, and Commerce, Meteorology.

MY LORD MARQUIS,

Calcutta, the 1st December 1876.

IN continuation of our Despatch No. 1, dated the 24th ultimo, we have the honour to forward for your Lordship's information copy of a further letter from the Government of Bengal, with enclosure containing a report from the Officiating Commissioner of the Dacca Division, in which some details are given of the results of his inspection of those parts of the district of Backergunge where the storm and inundation of the 31st October were most severely felt.

Dated the 27th November 1876.

We have, &c.

(Signed)

H. W. NORMAN.

A. HOBHOUSE.

E. C. BAYLEY.

A. J. ARBUTHNOT.

No. 3,748, dated the 27th November 1876.

From H. J. REYNOLDS, Esq., Officiating Secretary to the Government of Bengal, to the
SECRETARY TO THE GOVERNMENT OF INDIA.

In continuation of Mr. Cotton's letter, No. 3,705, dated the 22nd instant, I am directed to submit the accompanying copy of a report from the Officiating Commissioner of the Dacca Division, giving some details of the results of his inspection of those parts of the district of Backergunge in which the storm and inundation of the 31st October were most severely felt.

2. It appears to the Lieutenant-Governor that while this report bears out very painfully the estimate already submitted regarding the dreadful loss of human life, it also sustains the hope which the Lieutenant-Governor had formed as to the speedy recovery of the district from the effects of the visitation.

No. 134T, dated on board the Steamer "Teesta," the 19th November 1876.

From F. B. PEACOCK, Esq., Officiating Commissioner of the Dacca Division, to the
SECRETARY TO THE GOVERNMENT OF BENGAL, Financial Department.

IN continuation of my letter No. 409, dated 6th instant, and subsequent correspondence, on the subject of the cyclone which passed over the district of Backergunge on the night of the 31st ultimo, I have the honour to submit the following account of a tour of inspection I have this day returned from round those portions of the district where the effects of the storm were most severely felt.

2. On Sunday the 12th instant his Honour the Lieutenant-Governor, who had arrived the previous day, left Burrisal. Mr. Barton, the Magistrate of the district, and myself accompanying him as far as the sub-division of Perozepore, which we reached early next day.

3. As I have already reported in my letter No. 411, dated 7th instant, this sub-division escaped the storm-wave, though some damage was done by the cyclone. A good many houses were blown down, and the Deputy Magistrate informed me that about one eighth of the crops had been injured. From what I could see, however, I think this is rather a high estimate.

4. Leaving Perozepore at 11 a.m. on Monday the 13th, Mr. Barton and I proceeded straight to the sub-division of Patuakhally, which we reached the next morning. The place is a perfect ruin, not a single hut having been left standing. The residence of the sub-divisional officer, his office, the Moonsiff's cutcherry, the school, the lock-up, the police outpost, the sudder distillery, and the dispensary, have all shared the general fate. Notwithstanding the complete destruction of the place, only one life was lost, an old woman's, who was killed by the falling of a house. The crops have been but little injured; the bazar was being supplied as usual; there was no distress, and no unusual amount of sickness of any kind. I may add that the whole of the damage was caused by the wind, the storm-wave not having penetrated so far inland.

5. I gave orders for estimates to be prepared for the re-erection of the public offices, and the Executive Engineer has been directed to send an overseer to the place for this purpose. As it is of great importance that the ordinary work of the sub-division should be resumed with as little delay as possible, I have the honour to request that, in anticipation of formal sanction to the estimate, which will be submitted as soon as prepared, the Collector may be authorised to advance to the Executive Engineer the sum of Rs. 2,000, in order that the necessary buildings may be commenced upon at once.

6. From Patuakhally we proceeded to Golachipa thana, the jurisdiction of which extends over about 800 square miles in the south-eastern portion of the district, and which from its exposed position we knew had suffered as severely as any place, not even excepting the island of Dukhin Shabazpore. On our arrival we found that the reports that had reached us had not been exaggerated. Three storm-waves of from 15 to 20 feet high have swept over the place, literally levelling it with the ground. Not a single hut and hardly a post was left standing, while large mandar trees and whole clumps of bamboos torn up bodily by the roots sufficiently testified to the overpowering force of the wind. It is as yet too soon to attempt to compute, with anything like accuracy, the loss of life which has occurred. This will be done later on, when the census ordered by the Lieutenant-Governor is taken. Some idea of it may, however, be formed from the figures given below.

7. From inquiries made, man by man, among a miscellaneous crowd of persons from Golachipa and the neighbouring villages, we ascertained that, out of the total number of which their families had been composed, 41.55 per cent. had perished. From other inquiries made from house to house by Mr. Barton, myself, and Baboo Troilakya Nath Sen, the Deputy Collector in charge of relief operations, we found in one place that out of 156 persons, 55, or 35.25 per cent., had been drowned, while in another 68 persons out of 115, or 59.65 per cent., had been swept away. The loss among the cattle has also been very great; I should think not less than 80 per cent.

8. Amidst all this misery it is satisfactory to notice that the crops have suffered far less than would be supposed. I do not think that hereabouts the amount of damage done will exceed four, or at the most six, annas, and this, it must be remembered, out of an exceptionally good crop. In places the "Gribi," a kind of *aous* dhan, had already begun to be cut, and in a few days the harvesting of the *aghani* or earlier *amun* will have commenced. For the first few days, no doubt, gratuitous relief was absolutely necessary. Every golah had of course been blown down, and the greater portion of their contents scattered to the winds. What little grain was saved had to be collected and dried, and for some few days the people were for the most part so appalled by the catastrophe that had fallen upon them that but little was done. Now, however, that they are resuming their usual occupations, and the new crop coming in, gratuitous relief is no longer required; it has therefore been ordered to be discontinued, and the surplus stocks of grain and salt sold at cost price. The health of the people is generally good, and no cholera has as yet appeared amongst them. There is no want of drinking water, several tanks about being quite free from any impurity.

9. From Golachipa we proceeded still further south to the Rabunbad Islands, amongst which we visited Korulia, Burra Bansdia, and Kujul Churs. Here the havoc committed by the storm was very much the same as that at Golachipa, except that, if possible, it was greater, the very bhitas of the houses having been broken down. The storm-waves, judging from the drift that clung about the few trees that were standing, must have been from 20 to 30 feet high. The loss of life has been consequently greater here than at Golachipa. The result of inquiries made by ourselves from house to house in the three churs above mentioned was as follows:—In Korulia, out of 296, inhabiting 34 houses, 225 or about 75 per cent.; in Burra Bansdia, out of 146, living in 19 houses, 98 or 67.12 per cent. were dead; while in Kujul, out of 21 persons, composing five families, we only found four alive. Very much the same result was obtained by the relief officer on Chur Rangabolia, another of the same group of islands, where the percentage of deaths was 76. Very few cows or bullocks have escaped. In Chur Bansdia, in one house, I counted nine, the property of three or four different persons; but I do not think I counted half a dozen more during the whole of my walk about the island, extending over upwards of two hours. Mr. Barton's experience on Chur Korulia was exactly the same. Buffaloes, being strong swimmers, had fared better, but even among them the loss has been very considerable.

10. Here, too, we found that the crops had been more extensively injured. In Bansdia the out-turn will, I think, be about six or seven annas; in Korulia eight annas; and in Kujul ten annas. There was a good deal of jungle about the last, and this to some

extent protected the crops, and accounts for their being better than those on the neighbouring islands. The people all had rice in their houses, but it was all more or less damaged, though quite eatable, and the stocks were not large. Still the people exhibited no signs of distress, and as gratuitous relief is no longer necessary it will be discontinued.

11. The next place visited was Dowla, on the western side of the island of Badura, to the west of Dukhin Shabazpore. This had apparently suffered somewhat less than the Rabunbad Islands; the mortality, according to inquiries at 20 houses, being 44.36 per cent.; the crops, too, were better, and we estimated the out-turn at from 10 to 12 annas.

12. Proceeding along this island in a northerly direction we landed at a place called Diola, where we met a relief officer, who informed us that he had been informed there was some distress in the centre of the island, which, judging from the appearance of the people we saw, I think very unlikely. There is no reason also why distress in the centre should be greater than distress at the sides of the island. However, he was ordered to proceed at once into the interior and inquire into the truth of what he had heard, reporting within two days the result to Mr. Harris, the District Superintendent of Police, who has the general control over all relief operations in Dukhin Shabazpore and the adjacent islands.

13. Rounding the northern extremity of Badura we then proceeded south down the Gayar River, landed at Chur Shumbhoopora, on the west part of Dukhin Shabazpore. The crops here are worse than we have found them anywhere, and I do not think the out-turn will be more than six annas. There was no appearance of distress, though the people complained of want of salt,—a want, however, that I do not think could have been very pressing, as they were within easy reach of a relief centre at Tozumuddin, on the other side of the island, where the following day I myself saw salt exposed for sale in the haut.

14. From Shumbhoopora we proceeded across the Megna to the island of Manpura, which we reached at 10.30 of the morning of the 16th instant. Here we found Deputy Magistrate Moulvie Mafuzooddeen and Moulvie Mahomed Hafez in charge of relief operations. Manpura is another of the places which experienced the full force of the storm, and where consequently the mortality has been great, though not so great as in the Rabunbad Islands. Our inquirer showed that in 102 families, consisting of 1,013 persons, 532, or slightly over 52 per cent., had been drowned. Considering what they were exposed to the crops here are wonderfully good. The early *amun*, sown over about 2-16ths of the cultivated area, and now being cut, will not yield less than a twelve-anna crop, while the "Chuplas" and "Banspati" rice, sown over 6-16ths of 8-16ths of the cultivated area, will yield probably a ten-anna and a nine-anna crop respectively. The people are busy rebuilding their houses, and trade is reviving. One of the principal shopkeepers in the place had received an advance of money from the Deputy Magistrate, and had left for the mainland to purchase rice, salt, dāl, &c., &c. There is plenty of drinking-water; the people are no longer in any distress; and, with the exception of a little rheumatism and fever, there is no sickness. All relief has been ordered to be stopped, and the Deputy Magistrate directed to return to head-quarters, after disposing of his surplus stock of rice, salt, &c.

15. Leaving Manpura we recrossed the Megna, and landed first at the village of Kosnaddee, and then at Tozumuddin, both on the east coast of Dukhin Shabazpore. The former is in a very exposed position, and our inquiries showed that out of 114 persons, comprising ten families, 46 or 40.35 per cent., have been swept away. The *aghani* crop is fair, and will yield about ten annas, the later rice appears to have been more injured, and will probably not be more than a five or six anna crop. At Tozumuddin we found the Reverend George Kerry, who had volunteered to take charge of the relief centre established here. This place, standing more inland than Kosnaddee, has suffered less, both as regards mortality and in the damage done to the crops. Mr. Kerry's figures give a death-rate of something over 15 per cent. among upwards of 7,000 persons—a rate that was confirmed by inquiries made by ourselves among a miscellaneous crowd assembled at the haut, which was being held for the second time since the storm. I found it fairly stocked with rice, nearly all more or less damaged, dāl, fish, salt, oil, treacle, spices, betels, and some cloth. The crop will be about a twelve-anna one all round, and there is no longer any distress requiring gratuitous relief. Mr. Kerry has therefore closed his operations, and after disposing of his surplus stock of food, for which he expected to find a ready market, will return to Burrisal.

16. The next place visited was Dowlutkhan, the head-quarters of the Dukhin Shabazpore sub-division, where we met the District Superintendent Mr. Harris. While coming up the khal from the river, a distance of between two and three miles, I counted

no less than 76 corpses, though this was the seventeenth day after the storm. The Lieutenant-Governor has himself recently visited Dowlutkhan, and it is therefore not necessary for me minutely to describe its condition; suffice it to say that it is a complete wreck. The sub-divisional buildings, the Moonsiff's cutcherry, the school, the thana the lock-up, and the sudder distillery have, together with the whole bazar, been levelled with the ground. The population being a floating one, it is impossible to attempt to estimate the loss of life that has occurred, though this must necessarily have been very large.

17. The following is, I believe, a complete list of the Government officers and servants who have lost their lives:—Moonsiff, rural sub-registrar, native doctor, post-master, court sub-inspector, abkaree darogah, two abkaree burkundauzes, seven constables, a mohurir of the Moonsiff's court, and a post-office peon. Mr. P. M. Gasper, a zemindar, and eight members of the family of the Deputy Magistrate, have been drowned, besides many hundreds in the bazar itself. Up to the 17th, nearly 250 corpses, in a fearful state of decomposition, have been drawn out of tanks, or extricated from the débris of houses in the bazar itself and its immediate neighbourhood, and floated out into the river. Many more must have been swept away altogether, and there are undoubtedly many still undiscovered among the ruins of the place. The atmosphere is in many places simply poisonous; and it is wonderful that some epidemic has not broken out among the people. Most of the tanks are full of decaying matter, animal and vegetable, and it is hard to conceive anything more sickening than the smell arising from them. I feel sure that if the people were to continue where they are disease must break out amongst them. I have therefore ordered the bazar to be moved to the north side of the khall, where the sub-divisional buildings stood. This being to windward of the bazar, the atmosphere is comparatively uncontaminated, and there is ample space and an abundant supply of wholesome drinking water. I have directed one large tank in the centre of this piece of ground to be reserved exclusively for drinking, and have prohibited all bathing or washing of clothes or utensils in it. For these purposes other smaller tanks are available close by. I trust the Government will approve of the action I have taken in this matter. It really involves no hardship, for none of the houses in the bazar have been rebuilt, and the people may just as well erect temporary sheds and huts on one side of the khall as on the other. I have also ordered the people to be informed that the sight of the sub-division will be changed, so that those who will move with it may not incur unnecessary expense in providing accommodation for themselves and their goods now.

18. In the meantime, arrangements have been made for resuming the ordinary work of the sub-division until a new site has been decided upon and the necessary buildings erected. The Collector will send out at once an excise darogah and staff, and a temporary distillery will be worked. Very few records and books have been saved, and what have been are much damaged. These will require to be examined and arranged; those that can be made any use of being retained and the rest destroyed. All the stamps and stamp paper have been destroyed or blown away, except one bundle of non-judicial four-anna stamps, and this has been so completely saturated with water that I doubt if they can be made any use of. The sub-divisional treasure chest has been recovered, but a wooden chest, said to contain about Rs. 1,500, is missing. This has probably been broken open and looted in the confusion that prevailed during the first two or three days succeeding the storm. Indeed, in this respect the people as a body seem to have behaved shamefully. Everything that appeared likely to contain property of any value that they could lay their hands on was broken open and rifled of its contents; and there is I fear reason to suppose that this indiscriminate plunder was not merely the work of the bad characters of the place.

19. The crops about Dowlutkhan are much the same as those we saw about Kosnaddee and Tozumuddin; the *aghani* rice will be a ten to twelve anna crop; the *aous* from six to eight annas. The haut has been re-established, and I found in it a fair quantity of rice at 20 seers the rupee, salt at three annas a seer, dâl, fish, treacle, tobacco, betels, and some vegetables and fowls. All distress has ceased, and Mr. Harris has been directed to stop all further gratuitous relief; to sell off his remaining stock of rice, salt and dâl; to call in all the subordinate relief officers; settle his accounts, and return to head-quarters.

20. From Dowlutkhan we proceeded up the east coast of the island, landing at Goneshpura, in the north-east corner of it, to inspect the crops, which are much the same as at Dowlutkhan. From thence we went to Bhola and Ruttonpore, places situated respectively about four and six miles inland on the north-western part of the island. Here there had been hardly any storm-wave, and no loss of human life, though a few cattle had been drowned. I think one or other of these places should be selected as the future head-quarters of the sub-division. They are neither of them as centrally

situated as I should like, but there appears to be no other place more in the interior that would answer as well. Of the two, I prefer Bhola, a place of considerable trade in rice and betel nuts. It has good water communication, which is essential, and it is connected with Dowlutkhan on the other side of the island by a road. I inspected a piece of land which I think will answer well as the site of the sub-division. It is high land, and has two or three tanks of good water already upon it, which will probably save the expense of digging others. I have directed the Executive Engineer to make a survey and prepare a block plan of the place, and this, when ready, will be submitted with a further report for the orders of Government.

21. Our next point was Bowfal, where we found Mr. Gupta, the sub-divisional officer of Patuakhally, and Baboo Jadu Nath Chowdhury, the Deputy Magistrate in charge of relief operations in this thana. This place was also visited by the Lieutenant-Governor in the course of his recent tour. Hardly a single kutchra house has been left standing, and though the storm-wave was not nearly so high here as in the Golachipa thana, Dukhin Shabazpore, and Manpura, the loss of life has been very great. About one fourth of the entire area of the thana, 194 square miles, was subjected to the fury of the storm, and the deaths in this portion of it, roughly estimated to contain between 27,000 and 28,000 people, are computed to be about 7,000. A census taken by Mr. Gupta himself in six villages shows that 27.6 per cent. of the inhabitants perished, and 87.8 per cent. of the cattle.

22. The crops will yield an average of ten annas, and all distress has ceased. Relief operations have been closed, and the surplus stock of rice despatched for sale to Backergunge, where it is expected a better market will be found for it than at Bowfal itself. No sickness has yet made its appearance; but the town is in a terrible condition, and this, and the fact that there are a number of small tanks and pools all about it contaminated with every kind of abomination, lead me to fear that it may still break out. I therefore directed Mr. Gupta to watch carefully the health of the people, and to apply to the Magistrate for medical aid the moment there was any necessity for doing so.

23. The last place visited was Kujlakatty, in the Backergunge thana, where there has been considerable loss of life and destruction of cattle, though nothing so serious as in many other places. At first, too, there was a good deal of distress, but this has entirely ceased; and the Deputy Magistrate, Moulvie Tuzummul Ally, who had had charge of relief operations, had closed them before our arrival and returned to Burrisal.

24. From what has been said in the foregoing paragraphs of this Report, it will be seen that there is no longer any reason to suppose that the people in the tracts affected by the cyclone are in want of food, nor, as the early *aman* crop is now either being cut, or will be in the course of the next few days, does there appear to be any necessity to adopt special measures to watch their condition. At first, no doubt, there was very considerable distress, but this was relieved by the timely arrangements made by the Magistrate of the district. The supplies of food which he sent to the places that had suffered most gave the people time to recover from the effects of the calamity that had overtaken them, to erect something in the way of shelter for themselves and families, and to dry the small quantities of rice they had managed to save. In the meantime also haunts were re-established and trade revived, and with this ceased the necessity for further relief, which was then discontinued.

25. There are two most providential circumstances about the late storm—first, that the crops were not utterly destroyed; and, secondly, that the storm-wave, or rather succession of waves (for there were three), was composed of fresh and not of salt water. It seems almost incredible that the crops should neither have been levelled by the wind nor torn up by the roots by the rush of water over them. At first I was inclined to think that, as for some time before the waves came the water had risen steadily, they might have been merged before the former passed over them, and had thus not felt the violence of an immense volume of water being suddenly thrown upon them. But this theory, it is clear, can only apply to places over which the storm-wave or waves passed, while the crops are standing just as well in places which only experienced the force of the wind. In some places, no doubt, they were protected to some extent by surrounding belts of trees and jungle; but in many others I saw wide plains, of miles in extent, which had no screen of this kind. Whatever may have been the cause, it is certain that the crops have not been laid, and in this fact lies mainly the removal of anxiety as to the condition of the people. With regard to the second point, the water being fresh, no injury has been done to the land, except possibly from a small deposit of sand upon it, and even this we saw nowhere. Instead, too, of all the tanks being made brackish and undrinkable by an infusion of salt water into them, we found no place where there

was any want of drinking water, notwithstanding that so much of it had been contaminated in other ways. The calamity is bad enough as it is, but had the above circumstances not attended it, or had it occurred a month or two earlier in the year, it would have been infinitely worse.

26. I have endeavoured in the figures I have given above to enable some idea to be formed of the loss of life that has occurred; these figures being, with one or two exceptions, the results of inquiries made by Mr. Barton and myself at the various places we visited. Any estimate based upon them can, however, be nothing more than approximate; but a census of those thanas which suffered most will be taken at the commencement of the ensuing year, from which a very nearly exact computation should be possible.

27. Next to the fearful loss of human life, the most serious part of the calamity is the enormous destruction of cattle, which in many places will not, I fear, fall short of 80 or 90 per cent. It is clear that if a considerable portion of these cannot be replaced much land will next year remain uncultivated, and it is not yet known whether the people have the means of replacing them. The Backergunge ryots in general, and those of Dukhin Shabazpore in particular, are as a rule remarkably well-to-do, and as any money they had is sure to have been buried, this will not have shared the fate of their other property. I hope therefore that, with a little help from their zemindars, and possibly in some cases from Government, they will be able to purchase bullocks enough to plough their land.

28. I have already been directed to convey to Messrs. Barton and Harris the Lieutenant-Governor's acknowledgments of the excellent service done by them in the late crisis, and I now desire to bring to his Honour's notice Mr. Bertelson, the Assistant Superintendent of Police, Deputy Magistrates Baboo Anund Chandra Sen and Moulvie Tuzummul Ally, who have throughout the relief operations worked with an energy and judgment deserving of all credit. The Reverend G. Kerry came forward as a volunteer when the Magistrate was greatly in want of relief officers, and has since that time laboured indefatigably and at great personal inconvenience in relieving distress, in ascertaining the condition of the people and the state of the crops, and in making inquiries as regards loss of life and destruction of cattle. I trust that I may be permitted to convey to these gentlemen his Honour's approbation.

29. In conclusion, I have to add that, as Mr. Barton and most of the district staff have returned to the station, I have directed Mr. Currie to rejoin his appointment as Joint Magistrate of Dacca, where his services are now more urgently required than at Burrisal. I request that, if necessary, he may be re-gazetted to the former district. I would further beg that the two Sub-Deputy Collectors, who are no doubt, in conformity with the Lieutenant-Governor's instructions, now under orders for Backergunge, may not be countermanded. As things settle down into their places, there will be heavy criminal work at both the Dukhin Shabazpore and the Patuakhally sub-divisions, and various local inquiries will have to be made, though any special watching of the people will not be required. For some time at least, therefore, I anticipate that a single officer will not be able to get through the work at either place, and at the same time visit from time to time the interior of a sub-division—a duty this year of more than ordinary importance. I would propose, therefore, that one of the additional officers directed to be sent should be posted to each of these sub-divisions, where there will be ample work for them for the next two or three months to come. At the end of that period they can either be removed, or their services can be utilized in connexion with the work under the Land Registration Act, which in Backergunge will be particularly heavy.

No. 4. of 1876.

DESPATCH from the GOVERNMENT OF INDIA to the SECRETARY OF STATE, Department of Revenue, Agriculture, and Commerce, Meteorology.

MY LORD MARQUIS,

Calcutta, the 8th December 1876.

IN continuation of our Despatch No. 2, dated the 1st instant, we have the honour to forward for your Lordship's information copy of a further letter* from the Government of Bengal, and enclosure, containing a report by the Commissioner of the Chittagong Division, in which

* Dated the 4th December 1876.

he gives further particulars of the effects of the late cyclone and storm-wave in the district of Chittagong and the neighbouring island.

We have, &c.
 (Signed) H. W. NORMAN.
 A. HOBHOUSE.
 E. C. BAYLEY.
 A. J. ARBUTHNOT.

From the JUNIOR SECRETARY TO THE GOVERNMENT OF BENGAL to the SECRETARY TO THE GOVERNMENT OF INDIA, Department of Revenue, Agriculture, and Commerce.

SIR,

Calcutta, dated the 4th December 1876.

IN continuation of the correspondence ending with this office letter No. 3,748, dated the 27th November, I am directed to submit the accompanying copy of a letter* from the Commissioner of the Chittagong Division, giving further particulars of the effects of the late cyclone and storm-wave in the district of Chittagong and the neighbouring island.

* No. 380G, dated 23rd November 1876.

2. It will be observed that in the tract referred to, which is on the east side of the Bay of Bengal, the damage done by salt water was much greater than in the localities visited by the Lieutenant-Governor and his party, which lay much further to the west. The cyclone on the Chittagong coast came from the south-west and passed in a north-east direction; whereas in Dukhin Shahbazpore, and along the mainland of the Backergunge coast, the course of the storm-wave was from the north-east, and the wave was in a great measure composed of fresh water.

I have, &c.
 (Signed) H. J. S. COTTON,
 Junior Secretary to the Government of Bengal.

No. 380G., dated Chittagong, the 23rd November 1876.

From A. SMITH, Esq., Officiating Commissioner of the Chittagong Division, to the SECRETARY TO THE GOVERNMENT OF BENGAL, in the General Department.

IN continuation of my letter, No. Jct., of the 12th instant, I have the honour to submit a further report on the effects of the late cyclone in the district of Chittagong and the neighbouring island.

2. The later reports received from the Collector and his subordinates sent out on relief work give a much more favourable account of things than was at first expected. It has now been satisfactorily ascertained that in the southern half of the district—that is, south of the River Kurnafoolee—there is no distress requiring any immediate help. The Magistrate reports that rice is selling along the sea coast, which in that part of the country had the worst of the cyclone, having been visited, though lightly, by the storm-wave, at 13 seers a rupee, and that the neighbouring hâts are being well attended. Those living nearest the sea have indeed lost their crops, and a few unfortunates have had their property washed inland with no great chance of finding it again. There has also been a heavy loss in cattle, but I do not think that advance for the purchase of cattle will be very necessary there. As was anticipated by me, the water in the tanks is becoming sweeter, and it is hoped that in a few days more the people will have no want of drinkable water.

3. At Kootubdia the crops are reported to have been very badly injured, and all round scarcely a six-anna crop is estimated by the sub-divisional officer of Cox's Bazar, who personally visited the island. The sea is said to have risen 12 feet above its ordinary level, and the whole island was under three feet of water. The Government khas tehsil, cutcherries, and native houses have generally been blown down, and the house of the superintendent of the lighthouse, with a portion of its protective revetments, has been carried away, only a masonry wall of the former surviving the wreck. The lighthouse itself is reported to have rocked, but has stood well. To remove the very generally felt want of sweet water the Sub-Deputy Collector stationed there has been directed to sink wells. No loss of life is reported from this island, but houses in the northern part of it are said to have been washed away, while no vestige is left of any

embankment, artificial or natural. The loss to Government on account of embankments alone is estimated at about Rs. 6,000. The western shore of the island is strewn with the dead bodies of human beings and cattle, nearly 300 of each. The sub-divisional officer has taken steps for the early burial of these carcasses. There was, however, no sign of any very great distress, but some rice has been supplied to the Sub-Deputy Collector to relieve any case of real destitution.

4. In the northern half of the district, with the exception of Kumaria and Sitakoond, there is nothing very exceptional beyond the usual damage more or less to crops, and the general destruction of houses everywhere. Later reports from Kumaria and Sitakoond, though still gloomy, are much more hopeful, and show that the crisis, as far as the immediate effects of the cyclone is concerned, has been tided over.

5. The state of the western half of these two thanas is thus described by Mr. Assistant Collector Pargitar, who is still on deputation there for purposes of relief.

"The storm-wave swept right across the country in an easterly or north-easterly direction, reaching everywhere, except at Kumaria, as far as the Government road, and wherever the road was low it passed across over the land to the east. The quarters from which the cyclone blew with the greatest violence were west and south. The wave passed over the road between Kumaria and Sitakoond at two places, one being Kuman Ali's hât, where the damage was greater. Generally, the damage seems to have been the greatest from this hât to some miles north of Sitakoond, and the marks of destruction are most abundant for two miles to the north, as described in paragraph 2. What damage has been caused yet further to the north in the Noakholly Division I do not certainly know, but I have heard that several miles of telegraph lines have been broken and injured."

"The wave swept everything before it, passing over the face of the country in a body of water about 12 feet deep at about three-fourths of a mile from the high road. Everything was swept onwards by it in its course, and the broken remains of boats were carried two or three miles inland. People were washed over from Sundeep, and supported themselves on roofs of houses, planks, bamboos, &c. Many children are said to have perished in the way. The people on the mainland here who could do so mounted the largest trees they could find, and remained there until the water receded. There is not a single house left standing; and the contents of the houses were carried off and scattered far and wide. I have seen about 50 corpses myself, besides hundreds of dead cattle of every kind, and the dead bodies of many birds. The reported number of deaths at first was very high, the people saying that at least one half of the inhabitants had been drowned; but they must have included the number of those who fled eastward and thronged the road. Now that all these persons have returned to their houses, the number of those who really perished in the storm can be ascertained with tolerable accuracy, especially since the matabars have had to distribute the rice to the survivors. I have inquired of many mohullas the number of persons who perished in the cyclone; the total number for about 50 mohullas, subject to this outpost and containing 4,000 houses, is about 1,900 persons; hence it would appear that (allowing $5\frac{1}{2}$ persons to each house) the mortality among human beings has been 8.5 per cent. It is not to be supposed that all these bodies have been found or are to be found. Large numbers have been found and buried, others still lie here and there unseen among the fields, but without doubt very many must have been carried out to sea on the reflux of the wave. The mortality among the cattle has been immense, and I think that at least one half have been destroyed. They lie about the country in large numbers, but more must have been swept out to sea. I have given orders for the removal of the former, and shall make journeys through the villages to see whether my orders have been complied with. The people who have been washed over from Sundeep, and some even from islands beyond, have been relieved by grants of rice and money, and have been, as I hear, forwarded from Kumaria to their houses."

"Sitakoond was filled with pilgrims at the time of the cyclone, and, owing to the destruction of the houses, and the overcrowding greatly increased thereby, cholera broke out. As soon as the storm was over they began to evacuate the place, mostly in a northerly direction, whence the greater number had come, and the virulence with which the disease would otherwise have raged has been checked thereby. There have, however, been five or six deaths each day; and it is the opinion of Dr. Murray that it will continue to prevail until the country is cleansed of the taint with which it is everywhere pervaded. Before my arrival the police carried out the dead and laid them close by the roadside, but I have removed them and given orders to have future dead bodies carried away into the midst of the fields. The presence of the native doctor and the

establishment of the temporary hospital will materially improve the health of the town and the surrounding country.

"The wave, as I have before said, swept the whole of the country to the west of the Government road, and all the crops there will be destroyed. As one proceeds in a westerly direction the fields are found to be inundated with salt water, which at a distance of a mile from the sea shore is generally a foot deep, in some places much more; and the depth increases with the proximity to the sea. The crops this year were superior to those of several past years, and the cultivators were anticipating a gain therefrom which would recoup them for former bad harvests. Those near the sea were more advanced than those inland, and would have been fit for reaping in a few days. The grain is still in the ear, and when reaped will furnish the people with a little sustenance. I have pointed this out to them. They are just recovering from the stupor produced by the general destruction, and are now taking every means to save all they can. They all say that in a week or two the growing crops will have withered and died from the salt water, but till then will furnish food for the cattle which remain. The only hope which remained after the storm of the crops being saved was that a plentiful rain would fall, but there has been none hitherto, and the probability as regards the future is small. The crops inland are young, and the cultivators say they are likely to perish. The land on which they stand is moist with salt water; they may continue to grow, but, if so, the produce will be small and poor. I have seen some of the crops which are standing in salt water putting forth new growths, but this would appear to be merely a transient effect. The general result will be, I think, that all the crops to the west will die, and the only harvest which will be detained will be the grain near the coast, which was approaching maturity. It is quite impossible to state what proportion this would be of the whole.

"Wherever the wave has passed over the road to the east side the same results, though in a mitigated form, will follow as on the west, but the wind has there blown out of the ear all the ripening grain, and has extracted the juices of the young and growing crops. The cultivators say these are ruined, and that they will obtain no harvest this year. It is possible that the latter may recover and produce some grain still; it will be but poor. It is difficult to give a precise statement; I suppose about one third of these crops are not yet in flower."

"The people are exerting themselves everywhere now to recover and preserve their property of all kinds. They have begun to remove the *débris* from their houses and build fresh houses, though they find much difficulty in procuring the materials. All bamboos, posts, thatching, &c. which the storm has brought near them they have freely appropriated. Those who live near the coast have lost almost everything, while those further inland have gained much that the former have lost, for the wave bore everything inwards with it. Owing to this fact there have been many disputes, and the finder usually refuses to restore to the real owner waifs and strays. Boxes containing much valuable property have thus been seized and rifled of their contents, and the claimants can frequently obtain no redress, as the thieves cannot be found out. Such disputes have led not infrequently to quarrels and assaults. In order to afford the dispossessed speedy redress I have exhorted the *matabars* to convene an assemblage of their principal villagers and decide such claims. But as, from what I have heard, this course seems open to much abuse, I purpose to proceed through the villages and settle such matters, for it would appear that the finders sometimes entertain doubts as to the rights of the claimants, and give up the goods on being satisfied.

"I visited several houses yesterday, and made a thorough search into all I could find there. Each person has sought for his property and brought it back when found; and on discovering the *handis* containing his grain, has searched the ground near. Whatever grain he has thus found (often almost grain by grain) he has carefully washed, sifted, and dried in the sun, and then stored away again. The labour bestowed on preserving the grain is sometimes surprising. Some grain has begun to germinate, but it is dried and then kept. Other grain of last year, which has been much damaged, is first dried in the sun, then boiled, dried again, and put away. So, too, with regard to chillies, *kuddus*, *suparis*, and other articles of food. Clothing of kinds has been dried carefully in the sun, and cotton has been picked, separated, dried, and put away. In every *bari* which I visited I found a maund or two of rice, Pous or Shail, or of all together, and sometimes as much as five or six maunds. There was besides a jar of chillies or *suparis*, and sometimes a small file of *kuddus*, or a small pot of dried fish. All these articles, however, have been soaked in the salt water, and are more or less injured."

6. Mr. Veasey and the newly arrived District Superintendent, Mr. Platts, are directed to put down the misappropriation alluded to with a vigorous hand, and they are now ended. Timely aid, in the shape of rice and cash, has been freely given here in cases of proved necessity, and there is at present no apprehension of any immediate distress. I have called upon Mr. Veasey to submit accounts, which, when received, will be duly submitted for the approval of his Honour the Lieutenant-Governor.

7. Tanks in these parts also have been rendered brackish by the influx of salt water, and many of them, being polluted by dead bodies, bamboos, grass, and débris generally, have become pestilential pools. Fortunately there are many springs and hill streams on the eastern side of the trunk road, but as they are not within easy distance of every place, Mr. Pargitar fears that the people will have recourse to the impure water at their doors, instead of resorting to the purer supply at a distance, adding one to the many unavoidable causes of sickness. Cholera is unfortunately raging very virulently over this part of the district, and in fact exists generally wherever the salt water had access. Steps have been taken to clear the neighbourhood of dead bodies by means of municipal sweepers. I have also directed Mr. Pargitar to see if some of the tanks—selections being made according to the necessity of the place—cannot be refilled by diverting the water of the nearest hill streams. One native doctor is already on the spot, and I intend sending him an assistant as soon as the three men expected by to-morrow's steamer arrive.

8. The prospect of the cold weather crops in this part of the district is thus described by Mr. Pargitar:—

“According to the general accounts of the inhabitants there is no prospect of any cold weather crops being obtained. The ground, they say, has been so impregnated with salt from the salt water that it will remain sterile until fertilized by the rains of next year. They expect then to obtain a moderate harvest, but the earth will not regain its former fertile condition for two years. They have no seed fit for sowing, and they say that if they were to sow all their fields they would reap but a paltry harvest, receiving less probably than they had sown. This disastrous condition is rendered more so by the loss of their cattle; many of the cultivators are absolutely destitute of the means of ploughing and tilling their land, and those who have lost beasts will still be straitened in cultivation of their fields. Their implements of agriculture have also been lost or destroyed, and the broken remains of ploughs are to be seen along the roads.”

9. I have not received much information from the Collector of Noakholly about Sundeep, but from a report submitted by the Deputy Collector, Mr. Sarson, who was sent with relief from the Chittagong side, I find there is no want of food. Mr. Sarson thus describes the state of Sundeep:—“In the afternoon went ashore and viewed the state of the country. The whole place looks as if had been on fire, and the whole vegetation, including the large trees (such as mango, jack, cocoanut, &c.), seem burnt up. There is a regular look of desolation in every direction you turn your eye. This southern part of the island is said to have suffered more than the northern. The water is said to have risen 12 to 15 cubics by native account, but I took the trouble to measure these trees in their different places on which rubbish had been deposited when the tide receded, and found it to be 11, 13, and 15 feet, according to the rise and fall of the land; the average may therefore be taken at the least at 12 feet. Such a body of water rushing over the land must have been most disastrous and terrific, and the effect has been, as may be imagined, the loss of hundreds of human lives, and of cattle, and the destruction of every house in the place. The houses have not been simply blown down, as in Chittagong, but have been literally carried away, no one can say where, and large boxes have also been washed away. With regard to the growing crop of paddy on the land, I should say that the people will get about four annas in this part of the island. There will, however, be cases in which some persons who planted late will lose their all, but on the whole the crop will be a four-anna one, and it is now ready for cutting. Grain, however, in the ear is not so fully developed as it would have been had it been allowed to mature another fortnight, but the people need not starve.”

After the measures that have already been taken it may now safely be asserted that there is no apprehension of any death from starvation.

10. The destruction of cattle along the seaboard of both the districts of this division, and at Sundeep, Hatya, and its adjacent island, has been of a wholesale character. The Collectors are inquiring to what extent it may be necessary to give effect to his Honour's suggestion to advance money to ryots on security for replacing their stock. In Noakholly the afflicted tracts belong largely to the estates of the Courjon and Paikpara

minors, both of which are now fortunately under the management of the Court of Wards, and provisions for the purchase of cattle could, if necessary, be easily made by the Collector. In the district of Chittagong the zemindars are, on the contrary, mostly petty landholders; but Merkaserai largely belongs to the local zemindar Baboo Goloke Chunder Roy, who I trust will not be wanting in the public spirit he has elsewhere shown on an occasion like the present.

11. As regards the damage done to the port, the Conservator has submitted a further report, from which it appears that all the principal buildings and the buoys have escaped without any injury worth mentioning, only the boats and kutchas having been somewhat injured. The port jetty, as already reported, is a complete wreck, and orders have been issued to put up the screw-pile one, the stores of which are lying in Calcutta.

12. As to the shipping, the two vessels that were reported as missing have since turned up, and it has been definitely ascertained that only one native vessel was lost in the storm. The European vessels, with the exception of two, seem to have escaped any very material injury, and will shortly be re-floated. The Commissioner's steamer and flat, and the Magistrate's schooner, have been got into water, but one of the pilot cutters and a Government budgerow are still aground. Mr. Warden estimates the damage done to the rice stored for shipment at 56,000 maunds, equivalent to about Rs. 84,000. About 50,000 maunds of rice were afloat on the night of the cyclone, of which only about 8,000 maunds will have to be re-landed for executing necessary repairs to the vessels containing them. Besides this, of 50,000 lb. of tea stated to have been stored for shipment, about 17,000 have been damaged, and about another 22,000 have suffered more or less from inundation.

Mr. Warden's remarks regarding the gloomy prospect of the trade are quoted *in extenso* for the information of the Lieutenant-Governor:—

“ However serious the damage done by the cyclone to the shipping in the port (and of course necessarily it is very considerable), the injury is as nothing in comparison to the loss to the trade and the gloomy forecast over the business prospects for the year, both of which were most promising, and seemed pregnant with abundance and prosperity to all engaged. All the preliminaries had been settled for establishing a direct trade in jute between Naraingunge and Europe *via* Chittagong, and which doubtless would soon have been followed by the addition of many, if not all, the other products of Eastern Bengal which are now exported to Europe by the longer and very much more expensive route of Calcutta. The rice was beginning to come in copiously, and whatever differences there had been between the vendors and buyers of rice had been laid aside, either permanently or forgotten for the time being, and confidence was felt in a lively resumption of the trade of the port of Chittagong, which had been languishing for the past three years owing to the pressure of exceptional circumstances, which, differing in themselves in each of the years of decline under allusion, are no criterion of a permanent decline of the trade.

No. 5. of 1876.

DESPATCH from the GOVERNMENT OF INDIA to the SECRETARY OF STATE FOR INDIA,
Department of Revenue, Agriculture, and Commerce, Meteorology.

MY LORD MARQUIS,

Calcutta, the 15th December 1876.

IN continuation of our Despatch No. 4, dated the 8th instant, we have the honour to forward for your Lordship's information copy of another letter* from the Government of Bengal, and its enclosure, containing a further report by the Commissioner of Chittagong on the effects of the late cyclone and storm-wave in the Noakholly District.

* No. 3,895, dated the 7th December 1876.

We have, &c.

(Signed) H. W. NORMAN.
A. HOBHOUSE.
E. C. BAYLEY.
A. J. ARBUTHNOT.

From the JUNIOR SECRETARY TO THE GOVERNMENT OF BENGAL to the SECRETARY TO THE GOVERNMENT OF INDIA, Department of Revenue, Agriculture, and Commerce.

SIR,

Calcutta, dated the 7th December 1876.

IN continuation of this office letter No. 3,833, dated the 4th instant, I am directed to submit, for the information of the Government of India, the accompanying * No. 398 G, dated 23rd November 1876. copy of a letter* from the Commissioner of Chittagong, submitting a further report on the effects of the late cyclone and storm-wave in the Noakholly district.

I have &c.

(Signed) H. J. S. COTTON,
Junior Secretary to the Government of Bengal.

No. 398 G, dated Chittagong, the 23rd November 1876.

From A. SMITH, Esq., Officiating Commissioner, Chittagong Division, to the SECRETARY TO THE GOVERNMENT OF BENGAL, General Department.

IN continuation of my letter No. 380 G, of the 23rd instant, on the subject of the ravages committed by the late cyclone in this division, I have the honour to submit a further report, embodying such information as has since been received from the Magistrate of Noakholly.

2. In this district, besides completely washing the islands of the Sundeep and Hattea groups, the cyclone wave swept the whole of the seaboard, the nearest main roadway generally marking the limit of its ravages. In some places, as in north Merkasarai and the mid Fenny tract, it penetrated further inland, though with abated force. Men, cattle, and houses have in large numbers been washed away, the survivors saving their lives either by climbing trees or floating on the roofs of their houses. The destruction of cattle and other domesticated animals seems to have been almost wholesale, and the loss of life and property has generally been greater than on the Chittagong seacoast. The islands were inundated at night during the mid-fury of the cyclone, but the wave proceeded so slowly that while the villages on either side of the mouth of the River Kurnafoolee were flooded at about 2 or 3 a.m., the inundation occurred on the coast of Noakholly about 4.30 in the morning, which soon supervened. Daylight must have enabled large numbers to save their lives who would otherwise have perished; the calamity would not have been half so disastrous if the inundation had taken place in the day. In my No. 359 G, of the 12th, I said that the loss of life could not be much, if at all, below 40,000, and might be more. The inquiries that have since been made, and a comparison of the results with the figures of the late census, indicate a much more serious total. The general census, to be held next month, will give more reliable figures, but the following is a rough present approximation:—

Seacoast, from Kurnafoolee to Fenny, about	-	6,000
One third residents of Sundeep	-	29,000
Half residents of Hattea	-	27,000
Coast of Noakholly	-	20,000
		82,000

3. As to the crops on the islands, the estimates made and the opinion expressed by different people are very conflicting. Those I personally saw on the eastern side of Sundeep are very much like what the Lieutenant-Governor saw in Hattea, that is, they were ripe and pretty well filled with and likely to yield a good outturn. Mr. Sarson's estimate has already been communicated. Mr. Badcock says the crops on the western side are damaged. On the other hand, the Moonsif-Magistrate tells me that the crops round the edges are ripe and good, but that those on the higher lands in the centre, being unripe, have been pretty nearly destroyed. The export traders in Chittagong, who have their own source of information, estimate the crop left at from six to twelve annas. The islands usually export largely, and it may be safely accepted that, considering the great loss of population, there will be ample food for the survivors. The great difficulty under which I found the people labouring was that of cutting the crops; they were offering half the produce to people to come and assist in cutting them, and, owing to the fear of cholera, they could not induce acceptance of the offer.

4. In the distressed tracts Mr. Porch took early steps for establishing the following relief circles :—

Circles.	Head-quarters.	Circles.	Head-quarters.
1. Thana Sudharam	- Sudharam.	5. Hattea - - -	} Nilakhyi.
2. " Bamni - -	- Old Bamni.	Nulchiri- - -	
3. " Mersarai - -	- Faradnagar.	6. Sundeep - - -	} Sundeep.
4. Lakhypore - -	} Lakhypore.	Magdhara - - -	
Raypore - - -		7. Siddhi Lakhyi - - -	} Siddhi.
Balammara - - -		Bodu - - -	
Chur Manasa - -			

5. Relief was regularly issued by the officers in charge of these circles, mostly deputy collectors and police officers of the higher grades, who had instruction to give gratuitously to those who had no means, and to sell at cost price to those who could pay. To the island of Sundeep Mr. Badcock, Joint Magistrate of Chittagong, was sent with relief, and acted in co-operation with the officers sent from Noakholly for the same purpose. Distribution centres were opened at—

- | | | |
|---------------|---|---------------|
| 1. Sundeep. | } | 3. Hudeakhal. |
| 2. Doparkhal. | | 4. Neamosti. |
| Magdhara. | | |

Through these circles and centres rice, gur, oil, fresh water, clothes, salt, and money have been distributed either gratuitously or at cost price, as the circumstances of the case rendered necessary, and by this means all immediate distress has, I believe, been everywhere relieved. No further direct assistance will, I hope, be for the present required. An account of the expenditure will be submitted as soon as it is received from the Collector, from whom it has already been called for.

6. Mr. Porch also took active measures for restoring communications between the several parts of his district, these having been very seriously interrupted by the destruction of bridges and cutting of roads, while boats were scarcely to be had, most of them having been either sunk or thrown high and dry on the land.

7. The police were strengthened, and the Magistrate ordered them to take immediate cognizance of all cases of criminal misappropriation; he reports that only a few cases have up to date come to his notice. A great deal of property has no doubt changed hands, and some people have enriched themselves at the expense of their neighbours; but the Magistrate thinks the accounts of such plundering as actually took place were greatly exaggerated. The Magistrate will, however, be told to see that such cases of misappropriation as come to light are so dealt with as to induce the return of their new treasures by others, and the Magistrates of both districts will be instructed to warn finders that they are bound to return and liable to punishment for criminal misappropriation if they don't. The stories that were widely circulated to the discredit of the police, of their having taken part in the plunder, the Magistrate reports, rest on small foundation. No genuine complaints have reached him, except as regards the outpost of Nulcaira, in Hattea, where two policemen, implicated in a case of appropriating silver ornaments, are in jail awaiting trial. To assist in repressing the crimes likely to crop up after such a wide-spread disaster, as well as to meet the strain that will be brought to bear upon his executive establishment generally, the Magistrate proposes to strengthen it by appointing Sub-Deputy Collector Baboo Bogola Prasono Mazumader, who has already been deputed to one of the worst affected parts and is doing good service there, temporarily as a Deputy Magistrate from the 10th instant, the date on which he was sent out to Hattea. He was, I find, on a previous occasion recommended for a similar appointment by Mr. Lewis, in his letter No. 44Ct., dated 29th November 1875. The recommendation has my approval. The nominee is an energetic young man, descended from a good family, and is the only educated non-official native of the place.

8. Thus everything has been done to re-establish order, and the people, who were at first stunned by the suddenness and completeness of the disaster, are now gradually returning to their avocation. Confidence is restored, the people are fast falling back into their old groove, and cholera is the chief difficulty that they have now to contend with. Medicines have been widely distributed through the police and from the local dispensary. The subordinates of the civil medical officers were sent out to visit houses and give medical relief in the immediate neighbourhood of the station, and three native doctors were deputed to the following relief centres where the disease was raging :—

1. Chururia, five miles south-west of this station.
2. Taktakhali, six miles south.
3. Jagadananda, five miles south-east.

4. Old Bamni.
5. Chaprassee Hât.
6. Faquiri „
7. Zorwargunge outpost.

The civil medical officer and his staff are reported to have worked indefatigably in keeping up supplies of medicines.

9. The salt water difficulty on the islands is not so serious as might have been expected. On Sundeeep some of the tanks are sweet, and on Hattea, which lay on the western side of the Vortex which passed over Noakholly. The wind was northerly, and the inundation was consequently largely fresh water from the Megna, and not sea water. The heavy rain now falling, and which seems connected with another cyclone to the westward, will assist generally in making the tanks less brackish and eliminating the salt from the ground; its effect on the crops it is not so easy to estimate. Those that are ripe and uncut it will probably somewhat injure, by causing the grain to sprout; where they are unripe, the reduction of the brackishness of the soil and the washing off the salt from the plants themselves should be beneficial. Whether it will have on the prevalent cholera the effect that rain usually has in March and April may be doubted, for it will aggravate the noxious emanations from decaying thatch, bodies, and carcasses, and increase the discomfort to which houseless people are subjected, and these are no doubt in part the causes of the present sickness.

No. 1. of 1877.

DESPATCH from the GOVERNMENT OF INDIA to the SECRETARY OF STATE FOR INDIA,
Department of Revenue, Agriculture, and Commerce, Meteorology.

MY LORD MARQUIS,

Calcutta, the 12th January 1877.

IN continuation of our Despatch No. 5, dated the 15th ultimo, we have the honour to forward for your Lordship's information copy of a letter* from the Government of Bengal and its enclosure, being a further Minute by his Honour the Lieutenant-Governor on the effects of the late cyclone and storm-wave in the Sundeeep group of islands in the district of Noakholly.

* Dated the 18th December 1876.

We have, &c.

(Signed) A. HOBHOUSE.
E. C. BAYLEY.
A. J. ARBUTHNOT.
A. CLARKE.
J. STRACHEY.

FROM the JUNIOR SECRETARY TO THE GOVERNMENT OF BENGAL to the SECRETARY TO THE
GOVERNMENT OF INDIA, Department of Revenue, Agriculture, and Commerce.

SIR,

Calcutta, dated the 18th December 1876.

IN continuation of my letter No. 3,895, dated 7th December 1876, I am directed to submit herewith, for the information of his Excellency the Governor-General in Council, a copy of a further Minute, dated 15th December 1876, recorded by the Lieutenant-Governor, regarding the effects of the late cyclone and storm-wave in the Sundeeep group of islands in the district of Noakholly.

I have, &c.

(Signed) H. J. S. COTTON,
Junior Secretary to the Government of Bengal.

ADDITIONAL REMARKS ON THE EFFECT OF THE CYCLONE AND STORM-WAVE IN THE
SUNDEEP GROUP OF ISLANDS ON 31ST OCTOBER 1876.

MINUTE by the LIEUTENANT-GOVERNOR OF BENGAL, dated the 15th December 1876.

The description of the storm-wave in Backergunge and Noacolly, and its effects, as given in my Minute of the 21st ultimo, referred more particularly to Noacolly proper, to Hattea, and to the Backergunge district, but not so much to the Sundeeep group of

islands (belonging to Noacolly) which I had not been able to inspect personally. On the 19th of November I deputed Mr. F. H. Pellew, of the Civil Service, to the Sundeeep group of islands, he being an officer specially experienced in relief operations elsewhere, and also having formerly served in Eastern Bengal. He has now returned from his deputation, and I wish to record briefly my impressions regarding the Sundeeep group of islands after conferring with him.

2. The Sundeeep lands differ in some respects from those of the other islands which I described in my Minute of the 21st ultimo. Being of older formation, the ground in Sundeeep proper is somewhat higher towards the centre. The habitations, instead of being scattered in little hamlets, are towards the centre collected into large villages well protected by trees, and (what was very important) having large tanks with high banks round them. Consequently, although towards the shores of the islands the people were swept off exactly in the manner I previously described, yet towards the middle they for the most part escaped, as the wave was not relatively quite so high, and the trees were more efficiently protective, apparently checking the rapidity of the wave, and allowing the poor people a few minutes of time, during which they crowded on to the banks of the tanks, and so kept their heads above water. On the outer villages towards the shores the mortality was quite as sad as anything that has been reported. In the inland villages it was fortunately less.

On the other hand, the storm-waves here came from the south, that is, from seawards, and receding left the tanks and other drinking water brackish (instead of being fresh, as was happily the case in Hattea and in Backergunge), and caused the stagnant water, remaining after the wave had passed, to be foetid. Thus cholera set in soon after the first disaster. Then, on the 23rd November, there came a storm of wind and rain (the ghost, as it is called, of the cyclone), suddenly lowering the temperature of the atmosphere and sorely chilling the houseless people. This fresh misfortune aggravated the choleraic plague. Thus Mr. Pellew found the people in a state of deep depression. It seemed as if the survivors of the cyclone-wave would slowly perish by pestilence. Every arrangement which forethought could suggest had been begun by the local authorities, and has been carried out further by Mr. Pellew. Native medical officers with medicines have been stationed at appropriate places. Additional assistant surgeons have been despatched from Calcutta. The Sanitary Commissioner, Dr. Coates, was deputed to Chittagong during November; he is already at work on these islands. The cholera is abating in the north part of the islands, but is still bad in the south, and there is no knowing when it will cease there. Wherever the cholera has abated, there the people are rebuilding their houses, and rehabilitating themselves altogether. They have supplies of food, also a fair crop on the ground; but the reaping and harvesting is delayed, because the cultivators are attending their sick and burying their dead. In one part of the island there is a Government estate; in another part an estate under the Court of Wards. There will be no difficulty in making advances to distressed cultivators. These will be needed, as the destruction of the cattle was almost total and absolute. The plundering and other attempts at mischief have been stopped.

4. The estimate now given of mortality in the Sundeeep group of islands differs somewhat from that given in my Minute of the 21st November. Out of a population of 87,000, I understood that 40,000 had perished in the catastrophe. Mr. Pellew makes out that not more than 25,000 perished at first, but that several thousands have since died from the effects of the catastrophe, and some thousands are still dying. He fears that, before this said affair is ended, the mortality will fully equal the higher estimate of 40,000.

5. I here cite a few remarkable facts extracted from Mr. Pellew's notes.

"The people in the villages on the south-western coast stated that the inundation commenced with a wave at least six feet high, which burst over the land from the south-east. Very shortly after another wave, six feet higher, came from the south-west. These waves came suddenly, just like the bore, mounting up and curling over. The second wave is described as lifting the roofs of the houses, and whirling the contents—human beings, with furniture, &c.—violently outside. The mat walls with their wooden posts were swept away, the latter being either broken off short or wrested out of the ground. All this was done suddenly; people described it to me as occurring in one second of time. Behind each wave the water did not fall again, but remained, so that after the second wave there was 12 feet of water over the land.

"In the centre of the island the water came up less suddenly. The Government Pleader at Hurrishpore was taking refuge from the storm in his new cutcherry. Suddenly an alarm was raised that the water was coming. He got on the wooden dais,

but the water immediately covered this. He then went, up to his neck in water, along a raised path, to the bank of his tank, which is about 12 feet high; he told me that the rising of the water did not take longer than two minutes from first to last, and that he was only just in time. The bank of the tank was not more than 10 yards from his cutcherry. I saw the place myself. This was in Hurrishpore, the most central village.

"In the village of Nyamustee one man was the sole survivor of 13; four men were the survivors of a household of 25. The women have perished in immense numbers. Most of the men who remain are wifeless.

"In Kangalee Chur (an island of Sundeep) the Sub-Inspector found nothing but two wild buffaloes alive, and the corpses of men, cows, and buffaloes.

"In Chur Moolavee, out of 177 people 137 died.

"In some villages along the west coast of Sundeep, out of a population of 2,460 people 734 were drowned."

6. As regards cholera, Mr. Pellew writes—

"The mortality generally in South Sundeep threatens to exceed the mortality from the inundation. The returns for 33 beats (with a population of 10,855 souls) give the deaths by drowning as 1,063, whereas those from cholera in the same tract have already amounted to 764.

"In Gachooa 111 people have died in a population of 1,033. In Dublaphar 83 have died in a population of 236. In Amanulla 84 have died in a population of 692. The greatest mortality from cholera is in the central portions of the islands, where the mortality from the inundation was comparatively trifling."

7. Mr. Pellew expresses himself as unable to suggest any protective works as against storm-waves in future. The old embankments round parts of the island which did exist only made matters worse on this occasion.

8. The thanks of Government are due to Mr. Pellew (who very properly volunteered for the duty) for his exertions in this sadly important case. I am sure that his visit and inspection must have been of great service to the suffering people. He makes a very favourable report regarding the exertions (under trying circumstances) of Baboo Umakanth Doss, Deputy Magistrate, whose services will be duly remembered by me.

RICHARD TEMPLE.

No. 6. of 1877.

FROM THE GOVERNMENT OF INDIA TO THE SECRETARY OF STATE FOR INDIA, Department of Revenue, Agriculture, and Commerce, Meteorology.

MY LORD MARQUIS,

Simla, the 12th April 1877.

WITH reference to your Lordship's telegram dated the 21st ultimo, we have the honour to forward three copies of the Report* of the Meteorological Reporter to the Government of

Bengal on the cyclones which visited the Vizagapatam and Backergunge Districts in October 1876.

2. The charts illustrating the gradual formation of the cyclone are still under preparation, and will be transmitted to your Lordship as soon as they are received by us from the Government of Bengal.

We have, &c.
 (Signed) LYTTON.
 F. P. HAINES.
 E. C. BAYLEY.
 A. J. ARBUTHNOT.
 A. CLARKE.
 J. STRACHEY.
 E. B. JOHNSON.

REPORT ON THE BACKERGUNGE CYCLONE OF OCTOBER 1876.

By J. ELLIOTT, Esquire, M.A., Meteorological Reporter to the Government of Bengal.

The following report deals with the cyclones which marked the transition from the south-west to the north-east monsoon during the month of October 1876. The first originated to the west of the Andamans, in latitude $14^{\circ} 30'$ N. and longitude 90° E., on the evening of the 5th, and advanced across the Bay in a west-north-westerly direction, and reached the coast about twelve miles north of Vizagapatam, from which it passed slowly northwards, gradually breaking up to the north of Cuttack, in the Chota Nagpore district, but influencing and modifying the meteorology of Bengal and Upper India for some days after the dissolution of the vortex. The second cyclone vortex was generated to the west of the Andamans, in latitude $13^{\circ} 30'$ N. and longitude 89° E., on the afternoon of the 29th, and advanced first almost due north, but was gradually deflected to the north-east, and struck the coast at the estuary of the Megna at 3 a.m. on the morning of the 1st, and was broken up a few hours afterwards by the disintegrating action of the Tipperah Hills. It influenced the weather in Eastern Bengal and Assam to a slight extent until the 3rd, when the north-east monsoon was finally fully established over Northern India and the head of the Bay.

The report, after a brief introductory chapter sketching the various theories which have been proposed to explain the formation and motion of cyclones, is arranged under the following heads:—

(1.) SECTION I.*—Gives the results of the observations for the month of October taken at the observatories in Bengal, Behar, and Orissa, and a few stations in the North-Western Provinces and Southern India. They are accurate and trustworthy, and it is from these mainly I have deduced the conclusions to which I have arrived, and from which they will admit of verification.

(2.) SECTION II.*—Deals with the Vizagapatam cyclone under the following chapters:—

Chapter I. gives the logs of six vessels involved in the cyclone, and special observations and information from Vizagapatam and its neighbourhood.

Chapter II. gives the meteorology of the Bay and Northern India before and during the cyclone, and traces out, from the information of the preceding section and chapter, the formation and line of advance of the cyclone vortex

Chapter III. gives a very brief summary of the cyclone, and discusses the causes and phenomena of the cyclone.

(3.) SECTION III.—Deals with the Backergunge cyclone, and is arranged under the following chapters:—

Chapter I.* gives *in extenso* the logs of 23 vessels involved in the cyclone.

Chapter II. gives the meteorology of the Bay and of Northern India prior to the formation of the cyclone, or from the 20th to the 30th October.

Chapter III. deals with the line of advance of the cyclone from its place of formation to the mouth of the Megna.

Chapter IV. investigates the path of the cyclone in Eastern Bengal until its disappearance under the action of the Tipperah Hills.

Chapter V. gives a brief account of the storm-waves which swept over the islands at the entrance to the Megna, and flooded the Chittagong, Noakholly, and Backergunge coasts.

Chapter VI. discusses the causes and phenomena of the Backergunge cyclone.

* This portion of Mr. Elliott's report has not been reprinted in the present paper.

INTRODUCTORY CHAPTER.—CYCLONE THEORIES.

A BRIEF recapitulation of the various theories which have been advanced to account for the phenomena and origin of cyclones will be useful, not merely for reference in the discussion of the recent cyclones, but also as showing the present practical and theoretical knowledge on the subject of cyclones. The observations hereafter given in detail will be employed partly to test the various theories.

The earliest writer of importance on the subject of cyclones was Mr. Redfield. Colonel Capper, in his observations on the wind and monsoons published in 1801, had stated his belief that the storms of the Indian Ocean were whirlwinds or rotatory storms. He stopped short at this anticipation, stating that "it would perhaps not be a matter of great difficulty to ascertain the position of a ship in a whirlwind by observing the strength and changes of the wind. If the changes are sudden and the wind violent, in all probability the ship must be near the vortex of the whirlwind; whereas if the wind blows a great length of time from the same point, and the changes are gradual, it may be reasonably supposed the ship is far from the vortex."

Mr. Redfield contributed a series of papers, dating from the year 1822, to American scientific journals, in which he developed the theory that they were vast progressive whirlwinds or rotating storms moving along curved paths. About the same time Professor Dove in Europe had come to the conclusion that all the phenomena of such storms are fully explicable by the assumption of one or more rotary atmospheric currents or whirlwinds advancing slowly in a definite direction.

The circular theory was also adopted by the next important writer on this subject, Lieutenant-Colonel Reid, of the Royal Engineers, in his work on the Laws of Storms. He not merely confirmed the results of the investigations of Mr. Redfield, but laid down, from examination of the tracks of a number of storms, the important generalization that in the rotary storms of the tropical regions of the northern hemisphere, the direction of rotation of the winds is N.W.S.E., or opposite to the direction of motion of the hands of a watch with its face upwards; whereas in the storms of the tropical regions of the southern hemisphere, the direction of rotation is the opposite—N.E.S.W. He was thus enabled to give a series of rules for the guidance of sailors navigating tropical seas.

Mr. Piddington took up a similar line of inquiry, and analyzed carefully the path of every storm in the Bay of Bengal and Indian Ocean of which he could obtain any records. He fully adopted the circular rotatory theory, and suggested the use of the word cyclone for all such storms. He gave an elaborate series of rules for the information and guidance of sailors navigating these seas.

But, as Mr. Buchan observes in his handbook on meteorology, it should always be remembered that in the charts given by Reid, Piddington, and others who adopt in its simplicity the circular theory, the arrows representing the wind direction are drawn always tangential to circles described about the centre of the area of calm solely on the assumption of the truth of the circular theory. They are hypothetical directions serving in their works a definite purpose, that of enabling them to lay down practical rules for sailors navigating seas visited by cyclones, and are undoubtedly a rough approximation to the actual character of the atmospheric motion during cyclones, which is what Sir John Herschel terms vorticose or spiral in its nature. Numerous synchronous storm charts, giving the absolute direction of the winds at the same instant, have been drawn by various meteorologists, and show that there is an indraught of air to the central region of calm as well as a rotatory motion. The combination of the two motions gives a spiral or incurving motion of the air towards the centre.

The upholders of the circular theory had thus seized only a part of the truth. The other element, the indraught or centripetal part of the motion, an important element, was left out of consideration. Mr. Espy, of Philadelphia, adopted this element to the exclusion of the other, laying down what is known as the centripetal theory. From personal observation of the direction in which the trees were lying on the ground after the tornado of the 19th of June in New Brunswick, he came to the conclusion that in this storm the winds must all have been blowing and converging to a centre. He afterwards adopted the theory of the converging motion of the air in the case of all cyclones to a centre caused by a rapid upward vertical motion at this centre, due to the vast amount of heat given out by the condensation of vapour and the subsequent fall of rain. He also laid down as a general rule that whenever a fall of rain is going on over a large

area, there is necessarily produced an upward motion of the strata in and above which condensation is going on, which is followed by an indraught from all directions in the lower atmospheric strata and an outdraught in the higher.

Dr. Dove meanwhile was devoting great attention to the subject of the meteorology of winds and storms. He elaborated the idea which underlay the explanation given by Hadley to account for the easting of the trades wind, and established what he termed the law of gyration. This is that, in consequence of the diminishing velocity of rotation at places of the earth's surface as we proceed from the equator to the poles, "in the northern hemisphere, when polar and equatorial winds succeed each other, the winds veer in the direction S.W.N.E.S., and in the southern hemisphere, when polar and equatorial currents succeed each other, in the direction of S.E.N. to S. He also explained on theoretical principles the opposite directions of rotation of cyclones in the northern and southern hemispheres. He also showed that the cyclonic movement of the wind was in all cases in accordance with the general principle underlying the law of gyration, and that it might be due to a mechanical obstruction, as a range of hills, or the resistance of another mass of air, or that it might result from the struggle of opposite currents which alternately displaced each other. The former is apparently his more matured explanation. The next theory of importance, that of Professor Taylor, adopted by Sir John Herschel in his work on meteorology, is a modification of Espy's Centripetal Theory and Dove's Law of Gyration. Cyclones owe their origin, according to this theory, to the action of local heat producing an upward expansion and vertical motion of the air over a limited area. This is followed by an indraught from all the neighbouring districts, which would be strictly in accordance with the centripetal theory, if the earth had no motion of rotation. The rotation causes these winds to be deflected in approaching the centre, and the result is an inner spiral motion round a centre, over which a continuous ascensional movement of the air is going on.

The latest authorities on the subject of cyclones in the Indian Ocean and Bay of Bengal are Messrs. Meldrum, Blanford, and Willson. Mr. Meldrum, who has made a lengthened study of the cyclones of the Indian Ocean, and has traced out a connexion between solar spot frequency and cyclone prevalence frequency, maintains that in the Southern Indian Ocean they are primarily due to the action of lateral parallel opposite currents of winds. In the intermediate belt between the opposite winds the mass of air is in a state of comparative calm, and in consequence of the friction on opposite sides, it gradually acquires a rotatory motion. In this theory the rotatory motion and the barometric depression at and near the centre primarily result from the action of the parallel and opposite winds. Mr. Willson maintained the same theory. His opinion, as given briefly in the report on the Meteorology of Bengal for 1874, is as follows:—"I have elsewhere stated that in the cases which I had been enabled to examine it appeared highly probable that cyclones in the Bay of Bengal, like those in the Southern Indian Ocean, were generated between parallel wind currents blowing in opposite directions, and that the determining causes were probably not local, but far removed from the place of the storm's origin; that, in fact, the unusual vigour of the opposing winds which precedes the generation of such storms is probably produced in the first instance by abnormally high pressure some 10 or 15 days beforehand on both sides of, but far removed from, the belt which afterwards becomes the battle ground of the opposite currents. In the case of the cyclone under report (the cyclone of 3rd to 5th May 1874) no doubt whatever can be entertained of the previous existence of the opposite winds, and it is equally certain that about eight days beforehand the pressures to the eastward and to the westward especially were very much above the average for the season."

The full explanation of his views and their extension to the October cyclones of the Bay of Bengal is given by Mr. Willson in his report on the Midnapore cyclone. The following extract will suffice to show its nature:—

"It appears to me that the theory of opposite currents, perhaps slightly modified in accordance with local circumstances, would account for the formation of this cyclone, as well as the local depression theory. The winds were N.E. over all the Bay north of latitude 17°, and W.S.W. south of latitude 15°. It seems therefore not improbable that long before the N.E. surface wind commences to blow with any strength, there is an upper N.E. current from the region of high pressure to the region of relatively low pressure. This current is drier, colder, and heavier than the opposing damp W.S.W. current, which must therefore be forced upwards along the belt where the winds collide and where the N.E. current descends. The W.S.W. current appears to be always the more powerful of the two. This fact is explained in the present instance by the high

pressure at Nancowry compared with the pressure over Bengal. However, it would seem probable that a very gentle N.E. current, or even a calm dense atmosphere would be sufficient to check and force upwards the powerful but less dense W.S.W. monsoon, thereby producing the enormous precipitation of moisture which is always observed near the place of the origin of a cyclone, and which probably plays a very important part in its formation. As the precipitation of moisture continues, the atmospheric pressure diminishes along the head of the W.S.W. monsoon. The north-easterly current hence becomes more vigorous, and gradually extends northwards as a strong surface-wind. Ultimately the N.E. current becomes sufficiently powerful to generate the cyclone. The above is a short sketch of how it appears to me the theory of opposite currents may be applied to account for the formation of the cyclones of the Bay of Bengal."

Mr. Blanford's theory is given briefly in an appendix to his paper on "The winds of Northern India." It is what has been termed the local depression theory. A calm state of the atmosphere, or one in which the winds are light and variable over the open sea, is the first condition favourable to the production of cyclones. The second condition is a high or moderately high temperature. The consequence of this combination of conditions will be the production and ascent of a large quantity of vapour, which will be condensed with the liberation of its latent heat over the area of its production, instead of its being carried away to some distant origin. If this state of things last for some days, the atmospheric pressure will be locally lowered, causing, or tending to cause, an indraught of air towards the place of minimum pressure. One further condition appears to be essential. The actual formation is finally determined by the inrush of a saturated stormy current from the S.W. or W.S.W.

CHAPTER II.—METEOROLOGY OF NORTHERN INDIA AND THE BAY OF BENGAL FROM 10th OCTOBER TO 31st OCTOBER.

THE easterly winds which prevailed in Upper India after the breaking up of the Vizagapatam cyclone continued until the 18th or 19th, gradually decreasing in force. They were accompanied by rainfall over the whole of Upper India, from Bengal westwards to the Punjab. The rainfall over the Bay of Bengal, judging from the returns of Port Blair, Nancowry, and the coast stations, was during this period very slight.

The barometer, which before and during the breaking up of the Vizagapatam cyclone had been abnormally low, rose rapidly on the 11th, 12th, and 13th, and during the next 10 days was from '1" to '13" above the average. The causes of these variations of pressure of long period are as yet very imperfectly known. They are intimately connected with oscillations of temperature, the changes of one, when the variations in the amount of aqueous vapour in the air are small, being inverse to the other—that is, a continuous fall of the mean daily temperature is associated with a continuous rise of the barometer, and *vice versa*. The temperature of Upper India after the Vizagapatam cyclone was very considerably below the average, falling rapidly from the 10th.

The following tables illustrate the two facts of diminished air temperature and increased atmospheric pressure over Northern India at this time:—

Stations.	Mean Pressure, 10th to 20th October.		Mean Pressure, 10th to 20th October 1876.	Variation from Mean.
	Years.	Average.		
Roorkee - - - - -	17	28·924	29·037	+·113
Agra - - - - -	17	29·254	·355	+·101
Lucknow - - - - -	17	·437	·552	+·115
Benares - - - - -	17	·578	·651	+·073
Patna - - - - -	8	·688	·746	+·058
Calcutta - - - - -	8	·834	·919	+·085
Sibsagar - - - - -	3	·569	·654	+·085
Akyab - - - - -	8	·828	·954	+·125
Port Blair - - - - -	9	·746	·895	+·149
Madras - - - - -	7	·827	·925	+·098

Stations.	Mean Temperature, 10th to 20th October.		Mean Temperature, 10th to 20th October 1876	Variation from Mean.
	Years.	Average.		
Roorkee - - - - -	17	76·2	71·6	-4·6°
Agra - - - - -	17	82·1	75·3	-6·8°
Lucknow - - - - -	17	79·7	74·3	-5·4°
Benares - - - - -	17	80·8	76·5	-4·3°
Patna - - - - -	8	80·1	75·9	-4·2°
Calcutta - - - - -	8	82·2	80·3	-1·9°
Sibsagar - - - - -	3	76·8	72·6	-4·2°
Akyab - - - - -	8	81·5	80·2	-1·3°
Port Blair - - - - -	9	79·8	80·7	+·9°
Madras - - - - -	7	78·6	83·1	+4·5°

The humidity, more especially in the North-West Provinces, was above the average. The last rainfall in these provinces and in Behar was on the 18th and 19th, after which the dry cool weather which follows the rains set in. The wind direction and velocity during this period show the prolonged intrusion of the monsoon current in Upper India. The easterly and south-easterly winds which were prevalent over the Gangetic Valley from the 10th gradually diminished in intensity until the 19th, when they were succeeded by the cold-weather opposite current. But during the period of transition from the 19th to the 21st of the month there was a condition of calm and almost perfect atmospheric equilibrium over the whole of the Bay of Bengal and Northern India. The wind velocity at a number of stations for these two days is given in the following table:—

Stations.	Wind Velocity.		Average daily Wind Velocity.			
	19th October 1876.	20th October 1876.	Months of July, August, and September.		Months of October, November, December, and January.	
			Years.		Years.	
Roorkee - - - - -	31·1	26·2	4—5	65·5	5	35·5
Lucknow - - - - -	53·0	41·0	3	76·6	4	39·2
Patna - - - - -	44·2	39·2	4—5	93·7	5	55·9
Calcutta - - - - -	44·4	68·3	8	103·4	6—8	91·4
Sagar Island - - - - -	105·0	114·5	5	253·4	4—5	124·9
Madras - - - - -	109·0	179·0	5	225·1	5	191·5
Nancowry - - - - -	7·3	42·7	3	290·5	2—3	190·2
Akyab - - - - -	41·0	39·0	4	72·1	3—4	57·3
Dacca - - - - -	30·3	48·0	7	152·7	7	49·5
Sibsagar - - - - -	31·0	41·4	2	73·9	2	40·9

The meteorological features of Northern India and the Bay were consequently at this time very simple and clearly marked. Increased atmospheric pressure (from '1" to '15" above the average) and diminished temperature over the greater part of the land area accompanied the almost quiescent state of the atmosphere which characterised the period of transition from the south-west to the north-east monsoon. What is, however, more important in the discussion of the causes of the cyclone is the near approach to equality of pressure over the whole of this area at this time. Thus on the 20th the barometric difference between Nancowry and Madras was only '011", between Nancowry and Sagar Island '021", and between Nancowry and Roorkee (a distance of 1,700 miles) only '047". These differences are so small that, if the moving mass between the two last stations were water instead of air, it would be equivalent to a difference of pressure spread over the interval of 1,700 miles of $\frac{1}{40}$ of a lb. on the square inch, or a head of '6 inches. Even taking into account the small density of air, the reversion of the current at this change of the monsoons over India and the Bay of Bengal cannot be primarily assigned to the small differences of pressure which actually existed within the geographical limits of India.

So far then as our meteorological knowledge goes, there was at this period as near an approach to an almost perfect equilibrium of meteorological conditions and actions over a large area as probably ever obtains. At such a time, as I have already indicated in the discussion on the Vizagapatam cyclone, if the conditions are such as to favour the gradual retreat of the south-west monsoon southwards, and the establishment of the north-east trade wind over India, the formation of a cyclone and its advance northwards or

north-westwards is impossible. If, however, the pressure is high to the south of the Bay of Bengal, from the existence of any of the various causes which might produce excessive pressure near the equator, the south-west monsoon will continue to prevail in the lower portion of the Bay, and the formation of a cyclone becomes not merely possible, but certain, if the conditions last long enough.

In the former case of the establishment of the north-east trade wind over the whole of the Bay, the vast quantities of aqueous vapour produced by evaporation are carried away to the south-west, to give rain to the Madras coast, Southern India, and other regions further south. In the latter the aqueous vapour due to evaporation in the Bay has no horizontal outlet, the north-east and south-west winds on opposite coasts indicating that at this time the atmosphere is in the condition of a land-locked area; hence the only possible motion of the vapour is that of vertical ascent or expansion. There thus commences almost immediately a vertical current, or an expansion followed by condensation and rainfall, over the area of production. The holding off the rains during this month along the Coromandel coast favours this assumption in the present instance. The rainfall at Madras for the month was 1·04", of which only ·4" fell during the last fortnight. The average rainfall for the month during the period 1822-1843 was 10·09".

The high pressure to the south of the Bay which accompanied the continuance of the south-west monsoon in the south of the Bay is indicated by the logs of three vessels. The captain of the "Tennyson" states that from the equator to latitude 10° N. he had light baffling winds, with a high barometer. Captain Piton, commander of the ship "Lightning," in his remarks, says that he crossed the equator on the 12th, and advanced very slowly northwards, reaching latitude 9° 17' N. on the 23rd; and that during this interval he experienced very light winds and calms, with showers of rain and hot sultry weather, the sun being so hot as to boil the pitch out of the seams of the deck. The "City of Venice" passed round Ceylon on the 26th. Her log from the 21st shows that in the Arabian Sea, in the same latitudes as Port Blair and Nancowry, the pressure was unusually high, and that the weather up to the 25th was fine and clear, with light breezes. On the 25th, to the west of Ceylon she had variable and light winds with unsettled weather, showing the transition from the region of high pressure and fine weather on the south and west to the area of disturbance in the Bay of Bengal.

These extracts from the logs of the three vessels seem to be sufficient evidence to establish generally the fact of an excess of pressure, due to some unknown action, at and near the equator. It is further confirmed by the returns from the Ceylon stations, which show that the pressure over the island was on the 19th and following days from ·06" to ·09" above the average. This excess of pressure, usually not large in amount, north and south of the area of cyclone generation prior to the formation of a cyclone was pointed out by Mr. Willson as a marked feature of the Midnapore cyclone, and by Mr. Blanford as accompanying the barometric depression in the Bay which preceded the Calcutta cyclone of 1867.

I shall now proceed to discuss the meteorology of the Bay and Upper India day by day, with the aid of the small charts (Plate II.) These give the isobars either for the day, as in the case of the charts from the 20th to 29th, or for the actual hour of observation indicated on the charts, as in the case of the 30th, 31st, and 1st, together with synchronous wind observations at the various observing stations at 10 a.m. in the case of the charts up to the 29th, and after that day of the hour named on the chart. The wind directions in various parts of the Bay are derived from the logs of the vessels traversing the Bay and given *in extenso* in the preceding chapter.

October 20th.—The isobars in the chart for this day indicate, what has been already pointed out, the near approach to equilibrium of pressure over the whole of this region. The winds generally show the usual cold-weather direction, the motion of the air being from Upper India to the Bay, over which there was a gentle flow to the south or south-west.

October 21st.—The isobar of 30·00 had during the previous 24 hours advanced down the Gangetic Plain as far as the great bend of the Ganges, but retreated slightly from the Orissa coast. The pressure in the centre and south of the Bay of Bengal was diminishing during the day. The decrease at Port Blair and Nancowry was ·035" and at Vizagapatam ·024". In Ceylon the pressure on the western coast was slightly greater than on the preceding day, and on the eastern coast at Trincomalee it was ·046" less. The most important circumstance connected with this decrease of pressure was the re-establishment of south-westerly winds at Nancowry; and along the coast from Chittagong to Vizagapatam the easterly element of the wind became more strongly

marked. There was thus around the coast a tendency to a cyclonic motion of the air. The wind velocity, however, continued to be very small, averaging from two to four miles an hour, and was greatest at the embouchure of the Ganges, where the currents down the Assam and Gangetic valleys passed seawards. Also, with the re-establishment of the south-westerly current and its extension northwards began a period of almost continuous drizzling rain at Nancowry, Port Blair, and Ceylon.

October 22nd.—The chart for this day gives the isobars of mean pressure and the wind directions at 10 a.m. In Upper India and the northern half of the Bay the atmospheric state was almost identical with that of the previous day, whilst in the south of the Bay the pressure continued to diminish. At Port Blair the mean pressure for the 22nd was '022' less than that of the 21st, whilst at Nancowry it had fallen '016.' The pressure at Port Blair was now '010' less than Nancowry. This is the first evidence of the commencement of an area of barometric depression to the north-west of Nancowry, which became more and more intense during the next five or six days, and from which the cyclone of the 30th and 31st had its origin. The pressure in Ceylon increased during the day, and it was now from '05' to '09' above the average. The wind velocity in Upper India and along the western coast and in Ceylon was very small. At Nancowry during this and the next three days it increased from an average of $1\frac{1}{2}$ miles to 3 miles per hour.

October 23rd.—The isobars for this day show a slight increase of pressure in Northern India, the isobar of 30.00 having advanced almost parallel to its former direction, 120 miles to the eastward, during the preceding 24 hours. The isobar of 29.95, as on the previous day, ran across the Bay from Akyab to Madras. In the south of the Bay the decrease of pressure continued. The fall during the preceding 24 hours at Port Blair was '019' and at Nancowry '022'. It was, however, still slightly in excess at the latter station. The diminution of pressure over the island of Ceylon averaged '025'. Thus the area of low pressure still occupied the same position as on the previous day, the baric difference between its centre and Northern India being now considerable, probably '15'. The wind directions present no new features, except at Port Blair and Nancowry, where they show a tendency towards a cyclonic movement round the area of low pressure.

October 24th.—The chart for this day shows the continuation of the increase of pressure in Northern India. The isobar of 30.00 had advanced still further eastwards and included a small portion of the deltaic area. The pressure over the whole of Upper India was now very largely in excess of its normal amount. The position of the isobar of 29.95 was almost identical with its position on the previous days, the 22nd and 23rd. In the south-east of the Bay there was a slight increase of pressure, which was greater at Port Blair than at Nancowry. The mean pressure was also now very slightly greater at Port Blair, but the continuation of the same winds as on the previous day indicates clearly the persistence of the area of depression to the north-west of Nancowry, and the gradual development of a cyclonic movement of the air round this area.

October 25th.—The pressure during the day diminished slightly over the whole of Bengal and Northern India, the isobar of 30.00 now running north-west and south-east from False Point to Patna. The isobar of 29.95 occupied the same position as on the previous days, being a sort of fulcrum, about which the changes of pressure were taking place. The pressure at Port Blair fell '008, whilst at Nancowry it was increasing. Judging from this and the wind direction at Port Blair and the distribution of pressure on the succeeding days, it is probable that the area of barometric depression had now begun to extend or advance northwards. At all the Ceylon stations, except Trincomalee, there was a slight increase of pressure. Up to this date the north-easterly winds along the west coast of the Bay extended as far south as Ceylon. The wind velocity at the stations along the coast and in Ceylon and Upper India showed the continuance of very moderate breezes up to the evening of this day. The log of the "Tennyson," which was passing up the Bay, throws some light on the meteorology of the centre of the Bay and the region of diminishing pressure to the north-west of Nancowry. She had light winds from the west and a steady barometer until the 26th, when she was in latitude 13° , and after that date light breezes and a clear sky until the 29th, when she was overtaken by the cyclone, which had formed in the area over which she had passed three or four days previously. The "Lightning" passing over this area on the 23rd and 24th, had very hot, but fine weather, with very light winds and occasional showers. The barometers of these vessels have not been compared with the Calcutta standard, but from a rough comparison of their readings when the vessels were passing up the river to Calcutta with the Sagar Island and Calcutta barometers, it is probable that

at this period the lowest pressure in the Bay was to the north-west of Nancowry, and was not below 29·85". The "Forfarshire" was in latitude 11° 30' N. and longitude 90° 30' E. at noon of this day. The reading of her barometer at that hour corrected to the Calcutta standard was 27·879, and on the 28th at noon, when in latitude 18° 30', it was 29·829. This, and the fact that no fall of the barometer is noticed in her log, seem to establish conclusively that over the central area the pressure was as yet very slightly less than around the coast, and that its diminution was proceeding at a comparatively slow rate.

October 26th.—The chart of this day presents a continuation of the changes which began on the previous day. The atmospheric pressure was still diminishing over Northern India. It was now less than 30·00" over the whole of India, except in the eastern part of Assam and to the west of Bareilly and Meerut in the North-West Provinces, and Punjab. The isobar of 29·95 had also advanced to the west, and now passed through Dacca, to the east of Sagar Island, across the north-western angle of the Bay, meeting the coast again probably midway between Vizagapatam and Madras. In the south of the Bay the pressure at Port Blair continued to indicate diminishing pressure over the adjacent sea area. The fall at Port Blair during the preceding 24 hours had been ·015". This continued gradual diminution of pressure is partially confirmed by the statement of the captain of the "Tennyson" (advancing northwards about 250 miles to the westward of the Andamans) that his barometer fell on this day two-tenths of an inch. The wind directions at Nancowry (which had now changed from south-west to south-east), at Port Blair, and of the ship "Tennyson," now define the area of diminishing pressure more exactly. The centre was probably about 180 miles to the north-west of Nancowry, and the lowest pressure probably still exceeded 29·75. To the north and west of this area the winds were undoubtedly north and north-east (as shown by the log of the "Tennyson"), the weather fine and sky unclouded, whilst on the east and south-east the winds were south, south-east, and east, and accompanied with continuous rainfall. In Ceylon the easterly element in the wind during the previous five days began to be replaced by a westerly element, indicating the transition from the north-east winds to westerly and south-westerly winds, which were fully established on the following day over the island. The returns of Port Blair and Nancowry and the Ceylon stations and the log of the "Tennyson" seem to establish the fact that the rainfall was not as yet excessive. The rainfall at Port Blair for this day was ·71" and at Nancowry ·75". This was, however, the first day since the 10th on which rain in any considerable amount had fallen at these two stations. The character of the wind was now, however, rapidly changing. Hitherto there had been moderate winds with slight drizzling rain. The wind velocity at Nancowry, which had been 64·0 miles on the 25th (or 2·5 miles per hour) and 48 miles on the 24th, increased on this day to 254·1 miles, giving an average of 10·6 miles per hour. This sudden increase evidently indicates a powerful indraught of saturated air from the south into the region of low pressure. The "City of Venice" was at this time passing along the southern and eastern coasts of Ceylon, and experienced light breezes and heavy rain, with occasional squalls and unsettled weather. The wind velocities for the day at the Ceylon stations indicate the same fact, that in the south-west of the Bay the winds were very moderate, and indicated as yet no violent inrush from this direction.

October 27th.—The chart shows a very general decrease of pressure from the preceding day, averaging in amount over the whole of Northern India from ·04" to ·05", and in Eastern Bengal ·025". The isobar of 29·95' now passes in a very curved line from False Point to Berhampore, and thence westward to Allahabad; whilst the isobar of 29·90" occupies the same position as that of 29·95" did on the 24th and 25th, running across the Bay between Akyab and Madras. The isobar of 29·85 encloses an area to the north-west of Nancowry, and marks the persistence of the area of diminishing pressure. The meteorology of this portion of the Bay is now partially illustrated by the logs of five vessels—the "Empire of Peace" and "British Sceptre," which were on the south-east, the "Arabia" in the centre, the "Tennyson" on the north, and the "City of Venice" on the south-west of the area.

The "Empire of Peace" and "British Sceptre" were running north along the meridian of 92°, and were within a few miles from each other on this and the following days; the "British Sceptre" experienced strong breezes during the day and a deluge of rain; whilst the "Empire of Peace" reports thick cloudy weather with much rain, the wind varying from south-west to south-south-west. The rainfall at Nancowry (120 miles to the S.E. of these vessels at noon) was ·88 inches, and at Port Blair 1·92 inches. There was thus during the day heavy rainfall on the south and east quadrants of the area of diminishing pressure. The returns of Port Blair and Nancowry on this and the

following days suggest a considerable, but not an excessive rainfall (accompanied with a strong wind) over the whole of this area. Probably the rainfall at no part of it exceeded two or three inches, and the expression "a deluge of rain" must be taken as descriptive rather of an irregular intermittent violent rainfall than of one abnormally excessive in amount. The "Arabia," almost due east of Port Blair at noon, and advancing northwards to Calcutta along the meridian of 89° , had constant rain during the day, with a gradual change of wind direction from west through south to south-south-east, as she progressed northwards. The corrected reading of her barometer at noon was 29.512. She was in the same latitude, but at some distance further west than the "Forfarshire" was on the 25th, when the corrected reading of her barometer was 29.829. A considerable diminution of pressure had therefore taken place over this area during this interval. During the morning she experienced two squalls from the north-east, showing the commencement of the rapid indraught of air on the northern side of the region of diminishing pressure. The logs of the "Tennyson" and "Forfarshire," in latitude 16° and some distance north of the "Arabia," show the continuation there of the north-east monsoon, with clear weather and a steady moderate breeze. The wind velocities of the coast stations present little change from the 20th, and furnish no evidence of any extensive indraught to the centre or south of the Bay. At Nancowry the velocity was in excess of the previous day, 310.8 miles being registered during the day. This proves the continued indraught into the region of depression, and also what is important, that its centre was still at no great distance from Nancowry, and that it had probably not moved northwards to any considerable distance during the preceding 24 hours. There was a very slight increase in the wind velocities of the Southern Ceylon stations. Some of the wind directions in Northern India seem to be anomalous, but they probably indicate local winds, due to small differences of the pressure, or to slightly different atmospheric conditions over limited areas, and confirm the existence and continuation of the condition of almost uniform atmospheric pressure over the land area.

October 28th.—The chart for this day shows a further diminution of pressure over the whole area north of Nancowry, where the mean pressure was the same as on previous day. The isobar of 29.95 has again advanced up the Gangetic valley, and runs between Lucknow and Agra on one side and Allahabad on the other. The isobar of 29.90 crosses the head of the Bay from Chittagong to the coast south of Vizagapatam. The pressure at Ayab and Chittagong were on this day relatively very low to the adjacent coast stations. The pressure at Port Blair was .022" less than on the previous day. This and the readings of the barometer on board the "Arabia" on the previous day prove that the diminution of pressure was now proceeding at a more rapid rate over the area of diminishing pressure to the north-west of the Nicobars and west of the Andamans. The corrected reading of the "Arabia's" barometer at noon of this day was 29.551" (.039" higher than on the previous day, indicating that she was then advancing more rapidly northwards than the extension of the area of barometric depression). The pressure along the west coast of Ceylon was still above the average, whilst the variations were small in amount. Along the east and south coast the changes were much larger. The range of the mean barometric pressure at Colombo from the 20th to the 31st was only .09", whilst at Trincomalee it was .16".

The wind to the south of Ceylon was almost due west, at Nancowry south-west, and at Port Blair and to the west of it, as shown by the logs of the "Allahabad," "Empire of Peace," and "British Sceptre," all within a few miles from each other, south-south-east. The logs of the "Tennyson" and "Forfarshire" state that at the head of the Bay the wind was north-east, and the "City of Venice," to the west of the area of depression, that it was there north-north-east. Thus there was a decided cyclonic circulation round the area of diminishing pressure. The "Arabia," nearest the centre, had squalls from the S.E., a high sea and constant rain.

The rainfall at Port Blair and Nancowry during the day was not large in amount; .34 inches were recorded at Port Blair, and .14 at Nancowry. The ship "British Sceptre" reports torrents of rain, alternately warm and cold; the "Empire of Peace," strong breezes with much rain; and the "Allahabad," constant rain with very heavy squalls. These vessels were all to the west of the Andamans on this day. The steamer "Japan," passing along the east coast of Ceylon, reports squally winds from the west, with light rain. The log of the "City of Venice" for this and the following day is especially interesting, as it shows the gradual change of the weather which

preceded and accompanied the formation of the cyclone. Early in the morning there were frequent squalls of wind and rain, attended with vivid lightning and heavy thunder. At noon there was a fresh breeze with heavy squalls of wind and rain and a confused sea. At 8 p.m. there was a fresh gale with heavy squalls and a high cross sea, whilst at midnight there were hard squalls with bad looking weather. The "City of Venice" was during the day to the south-west and west of the centre of the area of low barometer. The "Tennyson" and "Forfarshire," in latitude 18° N., state that the weather became gradually unsettled during the day, and that a swell set in from the southward which gradually increased in strength. These facts all tend to prove that the area of low barometer and diminishing pressure was extending northwards, that the amount of the depression was steadily increasing, and that over this region of diminishing pressure the weather was rapidly becoming worse; whilst the wind directions and the frequency of squalls show that the disturbance was also acquiring all the characteristics of an extensive and violent cyclone.

The amount of wind registered at Nancowry during the day was only 29.9 miles, confirming the supposition that the centre of the area of depression had advanced considerably to the northwards during the preceding 24 hours. The wind velocity at all the coast stations, including Madras, was very small on this day, giving no indication whatever of the violent squalls in the mid bay. The wind returns for Galle, Colombo, and Trincomalee show a slight increase of the velocity of the westerly indraught to the region of low pressure.

October 29th.—The chart for this day indicates that a considerable change had taken place in the distribution of pressure in Northern India, over the whole of which it had increased by amounts varying from .03" to .05".

The isobar of 29.95 is now parallel to the head of the Bay, and at a distance of 150 miles from it. The isobar of 29.90 runs to the south of Akyab and Chittagong, showing increase of pressure at the north-eastern angle of the Bay, whilst it has advanced on the opposite coast as far north as False Point.

The isobar of 29.80 includes a closed area occupying the greater part of the Bay, the centre of which continued to be a region of steadily diminishing pressure. The pressure at Port Blair and Nancowry was .015 higher than on the preceding day. The centre of this area of depression and atmospheric disturbance, which was increasing by northward extension, as well as by the slow advance of the centre northwards, was on the afternoon of this day probably almost due west of Port Blair. The wind directions given in the chart for 10 a.m. indicate clearly the position of this area and its centre.

The corrected reading of the barometer of the "Arabia" at noon is 29.45. The barometers of the other ships within the disturbed area all indicate decrease of pressure, but do not afford sufficient data to determine the minimum pressure at this period.

The rainfall at Nancowry and Port Blair was still moderate in amount.

The ship "British Sceptre" reports torrents of rain and hard squalls; the "Empire of Peace," thick rainy weather; and the "Allahabad," constant rain with very heavy squalls. These vessels were on the north-eastern quadrant of the advancing storm and incipient cyclone. The "City of Venice," in latitude 14° N. and longitude $85^{\circ} 30'$ E., was advancing north with the storm during the early part of the day, and was in the north-western quadrant. She experienced early in the morning a moderate gale with continuous rain, and a high cross sea from the east. At noon the gale was increasing, blowing in hard squalls. The ship was reduced to half speed at 2 p.m. At 4 p.m. and during the remainder of the day the wind blew a hard gale with furious squalls from north-east and north-north-east, and rain, whilst the sea became more and more confused, causing the ship to labour and pitch heavily. The log of the "Arabia," which was in latitude $14^{\circ} 19'$ N. and longitude $89^{\circ} 30'$ E. at noon, confirms the evidence of the "City of Venice." She had during the day gloomy weather, a violent wind with strong squalls at intervals, and torrential rain. The atmospheric disturbance was thus rapidly intensifying and developing into a cyclone.

The "Tennyson," "Forfarshire," and "Lightning," were all approaching the mouth of the Hooghly, and experienced the gradual northward extension of the disturbance. The "Tennyson," farthest to the south and in latitude $18^{\circ} 20'$ N. at noon, had early in the morning squalls from the east with rain. The weather during the day became worse, and the swell from the south increased and rolled up heavily. The "Forfarshire" and "Lightning," 80 miles further north, had fair weather in the morning with a moderate breeze, but it changed rapidly during the afternoon, becoming unsettled and

squally with rain. At Madras there was calm clear weather. The steamer "Japan," 200 miles to the south-east, had a strong west-north-west wind during the day, cloudy weather with squalls, whilst towards evening there was every appearance of a gale.

The evidence furnished by the logs of the vessels, combined with the observations at the observatories at Port Blair, Nancowry, and the coast stations, establish clearly that the change from the larger and more general disturbance over the greater portion of the Bay and its intensification and development to a cyclone, took place during the afternoon and evening of the 29th and morning of the 30th. This change, moreover, was a mere expansion or development due to the continuance and insistency of the very same causes which had produced the diminishing pressure over the mild Bay, and not to the sudden inrush of a strong current from any neighbouring region south or north. The history of the advance of the cyclone from the morning of the 30th until its final breaking up amongst the Tipperah Hills is given in separate sections.

The following gives briefly the meteorology of the land area to the north of the Bay during the advance of the cyclone on the 30th and 31st up the Bay to the estuary of the Megna :—

October 30th and 31st.—The charts for these days give the synchronous (corrected and reduced) barometer readings and wind directions at the various observing stations, and illustrate the rapid changes of pressure round the coast and in Bengal due to the advancing cyclone. The probable position of the vortex is shown on each chart by a small circle.

The wind directions show clearly the general cyclonic character of the winds at this time over the whole of the Bay of Bengal and Northern India. The wind velocity in the North-West Provinces and Behar was on the 30th small in amount, averaging from half a mile per hour to $2\frac{1}{2}$ miles. It was increasing rapidly at False Point, 161·5 miles being registered. The wind velocity at Sagar Island showed a slight decrease from the previous day. At the land stations in Bengal and Assam there was a slight increase. The wind returns of False Point alone distinctly showed the approach of the cyclone.

The humidity and amount of aqueous vapour in the air increased considerably during the day, and a slight rainfall after a break of nine days occurred in the Burdwan Presidency, Dacca, and Chittagong Divisions, and on the coast of Orissa and in Assam. In Behar the sky was slightly clouded.

The wind velocities in the North-West Provinces and Behar on the 31st were almost identical with those of the previous day, and indicated very gentle breezes over this part of India. The number of miles registered at False Point was 232·2, and at Sagar Island 527·6, an average of 22 miles per hour. The returns of all the stations round and near the coast of Bengal show increasing velocity of the wind with the approach of the cyclone. The humidity was high during the day, and slight showers of rainfall occurred over the same districts as on the previous day. In no case, however, was the rainfall at all large in amount, the only rainfall exceeding an inch occurred at Khoohna, in the Jessore district. The rainfall at Nancowry on the 30th was 0·53", and on the 31st 0·32". For the same two days at Port Blair it was 1·38" and 0·31" respectively.

The pressure diminished over the whole of Ceylon on the 30th by amounts varying from ·009" to ·061", the fall being greatest at Colombo. It increased on the 31st at all stations except along the north-east. The wind during this period was from the west and south-west, the velocity at the coast stations showing a slight increase on the 31st. The greatest amount was recorded at Galle on the 31st, when 257·5 miles were registered.

CHAPTER III.—THE PATH OF THE CYCLONE IN THE BAY OF BENGAL.

The preceding section has shown that from the 21st a state of circumstances such as I conceive to be favourable to the formation of a cyclone had prevailed over the Bay. There was great uniformity of pressure on that date over the whole of the Bay, whilst the moderate north-east and south-west winds which were blowing on opposite sides of it prevented the dispersion of the aqueous vapour in the lower atmospheric strata towards the neighbouring regions, more especially the land area of Southern India. This had been followed from the 23rd by the formation of a region of diminishing pressure in the Bay to the north-west of the Nicobars, and by rapid condensation of vapour over that part of the area of evaporation which was to the south and south-east of the centre of the region of barometric depression. This state of things continued, and gradually intensified

in character; the weather became more unsettled and squally, the rainfall on the south-eastern quadrant increased, whilst a strong indraught set in from the south-west on the 27th and 28th, and a weaker indraught on the north. These are all proofs that the area of diminishing pressure gradually extended northwards, and that the amount of the depression increased, at first slowly, and afterwards with accelerating rapidity, owing to the prolonged persistence of the causes and the accumulation of the effects. The centre of the area of depression was probably in latitude 10° N. and longitude 89° E. on the 27th, and was then moving very slowly northwards. It was in latitude 13° N. and longitude 89° E. at noon of the 29th. There was a gale, cyclonic in its character, on this day in the area of depression, but the true cyclone appears to have been the further concentration of this cyclonic motion on the evening of the 29th and morning of the 30th. All the circumstances which had favoured the formation of the cyclonic disturbance up to the 29th still continued, and it is probable that the true cyclone, although formed on the evening of the 29th, did not acquire its full intensity until the afternoon of the 30th.

The S.S. "Japan," on the evening of the 29th, in latitude 11° N. and longitude 84° E., experienced a moderate gale and squally weather with heavy rain. She was at this time running parallel to the path of the cyclonic disturbance. The slight changes of wind (west-north-west to west) show that she was in the south-western quadrant at a very considerable distance from the centre. During the early part of the morning of the 30th she apparently was advancing northwards more rapidly than the cyclone, and approaching it, for at 7 a.m. the gale was freshening and the ship labouring from the heavy confused sea. There was also a very heavy bank of clouds forming to the north and north-east. The engines were then eased to dead slow until 5.30 p.m., during which the gale gradually moderated. They were again set at full speed at 6.30 p.m. The ship was now well in the rear of the storm, and the weather slowly improved. The "Japan" was probably nearest the centre at noon of the 30th, when in latitude $12^{\circ} 9'$ N. and longitude $85^{\circ} 30'$ E., but the very slight fall of the barometer during the previous 36 hours show that she was at a very considerable distance from the vortex. The centre was then to the north-east, and probably at a distance of 270 miles. This would give its position at noon of the 30th as in latitude $14^{\circ} 30'$ and longitude $89^{\circ} 15'$.

The log of the S.S. "City of Venice" shows that she was within the outer limits of the area of cyclonic disturbance on the evening of the 29th and the morning of the 30th. At midnight of the 29th she was steaming very slowly north (in latitude $14^{\circ} 40'$ N. and longitude $85^{\circ} 35'$ E.) amidst a hard gale, the force of which varied from 7 to 9, with fierce squalls of rain and spray. At 9.20 a.m. of the 30th the weather was so threatening that the ship's head was turned to the south-west for several hours, and she rapidly passed away from the cyclonic area. At 2.30 p.m. the ship was brought to and turned to the north-east. She then advanced almost parallel to the path of the cyclone, and continued for the remainder of the day in its outer limits. The changes of the wind and the barometric readings indicate that she was nearest the centre at midday of the 30th. The vortex was at this time probably almost due east, and in latitude $14^{\circ} 30'$ and longitude $89^{\circ} 10'$, assuming, from the amount of the fall of the barometer, that the vessel was 210 miles from the centre. The logs of these two vessels thus give approximate positions for the centre substantially agreeing with and confirming each other.

The S.S. "Penang" is the next vessel in order of time which was involved in the cyclone. She was steaming southwards, having left Calcutta on the 28th, and was rapidly approaching the cyclone on the 30th, experiencing rough weather during the greater part of the day. The wind increased rapidly during the evening. The sea broke over the vessel, washed away the starboard cutter, and burst open the starboard saloon door, flooding the saloon with water early in the evening at 8 p.m. The barometer continued to fall until 4 a.m. of the 31st, from which to 7.30 a.m. it varied very little. At 7.30 a.m. the whole of the front of the saloon was stove in, and the ship lay like a log, with the saloon full of water, whilst the sea continued to break over her and reduced her to a perfect wreck on deck. The weather began to moderate from this time, and the cyclone passed on, leaving the "Penang" in so disabled a state as to be compelled to return to Calcutta. Her position at the worst of the cyclone is stated in the log to have been $17^{\circ} 30'$ N. and $86^{\circ} 50'$ E. If this position is correct, the position of the vortex can be approximately ascertained on the morning of the 31st. As no readings of the barometer are given for the day on which the "Penang" left Calcutta, it is impossible to ascertain even roughly whether the instrument was comparable with the Calcutta standard, or what its error was. The slight fall of her barometer from 2.30 a.m. of the 30th to 4 a.m. of the 31st ($.18''$) shows that she was at least 150 to 160 miles distant from the vortex, which was therefore in latitude $17^{\circ} 45'$ N. and

longitude $89^{\circ} 13' E.$ at 7.30 a.m. of the 31st. This would give an average rate of advance from midday of the 30th of nearly nine miles per hour.

The "Scottish Chieftain" arrived at the head of the Bay on the 29th, and was unable to obtain a pilot on account of the heavy sea. She stood off to the south-east on the 30th. The gale increased rapidly in violence; the reading of the barometer at midnight, corrected to Calcutta, was 29.578. The wind at this time came from north-east. The barometer fell very quickly from midnight to 3 a.m. of the 31st, when the corrected reading was 29.161. The vessel was then in the north-western quadrant, and stood off to the south-west to avoid the centre. From 4 a.m. the wind blew in terrific squalls accompanied with constant rain, and at 10 a.m. was blowing a hurricane from the north. Shortly after this, at 11.30 a.m., it was found necessary to cut away the fore-topmast backstays, when the fore-topmast went over, carrying with it the main-topmast, mizzen, and top-gallant masts. The barometer at midday fell to 28.962, about which time the centre of the cyclone was passing to the east of the vessel, probably in latitude $18^{\circ} N.$ and longitude $89^{\circ} E.$ The wind at 4 p.m. was from north-north-west, and the barometer rising; the wind backed to the west at 8 p.m., after which the weather rapidly moderated. In this case, as in the logs of the pilot vessels, the "Foam" and "Coleroon," no latitude observations were taken during the storm, and hence their logs are mainly useful in confirming the path assigned to the cyclone from the logs of other vessels.

The log of the "Tennyson" gives the next position of the centre of the cyclone in order of time. She was proceeding towards the mouth of the Hooghly along the meridian of 89° , and was overtaken by the cyclone late on the evening of the 30th. The fall of the barometer up to the afternoon of the 30th had been so slight as to give no indication of the impending cyclone. The increasing swell from the south and the threatening appearance of the sky were the first signs of its approach. The wind was strong during the whole day from east-north-east, and at 10 p.m. began to blow in furious gusts. This was followed by rain in torrents for an hour, succeeded by a few minutes' calm, during which the confused sea was tumbling about in heaps in all directions. The first burst of the cyclone passed over the vessel with a roar like thunder, throwing the ship on her beam-ends until the first rush was past, when she righted. The barometer at midnight stood at 29.6, and fell rapidly with the advance of the cyclone until 1.30 p.m. of the 30th, when it was 28.15. During the earlier part of the cyclone, when the wind was comparatively steady, the "Tennyson" suffered very little damage from the heavy sea; but on the near approach of the vortex, with the more rapid changes of wind and the confused sea, the sails were torn from the gaskets, the ballast shifted, and the vessel thrown on to her beam-ends, the sea washing over her and sweeping off everything on deck. As no mention is made of any prolonged interval of calm during the cyclone, the great fall of the barometer indicates that the vessel was from 15 to 20 miles distant from the central area of calm, which, judging from the changes of wind direction, must have been to the east of the ship. From the assigned positions of the vessel at noon of the 30th and on the 1st the vortex of the storm was very approximately in latitude $18^{\circ} 45' N.$ and longitude $89^{\circ} 25' E.$ at 1 p.m. of the 31st. This would give an average rate of advance of nearly 12 miles during the preceding six hours, so that the velocity of the vortex was increasing as it advanced northwards.

The "Annie Fleming," "Forfarshire," and "Lightning" were near the vortex at 4 p.m.

The "Annie Fleming" was in the neighbourhood of the Eastern Channel lightship on the 29th, but as she could obtain no pilot, the captain put the ship's head to the south on the 30th to obtain sea room during the gale which was evidently approaching. At midnight there was every appearance of a severe storm. The barometer fell rapidly, the corrected reading at 8 p.m. of the 30th being 29.151 and at 4 a.m. of the 31st 28.754. The wind was now of hurricane force and accompanied with dense heavy rain. Her barometer fell to 28.455 at 2 p.m., and remained at this height until 4 p.m., during which interval the violence of the storm, ushered in at 2 p.m. by a terrific burst of wind, had carried away the sails and thrown the ship on her beam-ends. The position of the ship on the 1st was $18^{\circ} 59' N.$ and longitude $88^{\circ} 24' E.$ She probably had drifted some distance south and east during the passage of the cyclone. She was nearest the centre about 3 p.m., and the position, $19^{\circ} 10'$ or $19^{\circ} 15' N.$ and longitude $89^{\circ} 30' E.$ for the centre at that time obtained from these considerations, agrees closely with its subsequent position at 4 p.m. as obtained from the log of the "Forfarshire."

The "Forfarshire," which was passing up the middle of Bay, was in latitude $20^{\circ} 19' N.$ and longitude $88^{\circ} 55' E.$ at noon of the 30th, the wind being from east to south-east. She was then approaching the Eastern Channel lightship. She experienced heavy squalls and a strong gale during the day. The wind continued to increase during the night

and the morning of the 31st. At 11:30 a.m. it was blowing with great fury. The ship before this had stood to the southward under shortened sails, but at 11:30 a.m. lay to under bare poles. The ship's position at noon was latitude $19^{\circ} 30' N.$ and longitude $88^{\circ} 30' E.$ The barometer was lowest between 4 and 5 p.m., reading at that time 28.40, or, reduced for temperature and corrected to the Calcutta standard, 29.436". The vessel, which had probably drifted to the southward during the previous four hours, was then within 45 miles from the vortex, the position of which at 4 p.m. was thus approximately $19^{\circ} 20'$ and longitude $89^{\circ} 25'$, giving a velocity of 13 miles during the interval from the time when its centre passed to the east of the "Tennyson" to 4 p.m.

The "Lightning" arrived at the head of the Bay on the morning of the 30th. As the weather looked unsettled, she stood out to the south-east. The gale increased during the day. Her barometer, which at noon of the 30th stood at 29.90, fell until 3:30 p.m. of the 31st, when it read 28.90. The storm was at its worst between mid-day of Tuesday and 6 p.m., during which time the starboard and port life boats were cut away, and the mainsail, mizzen-topgallant sail, and lower fore-topsail were blown away by the wind. The ship was in the westerly quadrant of the cyclone. Her position at noon of the 31st was in latitude $19^{\circ} 46' N.$ and longitude $88^{\circ} 31' E.$ Allowing for the southerly current, the probable position of the vessel at the worst of the cyclone (3:30 p.m.) was $19^{\circ} 25' N.$ latitude and $88^{\circ} 30' E.$ longitude. This would assign the position of the storm centre at this time as in latitude $19^{\circ} 20' N.$ and longitude $89^{\circ} 30' E.$, agreeing very nearly with that obtained from the logs of the "Annie Fleming" and "Forfarshire."

The "Octavia," "British Statesman," and the "Palmas" were very near to the path of the vortex about 6 p.m. of the 31st.

The "Octavia" was on the 29th sailing northwards to Calcutta, being at noon in latitude $19^{\circ} 33' N.$ and longitude $90^{\circ} 14' E.$ She experienced heavy rains and variable winds during the afternoon. A whirlwind and waterspout passed near the vessel at 3 p.m., due to the same causes as the larger cyclonic disturbance further south. The weather became rapidly worse on the 30th, and towards evening the vessel, which was now near the lightship, turned southwards to obtain a safe offing. The barometer stood at 29.8 at 2 a.m. of the 31st, and fell rapidly during the day, reaching its lowest at 6.30 p.m., when it read 28.15. The vessel had drifted to the south-east towards the storm centre, and was at this time probably not more than 20 miles to the west of the vortex. The wind blew with hurricane force from noon, carrying away the sails and masts. The barometers and other instruments were broken to pieces by a wave which swept over the ship and washed them overboard. The storm began to abate at 8 p.m., so that the vessel appears to have been nearest to the vortex from 6 p.m. to 7 p.m. The lowest reading of the barometer on board the "British Statesman" was 28.2", taken at 6 p.m. These two vessels were probably within a few miles from each other. There is nothing in the logs of either vessel from which their exact position at the height of the storm can be assigned. Judging from the position of the vessels before the storm and the current southwards, the "Octavia" was probably in latitude $19^{\circ} 45'$ or $20^{\circ} N.$ and longitude $89^{\circ} 40'$ at 6 p.m., when the storm vortex passed a few miles to the east. The position of the vortex on this supposition would therefore be at this time in latitude $19^{\circ} 45' N.$ and longitude $89^{\circ} 50'$ or $90^{\circ} E.$, giving a rate of advance of nearly 15 miles an hour during the preceding two hours in a north-north-east direction.

The "Palmas" on the evening of the 30th was in the neighbourhood of the Eastern Channel lightship. The threatening weather induced the captain to put off to the south and prepare for the approaching storm. At noon of the 31st the position of the vessel by account was latitude $19^{\circ} 50' N.$ and longitude $88^{\circ} 50' E.$ Her barometer had fallen from 29.80 at midnight to 28.70 at 12 a.m. of the 31st. It continued to fall, and was at its lowest at 6 p.m., when it read 28.20. The vessel at this time was probably in latitude $19^{\circ} 40' N.$ and longitude $89^{\circ} 10' E.$ and at a distance of 20 or 30 miles from the centre. This would give the position $19^{\circ} 40'$ and $89^{\circ} 40'$ for the centre at 6 p.m., agreeing very closely with the positions as determined from the logs of the "Annie Fleming" and "Forfarshire," allowing for its north-north-east advance during the interval.

The last vessel in order of time which was within a few miles from the storm centre in its passage up the Bay was the steamer "Moulmein," proceeding from Chittagong to Calcutta. She left the former port on the 30th, and had a light northerly wind with a southerly swell during that day. The stormy weather did not extend to this corner of the Bay until the morning of the 31st. The barometer at 3 a.m. read 29.70, and fell to 29.53 by midday. The wind was then steady from the north-east, but rapidly increasing in intensity. The ship was at this time in latitude $21^{\circ} N.$ and longitude $90^{\circ} 17' E.$

The fore-topmast was carried away at 5 p.m. and the foremast at 7 p.m., at which time the spray was carried right over the ship. The lowest reading of the barometer was taken at 8 p.m., when it stood at 28.4". The centre of the cyclone was then passing to the east of the vessel between 8 and 9 p.m., and at a distance of from 40 to 50 miles. The "Moulmein" was at this time probably in latitude 20° 30' N. and longitude 89° 35' E., as her position at noon of the 1st, before she had resumed her voyage to Calcutta, was latitude 20° 20' N. and longitude 89° 10' E. The cyclone was therefore in latitude 20° 25' N. and longitude 90° or 90° 15' E. at 8.30 p.m., and was advancing now at a rate of nearly 18 miles per hour. The returns from the islands at the mouth of the Megna show that the centre passed over them between 3 a.m. and 4 a.m. of the 1st. They are in latitude 22° 35' N. and longitude 91° E. This gives during the last seven hours of its advance up the Bay an average velocity of nearly 22 miles. This is so very much greater than the velocity of advance of the majority of cyclones in the Bay, which very rarely exceeds 12 miles per hour, as to form one of the most important characteristics of the cyclone. Whether this unusually high velocity has any connexion with the other abnormal feature of the cyclone, the easterly element in its course, I am as yet unable to say.

The log of the French ship "Arabia" presents so many difficulties as to make it almost impossible to determine her varying position relative to the cyclone. Assuming that the log is recorded in nautical time, she was in latitude 11° 50' N. and longitude 89° 30' E. on the 28th, and therefore near the middle of the area of barometric depression, but to the east of the line of advance of the vortex on the 30th and 31st. Her log states that on the evening of the 27th she had incessant rain, a strong breeze, and a very high sea, and that from that time the weather became rapidly worse. On the 29th the weather was gloomy and threatening, and in the morning there was torrential rain. On the morning of the 30th the wind came in strong squalls, succeeding each other at short intervals. At midday she was in latitude 16° 6' N. and longitude 89° 27' E., and had a strong south-east wind, indicating that she was on the north-eastern quadrant of the advancing cyclone. On the evening of the 30th the wind blew in terrific squalls, and the waves swept over the vessel from stern to stem. At midday of the 31st the violence of the storm threw the ship on her beam-ends, and at 2.30 p.m. it was necessary to cut away the mainmast. Her barometer appears to have been lowest at 8 p.m. on the 31st, when the correct reading was 28.767. No latitude observation was taken on the 31st. Her position at noon of the 1st was 19° 15' N. latitude, and 89° 17' E. longitude. The only change of wind noted on the 31st is from south-east to north-west. This would seem to indicate that the vessel had passed round from the north-east to the south-west quadrant of the cyclone. From noon of the 30th to noon of the 1st, although only sailing north-east at the rate of a knot per hour, she had advanced from latitude 16° 6' N. to latitude 19° 15' N., notwithstanding that for some hours before noon of the 1st she must have drifted to the south under the action of the retreating mass of the storm-wave waters. The only supposition which will explain her assigned positions is that she drifted northwards with the advancing cyclone on the 30th and 31st, and was carried round by the force of the wind and current in front of the advancing cyclone from the north-eastern quadrant to the western and south-western quadrant during the afternoon of the 31st.

If this explanation, the only one I can suggest, be the true one, then the "Arabia" at 8 p.m. of the 31st, when her barometer indicated that she was nearest the centre, must have been in latitude 20° 30' N., and consequently have been carried a very considerable distance south during the next 8 or 10 hours, to account for her position at noon on the 1st.

The remaining logs are those of vessels which were in the upper part of the Bay during the cyclone, but at a considerable distance from the path of the vortex. They serve to confirm the accuracy of the assigned line of advance of the centre as determined from the logs of the vessels already discussed.

The S. S. "Busheer" was in the eastern quadrant at midday of the 31st, in latitude 17° 45' N. and longitude 92° 30' E., and at a distance of about 220 miles from the vortex. Her log is especially valuable, as it throws considerable light upon the character of the indraught on the outskirts of the southern and eastern quadrants. Early on the morning of the 31st she had terrific squalls from the south-east, with blinding rain at 7 a.m. They increased in violence and became of cyclonic intensity at 10 a.m. There was a lull of a few minutes at 0.30 p.m., followed by a return of the cyclone in full force from the east-south-east and south-east, with incessant terrific gusts, which continued to be accompanied by blinding rain.

The excessive rainfall on the south-eastern quadrant is confirmed by the logs of the "Empire of Peace," "Allahabad," and "Neva," all of which were in positions near latitude 20° and longitude 92° E. when the cyclone centre passed to the west of them about 10 p.m.

The "Empire of Peace" was in latitude 19° 30' N. and longitude 91° 20' E. at noon of the 31st. During the previous day the wind had blown a gale from the east-south-east, and was accompanied with heavy rain. The barometer fell to 29.18 at 6 p.m., and from that time to 10 p.m. she felt the full violence of the storm.

The "Allahabad" was in latitude 19° 10' N. and longitude 90° 48' E. by account at noon of the 31st or at midnight of the 30th; the time is not clearly stated, and appears from the log to be the latter. The corrected reading of her barometer at that time was 29.711". The lowest reading was 28.945 (corrected to the Calcutta standard) from 8 p.m. to 10 p.m. of the 31st. During the whole day there was constant rain. The exact positions of these ships are somewhat uncertain, as during the cyclone there was, as the captain of the "Allahabad" remarks, a strong current to the north-east on the eastern quadrant of the cyclone, whilst on the morning of the 1st, with the retreat of the waters of the storm-wave southwards, there was a very strong current in the opposite direction. The position of the ship at the worst of the storm was probably latitude 21° N. and longitude 91° 30' E., which would agree closely with its position as determined from the fall of her barometer and the position of the storm centre as previously obtained.

The "Neva" was in latitude 19° 21' N. and longitude 91° 33' at noon of the 31st, and therefore within a few miles from the "Empire of Peace" and "Allahabad." Her captain notes that on the morning of the 31st the heavy squalls were accompanied with torrents of rain. The wind, which at 4 p.m. was blowing a hurricane, continued to increase in violence during the evening. At 11 p.m. he reports that the wind was then blowing a terrific hurricane with tremendous gusts, accompanied with torrents of rain, and spray blown from the tops of the waves, which were at this time very high. She was nearest the centre between 10 p.m. and midnight of the 31st. Her position at noon of the 1st, after she had drifted south under the action of the return current due to the storm-wave, was 20° 33' N. latitude, and 91° 7' E. longitude. She was probably in latitude 21° 15' V. and longitude 91° 20' E. at the worst of the storm.

The logs of the remaining vessels throw no additional light on the path of the vortex, and it is therefore unnecessary to discuss them *seriatim*. The following table gives the probable position of the vessels whose logs are recorded in Chapter I. when they were nearest to the storm vortex, their distance and bearing from it, with a brief summary of the damage caused by the storm.

Vessel.	For log see page	Latitude when nearest.	Longi- tude.	Lowest reading of barometer (uncorrected).	Distance from and bearing of centre.	Time when nearest.	REMARKS.
S.S. City of Venice	80	14° 40' N.	85° 15' E.	29.45	Miles. 210 E.	30th, 10 a.m.	Ship at 9.20 a.m. of 30th. Found gale so severe that she was turned round to south-west for several hours.
„ Japan	- 97	12° 10'	85° 30'	29.65	270 N.E.	30th, 12 „	Fresh gale with heavy squalls and showery weather. Engines at dead slow from 7.20 a.m. to 6.20 p.m.
„ Penang	- 108	17° 30'	86° 50'	29.32	150 E.	31st, 4 to 7.30 a.m.	Boats washed away; sails carried away; ship a perfect wreck on deck and obliged to return to Calcutta.
Bushire	- 118	17° 45'	92° 30'	29.52	220 N.W.	31st, 12 a.m.	
Scottish Chieftain	- 115	18° 50'	88° 10'	29.00	90 E.	31st, 12 „	Fore-topmast, main-topmast, and mizzen-topgallant mast carried away.
Tennyson	- 92	18° 40'	89° 10'	28.15	20 E.	31st, 1.30 p.m.	Sails blown away; ship a wreck on deck.
Foam	- 117	19° 0'	87° 5'	29.10	100 E.	31st, 2 „	
Annie Fleming	- 109	18° 55'	88° 20'	28.50	50 to 60	31st, 4 „	Sails carried away; ballast shifted.
Light ni n	104	19° 25'	88° 30'	28.95	65	31st, 3.30 „	Port lifeboat and starboard lifeboat cut away; main sail, mizzen-topgallant sail carried away.
Thessalus	- 113	19° 40'	88° 10'	29.05	90 E.	31st, 4 „	Top-sails blown away; main-topgallant mast carried away.

Vessel.	For log see page	Latitude when nearest.	Longi- tude.	Lowest reading of barometer (uncorrected)	Distance from and bearing of centre.	Time when nearest.	REMARKS.
Forfarshire	103	19° 20'	88° 30'	28·40	45 E.	31st, 4.30 ..	Wind blew sails out of gaskets; three topgallant masts carried away.
Coleroon	113	19° 45'	87° 30'	29·25	125 E.	31st, 5 ..	
Lady Octavia	94	19° 45'	89° 40'	28·15	20 to 25 E.	31st, 6 ..	Sails carried away or blown to pieces; fore-gallant mast, mizzen-topgallant mast, starboard lifeboat swept away; deck gear all washed away.
Palmas	111	19° 45'	89° 10'	28·20	35 E.	31st, 6 ..	Ballast shifted; masts cut away; starboard anchor let go; sails blown and torn out of gaskets.
Allahabad	103	21°	91° 30'	28·90	80 N.N.W.	31st, 9 ..	Sails torn from gaskets; canvas in mizzen rigging blown away.
Clarence	110	20° 30'	88° 10'	29·10	100 E.	31st, 6 ..	
British Sceptre	94	19° 50'	91° 25'	29·22	110 N.N.W.	31st, 6 to 8 ..	Foresail and main-topsail split.
Planet	120	—	—	28·80	60 E.	1st, 2 a.m.	
British Statesman	110	20° 10'	89° 30'	28·20	20 E.	31st, 8 ..	Sails blown away; topgallant mast, topmast, fore and main mast carried and cut away.
Arabia	89	20° 30'	—	28·77	60	31st, 8 p.m.	Mainmast cut away; sails carried away by the wind.
Moulmein	116	20° 30'	89° 35'	28·40	45 S.S.E.	31st, 8 to 9 ..	Foremast, main-topmast, and funnel carried away.
Empire of Peace	88	20° 20'	91° 30'	29·18	95 N.N.W.	31st, 9 ..	Lower main-topsail split, fore-topgallant mast cut away, main and mizzen topgallant blown away, and rudder-head gave way.
Neva	119	21° 15'	91° 20'	29·05	85 W.N.W.	31st, 11 ..	Lower mizzen-topsail, upper and lower fore-topsail, foresail, cross-jack, mizzen-topgallant sail, and main and mizzen top-gallant staysails all blown away.

The following are the barometric readings taken on board of the vessels, the barometers of which were compared with the Calcutta standard after their arrival in the the Port of Calcutta:—

Ship's name.	Date and hour.	Barometer.		Barometer reduced and corrected.	Wind direction.	Ship's position.	
		Observed.	Attached Thermometer.			Latitude.	Longitude.
Forfarshire	October.						
	25th, 12h.	29·850	—	29·879	—	11° 30' N.	90° 30' E.
	28th, 12h.	·800	—	29·829	N.E. to E. & S.E.	18° 30'	88° 23'
	29th	—	—	—	Easterly.		
	30th, 12h.	29·750	—	29·779	E. to S.E.	20° 19'	88° 55'
	30th, 24h.	·600	—	·631	N.E. by E.		
	31st	—	—	—	N.E.		
	31st, 12h.	29·200	—	29·232	—	19° 30'	88° 30'
	31st, between 4 and 5 p.m.	28·400	—	28·436	Cyclone raging with its utmost fury.		
	31st, about 5 p.m.	—	—	—	N. & N.N.W.		
Forfarshire	November.						
	31st	29·800	—	29·829	From W. to S.W.		
Scottish Chieftain.	October.						
	29th	—	—	—	N.E.		
	29th, 7.30 p.m.	—	—	—	E.N.E. to S.E.		
	30th	29·800	—	29·758	N.E.		
	30th, 4 p.m.	—	—	—	N.E.		
	30th, 8 „ to mid-night.	·620	—	29·578	—		
	31st, 3 a.m.	·200	—	·161	—		
	31st, 10 „	·100	—	·062	N.		
31st, noon	·000	—	28·962	—			
31st, 4 p.m.	·100	—	29·062	N.N.W.			

Ship's name.	Date and hour.	Barometer.		Barometer reduced and corrected.	Wind direction.	Ship's position.	
		Observed.	Attached Thermometer.			Latitude.	Longitude.
	October						
	30th, 8 a.m.	30.000	80	29.852	E.	20° 28'	90° 55'
	30th 10 "	.026	—	.878			
	30th, noon	29.962	81.1	.811	E. by N.		
	30th, 4 p.m.	.886	82	.734	N.E.		
	30th, 8 "	.908	81	.758	N.E.		
	30th, midnight	.826	80.2	.679	N.E.		
	31st, 4 a.m.	.740	80.2	.593	N.E.		
	31st, 8 "	.600	79.1	.457	N.E. by N.		
	31st, noon	.400	—	.255	N.E. by N.		
	31st, 4 p.m.	.050	—	28.907	N. by E.		
	31st, 8 "	.420	—	29.274	N. or N.N.W.		
	31st, midnight	.700	—	.554	N.W. or W.N.W.		
	November.						
	1st, 4 a.m.	.810	—	.663	--	19° 52'	87° 54'
	1st, 8 "	.930	—	.782			
	October.						
	30th, 1h.	29.96	83	29.735	Calm.		
	30th, 2h.	.94	83	.715	Light airs from N.E.		
	30th, 3h.	.94	84	.715			
	30th, 4h.	.94	84	.712			
	30th, 6h.	.92	84	.692	N.N.E.		
	30th, 8h.	30.00	85	.771	N.E.		
	30th, 10h.	29.96	85	.730	N.E.		
	30th, 12h.	.98	86	.746	N.E.		
	30th, 14h.	.94	84	.715			
	30th, 16h.	.79	82	.568			
	30th, 18h.	.78	82	.558			
	30th, 20h.	.79	82	.568			
	30th, 22h.	.80	82	.578			
	30th, 24h.	.82	82	.598			
	31st, 2h.	29.67	—	29.449	N.E.N.N.E. at 9h.		
	31st, 11.30h.	.24	—	.021	N.		
	31st, 12h.	.20	—	28.982	N.		
	31st, 14h.	.10	—	.882	N.N.W.		
	31st, 15.37h.	.2	—	.982	N.W.		
	31st, 16h.	.5	—	29.279	N.W.		
	31st, 17h.	.27	—	.052	W.N.W.		
	31st, 18h.	.33	—	.112	W.N.W.		
	31st, 19h.	.45	—	.232	W.		
	31st, 20h.	.50	—	.282	W.		
	31st, 22h.	.62	—	.402	W.		
	31st, 24h.	.70	—	.482	W.		
	November.						
	1st, 2h.	.72	81	.501			
	1st, 4h.	.73	81	.511	W.		
	1st, 6h.	.80	85	.570	W.		
	1st, 8h.	.86	86	.627	W.N.W.		
	1st, 10h.	.90	82	.678			
	1st, 12h.	.89	83	.665	N.W. by N.		
	November.						
	1st, 14h.	29.86	84	29.633	W.N.W.		
	1st, 16h.	.84	84	.613			
	1st, 18h.	.85	84	.625			
	1st, 20h.	.87	83	.645	N.W. by N.		
	1st, 22h.	.90	83	.675			
	1st, 24h.	.99	83	.765			
	October.						
	28th, noon	29.725	—	29.512	—	11° 50'	89° 01'
	29th	.764	—	.551	—	14° 19'	89° 30'
	30th	.646	—	.433	—	16° 06'	89° 27'
	31st	.410	—	.198	—	19° 15'	89° 17'
	31st, 4 p.m.	.134	—	28.924	—		
	31st, 8 "	28.977	—	.767	—		
	1st, 1 a.m.	29.134	—	.924	—		
	1st, 5 "	.449	—	29.237	—		
	October.						
	28th	.70	79	29.744	S.S.E. to S.	12° 4' N.	91° 0' E.
	29th	.70	81	.738	S.E.	14° 53'	92° 10'
	30th	.70	80	.741	S. to E.	17° 57'	91° 40'
	30th, midnight (?)	.67	80	.711	—	19° 10'	
	31st, noon	.45	—	.492	—		
	31st, 2 p.m.	.30	—	.342	—		
	31st, 4 "	.20	—	.243	—		
	31st, 6 "	.10	—	.144	—		
	31st, 8 "	28.90	—	28.945	S.E.		
	31st, 10 "	.90	—	.945	S.S.E. to S.		
	31st, midnight	29.20	—	29.243	S.S.W.	20° 13'	91° 40'
	November.						
	1st, a.m.	—	—	—	W.S.W.		
	1st, noon	.80	—	.840			

Ship's name.	Date and hour.	Barometer.		Barometer reduced and corrected.	Wind direction.	Ship's position.		
		Observed.	Attached Thermometer.			Latitude.	Longitude.	
Clarence -	October.	Aner.	Bar.		Aner.	Bar.		
	30th, noon	—	—	—	—	—		
	31st, midnight	—	—	—	—	—		
	31st, 4 a.m.	—	—	—	—	—		
	31st, noon	29·35	29·40	81	29·362	29·324		
	November.							
	1st	—	·15	—	—	·078		
	1st, 6 p.m.	—	·10	—	—	·029		
	1st, midnight	—	·30	—	—	·227		
	1st, noon	—	·80	81	—	·725		
Annie Fleming.	October.							
	30th	—	29·60	—	—	—		
	30th	—	·50	—	29·450	—		
	30th, 4 p.m.	—	—	—	—	—		
	30th, 8 "	—	29·20	—	—	·151		
	31st, 4 a.m.	—	28·80	—	28·754	—		
	31st, 7 "	—	·60	—	—	·555		
	31st, 2 p.m.	—	·50	—	—	·455		
	31st, 4 "	—	·50	—	—	·455		
	November.							
1st	—	—	—	—	—	18° 59'	88° 24'	
2nd	—	—	—	—	—	19° 5'	88° 25'	

The following points, which are of importance in the meteorological discussion of the question, seem to me to be fully established by the discussion in this and the preceding chapters—

- (1.) That for some days after the 20th there was fine unclouded weather over the whole of the Bay, with moderate winds and very slight differences of pressure.
- (2.) That the stormy weather and rain squalls commenced in the south of the Bay and gradually extended northwards and became more violent, at first gradually, but afterwards with increasing rapidity, and that this was accompanied by a diminution of atmospheric pressure, similar in character—that is, the diminution at first proceeded slowly, and afterwards more and more rapidly with the persistence of the causes.
- (3.) That nowhere round the limits of the Bay were the winds during the whole of this period of such a character as to indicate an excessive indraught from any region external to the area of diminishing pressure and stormy weather. The slight increase of velocity which occurred round the south-western limits, more especially in Ceylon, was such as can be most easily explained by the supposition of an increasing internal action in the Bay followed by convergence of the winds from the outer limits. The Nancowry returns and the logs of the vessels, moreover, appear to show conclusively that the wind motion was from the first strongest near the centre and gradually decreased in violence towards the limits of the Bay.
- (4.) That the cyclone proper was preceded by a more general cyclonic movement around the Bay, due to meteorological conditions and action beyond the Bay.
- (5.) That the development of the cyclone proper was, however, due to causes and action confined almost entirely to the Bay, originating and intensifying there without exercising any marked effect on the meteorology of the coast districts until it was fully formed and proceeding towards the head of the Bay. Hence the immediate causes of the cyclone formation and action must be sought for in the meteorology of the Bay itself during this period.
- (6.) That the cyclone atmospheric action and motion was probably confined almost entirely to the lower strata of the atmosphere. During this cyclone period, from the 3rd to the 31st, the wind velocities of the two elevated stations in Ceylon—Kandy and Newara Eyla—were remarkably small, indicating almost perfect atmospheric equilibrium and calm in the higher strata. This supposition is, however, chiefly established by the fact that the Tipperah Hills formed an effective barrier to the cyclone, not merely disintegrating and breaking up the cyclone vortex in the lowest atmospheric strata, but completely dissolving and terminating the general atmospheric disturbance, of which the cyclone proper was the most marked feature.

CHAPTER IV.—PROGRESS OF THE CYCLONE OVER EASTERN BENGAL.

The account of the advance of the cyclone after it reached the mouth of the Megna is very brief, as its further progress inland was prevented by the Tipperah Hills, which speedily broke it up. The materials for investigating its path are very meagre, as the districts to the north-east of Noakholly are thinly populated. I shall first of all trace the path from the information supplied by the various district officers who have assisted me, as far as was possible under the peculiar circumstances, to obtain accurate information. This will be followed by a table giving a summary of the changes of wind direction in the area more or less affected by the storm, and by a series of observations taken during the storm at the Government observatories at Chittagong, Saugor Island, and Calcutta, and on board the steamer "Prince Albert," lying near Goalundo.

The following table, drawn up by Baboo Sreenath Ghose, Manager under the Court of Wards, gives in a brief form the most important facts respecting the cyclone when it struck the coast at the mouth of the Megna:—

—	Height of inundation in feet.	Duration and time of wind from north and north-east.	Duration and time of wind from east.	Duration and time of lull.	Duration and time of wind from west.	Time and duration of inundation, and time of subsidence.	Time of end of storm.	REMARKS.
South Banni	9 to 17	9 to 11 p.m. 31st October from north-east.	11 p.m. 31st October to 2 a.m. 1st November from east, east inclined to south. At 1 a.m. there were three or four rushes direct from south.	4.30 to 5 a.m. 1st November.	5 to 9 a.m. 1st November.	Water first came from south at 2 a.m. 1st November; then from west at 5 a.m.; from 6 a.m. began to subside.	9 a.m. 1st November.	The velocity of the wind from the east was greater than that of the wind from the north-east. The force of the wind from the west appeared to be about the same as that from the east.
Siddhi	8 to 13	9 p.m. 31st October to 2 a.m. 1st November north-east.	2 to 3.50 a.m. 1st November from east.	3.50 to 4 a.m. 1st November.	4 to 9 a.m. 1st November.	Water first came from north-east at 2 a.m. 1st November, then from west at 4 a.m. after half-an-hour began to subside.	Ditto.	Time of flood-tide was 11 p.m. 31st October. Time of ebb-tide was 4 a.m. 1st November.
Sundeep	7 to 15	11 p.m. 31st October to 2 a.m. 1st November from north-north-east.	2 to 2.50 a.m. 1st November from east, and then from 2.50 to 3.50 a.m. south-east.	Ditto	Ditto	Water first came from south-east at 2.50 a.m. 1st November then from west at 4 a.m.	Ditto.	In churs north of Hattiya and Sundeep the water first came from the north-east; it was salt water.
Nulchira Hattiya Nilakhyi	9 to 28 7 to 88 9 to 28	8 to 11 p.m. 31st October from north to east.	11 p.m. 31st October to 1 a.m. 1st November from east, then up to 3 a.m. from south-east.	3 to 3.50 a.m. 1st November	3.50 to 9 a.m. 1st November	Water first came from south-east at 2 a.m., then from west at 3.50 a.m.	Ditto.	
Sudharam	3½ feet on the very elevated parts, and 8 ft. on the general level land low in the town, and 10 ft. one mile south.	9 p.m. 31st October to 2 a.m. 1st November from north-east.	2 to 3 a.m. 1st November from east, and east inclined to south. At 3.30 there were three or four gusts from the south direct.	4 to 4.50 a.m. 1st November	4.50 to 6.50 a.m. from west, and then from north-west afterwards from north.	Water first came from south at 5.50 a.m., and then from west at 6.30 a.m.; began to subside from 7 a.m.	Ditto.	

The vortex passed over the islands of Nulchira and Hattiya between 3 and 3.30 a.m., over Siddhi between 3.30 and 4 a.m., over Noakholly, according to the most reliable accounts, from 4 to 4.30 a.m., and, as will be presently stated, over Dewangunge about 5 a.m. This would give a rate of advance of from 20 to 25 miles per hour, and confirms the unusually high velocity which has been already derived from the positions of the vessels in and near its path over the upper portion of the Bay.

The following are abstracts of the reports of the meteorology of the districts at the mouth of the Megna, obtained and forwarded by Mr. Porch, Collector of the Noakholly district, and give the whole of the information which could be gathered from the native officials and population of the changes of wind direction over the area including the path of the cyclone vortex:

"*Nulchira*.—The wind during the day was from the north and north-east, increasing during the night. It afterwards changed to south-west and west, and blew very hard. The wind fell rapidly during the morning of the 1st."

"*North Hattiya*.—The day of the 31st was cloudy, the wind blowing from the north-east. At noon there was a shower which lasted half-an-hour. At 3 p.m. it began to rain again, and continued until 8 a.m. of the following day. It was, however, not heavy, except before the commencement of the storm, which began about 8 p.m., the wind then blowing from the north and gradually increasing in intensity. It became very violent at 11 p.m., and then shifted to the east, still increasing in violence, and blew down trees and houses."

"*Sundeep*.—During the afternoon of the 31st the wind was from the north, and gradually increased in velocity. At 11 p.m. it shifted to north-east, and at 11.30 p.m. to east. The wind was at that time so violent that trees were uprooted and houses blown down. At 12 p.m. it veered to south-east and was still increasing in intensity and accompanied with rain. At 1 p.m. it veered through south to south-west, and

continued to blow in that direction during the remainder of the night. The result of later inquiries is that no period of calm such as that described in the report of Baboo Sreenath Ghose occurred in the island of Sundeeep during the cyclone."

"*Siddhi*.—The sky was cloudy on the 31st, rain falling during the afternoon. The wind was then from the north and north-east, and blew hard from 11 p.m. It afterwards changed to east, still increasing in violence, and blew down houses and trees. At about 3 a.m. there was a short calm, after which the wind went round rapidly from south through south-west to west, from which direction it blew hard. There was rain during the night, but no thunder or lightning."

"*South Bamni*.—The wind previous to 3 a.m. of the 1st had shifted from north through north-east to east. Shortly after 3 a.m. it changed to the west."

"*Noakholly*.—The information of the state of the weather for this station is much more complete. The following is Mr. Porch's interesting account of the storm at this station."

"The storm at Noakholly appeared at about 11 p.m. as a cyclone, the north being its general direction, with a bearing to the east. It showed a tendency also to go southwards by the east, but blew only a very short time from the south-east at about 11.30 or 12 p.m. in the extreme south of the district. It attained its greatest force from the east at about 1 a.m., and maintained the same force when it veered back to the north-east at 1.15 a.m. This was the first part of the storm, during which the wind blew chiefly from the north-east; and towards its close, at about 3.30 a.m. the wind was described as variable and unsteady, and shifting about with violent gusts, east and west and east, from a northerly direction. People say at Noakholly strong gusts at about 3 a.m. came from the north-east, then north-west and west, and then a few strong gusts from the south-west and south, and again from north-east, which last direction the storm generally maintained, when the wind rather quickly fell at about 3.30 a.m. Then there was a lull from 4 a.m. to 4.30 a.m., towards the close of which the inundation was heard coming in along with the wind from the west; the wind, again increasing from the west, blew hard. This was the second part of the storm as experienced by people at the Noakholly station. In that interval of calm, the moon being bright, people left their broken-down houses and homesteads to look after their neighbours and to see the injury done to one-another's houses, and to learn how they had fared in the storm. Then began to be heard what the natives describe as horrible sounds, viz., distant roaring from the wind and inundation in the south, which afterwards appeared at Noakholly between 5.15 and 5.30 a.m., and which they could then hear, while there was perfect calm and stillness, amid the desolation at the station of Noakholly.

"The greater part of the trees lie from north to south with much westerly direction, and a great many lie due west, and some very slightly inclined to the north-west. Some houses and some trees were found lying to the east. It seemed to me that night that the wind from the west at about 4.30 a.m. was quite as swift and strong as the wind from the north-east before it reached the climax at 1 a.m. It was very strong, and it may, as some others assert, have been as strong at this place from the west in the second part of the storm as it was at any time from the east and north-east in the first part; but it was of short duration in intensity from west compared with its duration from the north and north-east and east in the first part of the storm. The second appearance of the cyclone, with its counter-blast from the west, has not left such marked signs of its direction in fallen trees and houses, &c. as the protracted and intense blowing of the first part of the cyclone from the north-east has left everywhere. The force of the cyclone was greatest from the east and north-east at 1 a.m., and after as described till the storm began to oscillate and was followed by a lull at about 4 a.m. The European residents and almost all the people in the station were up all night and were observing what was going on. The Civil Medical Officer's report (given below) appears to be very correct as regards Noakholly (Sudharam).

"The cyclone appeared and prevailed first north and north-east, generally showing much variability from 3.30 to 4 a.m., just before the lull. After this it reappeared in an almost opposite quarter and considerably south apparently of its first area. It seemed to travel up, as it were, from the Bay to north, blowing across the islands obliquely from the west inclined to south-west towards the east, and this direction of the wind with the direction of the tide caused the great inundation from south-west to north-east. The Daula water inundation from the west after the lull was therefore experienced first in the islands on the extreme south, and then gradually in the north of the islands and over the mainland during the next two hours, as the westerly wind travelled northwards. The lull, too, appears to have been earlier and of much shorter duration in the islands to the south.

“The Sundeep and Hattya people say that for two or three days before the cyclone they constantly heard a roaring sound to the south in the Bay, and they knew that it was a traditional warning of a storm and flood, but in their easy-going heedlessness they almost all took no precautions. A very few people, however, in both islands, thus forewarned, are said to have prepared plantain-rafts and tied them with long ropes to the trees in their home plantations, and thus saved themselves and their families. The inhabitants of these parts know their danger in the months of Jyest and Kartick, and should always have such simple life-buoys of plantain trees or plaintain and bamboo and rope ready fixed adjoining their houses within their tree-surrounded compounds. Many people in the islands and on the mainland say they saw lights passing apparently from west to east at the beginning of the cyclone. The Amergong people saw lights keep on appearing at several points on the horizon in the east. In thanas Sudharam and Begumgunge hailstones fell at the beginning of the cyclone. At Begumgunge a light was seen in the east like a comet, the people say.”

The following account sent by Mr. Lyons, Civil Medical Officer, gives the observed changes of wind direction and the chief features of the storm at Noakholly :—

- “4 to 5 p.m.—Heavy shower ; wind N.N.E.
- “7 to 8 p.m.—Drizzling rain ; wind N.N.E., cold and sharp.
- “9 p.m.—Drizzling rain ; wind freshening, N.N.E.
- “10 p.m.—Rain heavier ; wind last half-hour blowing strong from N.N.E.
- “11 p.m.—Heavy rain ; wind blowing a hurricane from N.N.E.
- “12 p.m.—Heavy rain, but it looks like mist as it is borne along the wind ; wind blowing a hurricane from N.N.E.
- “1 a.m.—Heavy rain, but it looks like mist as it is borne along the wind ; wind, if anything, higher, and a few minutes past this hour it suddenly changed to east for about a quarter of an hour, returning as suddenly to N.N.E., when I noticed the falling of a tree some 50 yards north of the circuit-house. The storm evidently was now at its height, as tree after tree came down, and the window-shutters on the north face of the circuit-house were torn away.
- “2 a.m.—Still raining heavily ; wind blowing furiously from N.N.E.
- “3 a.m.—Rain abating ; wind still high from N.N.E., but not blowing so furiously.
- “3.30 a.m.—Rain ceased and there is a perfect lull. What little wind there is is from the west, and borne on it is a distant soughing sound, which gradually, as the wind again rising high at 4 a.m., deepens with a “booming,” now recognised as the sound of rushing water, which about 5 a.m. reached the station. Shortly after this hour the wind died away to a cold sharp breeze, the flood advancing meanwhile and reaching its maximum height some (3½ feet in the more elevated parts of the station) about 7 a.m.
- “The rainfall registered in the jail was 5.12 inches.”

NOTE by R. PORCH, Esq., Officiating Magistrate, Noakholly.

“Noakholly.—The wind blew with great force from N.N.E. from 11 p.m., and blew with its full force when it veered to the east at about 1 a.m. Then the destruction went on, and after, when it veered back to N.E., maintaining its highest force and velocity, and continued blowing furiously.

“Between 4.30 a.m. and 5 a.m. it blew as hard from the west, and sometimes slightly south-west, as it had done from N.E. between 11 and about 1 a.m. before the climax was reached by the change to east at about that time, viz., 1 a.m.

“Islands.—Between 3 a.m. and 4 a.m. the wind blew hard from the south-west, and very hard from the west, in the islands below the Megna.”

The centre of the storm passed over Nulchira and South Hattiya between 3 and 3.30 a.m., and was then advancing in a north-easterly direction. It passed over the island of Siddhi half-an-hour later. Noakholly is due north of the island of Hattiya, and it is almost impossible that the same vortex should have passed from Hattiya eastwards to Sundeep and Siddhi, and should still later have visited Noakholly. To reconcile these facts it would have been necessary to have assumed that the vortex was elliptically shaped, its greatest diameter measuring at least 30 miles and lying at right angles to the line of motion, and that it moved first eastwards from Hattiya to Sundeep and then northwards over Noakholly. I was assured by Mr. Porch that the facts and times given in the table compiled by Baboo Sreenath Ghose were very approximately correct, and were obtained after careful and lengthened investigation. However, he made further enquiry, and the result is, to quote his words,—“It appears conclusive that there was no lull in Sundeep proper. The lull was experienced in Siddhi, the northernmost of the three well-defined islands, like tracts, forming the island of Sundeep. In South Bamni there was a lull of about the same duration as at Sudharam (Noak-

holly); at Dewangunge and Silonea the duration of the lull was much shorter than at Noakholly and later in point of time. At Lakhyipur, as well as Raepur and Ramgunge, to the north of Lakhyipur, there was no lull during the cyclone, which prevailed all night from about 10 p.m. till after daybreak. There were brief intervals of comparative calm, after which the rushes and gusts of wind were intensely violent. The direction of the wind at Raepur and Rungunge was from N.N.E. and N.W.; at no time did it blow from due east or west or from a southerly direction."

The vortex, it is clear, passed over the islands of Manpoora, Nulchira, Hattiya, and Siddhi, and over the district including the stations of Noakholly, Bamni, Amergaon Silonea, and Dewangunge. If it was the same vortex which passed over this area, this would give it a breadth from N.N.W. to S.S.E. of at least 16 miles; while the duration of the calm, combined with the rate of progression of the storm, assign it a length in the direction, of motion of from 8 to 10 miles. This would prove it to have been elliptically shaped, the greatest axis being probably nearly at right angles to the direction of motion.

It is by no means conclusive from the evidence that there was only one well-defined vortex at this period. It seems to me probable that the first vortex either was spent out over the islands, and that a second vortex was formed near Noakholly, or that the vortex was already beginning to break up, giving rise to small eddies in advance.

These suppositions receive little confirmation from Dr. Lyons' observations, but the following remarks of Mr. Porch seem to favour one of these inferences. In his report he says,—“Towards the close of the first part of the storm, at about 3.30 a.m., the wind was described as variable and unsteady, and shifting about with violent gusts east and west, and east from a northern direction (*i.e.* through north). People say at Noakholly strong gusts came from the north-east, then north-west and west, and then a few strong gusts from the south-west and west, and again from north-east, which last direction the storm generally maintained, when the wind rather quickly fell at 3.30 a.m. Then there was a lull from 4 a.m. to 4.30 a.m., after which the wind, again increasing, blew hard from the west.” Mr. Porch's facts attesting the variableness of the wind are confirmed by the report of Annoda Kishore Roy, Court Inspector at Noakholly:—

“31st October, evening.—Wind due north.

“10 to 11.30. p.m.—North with violence.

“12 to 2 a.m. and 2 to 3 a.m.—Wind north-east and east, at the end of which time there were gusts from west and north-west, veering towards south-west at the close. The wind was, however, generally in the north-east.

“3.30 to 4 a.m.—Lull.

“4 to 5.30 a.m.—Wind westerly.

“8.30 in the morning.—Wind north and north-east.

“The length of the lull was about half-an-hour. It was general throughout the district.”

The Court Inspector states clearly that at 3 a.m. there were gusts of wind from west and north-west, and that it veered towards the south-west, but that the wind was generally in the north-east before the lull from 3.30 to 4 a.m.

Probable instances of the formation of a new vortex in advance are given in the report on the Calcutta cyclone of 1864.

A strange fact, brought to my notice by Mr. Porch as having given rise to much superstitious feeling amongst the natives, is that the great mandar-tree on chur Sekundur, on the coast to the south of Noakholly, a well-known land mark, has escaped injury, without, as the natives say, the loss of a branch or leaf to mark the completeness of its escape amidst the surrounding desolation.

Amergaon.—The wind blew from north during the 31st, increasing in velocity as evening set in. Rain began to fall about 2 p.m. At nightfall the wind still continued to increase, and at 11 p.m. changed its direction from north to north-east, and then veered to east and south-east about midnight. There was a short calm at about 3 a.m., when the wind veered to the west. There was a calm every time the wind changed its direction, but these calms were hardly perceptible, whilst the calm, which lasted about half-an-hour, when the wind changed from south-east to due west, was altogether different.

“Amergaon is north-east from Noakholly, at a distance of 18 miles. The eastern edge of the vortex passed over it, as indicated by the calm and change of wind. The time (3 a.m.) is evidently wrong, depending only upon the information of the villagers.

Dewangunge.—The sky was cloudy and gloomy during the whole day. At 3 p.m. rain began to fall in slight showers; it fell more heavily as night approached. The wind increased during the evening, and was blowing very strongly from the north-east at 11 p.m. It then shifted through east to south, blowing with redoubled force, and overturning whatever opposed it. It afterwards went round rapidly to west,

gradually abating, though rain continued to fall until 11 a.m. of the 1st. 'Another informant states that the storm ceased for a short time at 5 a.m., the calm lasting about 10 or 12 minutes. The sky at the time appeared red in the west.'

"*Silonea*.—There was a calm of about five minutes at 5 a.m., the only interval of prolonged calm which was observed at this station.

"*Lakhipoor*, 19 miles to west-north-west of *Noakholly*.—The weather was cloudy on the evening of the 31st, the wind being from the north-east. It was not so dark as is usually the case before the occurrence of a storm. It began to blow heavily at midnight from the north, then from the east, and afterwards from the west. There was no thunder or lightning, only horrible sounds were heard. The wind continued until 8 a.m. of the 1st. During its continuance there were occasional lulls lasting for two or three minutes.

"*Miserai*.—An easterly wind began to blow strongly at 9 p.m., and was attended with drizzling rain. It afterwards shifted to south-east, growing more violent until 3 a.m. From 4 a.m. to 7 a.m. it blew from the south-west with equal violence."

The reports from the remaining stations and villages near the storm centre from which I have received information are very meagre and unsatisfactory, judged from a meteorological standpoint.

Little more remains to be told of the path of the vortex of the Backergunge cyclone. After passing north-east over *Noakholly* at 4 a.m., and over *Dewangunge* and *Silonea* at 5 a.m., where the interval of calm was comparatively short, it was advancing towards the angle formed by the *Tipperah Hills* and the *Arrakan Hills*. The whole of the district is thinly populated. It is a tract gradually rising up from the flat land along the banks of the *Megna*. The *Tipperah Hills* are not very high, but they consist of a series of parallel ridges running north and south, increasing in height eastwards. The outlying spurs near the sea are not more than three or four hundred feet high, but the more central portions attain at their highest points an elevation of from two to four thousand feet. The cyclone disturbance occupied an area of at least 400 miles in diameter at sea. When the centre was passing over *Noakholly* the northern limits had been involved for some time amongst the *Tipperah Hills*. The disturbing action of these ridges, which were at right angles to the direction of motion of the wind in the northern quadrant of the cyclone, was rapidly shown. The large regular converging motion towards the centre was prevented on the north-eastern side, and a number of small eddies probably formed. The result was that the vortex broke up at some distance south of the *Tipperah Hills*, two or three hours after it passed over the north-east angle of the Bay.

"*Comillah*.—The Civil Surgeon of *Comillah*, a station 40 miles due north from *Noakholly*, writes that the wind for several days previous to the 31st had been steady from the north. The barometer fell on the 31st, whilst the wind changed to north-east. No readings of the barometer were taken, as the building containing it was unroofed during the storm. The anemometer was also blown away during the evening. The wind during the afternoon and evening blew strongly from the north, with occasional gusts, and shifted a little towards the east from 9 p.m. until 11.30 p.m., when the storm increased to a hurricane, the wind coming from the north-east, with occasional lulls. It continued to blow a strong gale from the same quarter until 5 a.m. of the 1st, when it gradually moderated, and was fine weather at 7.30 a.m."

The steadiness of the wind direction at *Comillah* and the cessation of the storm three hours after its centre passed over *Noakholly* are important. The wind direction indicates that the station was on the north-western quadrant of the cyclone when its vortex was passing over the mouth of the *Megna*. There was thus at *Comillah* a steady north-east wind, very violent from 11.30 p.m. to 4 a.m., during which the distance of the vortex had decreased from 130 to 45 miles. During the next two hours the centre did not advance so far north as to affect the wind direction. The only possible inference is that the vortex which passed over *Noakholly* advanced a very short distance to the north-east, and was broken up at least 20 or 30 miles south-east of *Comillah*. The *Backergunge* cyclone was on a much larger scale than the *Vizagapatam* cyclone. Its central area of calm was much larger, and the diameter of the air moving with hurricane force was probably five or six times as great. Its rate of progression was more than double of that of the *Vizagapatam* cyclone. Both advanced almost directly to the opposing mountain masses, and yet from slight differences in the character of the mountain obstructions, the smaller and slower moving cyclone merely suffered deflection and slow disintegration, whilst the larger and more rapid cyclone was not only completely broken up in the space of a few hours, but its extinction was very speedily followed by the disappearance of the atmospheric disturbance, of which the cyclone was one feature.

"*Agurtolla*.—*Agurtolla* is 30 miles due north of *Comillah*, on the western extremity of the *Tipperah Hills*. Here nothing more than a stiff gale was experienced. The sky was cloudy on the 30th and 31st, and a slight rainfall occurred on the latter day. The

wind during the advance of the cyclone varied from north-east to north, and was not so violent as to do any considerable injury to houses or trees. Mr. Bradbury, Magistrate at Agurtolla, writes:—‘The wind here shifted very little, and blew from the north and north-west during the night and the following morning until the storm subsided. There were no gusts from the east or south or west. The storm was most violent about 4 or 4.30 a.m., and then gradually lulled, ceasing entirely about 11 a.m. It was much less furious here than at Comillah; at Agurtolla not more than 20 or 30 huts were blown down, and no lives were lost. Throughout Hill Tipperah the only serious damage done was to the crops, which, being in ear, suffered to the extent of from one eighth to one fourth.’

“*Adamtilla.*—Captain Nuthall, R.N., a tea planter, residing at Adamtilla, about 30 miles north of Agurtolla, and amongst the northern spurs of the Tipperah Hills, states that there was a very heavy gale of wind there on the morning of the 1st. It commenced about 2 a.m., the barometer falling rapidly until 7 a.m. 1.32 inches of rain fell on the 1st. Although the wind was very violent, it did no injury beyond breaking down some plantain trees.

“*Sylhet.*—At Sylhet, 35 miles north-west of Adamtilla, there is a Government observatory, but the observer took no special observations, as the wind was not very violent there. The ordinary observations show that the 31st was cloudy, and that slight rainfall occurred at intervals. At 11 p.m. the wind was blowing from the east, and it gradually shifted to the north, from which quarter it was blowing when the gale was at its height at 4 a.m. The wind gradually abated as day came on, when it is said to have come from a little west of north. The storm was over by 10 a.m. The total rainfall was 1.24 inches. The amount of wind registered by the anemometer from 4 p.m. of the 31st to 10 a.m. of the 1st was 390 miles.

“*Cachar.*—The superintendent of the Cachar observatory, 60 miles to the east of Sylhet, and about 80 miles to the north of the angle formed by the Tipperah and Arakan Hills, states that the storm there was not severe. It began to blow from the north-east at 2.30 a.m. and continued until 10.30 a.m., during which interval 1.3 inches of rain fell. No damage was done in the station, a few old houses, however, being said to have been blown down in the district.

The above evidence is conclusive that the storm vortex not only did not reach the Tipperah Hills, but that it was broken up at a considerable distance south, and that the minor eddies which were formed by the obstructive and disintegrating action of the hills, although they continued for five or six hours after the arrival of the vortex at the mouth of the Megna, rapidly died away, and that at midday of the 1st the cyclone was practically extinguished, the only after effects on the weather being a slight rainfall during the next 48 hours in Assam and the neighbouring hills.

The following account of the cyclone at Burrisal, sent to me by the Civil Medical Officer, is the chief information I have received from the Backergunge district:—

“The weather had been cloudy for the last few days. On the 30th and 31st October slight rain occurred at intervals. On the morning of 31st October the wind blew from S.E. During the afternoon it changed to N.E. Towards evening it came from a direction nearer north and increased in strength. During the night it increased to a hurricane, prostrating trees and breaking large limbs and foliage from them. Most of these trees lie in a direction from a little to west of north. Towards morning, at about 4 a.m., the wind decreased in violence and changed to a direction from near west. Its period of greatest violence was from midnight to 4 a.m. Over 90 per cent. of the kutchra houses composing the bazar have been thrown down. In order to show the great force of the wind, I may mention that the largest portions of the north and south walls of the racquet court have been blown down in mass. This building did not suffer in the cyclone of 1867. Slight rain accompanied, but there was no thunder or lightning. An aneroid barometer on the evening of 31st October stood at 30.200. From this time it steadily fell to 4 a.m., when it stood at 29.280. The rainfall on the 31st was .36 inches and on the 30th .01 inches. No change occurred in the relative humidity of the air.”

The following table gives briefly the information sent to me by the various district officers, and whilst it confirms the path as charted from the facts given in the previous paragraphs, it is useful as supplying information defining the limits of the area affected by the cyclone. The cyclonic area extended from Saugor Island to the island of Katoobdia and the small station of Cox's Bazar. As it advanced inland it rapidly contracted, and included the whole of the Backergunge, Noakholly, and Chittagong districts, the Tipperah Hill Division, and the eastern portions of the Jessore, Dacca, and Mymensingh districts.

Districts.	Stations.	31st October 1876.			1st November 1876.			REMARKS.	
		Before 10 p.m.	10 p.m.	12 p.m.	2 a.m.	3 a.m.	4 a.m.		After 4 a.m.
Jessore	Bagirhaut	Cloudy - Raining, 4 p.m. Wind N.E.	N.E.	N.	-	-	N.W.	W.	
	Khoolna	Frequent showers	N.E.	N.	N.	-	-	-	
	Nurail	Strong wind Gloomy sky. Rain.	N.E.	N.	N.	-	-	-	
	Jhenidah	10 a.m., 29.8 4 p.m., 29.69 Gloomy; occasional rain; wind N.E.	29.63 Strong gusts N.E.	Bar. 29.51. Wind N.E. Strong gusts with light rain.	Bar. 29.47. Wind shifting to N.; blowing in puffs at intervals.	Bar. 29.43. Wind N., modera- ting; rain ceased.	Bar. 29.410; wind E.	6 a.m., 29.63; wind N.W., sky clear- ing.	Five day on the 1st, light N.W. wind; barometer rising ru- pidly.
	Jessore	Bar. reduced to 32°. 10 a.m., 29.783 4 p.m., 29.663 Wind N.E.	Bar. 29.610. Wind N.E. 109.2 miles regis- tered from 4 p.m. by anemometer.	-	-	-	-	10 a.m., 29.733; wind W.	Rainfall 1.03" during storm. The wind during the storm first blew from E. and veered round N. to W., from which it was blowing when the storm subsided.
Nuddea	Nuddea	Heavy clouds from early morning. 10 a.m., 29.72. 4 p.m., 29.72. Wind N.E.	Wind blowing fresh from N.N.E.	-	-	-	-	10 a.m., 29.60; wind W.N.W., heavy clouds. 4 p.m., 29.63; wind N.W., with sky clear.	Rainfall 0.8 inches.
	Krishnagar	Day very cloudy and windy.	Wind N. to N.E.	-	-	-	-	-	Rainfall 0.7 inches.
	Chocadanga	Sky very cloudy	-	-	-	-	-	-	Wind from N.E. during the night.
	Bongong	Cloudy and rain d ing the day.	E.	N.E.	N.	-	-	-	-
	Kishengunge	28th to 31st sky cloudy; wind in gusts from N.E., with rain.	9 p.m. "Strong close reefed top- sail breeze" with rain; wind N.E.	-	Wind began to abate.	-	-	-	6 a.m., wind veered to N.W. and W.
Jellinghy River Toll Office.	Wind N.E.	-	N.E.	N.E.	N.E.	N.E.	N.E.	-	

Districts.	Stations.	31st October 1876.			1st November 1876.			REMARKS.
		Before 10 p.m.	10 p.m.	12 p.m.	2 a.m.	3 a.m.	4 a.m.	
Dacca	Dacca	Bar. reduced to 29°. 10 a.m., 29° 8'06" Wind N.N.E. 4 p.m., 29° 7'01" Wind N.	Bar. 29° 6'43." N.E.	12.50 a.m. 29° 4'00." N.N.E.	Bar. 29° 3'50." N.E.	—	—	Total rain during storm 1.92 inches.
Furzedpore	Madaripore	7 p.m. to 10 p.m., N.	N.E.	—	—	—	—	About 6.30 a.m. the river began to rise rapidly, viz. 5 feet in three-quarters of an hour.
Mymensingh	Mymensingh	Cloudy day	N.E.	N.E.	N.E.	—	—	Storm lasted until 6 a.m.; rainfall 0.26; wind gusty, but never high, and did no damage.
	Kishoregunge	—	—	—	—	—	—	Rainfall 0.92; many huts were blown down and a boat capsized on the Megna.
Pubna	Attia	S.E. before gale	—	—	—	—	N.	Rainfall 0.08; no gale or destruction of property.
	Pubna	Cloudy day, 1.19 inches of rain up to 6 p.m. Afternoon cloudy with slight rain. Wind N.E.	N.E.	Wind blew hard and "almost a gale." N.	Direction of wind, N. to N.E.	—	Wind began to abate.	Total rainfall 0.2 inches from 6 p.m. of 31st.
Bogra	Serajgunge	No rainfall	—	—	—	—	—	7 (C) inches of rain fell during the night. Morning of 1st was fine with a light wind.
	Shiraghar	—	—	—	—	—	N.	No rainfall.
Rungpore	Newkhila	—	—	—	—	—	—	0.15 inches of rainfall.
	Rungpore	Sky cloudy, wind N.E.	N.E.	N.E.	N.E.	N.	N.	0.3 inches rain.
Chittagong Hill Tracts	Rungamattree	Closely during day	—	—	—	—	—	On the 31st, when sky was dark, the snowy range was very clearly visible.
	Demagiree	—	—	—	—	—	—	Was blowing from E. at 2 a.m., and shifted through S.E. and S. to S.W. The wind was very violent from the S.W.
	Ruma	—	—	—	—	—	—	Wind commenced to blow from the E. No damage was done to houses or huts.
		—	—	—	—	—	—	Began at 10.30 p.m., and lasted till 6 a.m.; wind S.E.

The chief feature of the storm in its passage over Eastern Bengal was the absence of heavy rainfall. There was slight rainfall over the whole of this portion of Bengal and the adjacent districts to the east on the 31st, followed by heavier rainfall during the storm on the morning of the 1st. The following gives the amount of rainfall registered on the 31st and 1st at the more important stations in the cyclone area :—

(1.)—Stations on Eastern Quadrant of Cyclone.

	31st October.	1st November.
Cox's Bazar - - -	0·06	3·15
Chittagong - - -	0·10	2·50
Fenny - - -	0·11	3·20
Rungamuttee - - -	—	2·00

(2.)—Station in Path of Storm Vortex.

Noakholly - - -	0·26	5·12
-----------------	------	------

(3.)—Stations on Western Quadrant of Cyclone.

Hill Tipperah - - -	0·05	1·92
Comillah - - -	—	3·54
Brahmunberiah - - -	0·06	1·51
Burrisal - - -	0·36	3·04
Perozepore - - -	0·60	1·81
Putuakhally - - -	0·90	5·85
Bagirhat - - -	—	2·78
Dacca - - -	0·14	—
Furreedpore - - -	0·89	—
Goalundo - - -	0·17	0·52
Khoolna - - -	1·03	—
Jhenidah - - -	0·89	—

Another feature was the almost entire absence of thunder and lightning during the storm on land.

The following observations were taken on board the S.S. "Prince Alfred," which left Goalundo for Dacca on the 31st ultimo, and passed the night in the Budderchur khal, abreast of the Hilsamaree, through which the steamers go from the Padma to the Megna :—

—	Hour.	Wind.	Barometer.	REMARKS.
October 31st	5.30 a.m.	N.E.	—	Weather looking doubtful.
	9 "	N.E.	26·86	
	12 "	N.E.	·84	Dull and dirty appearance all round.
	2 p.m.	N.E.	—	Weather looking worse. (Ran into Budderchur khal.)
	4 "	N.E.	·76	Squally from E.N.E.
	6 "	N.E.	·74	Increasing breeze and heavy rain. (Ordered fires to be banked.)
	7.30 "	—	—	
	8 "	N.E.	·72	
	10 "	N.E.	·69	Moderate gale.
	10.30 "	N.E.	·67	
	11 "	N.E.	·65	Fresh gale.
	11.30 "	N.E.	·50	
	12 "	N.E.	·49	Strong gale.
November 1st	1 a.m.	N.E.	·45	Strong gusts.
	1.30 "	N.E.	·40	Ditto.
	2 "	N.E.	·39	Heavy gale, with violent gusts and constant rain.
	2.30 "	N.E.	·38	
	3 "	N.E.	·35	Ditto ditto. (Engines at work 5 to 8 revolutions a minute.)
	3.30 "	N.E.	·34	
	4 "	N.	·34	Heavy gale, with passing squalls of wind and rain.
	5 "	N.	·37	More moderate.
	6 "	N.W.	·40	Strong breeze with gloomy weather and rain.
	7 "	N.W.	·45	
8 "	N.W.	·50		
9 "	N.W.	·53		
10 "	N.W.	·60	Weather clearing up.	

The following observations were taken at Chittagong, Calcutta, and Saugor Island during the cyclone :—

Date and Hour.	Barometer.			Wind Direction.			Wind Velocity.		
	Chittagong.	Calcutta.	Saugor Island.	Chittagong.	Calcutta.	Saugor Island.	Chittagong.	Calcutta.	Saugor Island.
October 31st.									
4 a.m.	—	—	29·714	—	—	N.E.	—	7	69·6
6.40 "	—	—	·700	—	—	N.N.E. to N.E.	—	—	—
7 "	—	—	·718	—	—	N.E.	—	40	47·9
8.20 "	—	—	·745	—	—	N.N.E. to N.E.	—	—	—
9 "	—	—	·726	—	—	N.N.E. to N.E.	—	25	31·2
10 "	—	—	·721	—	—	N.N.E.	—	15	19·3
12.15 "	—	—	·647	—	—	N.N.E.	—	—	40·5
1 p.m.	—	29·684	—	—	N.E.	—	—	52	—
2 "	—	·649	·576	—	N.E.	N.E.	—	15	38·5
3 "	—	·653	·553	—	N.E.	N.E.	—	18	23·8
4 "	—	·624	·521	—	N.E.	N.N.E.	—	20	23·4
5 "	—	·632	—	—	N.E.	—	—	19	—
5.20 "	—	—	·508	—	—	N.N.E.	—	—	39·3
6 "	—	·618	·485	—	N.E.	N.N.E.	—	16	25·2
7 "	—	·614	·477	—	N.E.	N.N.E.	—	25	34·9
8 "	—	·580	·475	—	N.E.	N.N.W. to N.N.E.	—	24	36·0
9 "	—	·558	·487	—	N.N.E.	N.W. by N. to N.N.E.	—	21	48·5
10 "	—	·570	·496	—	N. by E.	N.W. to N. by W.	—	19	49·5
11 "	—	·561	·523	—	N.N.E.	N.W. to N.	—	16	28·1
12 "	—	·528	·518	—	N. by E.	N.W. to N.	—	30	25·8
November 1st									
0.45 a.m.	29·283	—	—	E.N.E.	—	—	—	—	—
1 "	—	·514	·545	—	N.	N.W.	—	30	23·8
1.15 "	·205	—	—	N.E.	—	—	—	—	—
1.30 "	·196	—	—	E.N.E.	—	—	—	—	—
1.45 "	·186	—	—	E.	—	—	—	—	—
2 "	·191	·523	·578	S.E.	N.N.W.	N.W.	—	25	21·8
2.15 "	·166	—	—	S.S.E.	—	—	—	—	—
2.30 "	·132	—	—	S.E.	—	—	—	—	—
2.45 "	·102	—	—	E.S.E.	—	—	74·9	—	—
3 "	·081	·553	·606	S.E.	N.N.W.	N.W.	—	19	20·4
3.10 "	·081	—	—	S.S.E.	—	—	—	—	—
3.20 "	·062	—	—	S.S.E.	—	—	—	—	—
3.30 "	·058	—	—	S.S.E.	—	—	—	—	—
4 "	·062	·596	·645	S.	N.N.W.	N.W.	—	12	17·0
4.30 "	·124	—	—	S.S.W.	—	—	—	—	—
5 "	·165	·640	—	S.W.	W.N.W.	—	—	11	—
5.10 "	·184	—	—	W.	—	—	—	—	—
5.20 "	·216	—	—	W.	—	—	—	—	—
5.35 "	·266	—	—	W.	—	—	—	—	—
5.50 "	·358	—	—	—	—	—	210·6	—	—
6 "	·441	·682	—	—	W.N.W.	—	—	13	—
6.10 "	·487	—	—	—	—	—	17·1	—	—
6.20 "	·537	—	—	—	—	—	—	—	—
6.30 "	·590	—	—	—	—	—	19·5	—	—
7 "	·650	·712	—	—	W.N.W.	—	29·3	16	—
8 "	·670	·748	—	—	W.N.W.	—	28·3	18	—
9 "	·696	·781	—	—	W.N.W.	—	18·2	10	—
10 "	—	·790	—	—	W.	—	—	13	—

The Telegraph Master at Chittagong, Mr. Burke, who is also the meteorological observer, gives the following account of the storm and of the difficulties which he experienced in taking the observations :—

"On the evening of the 31st, at 16 hours, the direction of the wind had been N.E., but at about 9 p.m. it had veered round to N.W., and again when the first observation was taken it had gone round to E.N.E. At 9 p.m. the wind was not high, but would be called a pleasant breeze.

"At 0·30 hours I was required in office, owing to failure of telegraphic communication with Akyab. The wind at this time was very high and from a north-easterly direction. An observation was made of the barometer at 0·45 hours and the readings obtained reported by telegraph, immediately after which there was a total interruption to communication on both sides, and the further observations made could not be wired. It was also raining very heavily, and the rain carried by the high wind had wet all the instruments in the meteorological shed, so much so that water was running out at the bottom of the cage.

"I endeavoured to obtain readings of the dry and wet bulb thermometers, but owing to the fine spray by the dashing of the rain against the instruments and the motion of the water running down the tubes, I was unable to obtain one in the short time that the

lantern could be kept lighted. But the reading of the dry and wet bulb thermometers could not have differed, as they were equally wet.

"The same difficulty attended the reading of the anemometer, which, from its position on the roof of the building, was exposed to the full force of the storm and driving rain. After a number of unsuccessful attempts, owing to the lantern being blown out, and the difficulty of retaining my position at the edge of the parapet, a reading was obtained.

"At 1.45 hours the force of the wind had increased so much that the meteorological shed was in danger of being blown down; the instruments were therefore removed and brought into the office.

"At 2.45 hours another reading of the anemometer was made, but the force of the wind was so great as to prevent anything like accuracy in this observation. It was with great difficulty that I retained my position on the roof of the building, nor could the lantern be kept lighted more than a second or two when held up to throw light on the wheelwork.

"At 3.30 hours the masonry wall of the office, a pucca building, began to be shaken, the plaster falling off all parts. To save them from destruction, the clock and telegraph instruments were removed. I was about to remove the barometer also, (the wall above it showing signs of bulging in, when a piece of plaster about 10 square feet fell in, leaving the barometer uninjured. The position of the instrument then appearing to be safe, it was allowed to remain, and the observations continued at 10 minute intervals, as well as I could guess, there being nothing to show the time. At 6 hours I got time again and continued the observations regularly till the barometer rose again to its normal height.

"At 5.45 hours I observed that the feather of the arrow of the wind vane had been wrenched off. The exact time that this happened I am unable to state with certainty, but it appears to have been just about this time, for the index, which before that had been pointing to 24, suddenly swung round from 24 to 8, or just a half circle."

The barometric observations in the table are corrected for temperature. The height of the cistern of the barometer above mean sea-level at Saugor Island is six feet, at Calcutta, 18.1 feet, and at Chittagong 90 feet.

The lowest observed reading of the barometer at Saugor Island was 29.475 at 8 p.m., when the storm centre was at a distance of 150 miles to the E.S.E. The lowest observed reading at Calcutta was 29.514 at 1 a.m. Calcutta was at the same distance from the storm centre as Saugor Island. The difference of the lowest readings (reduced to sea level) is .051. The total fall at either station was not very great; the fall at Saugor Island from 8.20 a.m. to 8 p.m. was .239 inches, and at Calcutta from 1 p.m. of the 31st to 1 a.m. of the 1st .170 inches. Thus, even before its arrival at the mouth of the Megna, the land action on its outer limits was slowly diminishing the strength of the cyclone, whether measured by the total barometric fall or the rate of fall before the nearest approach of the storm centre. Chittagong was 35 miles from the storm centre at 3.30 a.m., when it was passing over the islands of Hattiya and Siddhi. The lowest reading of the barometer reduced to sea level was 29.148 at 3.30 a.m.; it fell from 29.373 at 0.45 a.m. to 29.152 at 3.20 a.m., or .221 inches in two hours and a half. It continued at nearly the same height for forty minutes, or until 4 a.m., after which it increased very rapidly. The reading at 6.30 a.m. was 29.680 inches, giving a rise of .528 inches in two and a half hours after the time of nearest approach of the storm centre. The barometer thus rose between two and three times as quickly as it had fallen—an additional proof of the fact that has been already stated, the rapidity with which the storm was broken up after 4 a.m. and also showing, as I believe, that a considerable part of the diminution of pressure during the cyclone is due to the actual motion of the air. The wind velocities recorded in the table give the actual motion of the air indicated by the anemometers between the time for which the velocity is given and the preceding observations.

The wind velocity at Saugor Island was highest between 8 p.m. and 10 p.m., or immediately after the lowest reading of the barometer. The average wind velocity at Chittagong between 2.45 and 5.45 a.m. was upwards of 70 miles per hour. From 6 a.m. to 7 a.m. the mean velocity was 58 miles per hour, and after this it decreased very rapidly. The amount registered between 7 a.m. and 8 a.m. was 28.3 miles, and between 8 a.m. to 9 a.m. was only 15.2 miles.

CHAPTER V.—THE STORM-WAVE.

The cyclone whose origin and path have been discussed in the preceding pages will long be remembered for the unprecedented loss of life, due to the flood of waters poured over the islands at the mouth of the Megna by the storm-wave which accompanied it.

The accumulation of water at and near the centre of a cyclone is produced by a combination of causes, the most powerful of which in this case was probably the diminished air pressure. This alone would account for a rise of from one or two feet over an area upwards of 400 miles in diameter. The vorticose motion of the atmosphere in cyclones also undoubtedly tends to give a similar movement to the water over which it is circulating. The logs of the "Allahabad," "Lightning," and other vessels show that during the cyclone there were strong north-east and south-west sea currents on opposite quadrants of the cyclone, the former of which, near the head of the Bay, was probably the stronger of the two for evident reasons. This motion, vorticose in its character, would necessarily tend to pile up the water in the central area of calm. The head due to the two causes might amount to three or four feet. This mass of water advanced with the storm, and the energy stored up in it as potential energy represented a considerable amount of the mechanical energy due, as a secondary effect, to the enormous heat given out in the process of condensation over the area of rainfall in the Bay. In the case of the Backergunge cyclone, this piled-up mass of water advanced under the pressure of the acting forces towards the head of the Bay as a storm-wave at the rate of at least 20 miles per hour, and reached the shallows near the entrance of the estuary of the Megna without any change of form or character. The friction from the shallow bed then began to act rapidly and retarded its progress. The storm-wave, under the action of this suddenly encountered and increasing resistance, rapidly accumulated over the shallows near the mouth of the river. It was also, over the same area and to the north, opposed by the fresh waters of the river seeking for an oceanic outlet, and tending to advance southward under the pressure of the continuously accumulating mass brought down more rapidly than usual by the action of the northerly winds in Bengal and easterly winds in Assam. These two vast and accumulating masses of water opposed each other over the shallows of the estuary. During the struggle and contention for mastery there would be for some time a very considerable piling up of the waters immediately to the south of the islands, the land-marks of the shallows stretching to some distance southwards. This accumulation would be followed by the inrush of the larger and more powerful mass of waters forming the storm-wave, driving back the river water and advancing first in the form of a wave, carrying all before it. The character and extent of the inundation in such a case depend upon a variety of causes, and would present very different features at different parts of the estuary. The magnitude of the storm-wave, the size of the river, the wind direction and changes of direction, and the relation in time of the storm-wave to the ordinary tidal wave, must all be taken into consideration.

Before tracing more fully the progress of the storm-wave of the morning of the 1st November, it will be desirable to describe briefly the character of the district near the mouth of the united Ganges and Brahmaputra, and the nature of the tidal action in the north-eastern angle of the Bay of Bengal.

The Brahmaputra, one of the largest and least known of the rivers of India, rises in the plateau of Thibet, and drains the northern flank of the Himalayas eastward of Lake Mansarawar; it brings down at all times a vast quantity of water, its volume has been computed at Goalpara at its lowest ebb to be 146,000 cubic feet per second, representing a mass of water covering 20 square miles to the depth of one foot per hour. The Ganges brings down an almost equal volume of water, and unites with the Brahmaputra opposite Goalpara. They are joined by the Megna, and the three united streams, known locally as the Megna, after a course of 100 miles, expand into a noble estuary, studded with large islands, which form three lines, stretching north and south, between which and the mainland the river finds its way to the sea. The most westerly of these three lines of islands is formed by the islands of Badura and Dukhin Shahbazpore, separated from the mainland of Backergunge by the Tetoolia River. In the centre are the islands of Nalchira and Hattiya, separated from Dukhin Shahbazpore by the Shahbazpore River, and from the third and most easterly line of islands, consisting of Sundip and Siddhi, by the Megna and the Hattiya Rivers. The Sundip Channel lies between the mainland of the Chittagong district and the third line of islands. The Shahbazpore and Megna Rivers are the chief exits for the fresh water brought down by the united streams. The Sundip Channel, on the other hand, plays the part of a waste-water reservoir or side channel, and its waters are always more or less brackish. The surface

rises and falls with the tide, but the amount of fresh water brought down by it is always small.

The islands at the mouth of the Megna are all extremely low, and are merely the crests of an extensive and increasing alluvial deposit at the mouth of the estuary. They are formed chiefly from the *detritus* of the Himalayas deposited over the area in which the tidal and the river waters wage incessant warfare, alternately displacing each other. The following account, taken from a paper given in the "Statistical Reporter" for May 1876, describes the growth and colonization of these island accretions at the mouth of the Megna:—

"The fluvial and tidal action by which the district of Noakholly has been formed is still at work. New churs and islands appear, Degi churs as they are called, land which is under water at high tide and is visible during the ebb. These island formations gradually emerge from the water, and as soon as they cease to be overflowed by the tide, an engagement for the land at a nominal rent is entered into as a venture. When the grass and bush spring up, wild men, speaking a barbarous *patois*, come down to pasture large herds of cattle on the young herbage, putting up sheds for the beasts, they themselves bivouacking in the open. The person who has made his venture on the land now compels the cattle owners a grazing rent at so much a head a year for their cattle, and a rent for cutting fuel is taken. In course of time as the land becomes fit for the plough, the person settling for the land will get a man of energy, if not of substance, to take charge of the cultivation of as much land as possible, and will give him a lease for a number of years. This man, the pioneer of cultivation, and afterwards often a leader of a colony of resident cultivators, will induce non-resident ryots from the neighbouring districts to plough and sow the lands, and the crops will be watched and harvested from temporary huts, and the grain carted away to their permanent holdings. As time progresses and the land improves, and the cultivation is permanently extended, ryots are induced to settle on the land and become residents. They dig large tanks for fresh-water supply and raise high mounds for foundations for their homesteads in the low country (which is intersected by numerous watercourses), and plant them round with betel, cocoanut, and date palms, plantains, mandar and other trees. Thus they settle with their families, and in a generation or two the new formation has become like the rest of the district."

The tidal wave in the Bay of Bengal advances most rapidly in the deeper and central portions. The crest of the wave, which to the south of the Bay is almost a straight line running north-west and south-east between the south coast of Ceylon and the southern coast of Java, gradually becomes more and more curved as it advances northwards. The crest at the head of the Bay is convex to the shore, and the central and more advanced portion of the tidal wave travels from south-west to north-east. It thus reaches the estuary of the Megna later than any other point of the coast. The tidal current is at that time proceeding in a north-easterly direction. At and near the estuary of the Megna it meets with several channels bringing down large quantities of fresh water, and separated by long lines of low islands, which are only the highest portion of a shallow area of considerable extent. The advancing tide meets this mass of water at an obtuse angle. The action of the two opposing masses of water is somewhat complicated. The tidal wave passes onwards, slightly deflected, towards the Chittagong coast, and the fresh water in the main channels—the Shahbazpore and Megna Rivers begins to accumulate over the shallows instead of passing seawards. Thus for some hours after the tide has turned, the fresh water continues to flow down in the upper portion of the estuary, and accumulates in the channels lying between the islands, whilst the advancing tide passes onwards to the Chittagong coast and is there deflected up the Sundip Channel. Thus, on ordinary occasions there is an accumulation of salt-water in the Sundip Channel and of fresh water in the other channels—or, in other words, a salt-water tide and a fresh-water tide. The meeting place of these tides is in that portion of the Sundip Channel (sometimes called the Baumni Channel) to the north-west of the island of Siddhi and south of Noakholly. Again, when the tide is more than usually strong, as at full moon, or under the influence of a strong south-west wind, or when the river is heavily flooded, the opposing masses of waters accumulate more rapidly than usual over the shallows to the south of the islands, and then the phenomenon of the bore is produced. But whenever this occurs there are always two bores—a salt-water bore, or rush of salt water up the Sundip Channel, known as the Chittagong bore, and a fresh-water bore up the remaining channels, and called by the natives the *daula* bore. These bores, like the ordinary tidal waves, meet to the north of Siddhi. On the east, therefore, of this line of meeting and of the eastern line of islands, is the region of salt-water tide and tidal bore, and to the west the region of fresh-water tide and bore. When

the conditions for the formation of the bore are peculiarly favourable, it advances as a wall of water stretching across the channels several feet high, and is so dangerous that the native boatmen will under no circumstances venture out into the river when it is expected. As the rapid piling up of the water on the shallows which produces the bore is partly due to the retardation of the advancing tide by the shallow banks of the estuary, and partly to the opposition of the tidal and river waters, it occurs in its most violent form during exceptionally high tides, as at the equinoxes, and also when the south-west wind adds to the height of the tidal wave.

Any other action in the Bay of Bengal which tends to produce a similar accumulation of sea water at the mouth of the estuary will, if sufficiently rapid and large, be accompanied by exactly similar phenomena. Hence the piled-up mass of water at the centre of the cyclone would, by its advance in the same direction as the tidal wave, necessarily produce a salt-water accumulation of water and a bore in the Sundip Channel, and a fresh water accumulation and bore in the remaining channels.

The above explanation will make clear the phenomena of the great flood on the morning of the 1st of November over the low land at the mouth of the Megna. It was due to an unusually high tidal wave followed by the storm-wave of the advancing cyclone, and was intensified by the violent north wind which prevailed from 10 p.m. to 3 a.m. and brought down the river water more rapidly than usual, and by the south-west and west winds which immediately followed and impelled a further portion of the storm-wave into the converging water area of the estuary. It was full moon on the evening of the 31st, and there was an abnormally high tide, which flooded all the low lands along the coast of the head of the Bay. At False Point on the morning of the 31st the tide rose two and a half feet higher than on any previous day of the year, and on the same night it rose still higher, and was three feet above the top of the bund enclosing the lighthouse. In the estuary of the Megna the tide was also unusually high. The advancing cyclone tended to accumulate the salt waters at the head of the Bay. High water took place at Chittagong at 0.30 a.m. of the 1st. The usual tidal bore at full moon occurred about an hour and a half before high tide in the channels, and was followed by an inundation of the lower grounds of the Chittagong coast and the islands in the estuary. This flooding of the low lands, which took place at 11 a.m. at the entrance of the river, was due mainly to the advance of a higher tidal wave than usual, but was probably intensified by the northerly wind blowing down the river. The inundation was a salt-water one along the Chittagong coast and in the islands of Sundip and Siddhi; over the low lands of the remaining islands and the Backergunge district it was of fresh water. The direction in which the water advanced in the various districts depended, of course, on their height and position with respect to the nearest water. That the inundation, as has been stated, came mainly from the north and north-east is simply impossible. The wind and the ordinary waves at the time were from the north and north-east, but the mass of water which caused the flood came from the south, driven forward by the advancing tide, and produced either a salt or fresh water inundation in strict accordance with the ordinary phenomena of high tides in the Megna, which have been already explained. This first inundation did little permanent damage, and was not attended by any considerable loss of life. A few persons, it is believed, were drowned, but this is no uncommon occurrence in these islands at high tides.

The pressure of the advancing storm-wave prevented the tide from ebbing and the tidal inundation from flowing off. The storm-wave, like the ordinary tidal-wave, was retarded on the shallows at the entrance of the river. It accumulated there, and finally overpowered the mass of fresh water brought down by the Megna, which had been unable to find an exit seawards for the previous six or seven hours. It then rushed forwards as a salt-water bore up the Sundip Channel and as a fresh-water bore up the other channels. Mr. Porch's account of the inundation, which seems to me to be thoroughly consistent and intelligible, states that this second and greater inundation occurred at the entrance to the estuary, or at the southern extremity of the islands of Nalchiri, Badura, and Sundip, at 3 p.m., when the vast mass of water, gradually advancing northwards, flooding the whole area of the islands to a depth varying from 10 to 45 feet. It is very doubtful whether the inundation consisted mainly of a succession of vast waves, each moving forward with irresistible energy, sweeping away houses, trees, and human-beings before it. The excessive violence of the wind from the north-east, which was a marked feature of the cyclone, undoubtedly overturned the majority of the trees, and the direction in which they lay indicates the wind, and not the flood direction. The fact that the crops were only slightly injured by wind and flood, except in the most exposed parts, is utterly at variance with the statements of advancing waves from 20 to 60 feet high. There was undoubtedly a rush of water or

bore up the channels, but, with the exception of this, the water rose slowly and supplemented the earlier inundation. The tidal-wave had gradually and partially covered the crops in the more exposed districts. This shielded them from the excessive violence of the winds, and the later inundation was not accompanied by a violent rush of waters sufficient to inflict any considerable damage. Mr. Smith, Commissioner of Chittagong, does indeed say that along the Chittagong coast the wave swept everything before it, passing over the face of the country in a body of water 12 feet high. There is no statement of the time at which this occurred, and all that it appears to establish is that there was an inundation preceded by a bore-wave of some magnitude up the Sundip Channel. Mr. Peacock, Commissioner of the Dacca Division, after visiting the islands of Dukhin, Shahbazzpore, Badura, and the mainland of Backergunge, says:—"It seems almost incredible that the crops should neither have been levelled by the wind nor torn up by the rush of water over them." The reports of all who visited the wave-stricken districts concur in showing that in the area of fresh-water inundation the damage inflicted on the crops was marvellously small, taking into account the violence of the storm and the rapidity with which the flood waters advanced over them. It is impossible to reconcile the fact of the slight injury inflicted on the crops with the passage of huge waves 20 and 25 feet high, and until very much stronger evidence is forthcoming than the testimony of the natives of the district, who were at the time in peril of their lives, amidst a blinding rain and a wind of almost unparalleled violence in Bengal—men who are, moreover, unaccustomed to accuracy either of measurement or of statement—the accounts that they give, affirming that the inundation consisted of a succession of huge waves, carrying all before them, must be rejected as a very inadequate view of the actual phenomena. Mr. Porch's explanation is consistent and satisfactory, and is partially confirmed by some rough notes sent by Mr. Barton, Magistrate and Collector of the Backergunge district.

The phenomena of the bore certainly occurred twice, and may have occurred thrice, during the storm. The first bore was at 11 p.m., and preceded high tide; the second was about 3 a.m., occurring immediately before the arrival of the cyclone centre; the third, for the existence of which the evidence is not quite conclusive, may have occurred with the change of wind from north to north-east to south and south-west, after the passage of the cyclone vortex. Each probably consisted of a succession of waves, and was introductory to further inundation. The first wave, at 11 p.m., and the accompanying flood was the least violent in character. It covered the rice and other crops slowly before the wind had become very violent in the more exposed parts near the seashore, and thus prevented the wind from breaking down and destroying the crops, and the succeeding more violent rushes of water from tearing them up. Thus, in the districts which suffered from the fresh-water inundation, little permanent injury was done to the crops, the amount of loss in the majority of cases being less than one fourth. In Chittagong, the eastern portion of Sudaram, and the islands of Siddhi and Sundip, where the inundation was of salt water, the effects were much more disastrous. These consequences, the most serious of which were the almost entire destruction of the crops by the action of the salt water, the prolonged contamination of the atmosphere due to the slowness of decomposition in salt water, the temporary deterioration of the land by saline absorption, and the subsequent origin and rapid spread of epidemics amongst the surviving population, are very clearly pointed out in Mr. Porch's account (page 61).

Along the Backergunge coast and the islands of Dukhin, Shahbazzpore, Badura, Manpoora, and Hattiya, the inundation everywhere consisted of fresh water, except at places very near the coast, where it was very slightly brackish. The waves and inundation began at 11 p.m., and the water continued to rise until about 4 a.m., when it began to subside. The greater portion of the flood water flowed off before 8 a.m. At that time, even in the districts where the depth of the flood-waters had exceeded 40 feet, there was only from one to three feet of water left. The main body of the flood-waters thus retreated even more rapidly than it had advanced.

In the Rabunbad Islands the inundation was from 30 to 45 feet deep; the water here came in directly from the south-west. These islands, which are very low and more exposed than any other of the districts at the mouth of the Megna, suffered most severely. The flood was higher than over any other part of the wave-stricken area, and swept off 75 per cent. of the population; the trees were blown down and fearfully torn by the wind, and left leafless.

The Golachipa thana was to a considerable extent protected by the Rabunbad Islands which lay to the east and south-east. The waves here came from the open river to the north-east, pouring in until the accumulated waters reached a height of from 15 to 18 feet. The crops were very slightly injured, and are standing, to quote the Collector's

words, "in spite of storm-wave and wind. From two to three annas of the Agrahan "paddy was injured, the rest being a very good crop."

In Badura and the southern portion of the island of Dukhin Shahbazzpore the storm-wave poured in a flood varying from 15 to 25 feet high, and came directly from the west and south-west. It was therefore here due to the direct thrusting back of the large accumulation of fresh water at and near the mouth of the estuary and to the south of the islands. At the village of Dowla, in the island of Badura, the inhabitants state that the waves came from two directions—first, from the north-east, during which the water rose slowly, and afterwards with a rush from the west and south-west. The comparatively slow inundation was probably due to the gradual accumulation of the river waters, held back at the mouth of the estuary by the advancing mass of water forming the storm-wave proper, but driven down in the upper reaches of the estuary by the fierce north-east wind which blew from 11 p.m. to 3 a.m. The latter part of the inundation—the violent rush from the south-west—was evidently due to the forcing back and lifting up of the mass of fresh water piled up near the estuary by the immediate pressure of the storm-wave and cyclone, and further assisted after 3 a.m. by the wind, which then changed to south-west. In the northern half of the island of Dukhin Shahbazzpore the flood-waters poured in mainly from the north-east. During the early part of the storm this was due to the same causes as have been advanced to explain the north-east wave in the southern portion of the island. The bore and flood-waters at 3 a.m., due to the approaching accumulation at the storm vortex, would advance more rapidly up the channel than over the island itself. Consequently, due to the greater friction of the land, the main body of the flood-water would pour in from the upper half of the wide channel of the Shahbazzpore River, and thus came from the north-east, as was undoubtedly the case at Dowlutkhan.

The island of Manpoora, to the south-east of Dukhin Shahbazzpore, was one of the districts that suffered most severely. It also appears to have had a slow flooding from the north, followed by a more rapid inundation from the south-west. The flood waters were here 40 feet deep, and carried away 52·5 per cent. of the whole population, of whom the larger proportion were women and children.

The following extracts from the report of the Commissioner of the Dacca Division give fuller details of the loss of life and destruction of crops over this portion of the wave-stricken area:—

"The sub-division of Perozapore escaped the storm-wave, though some damage was done by the cyclone. A good many houses were blown down, and the Deputy Magistrate informed me that about one eighth of the crops had been injured. From what I could see, however, I think this is rather a high estimate.

"Leaving Perozapore at 11 a.m. on Monday, the 13th, Mr. Barton and I proceeded straight to the sub-division of Patuakhally, which we reached the next morning. The place is a perfect ruin, not a single hut having been left standing. The residence of the Sub-divisional Officer, his office, the Moonsif's cutcherry, the school, the lock-up, the police outpost, the sudder distillery, and the dispensary have all shared the general fate. Notwithstanding the complete destruction of the place, only one life was lost, an old woman's, who was killed by the falling of a house. The crops have been but little injured, the bazar was being supplied as usual; there was no distress, and no unusual amount of sickness of any kind. I may add that the whole of the damage was caused by the wind, the storm-wave not having penetrated so far inland.

"From Patuakhally we proceeded to Golachipa thana, the jurisdiction of which extends over about 800 square miles in the south-eastern portion of the district, and which, from its exposed position, we knew had suffered as severely as any place, not even excepting the island of Dukhin Shahbazzpore. On our arrival we found that the reports that had reached us had not been exaggerated. Three storm-waves of from 15 to 20 feet high have swept over the place, literally levelling it with the ground. Not a single hut and hardly a post was left standing, while large mandar trees and whole clumps of bamboos torn up bodily by the roots sufficiently testified to the overpowering force of the wind. It is as yet too soon to attempt to compute with anything like accuracy the loss of life which has occurred.

"From inquiries made man by man among a miscellaneous crowd of persons from Golachipa and the neighbouring villages, we ascertained that out of the total number of which their families had been composed, 41·55 per cent. had perished.

"The loss among the cattle has also been very great; I should think not less than 80 per cent.

"Amidst all this misery it is satisfactory to notice that the crops have suffered far less than would be supposed. I do not think that hereabouts the amount of damage

done will exceed four, or at the most six, annas, and this, it must be remembered, out of an exceptionally good crop.

"From Golachipa we proceeded still further south to the Rabunbad Islands, amongst which we visited Korulia, Burra Bansdia, and Kujul churs. Here the havoc committed by the storm was very much the same as that at Golachipa, except that, if possible, it was greater, the very *bhitas* (i.e., the wooden piles on which the houses are built) of the houses having been broken down. The storm-waves, judging from the drift that clung about the few trees that were standing, must have been more from 20 to 30 feet high. The loss of life has been consequently greater here than at Golachipa. The result of inquiries made by ourselves from house to house in the three churs above mentioned was as follows:—In Korulia, out of 296 inhabiting 34 houses, 225, or about 75 per cent; in Burra Bansdia, out of 146 living in 19 houses, 98, or 67·12 per cent., were dead; while in Kujul, out of 21 persons composing five families, we only found four alive. Very much the same result was obtained by the relief officer on chur Rangabolia, another of the same group of islands, where the per-centage of deaths was 76. Very few cows or bullocks have escaped. In chur Bansdia, in one house I counted nine, the property of three or four different persons; but I do not think I counted half a dozen more during the whole of my walk about the island, extending over upwards of two hours. Mr. Barton's experience on chur Korulia was exactly the same. Buffaloes being strong swimmers had fared better, but even among them the loss has been very considerable.

"Here, too, we found that the crops had been more extensively injured. In Bansdia the outturn will, I think, be about 6 or 7 annas, in Korulia 8 annas, and in Kujul 10 annas. There was a good deal of jungle about the last, and this to some extent protected the crops, and accounts for their being better than those on the neighbouring islands. The people all had rice in their houses, but it was all more or less damaged, though quite eatable, and the stocks were not large.

"The next place visited was Dowla, on the western side of the island of Badura, to the west of Dukhin Shahbazpore. This had apparently suffered somewhat less than the Rabunbad Islands; the mortality, according to inquiries at 20 houses, being 44·36 per cent.; the crops, too, were better, and we estimated the outturn at from 10 to 12 annas.

"Rounding the northern extremity of Badura, we then proceeded south down the Gayar River, landed at chur Shumbhoopora, on the west part of Dukhin Shahbazpore. The crops here are worse than we have found them anywhere, and I do not think the outturn will be more than six annas.

"From Shumbhoopora we proceeded across the Megna to the island of Manpoora, which we reached at 10.30 of the morning of the 16th instant. Manpoora is another of the places which experienced the full force of the storm, and where consequently the mortality has been great, though not so great as in the Rabunbad Islands. Our inquiries showed that in 102 families, consisting of 1,013 persons, 532, or slightly over 52 per cent., had been drowned. Considering what they were exposed to, the crops here are wonderfully good. The early *amun*, sown over about $\frac{2}{16}$ ths of the cultivated area, and now being cut, will not yield less than a 12-anna crop, while the *chuplas* and *banspati* rice, sown over $\frac{6}{16}$ ths and $\frac{8}{16}$ ths of the cultivated area, will yield probably a 10-anna and a 9-anna crop respectively.

"Leaving Manpoora we re-crossed the Megna, and landed first at the village of Kosnudee, and then at Tozumuddin, both on the east coast of Dukhin Shahbazpore. The former is in a very exposed position, and our inquiries showed that out of 114 persons, comprising 10 families, 46, or 40·35 per cent., have been swept away. The *aghani* crop is fair, and will yield about 10 annas; the later rice appears to have been more injured, and will probably not be more than a five or six anna crop.

"The next place visited was Dowlutkhan, the head-quarters of the Dukhin Shahbazpore sub-division, where we met the District Superintendent, Mr. Harris. While coming up the khall from the river, a distance of between two and three miles, I counted no less than 76 corpses, though this was the 17th day after the storm. The station is a complete wreck. The sub-divisional buildings, the Moonsif's cutcherry, the school, the thana, the lock-up, and the sudder distillery, have, together with the whole bazar, been levelled with the ground. The population being a floating one, it is impossible to attempt to estimate the loss of life that has occurred, though this must necessarily have been very large.

"The following is, I believe, a complete list of the Government officers and servants who have lost their lives:—Moonsif, rural sub-registrar, native doctor postmaster, court sub-inspector, abkaree darogah, two abkaree burkundauzes, seven constables, a mohurir of the moonsif's court, and a post office peon. Mr. P. M. Gasper, a zemindar,

and eight members of the family of the Deputy Magistrate have been drowned, besides many hundreds in the bazar itself. Up to the 17th nearly 250 corpses, in a fearful state of decomposition, have been drawn out of tanks or extricated from the *débris* of houses in the bazar itself and its immediate neighbourhood, and floated out into the river. Many more must have been swept away altogether, and there are undoubtedly many still undiscovered among the ruins of the place. The atmosphere is in many places simply poisonous; and it is wonderful that some epidemic has not broken out among the people. Most of the tanks are full of decaying matter, animal and vegetable, and it is hard to conceive anything more sickening than the smell arising from them.

"The crops about Dowlutkhan are much the same as those we saw about Kosnuddee and Tozumuddin; the *aghani* rice will be a 10 to 12 anna crop, the *aus* from 6 to 8 annas.

"From Dowlutkhan we proceeded up the east coast of the island, landing at Goneshpoora, in the north-east corner of it, to inspect the crops, which are much the same as at Dowlutkhan. From thence we went to Bholā and Ruttunpore, places situated respectively about four and six miles inland on the north-western part of the island. Here there had been hardly any storm-wave, and no loss of human life, though a few cattle had been drowned.

"Our next point was Bowful. Hardly a single kutchā house has been left standing, and though the storm-wave was not nearly so high here as in the Golachipa thana, Dukhin Shahbazpore, and Manpoora, the loss of life has been very great. About one fourth of the entire area of the thana, 194 square miles, was subjected to the fury of the storm, and the deaths in this portion of it, roughly estimated to contain between 27,000 and 28,000 people, are computed to be about 7,000.

"The last place visited was Kujlakatty, in the Backergunge thana, where there has been considerable loss of life and destruction of cattle, though nothing so serious as in many other places.

"There are two most providential circumstances about the late storm—*first*, that the crops were not utterly destroyed; and, *secondly*, that the storm-wave, or rather succession of waves (for there were three), was composed of fresh and not of salt water. It seems almost incredible that the crops should neither have been levelled by the wind nor torn up by the roots by the rush of water over them. At first I was inclined to think that, as for some time before the waves came the water had risen steadily, they might have been merged before the former passed over them, and had not thus felt the violence of an immense volume of water being suddenly thrown upon them. But this theory, it is clear, can only apply to places over which the storm-wave or waves passed, while the crops are standing just as well in places which only experienced the force of the wind. In some places, no doubt, they were protected to some extent by surrounding belts of trees and jungle, but in many others I saw wide plains of miles in extent which had no screen of this kind. Whatever may have been the cause, it is certain that the crops have not been laid, and in this fact lies mainly the removal of anxiety as to the condition of the people. With regard to the second point, the water being fresh no injury has been done to the land, except possibly from a small deposit of sand upon it, and even this we saw nowhere. Instead, too, of all the tanks being made brackish and undrinkable by an infusion of salt water into them, we found no place where there was any want of drinking water, notwithstanding that so much of it has been contaminated in other ways. The calamity is bad enough as it is, but had the above circumstances not attended it, or had it occurred a month or two earlier in the year, it would have been infinitely worse."

Mr. Poreh, Collector of Noakholly, thus describes the inundation in his district:—

"The inundation, the direct effect of the cyclone, was the cause of the catastrophe here. I therefore beg to offer the following observations and local experiences on the subject of the inundation. A map is sent herewith to illustrate the subject further. (This is included in the map of the wave-stricken districts.—J.E.)

"This part of the country, from its lowness and exposed face, as gradually formed towards the south in the Bay of Bengal, has always suffered from time to time from inundation. The tides at full moon and new moon and the equinoxes produce inundation sufficient to destroy the crops over large areas when there is a wind from the south in either quarter, and there is thus a conjunction of wind and wave. According to the time, duration, and direction and strength of the wind at these junctures the inundations assume fearful dimensions. On this subject I beg to refer you to the closing paragraphs of an article on Noakholly at page 340 of the "Statistical Reporter" for May 1876:—

"A remarkable feature of the Noakholly district is the *bore* or tidal wave that traverses the channels leading into the Megna. It makes all the water dangerous at times from the Bhowanigunge khal to the east coast of the Sundip Channel. At every full and new

moon, especially at the time of the equinoxes, the bore lasts for some days before and after, and has to be carefully reckoned with by those whose business is on the water. The tide as it runs up the Bay is confronted by Sundip and Hatiya and the churs between, and the current is divided. The main current speeds away to the right up the Fenny river, and the remainder round by the coast to the west, where, north of Hatiya, it is met by the left or counter-current, which, after swerving round Hatiya, has been deflected in that direction by the west coast. The united volume of water rushes on like a white wall from 14 to 20 feet in height, at a pace of about 15 miles an hour, until exhausted at the eastern limit above the Bhowanigunge khal, as far as Raipur on the Dacootia. The bore is the creation of the churs; but besides this there are whirlpools occasionally formed, and strong eddies and rushes of water are encountered in the channels about the islands in bad weather, especially when there is a strong southerly wind at the beginning and at the end of the rains. The water is then sometimes blown in a heap and rolled miles in on the islands and on the mainland.

“Nulchira, on the south of the island of Hatiya, suffers periodically from an inundation of salt water. It is the south-east wind for the most part that brings the salt flood on the islands and kills the crops.

“The south-west hurricanes during the equinoctial gales do much damage. In the cyclone of November 1867 the storm-wave swept right over the island of Hatiya from end to end, a distance of about 25 miles.’

“The left-hand or western tide—the Daula—is composed of rather fresh water and makes first. The right-hand or eastern tide—the Chittagong tide—is the stronger and is entirely salt, and goes round the Sandip Channel somewhat after the Daula or western tide. When the wind is in the east, or more especially south-east, the Chittagong tide floods the east and south-east coast with a salt inundation.

“This occurred at about 11 p.m. on October 31st, when all the people of the east and south-east coasts of Sundip, Hatiya, Bamni, and Sudharam thanas were put in great danger and had to get on the roofs of houses and up into trees for safety. Very little loss of life has been ascertained to have occurred then from the salt inundation from the east at the “flood-tide and bore-time” before midnight. The naib of Nilakhyi (Bhulua estate), in Hatiya, and his family were drowned at this time in four feet of salt inundation, it appears, by their house falling upon them and pressing them down into the water. Some people whose boats were wrecked at this time were drowned then also. In these coast parts people remained aloft all night on trees and house-tops or floating roofs or similar things, owing to this inundation from the east. It was this commotion in the water from the east that, with the bore, wrecked Mr. Higgins’ boat when the wind had veered from north-north-east to the east and south-east. This was a truly critical time for the station of Noakholly, but the wind changed quickly from south-east to east and north-east and kept the water off. After that the wind blew from about 3 or 3.30 a.m., or after, from the south-west and west (below the Megna across the islands), and drove ahead all the fresh water and diluted salt water of the Daula tide heaped up in the channels of the Megna by the wind blowing from the north and the tide pressing in from the south. The south-west and west wind lifted up all this water and drove it over the channels and the islands from the south-west to north-east at about 3 a.m. or 3.30 a.m., or 4 a.m., according to locality, carrying away almost everything in that direction, and thus inundated all South Noakholly, viz., the islands on the south and the mainland to the north up to the dotted line in the map (which corresponds nearly with the main road running across the district from Raipore west to Lalgunge east), except near the mid-Fenny tract, where from lowness and river-face exposure, the water was carried up further north by the wind and the tide. Here the bulk of the countless dead of all descriptions and *débris* of houses were swept up, but were again for the most part carried out to sea as the tide flowed back to the south and south-east.”

“Fortunately, the cyclone blew from north-east against the tide during most of the time the tide was flowing in (people felt themselves safe then). Towards the end of the ‘joar’ or flow-tide the wind turned, as before stated, and lifted up and carried the heaped-up half fresh water of the western channel over the exposed country, part of which had already suffered from the salt inundation from the east. It flowed on over islands, churs, channels, and became saltier as it went north-east, where it dashed in over the banks of the Fenny and the Chittagong coasts on the east.

“Had the cyclone, just as it blew, taken place four hours earlier, the station of Noakholly would, there is reason to believe, have had 20 feet of water over it, and the inundation would probably have reached the old factory road above Begungunge, Gopgunge, and Dewangunge. Along this line there are many very highly-embanked

tanks, probably made scores of years ago to meet a calamity of this kind, as the result of experiences that have long since been forgotten, but revived by this recent disaster; moreover, in that case the inundation would have lasted some hours longer, and the destruction of property and life would have been proportionately greater than it has been owing to the rapid subsidence of the flood, as the wind at Noakholly veering to the north at about 6.30 a.m., just after the turn of the tide, helped to carry off the flood, and then gradually fell. A consideration of the facts noticed about wind, tide and time, and physical features of the country make this seem probable.

"Looking at the line of very highly embanked tanks of great size along the old factory road, it would seem that, with a view to meet the calamity of a wide-spread salt inundation, such tanks were dug and embanked in former days, when the sea or river coast was many miles inland on the north. A cordon of the existing tanks along the lower road, the line of the recent inundation, should be highly embanked to supply fresh water to the coast people in case of a like visitation in future.

"As such cyclones may occur at these seasons, this part of the country will always be liable to flood by inundation, especially at the time of the equinoxes. The autumn flood in Kartik (October and November) will be most destructive in its after effects from its saltness, which will bring much cholera and other disease, and will destroy most of the produce. The spring flood in Jyesta (May and June) would be the highest probably, and would cause more loss of life by drowning, owing to the rivers and the estuary being very full then, but it would be a comparatively fresh-water overflow, much less brackish than the autumn flood, owing to all the fresh rivers converging on the Bay, and largely diluting the salt water; so that the after consequences of a flood then, with the rains immediately following, would be less disastrous to the country at large than the comparatively less volume of the salt inundation of the autumn.

"The great inundation at 3.30 a.m. in the south and at 4 a.m. in the north of the islands, and 5.30 a.m. at the station of Noakholly, was caused by the very high tide at the full moon with the Chittagong bore and the Daula bore, and was very much increased by the commotion caused in the Bay from the changeableness of the wind and probably from the previous stormy weather out in the Bay. This had caused inundations on various parts of the coast at about 11.30 p.m. of that night. The wind from the north-east in the first part of the storm had also driven down much of the fresh river water from the Megna and other rivers into the channels of the estuary, where it was heaped up by the pressure of the incoming tide, causing considerable inundations on the coasts of these islands. When the wind veered round to the south-west and west at about 3.30 a.m., 4 a.m., and 5 a.m., according to their position (at Nulchira, furthest south, it blew from the west at 3.30 a.m.), it forced this mass of water from the estuary of the Megna over the adjacent country and islands, causing an incursion of the river and the sea from the direction of the south-west to the north-east. This caused the destruction of property and calamitous loss of life. What saved the people and cattle from almost universal destruction over even a further area north of Noakholly was, first, the cyclone did not blow from south during the flood tide; it did not blow long from the south-west and west, and then only towards the end of the inflowing tide. The ebb soon came and the water run off. It occurred only two or three hours before daybreak, and there was clear moonlight then. It was full moon, so there was moonlight all night everywhere, except when the different localities were darkened by the storms of rain.

"From this it will be understood how that inquirers from survivors in Hatiya, Sudharam, and Bamni might hear that at one time in the night salt water came and inundated the houses and tanks, and that a few hours after a fresh-water flood came. At Hudrakhali, east of Sundip, at 11 p.m., by the east wind and heavy sea breaking in, four or five *gada* boats were loosed from their moorings and swept away with the men on board. People then had to climb up trees and remain there to save themselves until next day. One man stated:—'It was about midnight; the sea was very high and 'tossing about and coming in over the coast. I was up in a tree, and as the wind blew 'from the east and south-east, the water came rushing in, and with such force that I 'thought no place would be safe and nothing would be saved. I saw a large mass 'of water like the bore coming up the river as high as the tree I was on. I expected 'to be soon swept away by this water, but the wind suddenly came down from the 'north. It looked dark as it dashed against the wave, and both wind and wave stood 'still for a time opposed to each other, and the wave rose up to 60 feet high and then 'fell back, driven by the wind to the sea, and so I escaped.' It does not appear to be correct to speak of the flood (between 3.30 a.m. and 5.30 a.m., according to locality)

in the second part of the cyclone from the west as a 'storm-wave,' for the water came on advancing and rising like the tide. It was a regular inundation, and not a mass of water like a 'storm-wave,' or like 'the bore,' though it sounded something like the bore as it flowed in. It was a storm-wave in the correct sense of the word which wrecked Mr. Higgins' boat at 11.30 p.m., or midnight, during the first part of the cyclone, when blowing from the east and south-east."

The following extracts describing the character and extent of the inundation along the Chittagong coast are taken from a report submitted to Government by the Commissioner of the Chittagong Division :—

[*Will be found reprinted in extenso at p. 15.*]

The inundation of the Chittagong and Noakholly coast districts, and of the islands of Nulchira, Hatiya, Sundip, and Siddhi, was in one part fresh water, and the other salt water, with an intermediate region along the Noakholly coast, where the flood became more brackish towards the east.

The mainland of the Noakholly coast along the borders of the Megna to the west of Noakholly and Chur Sikander, and the islands of Nulchira and Hatiya, experienced only a fresh-water flood, whilst the area to the east of these, including the eastern portion of the Noakholly district along the Sundip and Fenny rivers, the Chittagong coast districts, as far south as the island of Kootubdia and Cox's Bazar, and the islands of Sundip and Siddhi, had throughout a salt-water inundation.

The reports given above, and the information supplied by Baboo Sreenath Ghose (p. 44) show that the inundation commenced about 11 p.m., and was due to the high tide. It was preceded in this part by the usual bore, the Chittagong (salt water) bore, which flooded the whole of the low-lying districts nearest the coast. This was followed by the greater inundation due to the storm-wave, which began from 2 a.m., and continued to pour in water until 6 or 7 a.m., according to the position of the district with reference to the cyclone vortex. It came on slowly at first in the more westerly districts, as in the Backergunge districts, but with the change of wind to south and south-west the flood waters were poured in very rapidly from 3.30 a.m. to 4.30 a.m. or 5.30 a.m. This second and further inundation was preceded and probably accompanied by large waves resembling the usual bore in character, due, first of all, to the storm-wave overpowering the accumulating waters at the mouth of the estuary, and afterwards to the change of wind driving up the waters into the confined channels of the estuary. There were thus probably three great rushes of water during the storm; the first, at 11 p.m., in advance of, and due to, the tidal wave; the second, between 2 a.m. and 3 a.m., preceding the arrival of the crest of the storm-wave at the entrance of the estuary; the third, between 4 a.m. and 5 a.m., produced by the action of the south wind pressing an additional portion of the mass of the storm-wave into the confined channel of the Megna, and causing a further increase of the inundation. These appear to be the three waves or rushes of water which Mr. Smith, the Commissioner of Chittagong, describes as occurring along the Chittagong coast. The character of the inundation at the various parts of this area is intelligible by taking into account the action of the accumulating river-water in the estuary, the tidal wave at midnight, the cyclone wave, the crest of which advanced with the calm area at a rate of about 20 miles an hour, and reached the entrance to the estuary at 3 a.m., and the change of wind from north-east to south-west over the greater part of the estuary with the passage of the storm centre.

Along the Chittagong coast the flood-waters came entirely from the west and south-west. In the more southerly of the islands, including Sundip, Nulchira, and South Hatiya, the inundation came mainly from the south-east. This direction was partly determined by the wind direction on the eastern quadrant of the cyclone, and partly by the north-eastward motion of the advancing mass of the storm-wave at the entrance to the channels by the side of the accumulating river-water to the north, which tended to pile up the waters along the Chittagong coast, from which they spread to the north and north-west. The flood at Siddhi, as in the northern portion of the island of Dukhin Shahbazpore, was mainly due to the accumulating mass of river-water held back in the lower reaches by the storm-wave and driven down in the upper reaches by the violent north-east wind. The inundation here began from the north-east at 2 a.m. Afterwards, when the cyclone had passed over the island, bringing with it the crest of the storm-wave, the flood-waters came from the west and south-west. At Noakholly, and in the districts bordering on the Fenny river, the flood poured in before 5.30 a.m. was not very considerable. But at this time the crest of the storm-wave was to the north of Siddhi, and the mass of waters brought forward by it advanced from the south and flooded rapidly the whole of this district. The effect of the north-east wind in

bringing down the river-water is shown by the character of the inundation at Ramgunge, some miles to the north of the district directly flooded by the tidal and storm-waves. Here the fresh-water flood was due to the wind bringing down volumes of river-water which found its way up the numerous channels, and refilled the dried-up khals and marshes and the surrounding lowlands which form the natural drainage of the district. This caused a flooding of the country and a disturbance of the ordinary conditions of surface water and subsoil moisture at this season. The rice crops have been considerably injured, and the public health has suffered much from choleraic disease.

The following is the report of the Master Attendant of the port of Chittagong of the storm and inundation :—

“The barometrical readings for two days previous to the passage of the cyclone registered indications of a change of weather, as it fell from 29.90 at 4 p.m. of Monday the 30th October to 29.69 at the same time of Tuesday following. Measures were therefore adopted to warn the shipping in time; but, owing to the storm-wave, the vessels started their anchors, which necessarily resulted in their dragging, and ultimately getting ashore. Rain was much wanted, and had been anxiously awaited for weeks past to perfect the fine and promising crops into yielding a rich and abundant harvest; and the weather, which had been overcast for some days previously, at last seemed to betoken the much-invoked rain which is customary at this season of the year.

“Towards 8 p.m. of the 31st ultimo, however, it became evident that more than rain portended. The wind was blowing in ‘fitful gusts’ from the north-east, a most suspicious quarter for the time of year. The barometer stood at 29.75, showing a downward tendency. There was little or no scud at this time, and the clouds had a slow rotatory sort of progression from east to west. Thunder was occasional, and the lightning was forked and very vivid, the wind increasing at each gust, and the barometer falling steadily. At 11 p.m., after a lull, the wind suddenly shifted east. So the weather continued till 2 a.m., by which time the storm had developed into a perfect hurricane, the wind increasing, and the barometer still falling, when, with a shift of wind to east-south-east, trees, houses, godowns were all now being torn to pieces by the violence of the wind; yet most of the people remained at home, and the shipping, notwithstanding the wind, still held on in safety to their anchors. Within 30 minutes afterwards the wind had shifted to south-east. The rain was driven before the raging of the tempest into a dense mist more impenetrable than darkness, and the terrors of the cyclone which swept over the port were enhanced by finally culminating in a storm-wave. It was high water at 12.30 a.m., and the tide, which should have ebbed for two hours, suddenly rose three feet above the Government road (which is considerably higher than the adjacent lands and high-water-mark). The vessels started from their anchors and were drifted about at the mercy of the wind and waves, the latter of which in a short jumping sea broke over the largest vessels in port. The vessels were fouling one another, and, as a consequence, the port was soon entirely cleared of its shipping, save one American barque, which happened, strange to say, to have been anchored in shallow water. People were in water from their knees to their armpits; their houses were inundated as well as roofless, and now the great loss of life occurred. The wind at 3.30 a.m. shifted to south-south-east. The barometer was down to 29.27, and so continued to fall to 29.25, the cyclone all the time raging with the greatest fury and devastating the whole place. At 4.30 a.m. the wind veered south, the barometer having risen to 29.29, but the wind continued unabated to carry all before it till 5 a.m., when it again shifted to south-south-west; barometer 29.35. At 5.30 the weather showed the first faint symptoms of clearing: wind at south-west, barometer risen to 29.45.

“By this time, however, all the vessels except one had dragged their anchors and were aground on the northern bank of the river; some of them had lost boats, some their rudders, and all had sustained damages of a more or less serious nature, and one had sunk in the river.

“The jetty had been carried away and was a complete wreck; the departmental boats were long since stranded far inland; the shores were strewn with the results of the cyclone, carcasses were lying about, bodies drifting in the river, and people struggling for life in the water.”

The following extracts from Sir Richard Temple’s report to the Government of India of the cyclone and storm-wave give a graphic description of the appearance of the wave-stricken area a few days after the cyclone, and furnish the only authoritative statement yet published of the probable loss of life :—

[*Sir Richard Temple’s Minute will be found reprinted in extenso at page 2 of the present paper.*]

CHAPTER VI.—THE CAUSES OF THE BACKERGUNGE CYCLONE.

The following is a very brief summary of the more important features of the origin and progress of the cyclone. On the 20th and following days there was almost uniform distribution of pressure in the Bay and Northern India. The pressure then increased to the north of the Bay, and was probably high to the south. The south-west monsoon, instead of retreating southward, continued to prevail over the sea region near the entrance to the Bay. The weather was fine and clear over the greater part of the Bay at this time, except in the south, where slight rainfall commenced. The wind directions were north and north-easterly on the west side of the Bay, and westerly to southerly on the south and east limits of the Bay. An area of diminishing pressure began to be formed on the 23rd. Constant precipitation of rain on the south-east accompanied its formation and gradually increased in amount. The area of depression extended northwards, and on the 26th and 27th the winds in the neighbourhood of the area began to show a vorticose motion and were of considerable intensity, if, as I believe, the Nancowry returns can be accepted as indicating a general cyclonic motion comparable with the wind velocity registered at that station. This area of diminishing pressure extended northwards during the two following days, whilst at the same time its vortex was also advancing slowly in the same direction. With the continuance of the cyclonic conditions the area of diminishing pressure not only expanded, but the amount of the depression at its centre increased, and on the evening of the 29th the gale of cyclonic character, which had set in some time previously and was rapidly increasing in violence, became at length a cyclone of great force. Its vortex was in latitude 14° N. and longitude 89° E. at noon of the 30th, and was then advancing slowly north at a rate of about seven miles per hour. Its velocity gradually increased, and it also acquired during its progress, very slowly at first, an eastward motion. It crossed the 20th parallel of latitude in longitude $91^{\circ} 45'$, and at this time was being rapidly deflected to the east. It reached the islands at the mouth of the Megna with a velocity of progression of upwards of 20 miles per hour at 3 a.m. on the 1st. The central area of calm was then from 15 to 18 miles in diameter, and was probably elliptically shaped, its greater axis being nearly at right-angles to its path. The cyclone at sea extended over a very considerable area, blowing with hurricane force and disabling vessels at a distance of 200 miles from the vortex. In its brief passage on land its dimensions were much more contracted. It advanced to the north-east from Noakholly at 4.30 a.m., but at this time its north-eastern quadrant extended over the Tipperah Hills. They consist of a series of wave-like crests or elevations running north and south. These numerous ridges presented a formidable barrier to the rotation of the wind on the north-western quadrant. They quickly broke up the regular cyclonic motion of the wind on this side. The cyclone was completely dissolved by 10 a.m. of the 1st, the only evidence of its existence a few hours after being a slight barometric depression over the Tipperah Hills, Cachar, and Assam. There was a cloudy sky, with slight rainfall in the hill districts and in Assam on this and the following day. In the centre and north of the Bay there was calm weather, a clear sky, and a smooth sea, where from 12 to 24 hours before the wind had been blowing with hurricane force, the rain falling in torrents, and the sea tossing about in the wildest confusion. At noon of the 1st the only evidence at sea of the passage of one of the fiercest cyclones which has visited the coast of Bengal were some 20 vessels, the majority dismasted and reduced to mere wrecks, struggling feebly towards the nearest port; whilst a few scattered sheets of water on land were all that was left to indicate that the panic-stricken, houseless, starving inhabitants of one of the richest and most populous districts of Bengal had been visited by a flood more destructive in its character than history has yet recorded.

The origin and formation of the cyclone can be explained by the same theory as I have already advanced in the case of the Vizagapatam cyclone. On the 20th there was almost uniform pressure over the Bay and the adjacent coast regions. The pressure was slightly in excess both to the north of this large area and also to the south. The two great lower atmospheric currents, which alternately blow over the Bay during the monsoon periods, were at that time neither in full possession. Each occupied a portion of the Bay. The south-west monsoon was gradually retreating southwards and blowing with diminished force, whilst the north-east trade wind, as yet very gentle in its character, had only advanced over the northern and western coasts of the Bay. It was a period of transition and of gentle winds, local rather than general in their character. The Bay thus became a closed area, so far as its atmospheric changes and motion are considered, whilst round its limits there was a near approach to a gentle cyclonic motion of the air. These conditions continued during the next 11 days. It is at all times an area of rapid evaporation. The Madras published observations, although in this one

point not accurate from acknowledged defects in the construction and position of the registering instrument, show that in this month, notwithstanding that it is a cloudy period and accompanied with an average rainfall of 10", the mean daily evaporation is .2". On the 20th and following days a clear sky and warm weather prevailed over the greater part of the Bay. Evaporation was probably taking place at a much more rapid rate than the above. The amount of heat absorbed by the conversion of this amount of water daily over so large an area as the Bay of Bengal is enormous. Roughly estimated, it is equal to the continuous working power of 800,000 steam engines of 1,000 horse-power. This will give some idea of the enormous amount of energy absorbed or rendered latent in the process of conversion of water into aqueous vapour over a large area like the Bay of Bengal. There was thus a process of absorption of heat, and therefore of mechanical energy, by the atmosphere over this area, compared with which even the energy of the moving mass of air during the cyclone and of the disturbed and elevated water surface over which the cyclone passed was small. There was no horizontal outlet for this accumulating aqueous vapour. Hence, instead of passing away from the producing area, to fall as rain over Southern India and other regions to the north or south, it ascended or expanded vertically upwards. The very slight rainfall at Madras and over Southern India seems to establish conclusively the condensation of the vapour over the producing area. The rainfall at Madras, which occasionally exceeds 20" during the month and averages 10", was only 1.04" for the month. The relations of aqueous vapour with respect to temperature and height are, as I have already stated, such that an equilibrated mass or atmosphere of saturated vapour of density diminishing with the height in accordance with the laws of hydrostatics or hydrodynamics is impossible. Before complete saturation can occur in the lowest strata, condensation will necessarily commence in some higher stratum, determined by the rate of decrease of temperature with the height. Hence it may be laid down as a general principle, that if over any area of constant evaporation there is not for any considerable period an atmospheric current of sufficient intensity to carry off the aqueous vapour as fast as it is produced (which outflow may take place either in the lower or higher atmospheric strata), condensation must occur over the producing area, and also that the process of evaporation and subsequent condensation will be accompanied by the formation of an area of diminishing atmospheric pressure. The meteorology of the region of Calms is a striking illustration of these facts. In this narrow belt of continuous low barometer between the two trade winds the lower winds are very light and variable, whilst daily during the period of greatest evaporation there is heavy precipitation of rain.

During the continuance of these conditions which have been shown existed over the Bay from the 20th, the Bay was in a state resembling the Belt of Calms. Rapid evaporation went on, accompanied with increasing rainfall. This rainfall, as I have already pointed out, is necessarily, according to this explanation, greatest on the south side, because here the gentle wind current from the Indian Ocean on the south pours in large quantities of vapour, and thus hastens and increases the condensation on this side. The region of disturbance, with the continuance of the favourable conditions, consequently extends northwards from the southern limits of the Bay and becomes an area of diminishing pressure, just as in the Belt of Calms the continuance of the two actions of continuous evaporation and condensation over the producing region makes it a region of persistent low pressure.

Perhaps it may be urged against this, as I believe has been done by Dr. Hann, one of the greatest European authorities on all meteorological questions, that the observations at land stations within the tropics show that continuous rainfall is not accompanied by a diminution of pressure. The returns of the observations in India undoubtedly show that on land the barometer generally, but not universally, falls previous to rainfall and rises during the rainfall. But the conditions of a closed area, such as the Bay of Bengal was at this time, and the Belt of Calms is at all seasons, are so different in every respect from any land area in the tropics, except, perhaps, small islands far removed from any continent, such as the Mauritius, or even the Andamans or Nicobars, that this fact is no argument against the present theory. So little is known of the action and independent motion of the aqueous vapour in the atmosphere, and of its relations to the atmosphere of dry air, that in such a case we can only argue from the strictest analogy. The atmospheric pressure in the Belt of Calms is always lower than in the neighbouring regions of the trade winds to the north and south, and for the same reasons, whatever they may be, the southern portion of the Bay, with the prevalence of similar conditions, became at this time an area of diminishing pressure.

I might also refer to the low pressure of the great southern oceanic area as compared with the northern land area, and to other similar facts, in confirmation of my opinion.

Probably, however, it will not be considered as satisfactorily established until hourly or continuous observations for a lengthened period at some small oceanic island have been carefully analysed, and the materials for this are not at present at my disposal. A cursory examination of the observations at Sagar Island, Port Blair, and Nancowry seems to confirm my theory for oceanic closed areas. The action appears to be as follows. The evaporation over a closed area is attended by an upward expansion or vertical current, imperceptible of course to any instrument or observation. If this did not take place, the atmospheric pressure would, and must, increase. The first tendency of evaporation is undoubtedly to increase the pressure, but this, by disturbing the equilibrium, or the previous condition of motion, causes further motion, which in this case is vertical expansion. The same cause thus produces two effects opposed to each other, so far as their action on the atmospheric pressure is considered. The resultant action is a differential one, and, as in the case of the ordinary barometric tides, the balance is in favour of the expansive action; or, in other words, the cause, evaporation (just as the solar heating power in the case of the diurnal barometric tides), which first produces or tends to produce increase of pressure is actually followed by diminution of pressure. A similar argument obtains in the case of condensation and precipitation of the aqueous vapour as rain. An unknown portion of the heat given off during the process of condensation is undoubtedly radiated off into space. Some portion of it must, however, be absorbed by the surrounding air. The first tendency of this will be to increase the pressure of this portion of the atmosphere, and therefore of every other portion. This, however, will be followed by the usual expansive action, and the question then simply resolves itself into which of the two opposing actions, increase of temperature and expansion, produces the greatest effect on the pressure. In certain cases it may be the former, and that there is therefore increase of pressure with rainfall. In closed oceanic areas, where the action is continuous (like the action of the sun on the atmosphere in producing the diurnal changes of the pressure), it seems to be more consonant with analogy to assume that the resulting action will be diminution, and not increase, of pressure.

For the reasons already stated, I assume that the evaporation in the Bay of Bengal over a closed area of uniform pressure which commenced on the 20th was followed by condensation, greatest on the southern side, where the action of evaporation in saturating the atmospheric strata was supplemented by the south-westerly current from the Indian Ocean, and that both these actions produced the same effect—diminution of pressure, which commenced to the west of the Nicobars and gradually extended northwards. It is, then, easy to see how the continuance of these conditions in the Bay would produce a cyclone. The *ascendant courant* due to the action of evaporation and condensation was greatest over a small area near the Nicobars, and the centre of the area of diminishing pressure was also there. A strong indraught from the neighbouring districts followed. There, however, was no violent change or subversion of the winds in or around the Bay at the time. The atmospheric circulation was already cyclonic in its character, and the formation of the area of low pressure implies only an increase of this motion, and an advance from all sides, or closing up towards the centre. This assisted in maintaining and increasing the vertical ascent at the centre. The continuous rainfall, due partly to the indraught from all directions, also added fresh energy to the forming cyclone. Finally, from the combination of all these causes and actions, and their persistence for a week or ten days, the cyclone was fully formed. It advanced at first slowly, but gradually increased in velocity in its passage over the Bay, and then, after reaching land, rapidly broke up, partly from the friction with the land, which, however, appears to be a very slight cause, but chiefly from the irregularity of the land action, tending, especially where it is hilly, to break up the large cyclonic motion into small eddies, which rapidly die away, and partly from the diminution of evaporation and rainfall in its passage over the land surface. It will thus be seen that the theory advanced to explain the origin and formation of the two cyclones in the preceding pages is quite different from that put forward by Mr. Meldrum to account for the cyclones of the Indian Ocean, and adopted by Mr. Willson in his cyclone reports. As the subject is an important one, I shall refer briefly to Mr. Blanford's examination of the Calcutta cyclone of 1867, the first which he investigated with the aid of accurate and abundant observations. A brief summary is given in the Proceedings of the Royal Society, vol. XVII., for the year 1869.

1st. Mr. Blanford states that for four or five days previous to the formation of the cyclone vortex the atmospheric pressure to the westward of the Nicobars was lower than elsewhere around the Bay, and that round the northern and western coasts the differences of pressure were very small.

2nd. That the winds were variable in Bengal some days previous to the cyclone, but become north and north-west three days before its formation; and that the light south-easterly winds which had prevailed along the west coast of the Bay also changed to north-easterly gentle winds three or four days before the formation of the cyclone.

3rd. The formation of the vortex was formed by the indraught of three currents—a north-east current on the west coast, a south-west current on the south, and a south-east current on the east—towards a region of low pressure produced by the action of evaporation and condensation; but was mainly and finally determined by the inrush of a saturated westerly current towards the area of low barometer.

The first and second conditions are equivalent to uniformity of pressure at a period of transition, which I have pointed out existed prior to the two cyclones I am dealing with, and the third to the general cyclonic motion of the atmosphere round the limits of the Bay, such as must occur at the period of transition from the south-west to the north-east monsoon. The only difference that may exist between Mr. Blanford's theory and mine is in the order and relation of the causes. The primary one is evaporation and condensation in a closed area, over and round which there is almost uniformity of pressure, and the formation of the cyclone due to this is promoted and intensified by the general cyclonic circulation around its limits, and by the saturated current passing in on the south from the Indian Ocean.

I am unable as yet to decide whether all cyclones in the Bay of Bengal present the same general meteorological phenomena and admit of the same explanation.

The most difficult point in connexion with the cyclones of the Bay of Bengal is to assign an adequate reason for their line of advance from the area of cyclone generation to the coast of the Bay. The majority of cyclones appear to originate in very nearly the same portion of the Bay over a small area, latitude 14° N., longitude 89° E., to the west of the Andamans, for reasons similar to those assigned for the formation of the recent cyclones in this area. But starting from the same central area of cyclone generation in the Bay, cyclones travel in very different directions, varying between W.N.W. and N.N.E. Those whose paths have been chartered by the Bengal Meteorological Office during the last five or six years present one common feature. They all travel in paths very approximately straight lines in their passage over the Bay, advancing from the area of cyclone generation along the line of least resistance to their motion towards the head of the Bay. If the producing causes are not persistent for a long enough period, or are small in amount, the cyclonic disturbance dies away and never reaches the coast. But in all cases where they advance as far as the coast, they apparently never suffer deflection until they approach or reach the coast. The modifying cause in the deflection of cyclones on land is not terrestrial friction, which is probably not much greater or much more irregular than the friction of the confused and disturbed water surface over which the cyclone advances. The great modifying cause is, in the case of the cyclones of the Bay, the obstruction of mountain masses and ranges. The effect of this obstructive and disintegrating action is too strikingly shown in the case of the recent cyclones to admit of dispute. The determination of the line of least resistance to the motion of cyclones is of great importance, as it would afford a sure basis for cyclone prevision. The discussion on the causes of the recent cyclones has shown that they originated from the formation and development of an area of low pressure, commencing at the south of the Bay and extending northwards. This alone would give a reason for their advance from south to north. They have also been shown to be produced by evaporation, condensation, and rainfall over a closed area. Unfortunately there are no returns of rainfall over the sea area during the advance of a cyclone, and it is impossible therefore to infer the character of the distribution of the rainfall over the region of the moving cyclonic disturbance in the Bay. The distribution of the rainfall over the land area of a cyclonic disturbance is due to very different causes and affords little or no information on this important point. As far as can be judged from the general description of the rainfall in the logs of the vessels, it appears that in the outer limits of the cyclonic disturbance the rainfall is greatest (*i.e.*, the rate of fall is greatest) on the southern quadrant, and that nearer the centre it is greatest on the eastern quadrant, and very near the vortex, it may be greatest on the north-eastern or even on the northern quadrant, and therefore in advance of the cyclone vortex. The action consequent on the giving out of the latent heat due to condensation is, however, on the whole greatest on the southern and eastern quadrant, and hence a second probable cause for the determination of the cyclones to some direction between west and north. The only other key to the determination of the line of least resistance to the cyclone motion appears to be the distribution of pressure around the coast. Here

again, from the very brief period during which meteorological observations have been taken round the Bay, the materials for consideration are much too limited to afford data for generalization. A comparison of the distribution of pressure round the coast of the Bay at the time of the formation and first advance in the case of five cyclones shows that in four out of the five it was lowest at that part of the coast which the cyclone afterwards reached. It remains to be seen whether subsequent additional knowledge will confirm this inference, that the line of least resistance is indicated partly, if not entirely, by the distribution of pressure round the head of the Bay, and that the path of the cyclone is usually from the area of cyclone formation in some direction between west and north to that part of the coast where the pressure is relatively lowest at the time of its formation.

No. 7. of 1877.

DESPATCH from the GOVERNMENT OF INDIA to the SECRETARY OF STATE FOR INDIA,
Department of Revenue, Agriculture, and Commerce, Meteorology.

MY LORD MARQUIS,

Simla, the 19th April 1877.

IN continuation of our Despatch No. 4, dated the 8th December last, we have the honour to forward, for your Lordship's information, copy of a further letter* from the Government of Bengal, containing a Resolution recorded by the Lieutenant-Governor regarding the mortality from the storm-wave of the 31st October 1876, and subsequently from cholera, in the districts of the Chittagong Division.

*No. 900, dated the 27th March 1877.

We have, &c.

(Signed) LYTTON.
F. P. HAINES.
E. C. BAYLEY.
A. J. ARBUTHNOT.
A. CLARKE.
J. STRACHEY.
E. B. JOHNSON.
W. STOKES.

FROM the JUNIOR SECRETARY TO THE GOVERNMENT OF BENGAL to the SECRETARY TO THE GOVERNMENT OF INDIA, Department of Revenue, Agriculture, and Commerce.

SIR,

Calcutta, dated the 27th March 1877.

I AM directed to submit herewith, for the information of his Excellency the Governor-General in Council, copy of a Resolution recorded this day by the Lieutenant-Governor regarding the mortality from the storm-wave of the 31st October 1876, and subsequently from cholera, in the districts of the Chittagong Division.

I have, &c.

(Signed) H. J. S. COTTON,
Junior Secretary to the Government of Bengal.

RESOLUTION of the GOVERNMENT OF BENGAL.

Calcutta, the 27th March 1877.

READ—

A memorandum, No. 662G, dated 13th March 1877, from the Commissioner of the Chittagong Division, submitting reports from the District Superintendent of Police in Chittagong, and the Magistrate of Noakholly, regarding the mortality in those districts from the storm-wave on the 31st October 1876, and subsequently from cholera.

THE total mortality in the district of Chittagong is now estimated, after careful police inquiries, to have been 2,857 from the storm-wave, and 44 from the effects of the cyclone, in those villages to which the storm-wave did not penetrate. As many as 7,399 persons are estimated to have died from cholera between the date of the cyclone and the 31st December 1876. But it is known that the epidemic of cholera continued

without abatement for a considerable period after this latter date, and the Lieutenant-Governor is still awaiting the submission of a final report on the subject, which has been called for from the Commissioners of both Chittagong and Dacca.

2. In the district of Chittagong there was not a succession of storm-waves such as occurred in Noakholly and Backergunge, but in the villages along the coast, and especially towards the north of the district, there was very great destruction of property and considerable loss of life. On the sea-coast, near the town of Chittagong itself, heaps of straw and thatch were found on the branches of trees 18 feet from the ground, and this would appear to have been the height of the storm-wave all along the coast north of the Kurnafoolee. The destruction of property at the port was great; every vessel in the river, except one, was stranded; houses were blown down in great numbers, and half the rice crop of the district was lost.

3. In the district of Noakholly the deaths caused by the cyclone and inundation on 31st October 1876 are numbered at 43,544. The deaths from cholera from that date to 31st January 1877 are reported as 30,263. Everywhere, except on the islands of Hattea and Sundeep, the deaths from cholera appear to exceed those from drowning. On these islands the deaths from drowning are stated at 34,708, and from cholera at 7,133.

4. Terrible as these figures are, they represent an estimate of mortality far less than was at first apprehended. The total number of deaths from drowning in the districts of the Chittagong Division and in Backergunge is now stated to be about 100,000, whereas at first it was feared that the deaths amounted to double this number. No accurate census has been attempted. It was represented, and no doubt truly, by the district officers, that the people would feel a census at the present time, and so soon after such a terrible calamity had fallen on them, to be a hardship, and it is the case also that Government is not now in a position to obtain a fair census. The people have, many of them, temporarily left their homes; others are wandering about buying cattle to supply their losses, and the outbreak of epidemic disease had placed the local subordinate establishment in a state of disorganisation. Any attempt at a regular census has therefore been postponed. But the recent estimates have been made as carefully as circumstances would permit, and the Lieutenant-Governor cannot doubt that they furnish results which approximately indicate the extent of the calamity. The deaths from cholera, notwithstanding the unceasing exertions of the Medical Department, are appalling in numbers; but it is satisfactory to know that this disease, in an epidemic form at least, disappeared before the close of the cold weather.

By order of the Lieutenant-Governor of Bengal,

H. J. S. COTTON,

Junior Secretary to the Government of Bengal.

No. 899.

Copy forwarded to the Commissioner of the Chittagong Division for information.

No. 10. of 1877.

DESPATCH from the GOVERNMENT OF INDIA to the SECRETARY OF STATE, Department of Revenue, Agriculture, and Commerce, Meteorology.

MY LORD MARQUIS,

Simla, the 24th May 1877.

IN continuation of our Despatch No. 7, dated the 19th ultimo, we have the

From the Government of Bengal,
No. 1,319, dated the 5th May 1877,
and enclosures.

Noakholly, and Chittagong.

honour to forward for your Lordship's information a copy of the papers noted in the margin, relative to the recent cholera epidemic in the districts of Backergunge,

We have, &c.

(Signed)

LYTTON.

F. P. HAINES.

E. C. BAYLEY.

A. J. ARBUTHNOT.

A. CLARKE.

J. STRACHEY.

E. B. JOHNSON.

W. STOKES.

From the JUNIOR SECRETARY TO THE GOVERNMENT OF BENGAL to the SECRETARY TO THE GOVERNMENT OF INDIA, Department of Revenue, Agriculture, and Commerce.

SIR,

Calcutta, dated the 5th May 1877.

IN continuation of this office letter No. 900, dated 27th March 1877, I am

From the Commissioner of Dacca, dated 24th March 1877.
 To ditto ditto, No. 949, dated 2nd April 1877.
 From ditto of Chittagong, No. 75G, dated 27th April 1877.
 To ditto ditto, No. 1308, dated 4th May 1877.

directed to submit herewith, for the information of his Excellency the Governor-General in Council, a copy of the papers noted on the

margin, regarding the recent epidemic of cholera in the Backergunge, Noakholly, and Chittagong districts.

I have, &c.

(Signed) H. J. S. COTTON,
 Junior Secretary to the Government of Bengal.

From F. B. PEACOCK, Esq., Officiating Commissioner of the Dacca Division, to the OFFICIATING SECRETARY TO THE GOVERNMENT OF BENGAL.

Dated Dacca, the 24th March 1877.

IN accordance with orders contained in your letter No. 585, dated 23rd ultimo, I have now the honour to submit in original the accompanying reports from the Magistrate and Civil Surgeon of Backergunge on the recent severe outbreak of cholera in those parts of that district which suffered most from the effects of the cyclone and storm-waves of the 31st October last.

2. I do not think there is anything in the circumstances of the places affected by the late epidemic which would operate to exempt them from the occasional visitations of this disease, to which all parts of Eastern Bengal are liable. But, as the Magistrate remarks in his second paragraph, there can be no doubt that the late outbreak was aggravated and intensified, if not actually caused, by the state in which the people were living. It can hardly be a matter for surprise that cholera should rage among people living in an atmosphere so polluted as to be almost unbearable, especially when, in addition to this, they were insufficiently clad, indifferently housed, and badly fed. The only wonder, to my mind, is that the disease did not sooner make its appearance and was not much more destructive than it was.

3. It is of course impossible to give with anything like certainty the number of deaths that have occurred. The sub-divisional officers of Dukhin Shabazpore and Patuakhally estimate them at 10,088 and 1,788 respectively, while Dr. Cameron puts them down at about 8,000 in the former, and about 2,900 in the latter sub-division. Neither of these estimates can, in my opinion, be accepted as anything more than the merest approximation to correctness, though of the two, from the manner in which it was framed, I consider Dr. Cameron's the most reliable. Information derived from the native doctors would no doubt be correct enough so far as it went, but there must have been many deaths in outlying villages which were never heard of. As for the information derived from a number of unintelligent, panic-stricken chowkedars, it is palpable that this must be unreliable and unsatisfactory to the last degree.

4. In addition to the figures above given, Dr. Cameron estimates that about 300 deaths occurred in the portion of thana Backergunge visited by the disease, and about 1,550 in thana Mendigunge, or a total in all of 12,750 deaths. I can only hope that these figures do not represent a smaller mortality than actually occurred.

5. As regards the treatment of the disease, Dr. Cameron's report shows that all possible endeavours were used to bring medical assistance as speedily and as close to the sufferers as possible. On receipt of the first intimation of the outbreak of the disease, the Surgeon-General was asked to send five native doctors, fully equipped with medicines, &c., to Burrisal, and subsequently, as the disease spread, a further requisition for 20 more native doctors was made. Both these requests were complied with by the Surgeon-General with the utmost promptitude. Dr. Tomes was, under the orders of Government, specially deputed to Burrisal, to take charge of the Civil Surgeon's duties at that place, so as to allow of Dr. Cameron giving the whole of his time and attention to the adoption of measures for the abatement of the disease, and to the supervision of the native doctors employed in various parts of the district. An Assistant Surgeon, Baboo Kali Dass Mookerjee, was also sent to Burrisal with the first

of the native doctors, and rendered useful service in Dukhin Shabazpore till the 5th February, when he was unfortunately drowned through his boat being upset in a storm as he was crossing the Megna to visit the adjacent island of Manpura.

6. Nor were our endeavours confined to the actual treatment of the disease itself. Both before and after the outbreak, everything that could be done was done to get the people to burn, to bury, or to dispose of in some way or other, the numerous bodies of men and carcasses of cattle that were lying strewed about in all directions, to cleanse the tanks of the *débris* with which most of them were filled, and generally to take such steps as might prevent or, at least lessen, the chances of an outbreak. These endeavours were not relaxed, but were persevered into the end, notwithstanding the apathy displayed by the people themselves, and the little assistance rendered by the zemindars and others who should certainly have been more alive to the extent of the calamity than they were.

7. The disease has now happily almost disappeared, though a few places still require to be watched, principally in the thana of Mendigunge and of Burhamuddin in Dukhin Shabazpore. Ten native doctors have already been sent back to Calcutta, and the services of others will be dispensed with as soon as this can safely be done.

8. It is satisfactory to notice that, with one exception, the native doctors behaved fairly well. That they should take, or attempt to take, fees from the people was inevitable under the circumstances in which they were placed, but so long as they did not neglect those who could not pay, and were active and energetic in the discharge of their duties, I should not be disposed to take too severe notice of this, even if the fact could be proved.

9. On the whole, therefore, I trust what has been done will have the approval of his Honour the Lieutenant-Governor, and that he may be pleased to signify, either through me or through the Medical Department, his appreciation of the good service rendered by Dr. Cameron throughout the whole of the operations.

10. The return of the original papers when no longer required is requested.

No. 519, dated Burrisal, the 16th March 1877.

From E. J. BARTON, Esq., Officiating Magistrate of Backergunge, to the OFFICIATING COMMISSIONER OF THE DACCA DIVISION.

WITH reference to your No. 84 of the 2nd instant, I have the honour to send you herewith a copy of a report by Dr. Cameron, the late Civil Surgeon here, on the recent outbreak of Cholera in the wave-stricken tracts of this district.

2. Last cold weather there was an outbreak of cholera in these tracts, and this would seem to point to the existence there, independently of the storm-wave and its consequences of conditions capable of themselves of calling into activity this terrible disease. That the special calamities of this year greatly aggravated these conditions there can of course be no doubt.

3. It will be in your remembrance that when the Lieutenant-Governor was here, shortly after the cyclone of the 31st October, the probability of the occurrence of a cholera epidemic in the wave-stricken tracts was discussed, and it was resolved to have a number of native doctors in readiness to meet such a contingency. Cholera appeared in Noakhally shortly after the cyclone, but here for weeks there was no appearance of the disease in the wave-stricken tracts. The matter was often talked of by the Civil Surgeon and myself. The Civil Surgeon seemed to think that the two native doctors whom you sent from Dacca, and to whom he refers in the 2nd paragraph of his report, might be returned. I asked the Civil Surgeon to retain them, as I felt almost certain that cholera would come. He, however, did, I believe, return the men to you on the ground that there was nothing here for them to do.

4. In the sub-division of Dukhin Shabazpore cholera, as an epidemic, broke out early in December, in the extreme north, in the Gazipura outpost, and soon after in Dowlutkhan thana. It was not, however, till January that the disease assumed its great and alarming proportions. Two additional native doctors were sent in December to this sub-division and posted in charge of the affected villages. By the beginning of January the disease had travelled southwards and appeared in the Burhamuddin thana. Dr. Cameron's report will show that nine native doctors were at work in the cholera-stricken tracts in the month of January. There was no time lost during the visitation to utilize to the utmost all the means of relief that were at our disposal. It will be in your recollection that I went to Calcutta after the durbar in January, and one of the matters which took me there

was the supply of a greater number of native doctors for the cholera-stricken tracts. In the first ten days of January cholera raged throughout the sub-division; the number of deaths was very large, and the people became everywhere disheartened. The disease, in its most virulent and destructive form, began to abate in Dukhin Shabazpore about the middle of January. The northern half of the sub-division, where the disease first appeared, recovered first, and by the end of January the epidemic had greatly decreased everywhere. The rains that followed in the beginning of February put a complete stop to it. At any rate, the epidemic ceased almost coincidentally with the copious rainfall which we had in the beginning of February.

5. The number of deaths from cholera in Dukhin Shabazpore cannot at present, and probably never will, be ascertained with correctness. The figures of mortality given by the sub-divisional officer differ somewhat from those given by Dr. Cameron, and are these:—

Police Stations.	November 1876.	December 1876.	January 1877.	February 1877.	Total.
Dowlutkhan and Bhola	36	627	3,294	248	4,205
Gazipura	60	437	929	68	1,494
Burhamuddin	12	239	1,862	461	2,574
Taltoli	—		430	80	510
Tozamuddin	—		944	361	1,305
Total	108	1,303	7,459	1,218	10,088

The chowkeedars, who are universally the most ignorant of men, might and probably did, report the same deaths several times over, and omit or forget to report other deaths. Those conversant with the inexactness, both of memory and thought, which is a characteristic of these utterly illiterate and unintelligent men, will admit that this certainly occurred. These figures are based on the reports made by the chowkeedars, and are probably wrong. The sub-divisional officer thinks that the mortality is heavier than what is represented here. But I do not agree with him. Dr. Cameron's estimate, being based on the more intelligent observations of the native doctors, whom we had studied all over the sub-division, is probably the more accurate.

6 These figures show that the epidemic in Dukhin Shabazpore travelled from north to south. In November the largest number of deaths reported was in Gazipura outpost, *i.e.*, in the extreme north of the sub-division. In December, too, the epidemic was severer in proportion to the population at Gazipura than at the more southern stations (Dowlutkhan and Bhola), for the number of deaths in the former was nearly three fourths of the number in the latter, though in extent Gazipura is scarcely half of Dowlutkhan and Baola. The number of deaths in the southern half of the sub-division had increased from 12 in November to 239 in December, but this number is not a fourth of the number for the northern half, and cholera therefore was still most severe in the north. In January the mortality attained its highest point everywhere, and it was severer in Dowlutkhan than in Gazipura, and severest in Burhamuddin, which is more to the south. The number of deaths in Burhamuddin was more than half that in Dowlutkhan, though the area of the former is scarcely half of the area of the latter. In February the number of deaths in the south was greater than that in the north, not only relatively to area, but absolutely.

7. Mr. Datta, the sub-divisional officer of Dukhin Shabazpore, gives the following opinion regarding the causes of the epidemic:—

“The causes of this outbreak are various. Cholera, in an epidemic form, raged here last winter, and gradually died out in the rainy season, when good drinking-water was available everywhere. On the close of the rainy season cholera appeared again, even before the 31st October, and there can be no doubt the storm-wave of that date has fearfully aggravated it in various ways. The stench proceeding from dead bodies and dead cattle everywhere and in every village in this sub-division was of itself sufficient to bring on a fearful outbreak. I have endeavoured as much as I could, by orders on the police, proclamations in hâts and villages, injunctions on the villagers, and by personally impressing the subject on influential people in every place I visited, to have the dead bodies buried and the ground cleared, and I am assured that something in this way has been done and is still being done.

“The storm-wave has brought in the outbreak in other ways too. Houses have been everywhere blown down and washed away, and people, who have built up temporary sheds, suffered from exposure in the cold season. The stored grain, which has been

recovered, as well as some portion of the new rice [reaped], remained under water for many hours, and in some places for days, and were partly spoilt, and the consumption of this spoilt rice is another aggravating cause. The water in tanks in many places has been spoilt, and the use of this water tends to disease. Imperfect clothing, imperfect food, and imperfect shelter have in all probability added to the virulence of the disease."

8. In connexion with this, I beg to call prominent attention to the fact that the apathy and indolence of the people everywhere were conspicuous. Every means short of force were employed by the local officers to induce them to remove the carcasses. Mr. Harris was sent to the spot on the day when first I heard of the inundation of Dukhin Shabazpore, and he did all that was legally possible in trying to get the people to help themselves and clean their villages. The relief officers and the native doctors who were in the sub-division in the beginning of November did the same. But the people obstinately refused to help themselves. I sent all the mehters I could raise. It would have taken thousands of them to clean the wave-stricken tracts of the dead bodies of human beings and cattle, for a great tract of country (about 1,100 square miles) had been affected by the waves. In this district and the neighbouring districts there are very few mehters. Of these most are already employed, and a great many of them will not touch dead bodies. With the exception of one or two, none of the zemindars did anything. They did not even send their servants to incite the inhabitants to help themselves. Even if they had sent their servants, I doubt if they would have succeeded in rousing the people and forcing them to do something. Altogether this was as dis-heartening an episode as any that occurred in connexion with this great calamity.

9. Mr Datta thus reports regarding the present condition of the people:—

"The people are recovering themselves from the effects of the recent calamity—the wave-storm and the cholera. Although the crops were very seriously injured by the storm-waves, the people had their betelnuts and their saving of preceding years to fall back upon, and they are just at present disposing of large quantities of betelnuts and importing rice. Unlike what takes place in other years, there is no exportation of rice from this sub-division at present. On the contrary, boat-loads of rice are coming to the several large hâts in this sub-division from Hattia, Noakholly, Nalchitti, and other places. Cattle, too, are being imported to the cattle markets from Madaripore, Mendigunge, and other places, while vegetables come mostly from Naraingunge and Dacca. Calamities so severe would have, of a certainty, been followed by a scarcity in most other places in Bengal, but the peasantry here are so well to do that they have up to the present time been able to find themselves in all the necessities, and will probably be able to tide over till the next harvest. Their hâts are thronged with people and tolerably well supplied, only that rice is not exported as in other years, and they have everywhere put up new sheds or houses and resumed their accustomed industries; and all this has been done although the crops suffered fearfully by the two cyclones; and in many villages that I have seen the dhan has not been at all reaped from the fields, for there was little to reap. To be sure many people have been impoverished and are distressed, especially those who found employment in previous years in building up huts, excavating tanks, &c. These people find no employment this year, as ryots are building their own huts and cannot afford this year to dig tanks. Some relief, however, will be given to these people when Government works are undertaken, either from the Khas Mehal Improvement Funds or in the Road Cess Department. There is still greater distress in the extreme south in Bhuta, Lalmohan, Shombhupura, Golukpura, Dhali Gournagar, and Lakhi—places where the cyclone caused most dreadful loss in lives and property. The people of these parts will require assistance to recover themselves, and investigations are now being made regarding their necessities and circumstances.

10. The cholera epidemic in the sub-division of Patuakhali was not nearly so severe as in Dukhin Shabazpore. I give in the margin the figures of mortality which were supplied by the police. It is believed that they are only approximately correct. The figures for thana Golachipa are certainly wrong, and I think Dr. Cameron's estimate of 1,900 deaths there is probably nearer the truth. Dr. Cameron's report shows that we had no less than seven native doctors at one time in this thana. The figures for Mirzagunge are

believed to be tolerably accurate. There the people suffered much less in the cyclone, and there was no storm-wave, and cholera did not rage in an epidemic form. The large figure shown for that thana is due to better registration. In Bowfal and Golachipa,

Name of thana.	Total mortality from cholera.
Bowfal	775
Golachipa	369
Mirzagunge	644
Total	1,788

which suffered most in the cyclone, cholera raged virulently from the latter end of December till the end of January. The village police became temporarily disorganized. Many of the chowkeedars are not alive, and the survivors during the epidemic were irregular in their attendance at the thanas. The result has been that the registration of vital statistics by the police was extremely unsatisfactory. Mr. Gupta, the sub-divisional officer of Patuakhali, visited several villages in Bowfal and Golachipa while the epidemic was raging, and also afterwards, and he is inclined to estimate the actual deaths in Golachipa to be quite three times what has been reported by the police, and in Bowfal twice.

11. The rainfall towards the end of January gave the first check everywhere to the disease. The cholera disappeared altogether in the sub-division of Patuakhali immediately after the heavy rainfall in the first week of February.

No. 144, dated Burrisal, the 14th March 1877.

From DR. L. CAMERON, Civil Surgeon of Backergunge, to the MAGISTRATE OF
BAGKERGUNGE.

WITH reference to your endorsement No. 428 of 5th instant, forwarding Bengal Government letter No. 585, dated 23rd ultimo, I have the honour to report as follows regarding the outbreak of cholera following the cyclone and storm-waves of the 31st October and 1st November last.

2. Alarming reports of sickness were received from Dukhin Shabazpore, Golachipa, and Bowfal thanas on the 3rd November. Four temporarily entertained native doctors were immediately sent to these places with supplies of medicines and instructions to afford medical aid to the people. His Honour the Lieutenant-Governor visited Dowlutkhan and Bowfal on the 10th November, and expressed himself satisfied with the medical arrangements. The storm-wave had affected the whole of the thanas of Dowlutkhan and Burranuddi, and portions of those of Backergunge, Bowfal, and Golachipa. Consequent on the storm-wave, the sanitary condition of these parts was excessively bad. The country was dotted over with dead bodies of men and carcasses of animals. Although the water of the storm-wave was fresh, the tanks were in all instances filled with *débris*, and in many polluted by dead bodies. Notwithstanding the exertions of the Magistrate, the Joint Magistrate of Patuakhali, and the District Superintendent of Police, the people were slow in taking steps even to clear their tanks and rebuild their houses. They could not be got to burn or bury the dead bodies. Valuable service was rendered in Dowlutkhan by Mr. Harris, the District Superintendent of Police. He remained on the spot about a month and caused all dead bodies in the vicinity to be buried or thrown into the khal, from whence they were floated out into the river. At Koralia, in Choto Basdia, the zemindars sent a staff of mehters, who rendered similar services. At these places the tanks were also cleared. Good result followed, for little or no cholera or other sickness occurred at these places. At all other places the dead bodies were allowed to putrefy where they lay; swarms of flies were generated, and the stench was so bad as to be almost unbearable. The houses of the people were all destroyed, and they had to subsist on new and damaged rice. Although much disease might have been expected to be caused by these conditions, as a matter of fact little disease occurred till the middle of December.

3. The four native doctors treated a considerable number of cases of bowel complaints, fractures, wounds, contused wounds, and a few of cholera. Towards the end of November, there being no further occasion for their services, they were recalled. There was so little disease at this time that the services of two native doctors sent from Dacca could not be utilised.

4. On the 11th December six native doctors reported their arrival from Calcutta. They had been ordered by the Surgeon-General to come here for special duty in the cholera affected tracts. Reports of the prevalence of cholera having been received from Dukhin Shabazpore, Perozepore, and Mirzagunge thanas, three of these native doctors were sent to those places.

5. Fresh reports continuing to be received, the remaining ones were shortly afterwards sent to Perozepore, Dowlutkhan, and Bowfal. On the 2nd of January, the police native doctor of Burrisal was deputed to Burranuddi, and on the following day a native doctor

entertained here was sent to Darial, in Backergunge. On the following days alarming accounts were received from Dukhin Shabazpore and Bowfal, the worst accounts coming from Gazipura, in the north of the island, and from Dowlutkhan and Burranuddi in the south. The two native doctors sent to Perozepore thana were at once withdrawn and sent to Dukhin Shabazpore, early in January. There were nine native doctors posted or proceeding to their destination, as follows:—

Backergunge thana	-	-	Darial	-	-	-	1
Bowfal thana	-	-	}	Bowfal	-	-	1
				Kalaia	-	-	1
Dowlutkhan	-	-	}	Taltoli	-	-	1
				Gazipura	-	-	1
				Dowlutkhan	-	-	2
				Mongulsikdar hát	-	-	1
				Burranuddi	-	-	1

6. At this time (5th of January) very alarming accounts continued to be received of the number of seizures and deaths from cholera. Great alarm prevailed in storm-affected tracts. Numbers of the trading classes, and such of the cultivators as could afford the expense, were reported to be leaving for places outside the area of the storm-wave. At Burranuddi and Tosheenuddi it was reported that there was not enough of people left to bury the bodies of those dead from cholera.

7. The chowkeedar service was much disorganised. Many of the chowkeedars had been drowned by the cyclone, many had since died of cholera, and those who remained were very irregular in their attendance at the thana. Reliable information about many parts of storm-affected tracts could not be had. After indenting for a young surgeon, an assistant surgeon, and five additional native doctors, I proceeded to visit Dukhin Shabazpore Island and Bowfal thana, in order to ascertain their condition, and to determine what further help was necessary, and where native doctors might be posted to the best advantage.

8. Leaving Burrisal on the 7th of January, I reached Gazipura, in the north of Dukhin Shabazpore, on the 9th. The native doctor had been at work here from the 23rd of December. He had treated 316 cases of cholera in 11 villages. The sanitary condition of the villages was very bad. The tanks for drinking-water had only been cleaned; the others were still filled with *débris* as they were left by the storm-wave. The houses had not been re-erected on account of scarcity of labour and the excitement caused by the prevalence of cholera. Perwannas had been issued to zemindars to dispose of corpses and clear tanks, &c., but nothing had been done. Wherever corpses lay a bad smell was apparent; least where the body had been exposed and had become dry, and most where they remained under rubbish. Swarms of flies infested the country and settled down on everything; especially on eatables. Cholera had been severe and general from about the 20th of December to the 5th of January. After this date it rapidly declined, and dysentery, diarrhœa, and dyspepsia began to prevail.

As cholera was declining, the native doctor was ordered to leave simple medicines, with directions for use, with the police, and to go round all the villages in the north of the island for the purpose of treating cases of disease, but more especially for the purposes of getting the people to clear their tanks, so as to prevent further deterioration of the drinking-water, to dispose of dead bodies, and to re-erect their houses. Bhola, the new head-quarters of the sub-division, was then visited. With the exception of a village called Bapta, near Bhola, there was not much cholera in this vicinity. Medical help had been given from Bhola. Dowlutkhan was reached on the 11th. The loss of

life must have been terrible all along the east coast. All the villages on the banks of the Megna were deserted.

In the villages further inland sometimes as few as five or six people were found. Near Dowlutkhan I counted in one place 27 bodies, all in a state of decomposition. In this vicinity cholera began to appear in the beginning of December, but did not become severe until the 20th. Subsequently to that date the number of deaths was alarming and caused great consternation amongst the people. The police reported 780 deaths in December. Two native doctors had been at work here, one from the 17th of December, and one from 7th of January. They had treated 822 cases in 69 villages. Some of the large villages, such as Nyamutpore, Betua, Bejoypore, Noldagu, Hazipore, Bukshemaji, &c., suffered most severely. The sanitary condition here was similar to that of Gazipura, as mentioned above. Dowlutkhan almost

escaped the disease. Cholera began to markedly decline from the 2nd of January. In consequence of this, one of the native doctors was removed to Tosheenuddi. At

The storm-waves here caused an exceptionally great destruction of life.—E. J. BARTON. Tosheenuddi great alarm prevailed. Cholera was very severe in the large villages of Chandpore and Tosheenuddi. After the cyclone many of the dead bodies had been thrown into the khals, but much *débris* still encumbered the villages. Cholera prevailed in all villages in this outpost. At Ramprosad's hât and Dhali Gournagur, &c., in the south of Dukhin Shabazpore Island, similar conditions prevailed. Here a native doctor was at work. The south end of Dukhin Shabazpore Island was then rounded and the villages on the east coast visited as far as Taltoli, in Badura Island, on the east coast of Dukhin Shabazpore. Although cholera prevailed it was not severe.

9. The condition of Badura Island was found to be fair; there was little cholera but much dysentery and diarrhœa. A native doctor was at work here. At Burranuddi there had only been two deaths from cholera in December, but from the 1st to the 15th January, in 16 out of 90 villages 300 deaths occurred. Cholera declined here after the 15th.

10. At Bowfal, Kalaia, and Darial a similar state of matters prevailed. Cholera was rapidly declining. On arrival at Burrisal I found that Assistant-Surgeon Kali Dass Mookerjee and five native doctors had arrived. The assistant-surgeon was deputed to Dukhin Shabazpore for inspection duty. He was unfortunately drowned while proceeding to Manpura Island, by the upsetting of his boat in a storm on the 4th February. He was an intelligent and energetic officer, and had been of great assistance while employed in the island. The native doctors were disposed of as follows:—

One to Manpura Island.

One to Gorindar hât, for the tract of country between Mongulsikdar's hât and Tosheenuddi.

One to Dhonia Monia for the tract of country between Burranaddi and Bhola.

The remaining two native doctors were sent to Golachipa thana; one for the tract of country near Golachipa, and one for Basdia, Rangabali, and other islands and churs off the coast. On the 17th, before my arrival, a locally-entertained native doctor had been sent to Golachipa for the northern portion of the thana.

11. On the 19th of January there were 15 native doctors at work, as follows:—

Backergunge thana	-	-	Darial	-	-	1
Bowfal	"	-	Bowfal	-	-	1
			Mominpura	-	-	1
Golachipa	"	-	Golachipa	-	-	1
			Basdia	-	-	1
			Chiknikandi	-	-	1
Burranuddi	"	-	Burranuddi	-	-	1
			Badura	-	-	1
			Tosheenuddi	-	-	1
Burhamuddin	"	-	Gorinda hât	-	-	1
			Mongulsikdar's hât	-	-	1
			Manpura	-	-	1
Dowlutkhan	"	-	Dowlutkhan	-	-	1
			Dhonia Monia	-	-	1
			Gazipura	-	-	1

12. The sub-divisional native doctor of Bhola was available for the tract of country around. At this time, although cholera was declining, bowel-complaints were very prevalent, and it was not anticipated that the wave-stricken tracts would return to their normal state of health till after the beginning of the rains. With a view to the tracts being mapped out into circles, each in charge of a native doctor, 15 additional native doctors were asked for. Pending their arrival I proceeded to visit Golachipa thana. The sanitary condition of this was similar to that of Dukhin Shabazpore, but cholera had not been so prevalent or so fatal. Bowel-complaints also were less prevalent.

13. Six native doctors arrived from Calcutta on the 30th of January; they were disposed of as follows:—

One to Boro Basdia.		One to Alipore hât.
One to Boalia.		One to Selimabad.
One to Betagee hât.		One to Shastabad.

14. The disposition of the 21 native doctors stood as follows:—

Backergunge thana	-	-	Darial	-	1
Bowfal	„	-	{ Bowfal	-	1
			{ Mominpura	-	1
			{ Choto Basdia	-	1
			{ Boro	„	1
			{ Boalia	-	1
Golachipa	„	-	{ Alipore hât	-	1
			{ Betagee hât	-	1
			{ Nalkhola	-	1
			{ Chiknikandi	-	1
			{ Burranuddi	-	1
			{ Badura Island	-	1
			{ Native doctor with-		
			{ drawn to Mendi-		
			{ gunge.		
Burranuddi	-	-	{ Tosheenuddi	-	1
			{ Manpura Island	-	1
			{ Gorinda hât	-	1
			{ Mongulsikdar's hât	-	1
Dowlutkhan	-	-	{ Dowlutkhan	-	1
Burrisal	-	-	{ Dhonia Monia	-	1
			{ Shastabad	-	1
			{ Selimabad	-	1
Mendigunge	-	-	{ Daudpore	-	1
			{ Uttur Shabazpore	-	1

15. Eight native doctors arrived on the 13th February; they were disposed as follows:—

- One to Dowlutkhan, to relieve locally entertained native doctor.
- One to Nalkhola to ditto ditto.
- One to Darial to ditto ditto.
- One to Mendigunge thana.
- One to Dhulia in Backergunge.
- One to Police Hospital, Burrisal.
- One to Showluk in Gournuddi.
- One for duty in the Civil Surgeon's office.

Deducting three locally-entertained native doctors whose services are dispensed with, this left 26 native doctors on cholera duty in the district.

Mendigunge thana was visited in February and thoroughly gone over. There was little cholera, except in the south, around Selimabad.

On account of the improved state of health and the improved sanitary state of the wave-stricken tracts, 10 of these native doctors have now been sent back to Calcutta, leaving 16 still employed.

16. Cholera prevailed over the entire wave-stricken tracts from about the 15th of December to the 15th of January. After that date it gradually declined, bowel-complaints taking its place. These are not fatal diseases. Occasional cases of cholera only occur now, except at Selimabad in Mendigunge, Tosheenuddi, Guruprosad hât and Manpura Island in Burranuddi.

17. The real cause of the epidemic appears to have been deterioration of the drinking water by the dead bodies and vegetable *débris*, aggravated by the privations consequent on the cyclone and the bad smells.

18. The total number of deaths in Dukhin Shabazpore sub-division since 1st of November is estimated to amount to 4 per cent. on the original number of inhabitants, or about 8,000 deaths; in Golachipa to 2 per cent., or 1,900 deaths; in portion of Backergunge 300 deaths; and Mendigunge 1,550 deaths, in all 12,750 deaths.

19. Suggestions were made as occasion required for having dead bodies burnt in site, &c. The Sanitary Commissioner's memorandum was freely circulated among the people. In this instructions were given regarding filtering water, cleaning and improving tanks, &c. The native doctors were enjoined to explain its provisions to the people wherever they went. The sanitary condition of the tracts is now reported to be much

improved. The soft parts of the dead bodies are now completely decomposed, and they are harmless. A few native doctors may be required to remain at their posts till the rains set in; 10 or 12 may be enough for this purpose. When cholera ceases in the portions of Mendigunge and Burranuddi thanas, where it now still prevails, the number of the native doctors may be reduced to 10 or 12.

20. Surgeon Tomes, who was deputed to conduct the duties of the station during my absence, gave much assistance in compiling the weekly return of the native doctors and in forwarding them to proper authorities. The native doctors, with one exception, acquitted themselves fairly well. It is believed that in many instances they extorted fees from the people, but of this no sufficient proof is available to prove the charge against any native doctor in particular.

FROM THE JUNIOR SECRETARY TO THE GOVERNMENT OF BENGAL TO THE COMMISSIONER OF THE DACCA DIVISION.

SIR,

Calcutta, the 2nd April 1877.

I AM directed to acknowledge the receipt of your letter, without number, dated 24th March 1877, forwarding with your remarks a report from the Magistrate of Backergunge regarding the recent outbreak of cholera in that district.

2. The total mortality from cholera is estimated at 12,750 deaths. This is considerably less than has been reported from Noakholly, where, up to the 31st January, the deaths are stated at 30,263, and up to the end of February at 45,000. But a final official report from Noakholly has not yet been received.

3. The Lieutenant-Governor cordially acknowledges the exertions of both the civil and medical officers in Backergunge during the past very trying season. Assistant Surgeon Baboo Kali Das Mookerjee, who, it is stated, had done excellent service, was unfortunately drowned by the upsetting of his boat in the Megna River; and the Lieutenant-Governor has heard of his death with regret. Upon the whole, the extra native doctors behaved fairly well. The burden of the medical arrangements fell upon Dr. Cameron, the Civil Surgeon, and the Lieutenant-Governor has formed a very favourable opinion of the energy and judgment with which he directed, and himself shared in, the administration of relief. An expression of this opinion will be communicated to the Surgeon-General in the Indian Medical Department.

I have, &c.

(Signed) H. J. S. COTTON,
Junior Secretary to the Government of Bengal.

No. 950.

Copy of the correspondence forwarded to the Surgeon-General for information.

No. 951.

Copy of the correspondence forwarded to the Sanitary Commissioner for information.

No. 952

Copy, with copy of endorsements, forwarded to the Medical Department of this office for information.

By order of the Lieutenant-Governor of Bengal,
(Signed) H. J. S. COTTON,
Junior Secretary to the Government of Bengal.

No. 75 G, dated Chittagong, the 27th April 1877.

FROM E. E. LOWIS, Esq., Commissioner of the Chittagong Division, to the SECRETARY TO THE GOVERNMENT OF BENGAL, Financial Department.

WITH reference to your letter No. 585, dated the 23rd February last, I have the honour to submit the following report on the severe epidemic of cholera which has

occurred in my division. Statements showing the number of deaths that occurred up to 31st January 1877 have already been submitted with this office memorandum No. 662 G, dated 13th ultimo, and similar statements showing the number of deaths which have occurred during the whole period from effect of cholera in both the districts of my division are herein enclosed, showing at a glance the terrible results of this outbreak of sickness.

2. I beg also to submit sketch maps* showing the places where cholera prevailed in an epidemic form and caused great loss of life among the inhabitants, and also showing the localities at which the medical relief centres were formed.

3. Almost immediately after the cyclone of the 30th October cholera broke out in those places which had suffered the most from the storm-wave. In Chittagong cholera broke out immediately after the cyclone in Seetacoond and Coomirah, north of the station on the Dacca road. About the same time (7th November) cholera appeared at Bakolia and Changao, east of the station, in the town thana, and extended to the adjoining villages. On the 19th November it broke out in Moishkhali, Goshail Dengah, and Potengah, also in town thana; these places lie west of the station; these villages had also suffered much from the storm-wave, and on the 8th December the epidemic reached Kolagao, on the left bank of the Kurnafoolee, south of the sudder station, in Puttea thana, whence it extended by degrees to the adjoining villages. Kolagao had also been inundated by storm-wave. On the same date it appeared in Noapara and Raojan, where the storm-wave did not reach, though a small portion of the former was inundated by the overflowing of the river Kurnafoolee and its tributary the Halda; and on the 27th December it reached as far south as Banskali, on the Sungoo River in Satkanea. It thus gradually extended through the whole sudder sub-division of the district and Kutubdea, though it first appeared and raged with greater virulence in places inundated by the storm-wave.

4. The available native doctors were at once sent out to Seetacoond and Bakolia, where cholera first appeared; but in other places no medical assistance could at first be rendered, except by the distribution of cholera pills, as there were no extra native doctors or good medicines available. Assistance was, however, promptly indented for, as well as stores of medicines, both of which were urgently required. These were sent with all possible despatch, but the epidemic spread over the district in so short a time that, although the extra doctors with medicines arrived as early as could be expected, the disease had made great head before their arrival.

Dr. Coates, the Sanitary Commissioner, arrived here in December, just when men and medicines were most wanted; and with his valuable aid a scheme was drawn up for utilizing to the utmost the agency at our disposal. Nor did Dr. Coates content himself with simply giving advice; he personally visited some of the worst localities, carrying medicines with him, which he distributed on the spot, and by his presence and advice did much to allay alarm and anxiety in the minds of the people. It was determined to post the native doctors at different central places, dividing the stricken tracts into circles; and to ensure that the native doctors were on the alert, sub-assistant surgeons were placed in immediate charge of all these circles, the whole being under the control of the civil surgeons, to whom the native doctors submitted regular returns showing number of patients, success of treatment, stock of medicine in hand, &c. By this means the civil surgeons were kept informed of what was going on, and could exercise control. The two assistant surgeons and nine native doctors supplied by Government for this district were thus disposed of; and at the same time educated and charitable villagers were supplied with medicines for distribution to the village people who lived at a distance from the medical centres; while rules for observance of sanitary measures were circulated as widely as possible to all the villages, especially where the epidemic prevailed. Some of the native gentlemen also in the town distributed medicines gratis; in short, the aid and sympathy of every one who could render any help were enlisted. The disease reached its climax about the end of December, when several European residents were attacked. Soon after this there was heavy rain, which checked the virulence of the disease to a certain extent. Cholera in Chittagong has abated since the heavy rains in February last, but it is yet to be found more or less throughout the district, as the disease appears to be epidemic in Chittagong. As I write, I learn from the magistrate that news has reached him of cholera having broken out in Cox's Bazar, and to the extreme south of the district, a part which had hitherto escaped; the disease appears to have been carried there by persons returning from Akyab, where, I believe, cholera is now raging.

* Not reprinted.

5. The district of Noakholly suffered even more severely than Chittagong, and in consequence cholera appeared in a virulent form, and spread at once over almost all parts of the district, as well as in the groups of thickly inhabited islands of Sundeep, Hatea, Bamni, &c. &c. The disease first appeared where the salt water had penetrated, and this tract being more extensive than in Chittagong, it appeared in a greater number of places simultaneously, and spread more rapidly, causing at the same time greater devastation. As in Chittagong, the disease seems to have reached its climax in Noakholly in the end of December; and from persons who came to attend the durbar in the beginning of January I received most alarming accounts of the state of depression to which the people were reduced.

6. To prevent the spread of the disease much the same measures were taken as at Chittagong; in fact, a scheme practicable for both districts was concerted with Dr. Coates, and the instructions issued and suggestions made were identical for both districts. These instructions appear to have been admirably worked by Dr. Lyons, who appears to have been indefatigable in the discharge of his duties at this trying time. The following measures were as far as possible carried out by him:—

- 1st. Protection of drinking-water tank in station, and excavation of wells or tanks in large villages south-east and south-west of the district.
- 2nd. Burning and burying of corpses and carcasses, and, where not practicable, they were floated out with the tide.
- 3rd. People advised to make early applications for medicines, and to avoid exposure and fatigue.
- 4th. Police to see that the bodies of those who died from cholera were burnt or buried, and to advise relatives or friends of the cholera-stricken to destroy bedding, &c., and to bury as soon as possible all cholera evacuations.
- 5th. Burning of large fires to windward of affected villages.
- 6th. Fallen trees and branches in tanks and water-courses to be removed.
- 7th. Recommending people to be specially careful about drinking water, which should be boiled and allowed to cool before using.
- 8th. Attention to conservancy and burning of refuse heaps.
- 9th. Recommending that the people in the bazar (Shudharam) and neighbourhood should be required to clear up their latrines, or, if that was impracticable, that the exposed filth should be sufficiently covered with earth to render it inoffensive.
- 10th. Stagnant water in drains and watercourses to be baled out.
- 11th. Thatching grass fields in station to be cut down.
- 12th. That brickmaking operations carried on along some of the large drains in the station should be removed to outlets of drainage.
- 13th. Personal inspection by the civil surgeon of fish and other supplies in bazar on frequent occasions; and two fishmongers detected selling fish unfit for use were prosecuted.
- 14th. Forbidding the sinking of bodies in the khals.

7. Medical relief was afforded from the very outset of the epidemic (viz., from the 4th November 1876) at the charitable hospital, where, on the 8th November alone, as many as 114 persons applied for medicines for their friends; police thanas and outposts also were furnished with cholera medicine as fast as they could be prepared and sent out.

Native doctors and compounders were entertained, and on the 7th November one of the former engaged on the islands of Sundeep was placed there for duty, and two of the latter were on the 9th of November sent to Ingadia and Chur Uria, while on the 11th November the sub-divisional native doctor proceeded to Faquir Hât. Meanwhile, further help had been called for, and, on the 12th November, two out of four native doctors telegraphed for arrived, and were sent to Hatiya and Sundeep. On the 14th a compounder was despatched to Chaprassee Hât, and the remaining two native doctors telegraphed for on the 7th November, on their arrival on the 24th November, were sent to Farashgunge and Bamni. On the 27th and 29th two locally engaged native doctors were sent to Zorwargunge and Chagalnaya, and on the 30th November two more Government men arrived and were posted to Sundeep and Nulchira in Hatea. On the 8th December two more arrived from Calcutta, and were despatched to Mirkaseraï and Sundeep, and on the 11th December two more native doctors arrived, and were sent to Sundeep. On 16th December two assistant surgeons arrived, and in pursuance of the plan proposed by Dr. Coates were placed, one in charge of the Mirkaseraï circle, and the other to Sundeep in the first instance, but he afterwards directed to supervise Hatiya as well. In January I sent off a party of native doctors who had come by steamer, with instructions to proceed to Noakholly, and *en route* to report themselves to the Fenny sub-divisional officer, in case their services might be urgently required there. Of these, one assistant surgeon and a native doctor were detained by the officer

in charge of Fenny sub-division, and stationed—the former at Kazi Hât, and the latter at Bamni; the remainder reported themselves at Noakholly, and were posted on 23rd January—a sub-assistant surgeon to Bhulloah and four native doctors to Moonshee Hât, Moigdee, Chur Fakira, and Gungadas Moonshee's Hât. On the 7th February another native doctor arrived and was sent to Shantashita, to replace a locally entertained compounder who had fallen sick.

8. Supplies of cholera medicines were furnished to the District Superintendent of Police, to intelligent people of Luckhipore, Begumgunge, Shantashita, Shonadea, Dulal Bazar, and to many others who desired to be provided with them for distribution; the officers, both European and native, proceeding into the interior were also liberally supplied. Renewal of supplies on their requisitions were also made, and continued to be made, to native doctors and police thana officers.

9. The native doctors and compounders were given verbal and written instructions to explain to the people to be careful in their diet, drinking-water, and conservancy arrangements, &c.

10. One assistant surgeon was placed in inspecting charge of the islands, another of Mirkaserai or Eastern Division, a third of Bhulloah or Western Division, and the fourth was deputed to Kazir Hât by the sub-divisional officer. The sub-assistant surgeon, besides inspecting the work of the native doctors and seeing that the latter moved about their circles, were also provided with medicines and directed to treat cholera cases themselves.

11. According as the medical relieving officers arrived and could be entertained they were sent to the parts most needing their services, and when the disease abated in one place they were sent to another. The staff consisted of 4 assistant surgeons, 16 Government native doctors and 3 local, 3 Government compounders and 3 local; total 29. Besides this, for jail, police, and dispensary works there were two native doctors and one compounder.

12. All the native doctors have been withdrawn from the islands, and the assistant surgeon who was there left for Calcutta on the 23rd February, while the services of the locally engaged men have also been dispensed with. There now remain at Noakholly two assistant surgeons and eight native doctors, who are distributed as follows:—

One assistant surgeon at Bhulloah and the other at Kazir Hât, and a native doctor at Moigdee, Begumgunge, Dulal Bazar, Bammi, Mirkaserai, Boktar Moonshee's Hât, and two in a reserve in Noakholly.

13. The services of the extra establishment at Chittagong have been dispensed with, and any necessity for keeping up that at Noakholly will, I trust, soon disappear.

14. The primary cause of the disease was of course the cyclone and storm-wave.

Causes of disease; salt inundation. Wherever the salt water penetrated vegetation was killed and the drinking water spoiled, and there the cholera first began. In fact, Dr. Coates found the limits of the first outburst coincident with the extent to which the salt water penetrated. This was peculiarly marked along the Dacca road, the embankment of which saved the country to the east of it from inundation. Along that road every village to the west which had suffered from inundation was visited at once with cholera, while the villages on the other side of the road escaped at first. A poisoned state of atmosphere was added to

* Poisoned atmosphere. bad drinking water, for the storm-wave swept away everything before it, and the whole sea-coast towards the north was strewn with the carcasses of cattle and human bodies. In other places also the khals, tanks, the sea-shore were full of carcasses and corpses. No vultures were to be seen at first, and the people, who have suffered a great shock from the cyclone, could not be persuaded to bury the dead bodies. The local authorities tried their best, with the small agency at their disposal, to bury or float away the carcasses, but long before it could be accomplished the atmosphere was tainted, and so great was the smell that travellers passing along the roads, especially along the Seetacoond road, kept their nostrils and mouth covered with their hands or dress; and the same state of things in an intensified form was to be found all over the islands forming part of the Noakholly district. Salt water, too, accumulated in innumerable ditches and other low places from which it was impossible to drain it, and this added to the evil.

15. The disease was further intensified by the use of bad food, the greater portion of the grain and other food upon which the people depended for their living having been destroyed or damaged. The people used the damaged grain for about a fortnight after drying it in the sun; large quantities of grain contaminated by salt water were also carried away from the town

by the people, who mobbed the merchant's godowns for the same, the police being unable to restrain them.

16. Bad water I have already alluded to as a cause of sickness. The water of almost all the tanks on the sea coast was rendered either salt or brackish, while all vegetation in them was destroyed by the admission of salt water, and the accumulation of carcasses and débris in them made the water more impure than ever. The narrow strip of country, about 24 miles long and 4 miles wide, along the west of the Dacca trunk road, portion of the eastern bank of Kurnafoolee, Banskhal, and northern part of the Kutubdea, as well as the islands and coast of Noakhally, were submerged, and the people had no alternative but to use the water of those tanks. Where tanks were distant the people fared rather better, for, by digging small wells for themselves, they obtained, it is true, brackish water, but water that was less contaminated by decayed vegetable matter.

17. Thanks to the promptitude with which our indents for men and medicine were attended to, and thanks especially to the counsel and help of Dr. Coates, the late terrible outbreak of disease has been checked and successfully combatted. I do not mean to say that medical help was afforded to every sufferer, but it has been afforded to many, and the very fact of help being at hand did much to dispel anxiety and give the people courage and confidence. To Dr. Coates, as I have said, is due the organization of a scheme for affording medical aid and for utilising to the utmost the agency at our disposal, as well as for valuable professional suggestions and instructions; but the best devised scheme will break down if inefficiently administered; and it is due to the civil surgeons of Chittagong and Noakhally, Dr. Murray and Dr. Lyons, to state that, but for their personal exertions and the interest taken by them in the work, the disease would not have been as successfully dealt with as it has. The magistrates of the two districts afforded valuable help, but of course professionally they could do little. The sub-assistant surgeons and native doctors did well, with two unfortunate exceptions, viz., Sub-Assistant Surgeon Baboo Shibkisto Dass, who refused to go to Sundeeep when cholera there was at its worst, and a sub-assistant surgeon who deserted his duty at Mirkaserai. Both these cases have been separately reported. With these exceptions the other native doctors have done excellent service.

18. I have not been able to submit this report as soon as I hoped, for cholera has taken longer to abate than I expected; it was not till after 1st April that I could say it had almost entirely disappeared, and until I could report to that effect it seemed useless reviewing the success of the measures adopted for its suppression.

STATEMENT showing the DEATHS from CHOLERA in the districts of the CHITTAGONG DIVISION from 31st October 1876 to 31st March 1877.

1	2	3	4	5	6	7	8
Name of District.	Name of Thana and Outpost.	November 1876.	December 1876.	January 1877.	February 1877.	March 1877.	Total.
Chittagong	Town - - - -	529	615	550	149	20	1,863
	Hathazari - - -	35	228	337	133	32	765
	Futtickchery - -	49	260	383	161	27	880
	Sectacoond - - -	574	1,385	801	166	—	2,926
	Kumaria - - - -	255	487	422	209	—	1,373
	Raojan - - - - -	140	407	273	120	68	1,008
	Ramgania - - - -	7	39	67	10	6	129
	Pattia - - - - -	245	674	583	259	151	1,912
	Anwarah - - - -	43	319	375	193	60	990
	Parki - - - - -	80	484	503	26	—	1,093
	Satkania - - - -	6	89	60	55	38	248
	Jaldi - - - - -	118	171	159	116	63	627
	Banskhal - - - -	34	92	104	109	34	373
	Kutubdea - - - -	—	—	55	44	21	120
	Moishkhali - - -	—	9	34	4	—	47
	Cox's Bazar - - -	—	2	74	118	13	207
	Ramoo - - - - -	—	18	45	30	6	99
	Chakaria - - - -	—	4	43	32	4	83
	Doolahazara - - -	—	—	16	4	—	20
	Ukhia - - - - -	—	—	3	14	1	18
Nhila - - - - -	—	—	—	4	—	4	
Teknaf - - - - -	—	—	3	—	—	3	
Total of the district -		2,115	5,283	4,890	1,956	544	14,788

Statement showing the Deaths from Cholera in the Districts of the Chittagong Division, from the 31st October 1876 to 31st March 1877—*continued*.

1	2	3	4	5	6	7	8
Name of District.	Name of Thana and Outpost.	November 1876.	December 1876.	January 1877.	February 1877.	March 1877.	Total.
Noakholly	Town - - - -	1,101	2,847	2,407	2,115	256	8,726
	Bamni - - - -	469	1,790	1,044	277	28	3,608
	Sundeeep - - - -	6,232	4,809	871	37	1	11,950
	Siddi - - - -	63	690	71	2	—	826
	Hatea - - - -	100	575	1,641	95	—	2,411
	Nulchira - - - -	30	229	188	6	—	453
	Lakhipore - - - -	196	169	907	355	278	1,905
	Royppore - - - -	37	87	385	115	45	569
	Farashgunge - - - -	452	369	889	389	73	2,172
	Ramgunge - - - -	51	79	186	87	123	526
	Begumgunge - - - -	41	162	511	788	953	2,455
	Fenny - - - -	513	2,940	1,590	1,632	396	7,071
	Chagulnaya - - - -	524	192	150	440	171	1,477
	Mirkaserai - - - -	711	475	589	165	—	1,940
	Zorwargunge - - - -	572	342	378	293	9	1,594
Total of the district of Noakholly - - - -		11,092	15,755	11,807	6,796	2,333	47,783
Total of the district of Chittagong - - - -		2,115	5,283	4,890	1,956	544	14,788
Grand total of the Division -		13,207	21,038	16,697	8,752	2,877	62,571

Chittagong Commissioner's Office,
27th April 1877.

E. E. Lewis, Commissioner.

FROM THE JUNIOR SECRETARY TO THE GOVERNMENT OF BENGAL TO THE COMMISSIONER OF THE CHITTAGONG DIVISION.

Sir,

Calcutta, 4th May 1877.

I AM directed to acknowledge the receipt of your letter No. 75 G., dated 27th April 1877, in which you submit a report on the epidemic of cholera that has recently occurred in your division.

2. The Lieutenant-Governor deeply deplores the terrible effects of this outbreak, which have resulted, it is believed, in a mortality unprecedented even in the annals of cholera. At the same time, it is satisfactory to be able to say that the exertions of all the officers of Government to alleviate the disease were unremitting. All possible assistance was afforded, and very great credit is due to both Dr. Murray and Dr. Lyons, the civil surgeons of Chittagong and Noakholly, for the zealous and indefatigable manner in which they devoted themselves to their professional duties during a most trying period. The especial acknowledgments of Government are also due to Dr. Coates, the Sanitary Commissioner, who was deputed to Chittagong in December, and who not only organised a scheme for affording medical relief and for utilising to the utmost the available agency, but himself personally visited the worst localities, lived among the people, and afforded them encouragement by his presence and advice. With two unfortunate exceptions, the native assistant surgeons and native doctors also did their duty well.

I have, &c.

(Signed) H. J. S. COTTON,
Junior Secretary to the Government of Bengal.

No. 1308½.

Copy of correspondence forwarded to Sanitary Commissioner for information and guidance.

No. 1308½.

Copy of correspondence forwarded to Surgeon-General, Indian Medical Department, for information.

No. 1308¾.

Copy of this letter forwarded to Appointment Department of this office for information.

By order of the Lieutenant-Governor of Bengal,
(Signed) H. J. S. COTTON,
Junior Secretary to the Government of Bengal.

DESPATCH FROM THE SECRETARY OF STATE FOR INDIA TO THE GOVERNOR-GENERAL OF INDIA IN COUNCIL.

Geographical No.

MY LORD,

India Office, London, 2nd August 1877.

Para. 1. I have received the Despatches (noted in the margin)* of your

- * No. 75 (Public), dated 24th Nov. 1876.
No. 1 (Meteorology), dated 24 Nov. 1876.
No. 2 " " dated 1st Dec. 1876.
No. 4 " " dated 8th Dec. 1877.
No. 1 " " dated 12th Jan. 1877.
No. 6 " " dated 12th Apr. 1877.

Excellency's Government, forwarding papers on the subject of the cyclone and storm-wave which visited the districts of Noakholly, Backergunj, and Chittagong, on the morning of the 1st November last.

2. Although this calamity, as regards the immediate loss of life occasioned by it, is almost without a parallel in history, it is a matter of satisfaction to observe that the estimate at first formed of the number of deaths was considerably in excess of the reality.

3. On the other hand, it is distressing to see that the ravages of cholera, following close upon the track of the first-named disaster, have carried off no less than 75,000 lives. I gather from the present papers that the total mortality occasioned by the cyclone wave and the ensuing cholera amounted at the end of last March to about 165,000, or, say, 50,000 within the first rough estimate of the number of those who died by drowning alone.

4. The extraordinary, though not wholly unprecedented, inundation which was the immediate cause of the loss of life has, together with the physical cause and development of the cyclone itself, received very careful investigation at the hands of the Meteorological Reporter to the Government of Bengal. His exhaustive and lucid report shows that this great flood was due to an unusually high tidal wave, followed by the storm-wave of the advancing cyclone, both these phenomena being intensified by a violent north wind, succeeded immediately by south-west and west winds, an aggravation of conditions which combined to flood the whole of the low lands and islands about the estuary of the Megna to a depth of between 10 and 45 feet.

5. Both the storm and inundation appear to have been in some degree foreseen by the natives in Sundip and Hattiya, islands which suffered most severely from the same. It is much to be deplored, too, that very few took heed of the traditional warning conveyed by the "roaring sound" which is described as having been heard in the Bay to the south for two or three days previously.

6. The outbreak of cholera which forms the subject of two later Despatches* was a calamity, the evil effects of which were, as might be expected, proportioned to the magnitude of the preceding one. Although the civil and medical officers under the Government of Bengal appear to have devised most judicious measures for preventing the spread of the disease, it has not been possible everywhere to carry out these, owing in many places to the apathy and want of co-operation on the part of the natives. A notable exception is recorded in the case of some native gentlemen and villagers of Chittagong, who, I observe with pleasure, rendered most serviceable aid to the medical staff during the prevalence of the epidemic in the town.

7. By the 1st of April the strenuous efforts of the Bengal officers appear to have effectually stamped out the disease. I have much pleasure in expressing my concurrence with the Lieutenant-Governor in the sense he has expressed of the value of the energy and judgment shown by his civil and medical officers in their relief measures throughout the duration of this great calamity.

8. The possibility of providing safeguards against future loss of life by inundations, by the erection of mounds or by other measures, such as those alluded to in Sir Richard Temple's valuable Minute of the 21st November last, will I have no doubt occupy the serious attention of your Excellency's Government.

9. I request that 10 additional copies of Mr. Elliott's report may be forwarded to this Office.

I have, &c.
(Signed) SALISBURY.

LONDON:
Printed by Thomas H. Bland, 11, Abchurch Lane.
For His Majesty's Stationery Office.

The possibility of the above...
the attention of members...
the 21st Government...
the attention of...
the attention of...
the attention of...

(Signed)
SALISBURY

LONDON:
Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.

